Level K Consultant's Report

Minnesota Native Mussel Life History

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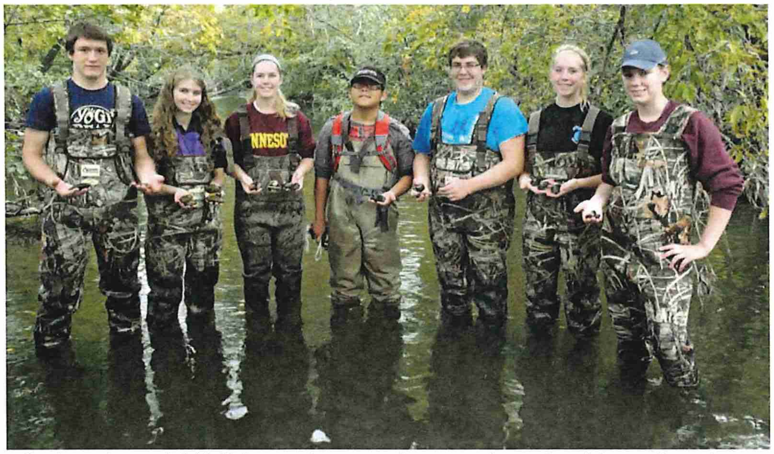
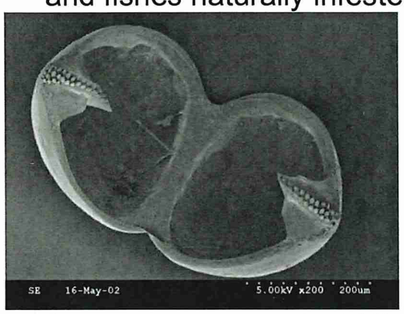


Grantsburg High School and UMN students who assisted with collecting creek heelsplitter and fishes naturally infested with glochidia from the Willow River



Lasmigona compressa glochidium

Creek chub, a suitable creek heelsplitter host

This report provides first evidence that logperch is a natural snuffbox host

Federally endangered juvenile snuffbox

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Abstract

Conservation efforts can be improved through greater understanding of rare species life history. We conducted several studies to expand our knowledge of Minnesota mussel biology. Most freshwater mussel larvae (glochidia) attach to a host in order to metamorphose into juveniles. Between 2014-15 we studied *Pleurobema sintoxia*, *Elliptio dilatata*, and *Fusconaia flava* brooding periods, and conducted host suitability studies on *Lasmigona costata*, *L. compressa*, *Pleurobema sintoxia*, *Elliptio dilatata*, and *Cumberlandia monodonta*. We also collected fishes from the Sunrise, Elk, St. Croix, and Willow Rivers in an effort to obtain juvenile mussels from naturally infested fishes. During 2014 *P. sintoxia* brooded glochidia between May 11-June 23 and *F. flava* between May 11-July 18 in the Yellow River. Many host suitability trials produced juvenile mussels. White sucker, shorthead redhorse, and northern pike facilitated *P. sintoxia* metamorphosis. *Elliptio dilatata* transformed on 14 of 34 fish species tested, and *L. costata* metamorphosed on 19 of 20 species tested. Thirteen of 26 fish species tested facilitated *Lasmigona compressa* metamorphosis. Neither American eel or burbot supported *C. monodonta* transformation. Natural infestation studies showed that logperch is a natural host for *Epioblasma triquetra*, and juvenile mussels were recovered from other naturally infested fishes. The identification of logperch serving as a natural host for the federaly endangered *E. triquetra*, and several previously unknown suitable hosts identified in this study, are the first reportings of these relationships. This information can be used to improve juvenile mussel propagation programs and help protect extant mussel populations by ensuring glochidia hosts co-occur with them.

