Eastern Pearlshell (*Margaritifera margaritifera*) dominates the unionid mussels of Scriba Creek, New York

John E. Cooper

Cooper Environmental Research, 1444 County Route 23, Constantia, NY 13044

www.CooperEnvironmentalResearch.com cooperesearch@twc.com

INTRODUCTION

•Seven species of native freshwater mussels were extirpated from Oneida Lake, NY, after the introduction of the invasive zebra mussel in 1991 (Harman 2000). Quagga mussels invaded in 2003. Early studies (Baker 1916;1918) of the mussel fauna in the lake resulted in many misidentifications and listing of up to 12 species of which only seven are recognized at present.

•Tributaries remain as a refuge for native mussels since zebra and quagga mussels cannot persist in a unidirectional flow without recruitment from upstream (Huang et al. 2017).

•Scriba Creek (Fig. 1) originates south of the Tug Hill Uplands and has no zebra or quagga mussels in the drainage area except at its confluence with Oneida Lake. It thereby serves as a refuge for native mussels.

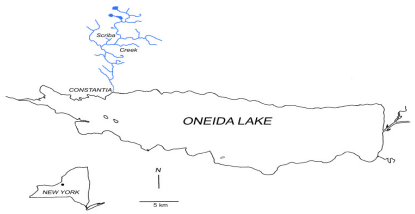

Figure 1. Scriba Creek enters Oneida Lake at Constantia and is one of four major tributaries on the north shore. Flow in the lake is from east to west.

SITE DESCRIPTION AND METHODS

•Discharge in Scriba Creek is flashy ranging from 0.1 to 37 m^3/s (USGS gage 04245840) with a gradient of 1.2 m/rkm, and a drainage area of 99 km^2.

•Land use is primarily forest with limited agriculture. The creek flows through extensive marshes and wetlands.

•Water was <1m in depth at each site with sand or sand/cobble substrate. Sites ranged from 0.1 rkm to 13 rkm from Oneida Lake (Fig. 2). Creek width ranged from 1 m to 15 m, and averaged 7.4 m.

•Systematic sampling with three random starts was used to survey nine sites: 4 to 12 quadrats of 1m^2 (average of 9 quadrats) were searched using visual and tactile methods. Each quadrat was designated by placing a 1m^2 PVC grid on the creek bottom.

•Living mussels were measured (shell length, height, and width), identified, and returned to the water in the location where found.

•Water chemistry was measured from grab samples at each site: temperature, dissolved oxygen (Hach sension6), pH (ecotestr ph2), total dissolved solids (TDS Testr3), alkalinity (Lamotte titrator), and calcium (ChemWorld titrator). Chlorine, sulfate, nitrate, and ammonia were measured with a Hach colorimeter.

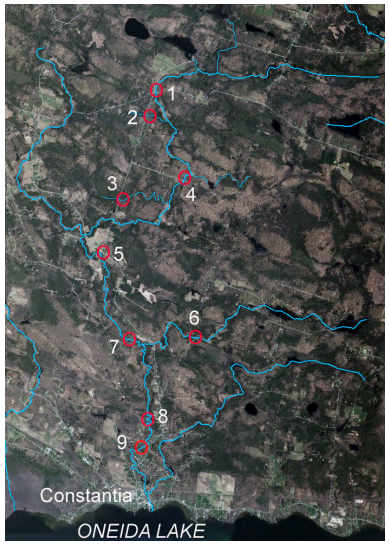

Figure 2. Location of survey sites in Scriba Creek. Sites 2 and 3 were small tributaries that drained marshy areas with limited flow.

RESULTS

•Three species of mussels were collected: Eastern pearlshell (*Margaritifera margaritifera*), Eastern elliptio (*Elliptio complanata*), and Creeper (*Strophitus undulatus*, Table 1).

•Eastern pearlshell dominated the collections at six sites (85% of mussels collected), Eastern elliptio dominated at site 6 (83%), and sites 2 and 3 had no mussels, only Sphaeriidae clams.

•One living Creeper was found at site 4 at 62 mm SL.

•Eastern pearlshell ranged from 70 to 126 mm in shell length (Fig. 3) and had a similar size distribution at each site where collected.

•Eastern elliptio ranged from 59 to 120 mm at site 6 and were 30% longer than elliptio at other sites.

Table 1. Species of living mussels collected at nine sites in Scriba Creek, and associated parameters of the collection sites.

Site	Species	Number collected	Shell length range	Density (N/m^2)	Collection area (m^2)	Stream width (m)
1	Eastern pearlshell	26	92–111	2.2	12	4.6
	Eastern elliptio	2	59–63	0.2		
2	none				7	3
3	none				12	1.8
4	Eastern pearlshell	91	91–126	10.6		8.5
	Eastern elliptio	6	66–87	0.5		
	Creeper	1	62	0.08		
5	Eastern pearlshell	41	90–119	6.8	6	9.4
6	Eastern pearlshell	5	96–114	0.6	8	5.2
	Eastern elliptio	24	91–120	3.0		
7	Eastern pearlshell	28	72–108	7.2	4	15.2
8	Eastern pearlshell	1	76	0.1	10	11.3
9	Eastern pearlshell	1	73	0.1	10	13.2

•Eastern pearlshell density was greatest at site 4 at 10.6/m^2. Density could be greater than measured as some areas that were not sampled had more than 100 mussels visible.

•Eastern elliptio density was lower than Eastern pearlshell density except at site 6 where it was five times greater.

•Density of creeper was very low but may not reflect the true population size: 3 empty Creeper shells were found in muskrat middens at site 7. It may still have low abundance in comparison to Eastern pearlshell but the population is more widespread.

