Journal of the Pennsylvania Academy of Science 88(1): 63-66, 2014

MUSSEL POPULATION AND DISTRIBUTION ON BUFFALO CREEK, AN AMERICAN EEL STOCKED TRIBUTARY TO THE WEST BRANCH SUSQUEHANNA RIVER†

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ABSTRACT

In 2009 the United States Fish and Wildlife Service began stocking young American eel into Buffalo Creek, a small agriculturally impacted stream that feeds into the West Branch of the Susquehanna River. The freshwater mussel *Elliptio complanata* is known to have higher success rates completing its life cycle using American eel as the host fish for its glochidia (Lellis et al. 2013). The objective of this study was to determine if the American eel will affect mussel populations within their first 5 years of reintroduction into Buffalo Creek and hopes to be a baseline study for future research. A total of ten sites were randomly distributed throughout Buffalo Creek with each site consisting of four 5m x 5m quadrants. In the first year of the study (2012) most mussels found were large *E. complanata* adults indicating that they had been present before the eel reintroduction. In 2013 we recorded almost twice as many mussels as last year and four new species (*Strophitus undulates*, *Lampsilis cariosa*, *Alasmidonta marginata*, and *Villosa iris*). [J PA Acad Sci 88(1): 63-66, 2014]

INTRODUCTION

Freshwater mussels are one of the most endangered taxonomic groups in the United States and can filter suspended sediments and particles from the water column and doing so can reduce turbidity and improve water quality (Newell 2004). Although numerous studies of mussel populations have been done in various parts of the country, there has not been extensive research conducted on the mussels of the Susquehanna River. Strayer's (1999) work on the upper river basin compared presence/absence data from 1955-1965 to his own mussel surveys at the same sites in 1996-1997. His results suggest that there was very little change in mussel communities during the 30 year time span between the two surveys (Strayer and Fetterman 1999). As there are few additional studies available regarding the abundance of mussel communities on the Susquehanna River, it is difficult to make strong conclusions about mussel growth and decline. In an effort to aid these studies and to supplement the data that are present, we conducted a survey in 2009 on the West Branch of the Susquehanna in Milton, Pennsylvania, downstream of Milton State Park and approximately 1.5 miles upstream of where Buffalo Creek enters the West Branch (Figure 1). During that survey 903 mussels were found with a density transformed CPUE of 0.77 mussels/m^2. Mussel densities by surveyed cell ranged from 0 (a pro-rated bank survey) to 2.37 /m^2 (a mid-channel cell). Of the 903 mussels found, *Lampsilis cariosa* was the most dominant species averaging 0.59 mussels per m^2 with a maximum of 1.93 mussels per m^2 and *E. complanata* averaging 0.089 mussels per m^2, second most dense mussel. While *E. complanata* is the most widespread freshwater mussel species in the Atlantic drainage, the Susquehanna River watershed contains far fewer *E. complanata* than neighboring watersheds like the Delaware (USFWS and USGS 2010). Looking at size distribution by species, we believe *E. complanata* is suffering from a loss of recruitment. One major factor behind this lack of young *E. complanata* may be the loss of the American eel from the upper Susquehanna River basin due to damming.

Anguilla rostrata, or the American eel, comprised roughly twenty-five percent of the total fish biomass in many locations along the Susquehanna River before damming (Minkinnen and Park 2008). American eels are catadromous fish, living in freshwater for most of their lives until sexual maturity and migrating to salt water (Sargasso Sea) to reproduce. Young eels return to freshwater to start the cycle all over again. Although there have been sporadic stockings of eels in the Susquehanna River basin, the population of American eels has been very small upstream of Conowingo Dam since the 1970's (SRAFRC 2010). In order to improve water quality and strengthen a weak population, juvenile American eels were reintroduced into Buffalo Creek and Pine Creek upstream of all major dams on the West Branch of the Susquehanna River through a joint effort of the U.S. Fish and Wildlife Service and the U. S. Geological Survey.

Freshwater mussels have a unique interaction with fish.

†Accepted for publication March1, 2014.