Introduction

Advancing our understanding of rare species life history can improve conservation efforts. According to a study conducted by the Nature Conservancy, freshwater mussels are more imperiled than any other U.S. floral or faunal group (Master *et al.*, 1998). The National Native Mussel Conservation Committee recommended strenghthening our understanding of mussel biology as a top priority (The National Native Mussel Conservation Committee 1998). Most freshwater mussel larvae (glochidia) must attach to a host in order to metamorphose into juveniles. Identification of hosts is the highest priority item listed under the national strategy basic biology research goal.

Knowledge of when mussels brood their young is useful life history information and helpful to juvenile mussel propagation efforts. Mussels brood glochidia in their gills prior to their release.

Biologists interested in propagating juvenile mussels need this information to help them find glochidia for juvenile mussel propagation. Limited information is available for most unionids although some brooding information has been gathered for the mussel species we studied, specifically, *Pleurobema sintoxia*, *Elliptio dilatata*, and *Fusconaia flava*. Brooding periods for these species are: May-July, May-July, and June-August, respectively (reviewed in Watters *et al.*, 2009). Although brooding periods for these mussels have been studied in the St. Croix River basin (Heath *et al.*, 2001), recent observations suggest brooding periods may vary between the St. Croix River and its tributaries.

Glochidia host studies have been conducted on several mussel species living in the upper Mississippi River watershed but most analyses are incomplete (Watters *et al.*, 2009). Some species that have been studied but would benefit from additional research include: *Pleurobema sintoxia, Lasmigona costata, L. compressa, Elliptio dilatata*, and *Cumberlandia monodonta*. Identification of suitable host species that facilitate glochidia metamorphosis is essential in initiating most juvenile mussel propagation efforts. Previous studies have shown that various minnow species and bluegill are suitable hosts for *P. sintoxia* in the laboratory (Hove 1995, Hove *et al.*, 1997, Watters *et al.*, 2005), and bluegill are naturally infested with this species (Surber 1913, Coker *et al.*, 1921). *Lasmigona costata* appears to utilize a wide variety of hosts. Laboratory studies have shown that bowfin, central stoneroller, creek chub, goldfish, longnose dace, northern hogsucker, brown bullhead, northern pike, banded sculpin, northern studfish, bluegill, green sunfish, largemouth bass, longear sunfish, pumpkinseed, banded darter, fantail darter, rainbow darter, striped darter, walleye and yellow perch are suitable hosts (Luo 1993, Hove *et al.*, 1994, Watters *et al.*, 1998a, Watters *et al.*, 1998b, Watters *et al.*, 2005). Additionally, gizzard shad and river redhorse have been observed naturally infested with flutedshell (Weiss and Layzer 1995). A variety of fishes have facilitated *L. compressa* glochidia metamorphosis in the laboratory, including: *Lepisosteus platostomus, Dorosome cepedianum, Cyprinella spiloptera, Hybognathus hankinsoni, Notropis atherinoides, N. volucellus, Rhinichthys cataractae, Semotilus atromaculatus, Ameiurus melas, A. natalis, Pylodictus olivaris, Culaea inconstans, Cottus cognatus, Lepomis cyanellus, L. humilis, L. macrochirus, Micropterus dolomieu, Pomoxis nigromaculatus, Perca flavescens*, and the non-native *Lebistes reticulatus* (Tompa 1979, Hove *et al.*, 1995, McGill *et al.*, 2002). Little work has been done on *E. dilatata* hosts. *Dorosome cepedianum* and *Pomoxis annularis* are known to be naturally infested with spike, and *Pylodictus olivaris, Pomoxis nigromaculatus, Perca flavescens,* and *Sander canadensis* are stated to be hosts but evidence for their status was not provided (Howard 1914, Wilson 1916, Clarke 1981). Many host suitability trials have been conducted on *C. monodonta* but to date there is no known host for this mussel (Watters *et al.*, 2009). Lack of accurate glochidia host fish information makes it nearly impossible to determine the viability of imperiled mussel populations either in degraded habitats, where they now occur, or in habitats being considered for reintroduction of locally extirpated species following an improvement in conditions or translocation of mussels to rescue them from spread of zebra mussels or from other adverse effects.

