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The Aquatic Animal Community in a Chagrin River Tributary at Case Western Reserve University's Squire Valleevue Farm

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Abstract: Since 1937 Case Western Reserve University has been managing Squire Valleevue Farm as a natural resource for education, research, and recreation. One of the most notable natural features of the property is a small headwater tributary of the Chagrin River that runs from west to east across the Farm's property. Even though the stream is a valuable educational resource, and its location at the Farm affords it a degree of environmental protection, the aquatic animal community inhabiting the stream remains undocumented. Therefore, the stream's fish, amphibian, and macroinvertebrate species were surveyed to determine which species are present. In addition, the typical ecological characteristics of each fish species were analyzed and compared to their geographical distributions within the stream in order to determine their path of immigration into the stream. Stream-adapted species (Western Blacknose Dace, *Rhinichthys obtusus*; Creek Chub, *Semotilus atromaculatus*) were found at downstream sites close to the Chagrin River, suggesting that these species had naturally colonized upstream from the River. Several pond-adapted species (Bluegill, *Lepomis macrochirus*, Largemouth Bass, *Micropterus salmoides*, Yellow Bullhead, *Ameiurus natalis*) were found at upstream sites that would be difficult to reach through natural colonization due to the presence of large waterfalls. The geographical distribution of these species within the stream indicates that at most two of them may have immigrated from artificial ponds located on Farm property, but at least two of the three species immigrated from a source located upstream of Farm property. The pond-adapted fishes are relatively large, predatory species, and their effects on the amphibian and macroinvertebrate communities remain to be determined.

Key Words: amphibian, exotic, fish, Great Lakes, invertebrate, Lake Erie, native, non-native, stream

Introduction

Squire Valleevue Farm, located in Hunting Valley, Ohio, was a gift to Case Western Reserve University in 1937 by the late Andrew Squire (Locci and Bond 2011). Since then, the 277 acres of the Farm have served the overall University community by providing opportunities for research, recreation, and education. The Farm also functions essentially as a nature preserve, because its property is protected from human development. A small stream runs from west to east along the northern border of the Farm's property and empties into the Chagrin River, which flows from south to north just east of the Farm and empties into Lake Erie. The stream is typically between approximately 1 and 2 m wide, and is typically only a few cm deep although it may be deeper (approximately 0.5 m) in pools. This stream is one of the most interesting natural features of the Farm, but the fish, amphibian, and macroinvertebrate species inhabiting the stream have not previously been documented. The goal of the current study was to survey the aquatic community living in the stream.

The presence of any native fish species in the stream would most likely be due to migration upstream from the Chagrin River. Over the past 3 million years, continental ice sheets have repeatedly advanced and retreated over the Great Lakes drainage (Smith et al. 2004). Species currently native to the Chagrin River and its tributaries originally colonized the area after the last glacial period, the Wisconsinan glaciation, retreated over 14,000 years ago (Ehlers and Gibbard 2004). At that time, ice-marginal lakes formed over the area that now encompasses the Great Lakes. Cool-water fishes colonized Lake Erie via inlets from several directions; the Wabash River connected Lake Maumee, Lake Whittlesey, and Lake Warren to western Lake Erie while the Hudson River connected Lake Wayne and Lake Warren to present day East Lake Erie (Smith et al. 2004; Szabo and Chanda 2004). Warm-water fishes entered Lake Erie mainly from the Ohio River drainage as numerous headwaters of southern tributaries to Lake Erie eroded headward, capturing headwater neighbors to the south as they did so (Smith et al. 2004). As glaciers receded after the Wisconsinan glaciation, the Chagrin River cut through the Allegheny Plateau towards Lake Erie (White 1982). However, the flow of the Farm stream is currently interrupted by numerous waterfalls that would impede fish migration upstream from the Chagrin River. Two of these barriers are exceptionally large. The waterfall closest to the Chagrin

River is currently in the form of a particularly large (approximately 4 m tall) man-made concrete wall. The second large waterfall is located further upstream and is much larger (approximately 10 m). If fishes were to be found in the stream, it would be expected that they would be small stream-adapted species that colonized upstream from the Chagrin River over the past 14,000 years, and more species would be expected at sites closer to the Chagrin River.