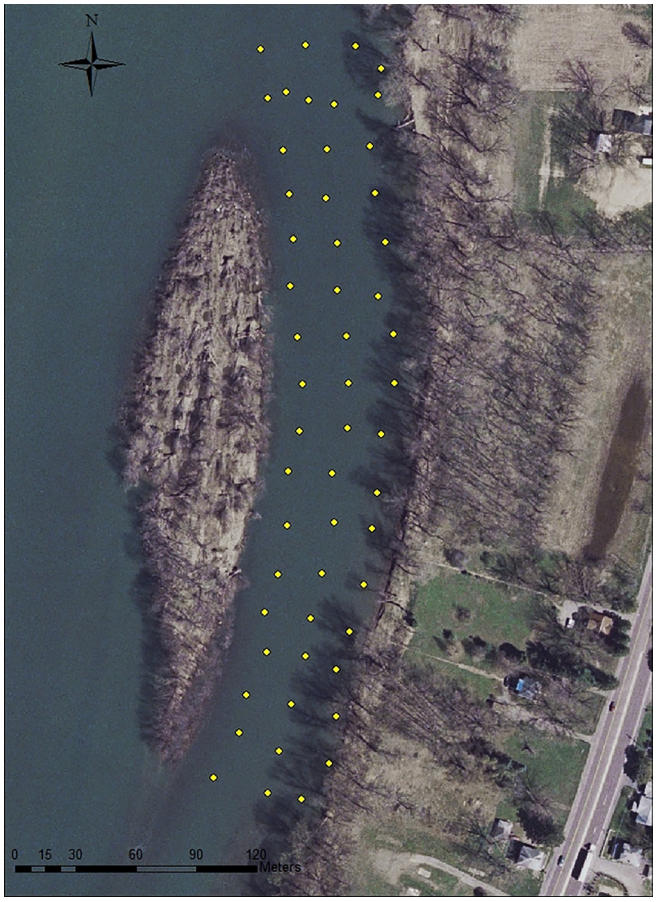

Figure 1. Map of mussel survey on West Branch Susquehanna River below Milton State Park, 2011.

Many use fish as a host for their glochidia or in their larval stage to complete metamorphosis into their juvenile stage. Some mussel species are generalists and can use a variety of fish species as their host while some mussel species are functionally dependent on a specific host fish to complete their life cycles (Haag 2012). Mussels without the specific host fish interaction face complications with reproduction and a diminishing population and eventual extirpation or extinction. American eels are the primary host fish of larval (glochidia) *E. complanata* and improves the success rate of *E. complanata* completing their life cycle when using American eels as their host fish (Lellis et al. 2013).

MATERIALS AND METHODS

We chose ten sites to survey in Buffalo Creek in Union County, PA. Five sites were randomly chosen upstream of the eel reintroduction site between Lewisburg and Mazeppa, and five sites were selected at random locations downstream of the introduction site over an area of four river miles (Figure 2). Due to logistics we avoided the approximate 1.3 km stretch of stream that ran through the property of the Lewisburg Federal Penitentiary. At each site, water quality measurements, including pH, dissolved oxygen, and temperature, were taken using a YSI 600 XLM V2 multiparameter water quality sonde. Furthermore, habitat and embeddedness at each site were recorded by the survey team at the time of mussel collection. To standardize our search methods, four 5m x 5m quadrants were made at the center of the creek using a premade dive array which divided the stream into four sections (Figure 3). Using an effective sampling fraction greater than 0.05, we determined an effective search time of five minutes per quadrant (Smith et al. 2001). Each quadrant was surveyed using a random start and timed search. A total of twenty minutes over the entire 10m x 10m site provided a comprehensive mussel density. The species of each individual found was recorded, and each mussel was weighed, measured, and photographed before being returned to the habitat and quadrant in which it was found. A three tiered sieve series ranging from 0.5 inch to 500 micron mesh was used for all excavations. Each quadrant had an excavation preformed in a 1 m^2 area to a depth $\geq$ 10 cm or to hardpan to search for juvenile mussels. Excavated material was passed through the sieve series, and mussels retained on the different mesh sizes of the sieves were identified and recorded.

RESULTS AND DISCUSSION

From June 2009 through August 2012 approximately 88,000 glass eels were introduced into Buffalo Creek in Union County, PA. In July 2012 we began conducting yearly quantitative surveys for freshwater mussels. In 2012 we found 111 mussels with *E. complanata* being the only species found alive. In 2013 we found five species of mussels, *Strophitus undulates*, *Lampsilis cariosa*, *Alasmidonta marginata*,

Figure 2. Mussel survey sites on Buffalo Creek, Union County, PA.

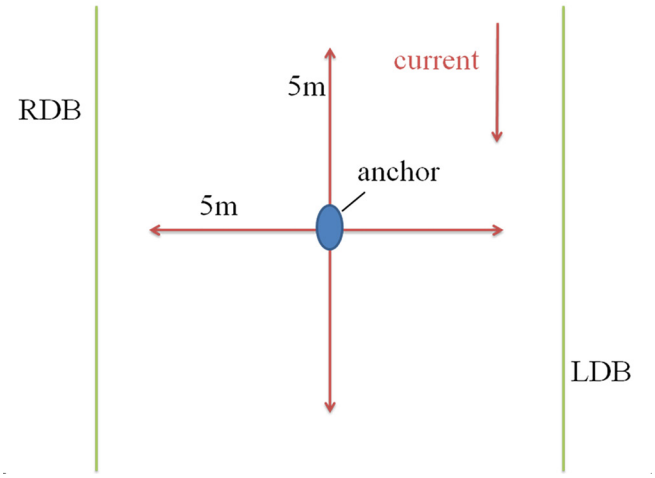

Figure 3. Diagram of dive array used to divide each site into four quadrants.