We had three research objectives for improving mussel management: 1) determine how *Pleurobema sintoxia*, *Elliptio dilatata*, and *Fusconaia flava* brooding period varies between populations in the St. Croix River and its Yellow River tributary, 2) determine fish species that facilitate glochidia metamorphosis of *Lasmigona costata*, *L. compressa*, *Pleurobema sintoxia*, *Elliptio dilatata*, and *Cumberlandia monodonta* glochidia, and 3) collect juvenile mussels from naturally infested fishes from the Sunrise, Elk, St. Croix, and Willow Rivers in hopes of identifying natural mussel hosts.

Methods

Mussel brooding behavior

We used snorkeling and SCUBA gear to study mussel brooding behavior in the Yellow River in northwestern WI and St. Croix River in east central MN during the spring and summer of 2014. We visited *Pleurobema sintoxia*, *Elliptio dilatata*, and *Fusconaia flava* populations bimonthly, discharge permitting, between April and August 2014. A helpful visual cue we used to find several *P. sintoxia* was the white papillae and mantle comprising the incurrent and excurrent apertures. We measured water temperatures with a datalogger, or downloaded temperature and discharge data from the St. Croix Falls, WI USGS gaging station. During each visit we collected 10-20 of each of the mussel species, briefly peered between the valves to determine gill inflatedness and color, and returned mussels to the collection site. If mussels had gills inflated at least three times normal thickness we considered them gravid. Age was estimated by counting rings on the periostracum, and length was measured using a caliper (length recorded).

Suitable Glochidia Hosts

We conducted glochidia host suitability trials using standard methods (Zale and Neves 1982, Hove *et al.,* 2000). Gravid mussels were collected from a variety of sources: *P. sintoxia*, *C. monodonta*, and *E. dilatata* were from the St. Croix River (near Franconia, MN), *L. costata* were primarily from the Sunrise River (Kost Dam) or St. Croix River (Franconia, MN), and *L. compressa* were collected from Turtle Creek near Owattona, MN. Fishes for many artificial infestation trials were collected using a seine, trap net, angling or electrofishing equipment from streams and rivers outside of the St. Croix River drainage. This precaution was taken to avoid testing fish that may have been previously exposed to the species of glochidia under investigation and thereby developing immunity to subsequent exposures (Reuling 1919). Host suitability trials were conducted at the UMN Wet Laboratory in St. Paul. Test subjects were held in holding tanks (40 L or 400 L) at least 14 d prior to glochidia infestation, at temperatures between 14-23 °C. Gravid female mussels were held in beakers in aquaria until they released glochidia naturally or glochidia were extracted by puncturing and flushing the marsupia with a water filled syringe. To determine glochidia health we exposed a subsample to a 0.1-1% NaCl solution. If ≥ 70% of the glochidia closed their valves upon exposure to salt, the rest of the glochidia were used for host tests. After completion of experiments, we returned female mussels to where they were collected. Fish and adult mussel identifications were based on Becker (1983) and Sietman (2003), respectively. Fish and mussel nomenclature follows Turgeon *et al*., (1998) and Robins *et al*., (1991), respectively.

Host suitability trials were conducted during 2014-15. Fishes were infested with glochidia by placing fishes in a 1-7 L bath with several hundred to several thousand glochidia under vigorous aeration for a few minutes to hours depending on species' susceptibility to infestation. The state of infestation was monitored regularly to ensure over-infestation did not occur. Once treated fish were infested with at least 10-20 glochidia on their gills they were transferred to clean aquaria. Infested fishes were held in aquaria at 20°C ± 3 °C and fed at least three times a week. Fathead minnows (*Pimephales promelas*) were given to piscivorous fish at least once a week and removed from aquaria 5-10 minutes after introduction to minimize the possibility of their consuming glochidia or juvenile mussels lying on the aquarium floor. Some of the small fishes (*e.g.*, cyprinids, etheostomids, catostomids, *etc.*) were held in suspended nets to prevent them from eating juvenile mussels on the aquarium floor. Aquaria were generally siphoned and siphonate checked for presence of glochidia and juveniles 2-3 times a week. A given search for juveniles was terminated after three consecutive searches failed to reveal a glochidium or juvenile mussel. At this termination point, each fish was searched for attached glochidia using a dissecting microscope. If we found a glochidium, the fish was revived and the experiment continued until we no longer observed glochidia attached to the fish. A mussel was considered a juvenile when we observe foot movement or valve closure among those individuals collected ≥ 10 d after infestation. A fish was considered a suitable host if we observed glochidia encystment and metamorphosis to the juvenile stage.