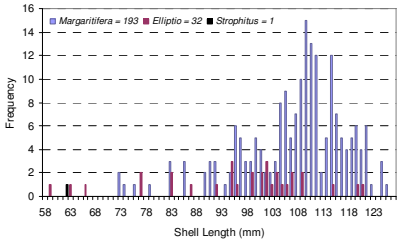

Figure 3. Shell length frequency of living mussels collected from all sites combined. There was no effort to find juvenile mussels.

•Water chemistry reflects the lack of limestone substrate on the north side of Oneida Lake with Scriba Creek being low in alkalinity and calcium (Table 2). A limestone belt exists on the south side of the lake and alkalinity in those tributaries is much greater (175 to 186 ppm alkalinity).

•Most collection sites were well-oxygenated with the exception of sites 2 and 3 that drained marshy areas and had little flow resulting in lower oxygen saturation.

•Nitrate levels were higher than the 0.1 to 0.3 mg/L that would be expected. Nitrate at sites 8 and 9 were higher than at other sites and might be a reason for the low mussel abundance at those sites.

Table 2. Water chemistry parameters by collection site in Scriba Creek.

Site	Water temperature (°C)	Percent saturation	TDS (µS)	pH	Alkalinity ($CaCO_3$) Total ppm	Mg mg/L	Ca mg/L	Cl mg/L	SO_4 mg/L	NO_3 mg/L	NH_3-N mg/L
1	13.5	95.2	80	6.4	58	2.93	19	0.2	1	6.4	0.01
2	19.1	26.6	190	7.7	120	3.11	29	0.08	1	2.6	0.03
3	17.1	77.6	700	7.5	170	2.12	23	0.1	0	0.9	0.57
4	16.9	100	80	7.1	64	2.59	19	0.1	1	3.5	0.01
5	20.5	86	130	7.6	80	1.75	17	0.11	1	7.3	0
6	19.8	77	130	6.6	80	3.02	18	0.12	0	5.9	0.03
7	20.9	93.9	190	7.4	80	1.73	24	0.11	0	7.6	0.02
8	20.9	97.3	200	7.5	100	2.31	20	0.09	0	8.4	0.48
9	20	99	200	7.6	100	2.78	21	0.11	0	8.6	0.08

•4 muskrat middens (Fig. 4) were found at site 7 in association with bank dens. This was the only site that had middens and there were no middens here in previous years.

Figure 4. Muskrat midden at site 7 with the entrance to the bank den above the large rock in the grass.

•Muskrat predation was primarily on Eastern pearlshell (Fig. 5) but there was no evidence of size-selective predation as shell length frequencies were similar between living mussels and those in middens (Fig. 6).

Margaritifera margaritifera 95.9 mm SL

Figure 5. A typical Eastern pearlshell from a midden in Scriba Creek. There was no physical evidence of muskrat predation (chips or scratches on shell).

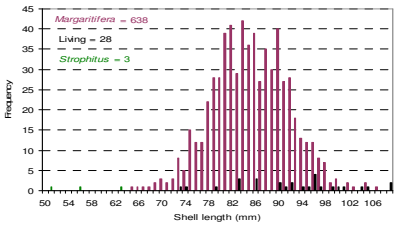

Figure 6. Length frequencies of mussels collected in four muskrat middens at site 7. Living mussels at this site had a length range of 73 to 108 mm.

•Small pores (function unknown) on the inside of the shells (Fig. 7) are characteristic of Eastern pearlshell. 30% of the shells examined from Scriba Creek (136 out of 452) did not have pores so this characteristic is variable.

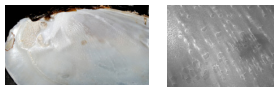

Figure 7. Pores on the inside of Eastern pearlshell (left) and a close-up of the same shell showing the pores (right).

DISCUSSION

•Eastern pearlshell is generally found in headwater streams with low alkalinity and calcium such as in the Adirondacks. Eastern pearlshell dominated the mussel population in Scriba Creek as it did in Black Creek (east of Scriba Creek; Clarke and Berg 1959). Eastern elliptio dominates most northeastern New York streams but that was not true here except for site 6.

•The decline in mussel density toward the lake might be due to rising nitrate levels, which were greatest at sites 8 and 9. Nitrate levels of 11 mg/L are known to reduce glochidia attachment and metamorphosis success (Moore and Bringolf 2018). Water quality parameters other than nitrate do not seem to be a factor in mussel success in Scriba Creek.

REFERENCES

•Baker, F. C. 1916. The relation of mollusks to fish in Oneida Lake. Tech. Publ. 4. New York State College of Forestry. Syracuse, NY.

•Baker, F. C. 1918. The productivity of invertebrate fish food on the bottom of Oneida Lake with special reference to mollusks. Tech. Publ. 9. New York State College of Forestry. Syracuse, NY.

•Clarke, A. H., Jr., and C. O. Berg. 1959. The freshwater mussels of Central New York. Cornell University Memoir 367. Ithaca, NY.

•Harman, W. N. 2000. Diminishing species richness of mollusks in Oneida Lake, New York State, USA. The Nautilus 114(3):120-126.

•Huang, Q., H. Wang, and M. A. Lewis. 2017. A hybrid continuous/discrete-time model for invasion dynamics of zebra mussels in rivers. SIAM J. Appl. Math. 77(3):854-880.

•Moore, A. P., and R. B. Bringolf. 2018. Effects of nitrate on freshwater mussel glochidia attachment and metamorphosis success to the juvenile stage. Environmental Pollution 242(Part A):807-813.