Villosa iris and *Elliptio complanata*, which had the highest densities. Of the 198 mussels found in 2013 *E. complanata* were the most abundant comprising 95% of the mussels found while *V. iris* was the least abundant at 0.01% (Table 1). We found higher densities of mussels in 2013 and there were signs of increased recruitment in young *E. complanata* from 2012 to 2013(Figure 4). In the summer of 2012 we found 9 *E. complanata* under 60 mm in length compared to 24 *E. complanata* under 60 mm in length in 2013 (Table 2). The cumulative CPUE for our entire 10 sites in 2013 was 58.8 mussels per hour. Our individual CPUE for each site ranged from 0 in downstream quadrants where substratum was heavily embedded to 204 mussels per hour in one of our upper sites. Higher densities of mussels continued to be more commonly found upstream in areas that had more favorable habitat consisting of mostly cobble/gravel substrate with lower degrees of embeddedness (Figure 5). Embeddedness refers to the extent to which rocks (gravel, cobble, and 0boulders) are surrounded by, covered or sunken into the silt, sand, or mud of the stream and can hinder a mussel's ability to burrow. Water quality was recorded at each site with the average water temperature at 22.4 °C in 2013 while 2012 had an average water temperature of 25.6 °C.

Table 1. Total number of live and dead mussels found by species in 2012 and 2013.

Species 2012	# alive	# dead
Elliptio complanata	111	34
Species 2013	# alive	# dead
Elliptio complanata	188	81
Strophitus undulates	6	3
Lampsilis cariosa	2	4
Alasmidonta marginata	1	1
Villosa iris	1	1

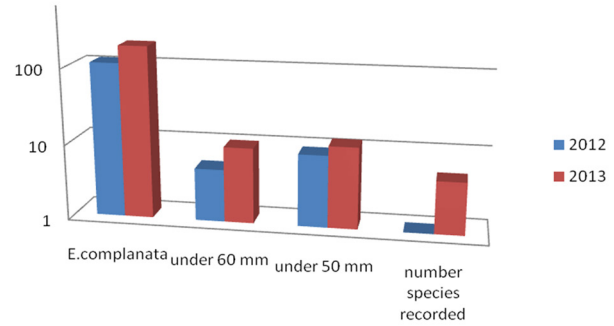

Figure 4. Abundance of *E. complanata* found during mussel surveys conducted in Buffalo Creek, Union County, PA .

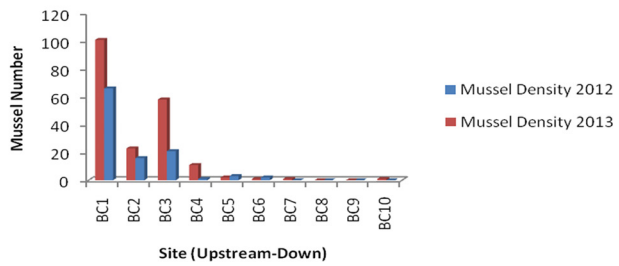

Figure 5. 2012 and 2013 mussel densities compared by site upstream to downstream in Buffalo Creek, Union County, PA.

CONCLUSION

We saw a correlation between embeddedness and number of mussels found suggesting the more impacted the substrate, the lower the population of mussels. The majority of mussels were observed upstream in more favorable, less embedded habitats. While there is not a way to easily and accurately quantify embeddedness, the lower sections of creek were clearly impacted creating unfavorable conditions for populations. Burrowing is a technique that mussels use to provide additional anchorage in streams and rivers to help prevent dislodgement and protection from predation. Some species use burrowing as an adaptation for drought survival and throughout the winter months (Haag 2012). The inability for mussels to burrow due to embeddedness can be a major factor for the absence of mussels in our lower sites.

Table 2. Size class comparison 2012 to 2013 (note all live mussels found in 2012 were *E. complanata*).

	2012	2013	*Elliptio complanata*
Total live mussels found	111	198	188
Mussels under 50mm	5	13	10
Mussels under 60mm	9	25	12

We saw an increase in the total number of specimens and species in 2013 from 2012. Factors for the increase of young *E. complanata* in 2013 could be cooler water temperatures, lower seasonal flows and the presence of more American eel available as host fish. Although mussel distribution is directly correlated with the geographical distribution of its host fish, other factors such as habitat can limit distribution and dispersal. Future biennial studies will be structured to assess the impacts of water quality, habitat, and introduction of juvenile eels on mussel population recruitment in Buffalo Creek.

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