Natural glochidia infestations

We collected fishes from the Willow River, WI, and Elk, Sunrise, and St. Croix Rivers, MN in an effort to obtain juvenile mussels from naturally infested fishes. Fishes were collected twice during the fall of 2014 from the Willow River and held at Grantsburg High School (GHS) where juvenile mussels were recovered using procedures described above. Fishes were collected from the other rivers at various times during 2014 and held at the UMN using methods described above. Glochidia and juvenile mussels recovered from these fishes were preserved in ethanol, and some of the juveniles were analyzed using standard scanning electron microscopy methods (Hove *et al.*, 2012).

Results

Mussel brooding behavior

We observed mussels brooding in the Yellow River during 2014 but high flows prevented our studying mussels in the St. Croix River. *Pleurobema sintoxia* brooded glochidia between May 11-June 23 and *F. flava* between May 11-July 18 in the Yellow River. Round pigtoe brooded glochidia in outer gills only, which were white in color. *Fusconia flava* used all four gills to brood, which ranged in color from light peach to orange, to light pink to red. During 2014 there were extended high flows in the St. Croix River from April through mid-July during 2014, which prevented our studying mussel brooding periods.

Suitable Glochidia Hosts

We conducted host suitability trials using *Pleurobema sintoxia*, *Elliptio dilatata*, *Lasmigona costata*, *L. compressa*, and *Cumberlandia monodonta* glochidia. We observed glochidial metamorphosis among most mussel species tested. Host suitability trials using *Pleurobema sintoxia* glochidia revealed that 3 of 19 fish species, white sucker, shorthead redhorse, and northern pike, served as suitable hosts (Table 1). We determined that *Elliptio dilatata* metamorphosed on 14 of 34 fish species tested, especially percids (Table 2). *Lasmigona* *costata* glochidia metamorphosed on a wide variety of fishes, 19 of 20 complete trials, with minnows often producing more juveniles (Table 3). Host suitability trials using *L. compressa* glochidia were successful on 13 of 26 fish species tested (Table 4). Neither American eel (n=3) or burbot (n=4) exposed to *C. monodonta* glochidia facilitated metamorphosis.

Natural infestations

We recovered juvenile mussels from several naturally infested fishes. During August 2014 we collected juvenile mussels from naturally infested St. Croix River fishes near Franconia, including logperch (Table 5). The logperch produced juvenile mussels that resembled *Epioblasma triquetra*. We used SEM to measure glochidia from known mussel species and created a database of glochidia shell dimensions for five species similar in size to *E. triquetra* (Hornbach 2001, Watters *et al*., 2009) (Table 6). We used these data to develop a discriminant function to differentiate among species. (This function correctly identified species approximately 90% of the time). We then applied this discriminant function to the juveniles collected from wild caught logperch. This analysis generated a ≥95% prediction probability that 3 juveniles collected from logperch were *E. triquetra* (Table 7). We also collected fishes from the Sunrise River near Kost Dam during spring 2014 and obtained 5 juvenile mussels from white suckers (Table 8). Several fishes (12 spp.) were collected around the Hwy. 63 bridge over the Willow River, WI during the fall to near ice cover but no juvenile mussels were recovered from these fishes (Table 9). Finally, we collected several fishes from the Elk River in hopes of finding fishes naturally infested with *L. compressa* but none of these fishes produced juvenile mussels (Table 10). Funds were not available to analyze all the young mussels collected from naturally infested fishes. These juvenile mussels were preserved in ethanol and saved for later analyses.

Discussion

Mussel brooding behavior

Like many members of the Tribe Pleurobemini (Campbell *et al*., 2005) living in the upper Mississippi River we found *Pleurobema sintoxia* and *Fusconaia flava* brood glochidia during spring and summer. Upper Mississippi River Pleurobemini that brood glochidia in the spring or early summer include: *Elliptio* (Apr-Aug), *Fusconaia* (May-Aug), and *Pleurobema* (May-Aug) (Howard 1914, Coker *et al*. 1921, Heath *et al*., 2001). Our observations of *P. sintoxia* brooding period (mid-May –late June) were similar to what has been reported by others; June in Ohio (Watters *et al*., 2005) and mid-May through mid-August in the St. Croix River, WI (Heath *et al*., 2001). Similarly, our observation of *F. flava* brooding between mid-May –mid-July is fairly close, although a little earlier than, the June–August brooding period reported in Ortmann (1919) or Heath *et al*., (2001). As we reported last year, *P. sintoxia* and *F. flava* brooding periods in the Yellow River ended earlier than periods reported for the St. Croix River (Heath *et al*., 2001). Knowledge of when mussels brood glochidia will assist biologists searching for glochidia for juvenile mussel propagation programs or for research.

Suitable Glochidia Hosts

Our research results increase our understanding of suitable hosts for *Pleurobema sintoxia*, *Elliptio dilatata*, *Lasmigona costata*, and *L. compressa* glochidia, but unfortunately not for *Cumberlandia monodonta*. Previous research had shown that minnows and bluegill are suitable hosts for *Pleurobema sintoxia* (Hove 1995, Hove *et al*., 1997, Watters *et al*., 2005). We tested a broader variety of minnow species and found positive and negative results, as well as previously unreported suitable hosts. We determined that several percids are suitable *E. dilatata* hosts, which suggests that additional percids, especially darters, might serve as suitable hosts for this mussel. These results build on a very limited number of previous studies, which showed that *Dorosome cepedianum* and *Pomoxis annularis* have been naturally infested with spike, and *Pylodictus olivaris, Pomoxis nigromaculatus, Perca flavescens,* and *Sander canadensis* are potential hosts (evidence not provided) (Howard 1914, Wilson 1916, Clarke 1981). *Lasmigona costata* metamorphosed on a wide variety of fishes. Previous studies had shown this species accepts a large variety of fishes (Luo 1993, Hove *et al*., 1994, Watters *et al*., 1998a, Watters *et al*., 1998b, Watters *et al*., 2005) and our research expanded that list. As previous research has shown, we found that a variety of fishes have facilitate *L. compressa* glochidia metamorphosis in the laboratory (Tompa 1979, Hove *et al*., 1995, McGill *et al*., 2002). Field studies are needed to determine which of these fishes are naturally infested with creek heelsplitter. Finally, the host(s) for *C. monodonta* remain a mystery. Undoubtedly the most studied mussel species without successful results, the spectaclecase needs additional early life history work. These observations show there is still much to learn about relationships between mussels and their hosts.

Natural infestations

We attempted to collect juvenile mussels and glochidia from naturally infested fishes in hopes of recovering *Epioblasma triquetra*, *Lasmigona costata*, and *L. compressa*. Laboratory research has shown that percids (especially logperch, *Percina caprodes*), cottids, and fundulids, are potential *E. triquetra* hosts (Hill 1986, Sherman 1993, Yeager and Saylor 1995, Hillegass and Hove 1997, Barnhart *et al*., 1998, Jones and Neves 2000, Hove *et al*., 2003, Watters *et al*., 2005). Combining potential host research with evidence that snuffbox naturally infest logperch shows this fish is a natural host. Although no juvenile mussels were obtained from fishes collected near *L. compressa* in the Willow River we did collect some glochidia and hope to analyze these specimens as funds become available.

Acknowledgements

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Table 1. *Pleurobema sintoxia* host suitability trials.

Fish species	No. of individuals inoculated	No. of survivors	Glochidia/ juvenile recovery period (days)	No. of juveniles recovered
longnose gar	5	5	3	0
bowfin	5	5	6	0
goldfish	1	1	3	0
white sucker	5	5	13-20	17
shorthead redhorse	2	1	11-20	22
brown bullhead	2	2	3	0
yellow bullhead	5	5	3	0
blue catfish	1	1	3	0
tadpole madtom	1	1	3	0
northern pike	3	1	9-13	27
burbot	4	4	3	0
rock bass	1	1	3	0
green sunfish	3	3	3	0
pumpkinseed	1	1	3	0
orange-spotted sunfish	2	2	3	0
bluegill	10	10	3	0
yellow perch	10	10	6	0
sauger	1	1	3	0
freshwater drum	2	2	3	0

Table 2. *Elliptio dilatata* host suitability trials.

Fish species	No. of individuals inoculated	No. of survivors	Glochidia/ juvenile recovery period (days)	No. of juveniles recovered
longnose gar	4	4	12-17	125
bowfin	5	5	3	0
American eel	4	4	4	0
spotfin shiner	2	0*		
common shiner	8	8	13-18	79
hornyhead chub	1	1	4	0
golden shiner	3	3	7	0
bigmouth shiner	4	4	4	0
mimic shiner	2	2	5	0
bluntnose minnow	4	4	4	0
fathead minnow	4	4	4	0
bullhead minnow	2	2	4	0
blacknose dace	1	1	4	0
creek chub	4	4	4	0
white sucker	2	2	4	0
black bullhead	7	7	7	0
yellow bullhead	5	5	4	0
tadpole madtom	2	2	4	0
northern pike	1	1	8	0
burbot	8	8	3	0
rock bass	1	1	9	0
green sunfish	3	3	14-16	2
pumpkinseed	1	0*		
bluegill	10	10	15-17	13
black crappie	1	1	14-21	172
yellow perch	10	10	15-20	361
logperch	5	4	13-20	318
blackside darter	11	4	12-21	263
slenderhead darter	8	5	13-20	44
river darter	3	1	15-18	32
rainbow darter	7	1	13-25	199
fantail darter	3	2	14-28	120
Johnny darter	5	3	12-21	383
banded darter	11	9	13-18	17

* Incomplete trial

Table 3. *Lasmigona costata* host suitability trials.

Fish species	No. of individuals inoculated	No. of survivors	Glochidia/ juvenile recovery period (days)	No. of juveniles recovered
central stoneroller	7	6	9-16	223
spotfin shiner	8	4	9-14	50
red shiner	7	7	9-14	72
northern redbelly dace	5	0*		
southern redbelly dace	8	6	9-16	31
brassy minnow	8	3	9-14	12
silver chub	1	1	9-12	7
golden shiner	8	3	9-14	19
bigmouth shiner	6	4	12	0
spottail shiner	3	1	12	1
mimic shiner	8	3	12	1
bluntnose minnow	8	7	9-12	2
fathead minnow	8	6	12	2
bullhead minnow	8	3	14	1
quillback	2	0*		
trout perch	2	0*		
brook stickleback	8	0*	8-9	2
fantail darter	8	8	9	5
Johnny darter	6	6	10	1
banded darter	9	9	12	0
blackside darter	8	6	12	1
slenderhead darter	8	7	14	1
river darter	6	5	9-14	6
freshwater drum	2	2	9-14	33

* Incomplete trial

Table 4. *Lasmigona compressa* host suitability trials.

Fish species	No. of individuals inoculated	No. of survivors	Glochidia/ juvenile recovery period (days)	No. of juveniles recovered
longnose gar	4	4	3	0
bowfin	5	5	13	1
American eel	4	4	7	0
goldfish	1	1	7	0
common shiner	4	4	13-27	98
creek chub	4	4	14-27	419
white sucker	2	2	12	1
northern hogsucker	2	2	8	0
shorthead redhorse	5	5	8	0
black bullhead	8	8	11	0
yellow bullhead	8	8	8	0
channel catfish	8	8	3	0
tadpole madtom	3	3	4	0
northern pike I	1	1	11	0
northern pike II	3	2	12-14	4
troutperch	2	1	9	4
burbot	4	4	9	0
mottled sculpin	4	4	13-20	26
rock bass	1	1	10	0
green sunfish	2	2	12-14	3
pumpkinseed	4	3	14-17	13
bluegill	10	9	14	4
black crappie	5	5	12-17	11
smallmouth bass	1	1	11-15	11
largemouth bass	10	10	12	0
yellow perch	9	9	12-19	62
walleye I	1	1	13	0
walleye II	3	3	9	0

Table 5. Juvenile mussels recovered from naturally infested fishes collected from the St. Croix River at Franconia, MN.

Fish species	No. of individuals	No. of juveniles recovered
spotfin shiner	5	1
bluntnose minnow	2	0
western sand darter	4	0
logperch I	≈40	22
logperch II	3	1
Johnny darter I	8	0
Johnny darter II	1	0
walleye	2	20

Table 6. Glochidial shell dimensions of St. Croix River (S) and Kohlman Creek (K) mussels. Shell dimensions with different column superscripts were significantly different ($P<0.05$).

Species	Height ± 1 std dev (μ)	Length ± 1 std dev (μ)	Hinge length (μ)
Obliquaria reflexa (S)	256 ± 6^{a}	250 ± 7^{a}	$146 \pm 6^{a,b}$
Amblema plicata (S)	234 ± 8^{b}	216 ± 6^{b}	141 ± 5^{c}
Elliptio dilatata (S)	231 ± 12^{b}	221 ± 8^{b}	149 ± 5^{a}
Epioblasma triquetra (S)	206 ± 4^{c}	204 ± 4^{c}	$143 \pm 5^{b,c}$
Toxolasma parvus (K)	200 ± 11^{c}	181 ± 10^{d}	104 ± 6^{d}

Table 7. Juvenile mussels recovered from naturally infested logperch.

Logperch collection date	Mean height ± 1 std dev (μ)	Mean length ± 1 std dev (μ)	Mean hinge length ± 1 std dev (μ)	Discriminant analysis prediction probability
July-Aug 2014	211	193	133	*E. triquetra* (95%)
	215	192	132	*E. triquetra* (84%), *A. plicata* (15%)
	215	207	143	*E. triquetra* (77%), *E. dilatata* (13%)

Table 8. Juvenile mussels recovered from naturally infested fishes collected from the Sunrise River at Kost Dam.

Fish species	No. of individuals	No. of juveniles recovered
white sucker	1	5
yellow perch	8	0

Table 9. Juvenile mussels recovered from naturally infested fishes collected from the Willow River, WI.

Fish species	No. of individuals	No. of juveniles recovered
central stoneroller	3	0
northern redbelly dace I	50	0
northern redbelly dace II	12	0
brassy minnow I	30	0
brassy minnow II	1	0
fathead minnow	≈400	0
blacknose dace	11	0
creek chub I	50	0
creek chub II	57	0
white sucker I	10	0
white sucker II	18	0
northern pike	1	0
central mudminnow	5	0
brook stickleback I	10	0
brook stickleback II	15	0
mottled sculpin	2	0
Johnny darter I	17	0
Johnny darter II	20	0

Table 10. Juvenile mussels recovered from naturally infested fishes collected from the Willow River, WI.

Fish species	No. of individuals	No. of juveniles recovered
bowfin	1	0
common shiner	1	0
hornyhead chub I	3	0
hornyhead chub II	2	0
blackside dace	10	0
white sucker	4	0
tadpole madtom	2	0
northern pike I	2	0
northern pike II	8	0
central mudminnow	3	0
mottled sculpin	4	0
rock bass	2	0
largemouth bass	2	0
Johnny darter I	8	0
Johnny darter II	3	0
blackside darter I	1	0
blackside darter II	10	0