An alternative pathway for colonization could be from artificial ponds both on and nearby the Farm property. There are several ponds at the Farm that, after heavy rains, drain into the stream via two small intermittent drainage ditches. Both Bluegill, *Lepomis macrochirus* (Centrarchidae), and Largemouth Bass, *Micropterus salmoides* (Centrarchidae), are known to inhabit these ponds at high densities. There are also several ponds located off of the Farm property that could be potential routes of colonization. By comparing the geographical distributions of the fishes in the stream with their known ecological characteristics, we determine the most likely source of each species.

Fishes observed in the stream might function as consumers of invertebrates and small amphibians, in addition to macrophytes, phytoplankton, and other smaller fishes. The macroinvertebrates and amphibians in the stream were also sampled.

Methods

Study Site

Squire Valleevue Farm is located 14.5 kilometers east of Cleveland at 37125 Fairmount Boulevard, Chagrin Falls, OH 44022. Originating off the property, the stream enters the Farm at its northern border at Cedar Road and flows east into the Chagrin River. During its entire length within Farm property, the stream is surrounded by wooded terrestrial habitat. Two intermittent ditches allow the Farm's man-made ponds to drain into the stream during heavy rains. The ponds are known to contain Bluegill (*Lepomis macrochirus*) and Largemouth Bass (*Micropterus salmoides*). The section of stream upstream from where the west ditch intersects has low gradient with mostly muddy substrate. The section downstream of the west ditch has a steeper gradient, is characterized by a series of waterfalls, has a rockier substrate consisting of bedrock, cobble, and gravel, and is in a gorge surrounded by steep, high walls. Because of the physical differences between the two sections, samples taken upstream of where the west ditch intersects the stream were categorized as "upstream" samples and designated with negative numbers (-1 through -3), and those taken downstream of where the ditch intersects the stream were characterized as "downstream" samples, and were designated with positive numbers (1 through 6). Therefore, there were three sample sites upstream and six downstream, for a total of nine sample sites (Figure 1).

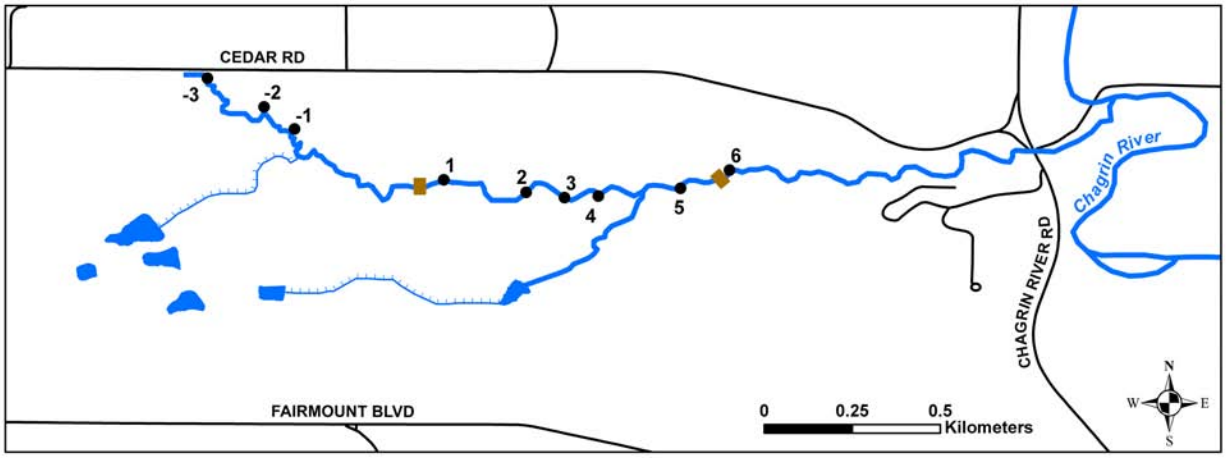

Figure 1. The nine study sites at Squire Valleevue Farm. Beginning north of the property, the stream enters the Farm at Cedar Road, flows downstream from west to east, and ends in the Chagrin River. Several research ponds at the Farm drain into the stream during heavy rainfall via two small ditches (hatched lines). Samples taken downstream of where the west drainage ditch intersects the stream are categorized based on physical differences (see text) as "downstream" samples (positive numbers) and those taken upstream of where the west ditch intersects the stream are characterized as "upstream" samples (negative numbers). Two exceptionally large waterfalls (see text) are indicated by brown rectangles.

Fishes
Fishes were sampled on several dates in the spring and fall, beginning in fall 2008 and ending in spring 2011. Fishes were sampled with either a 6 ft. or 12 ft. seine, depending on the width and depth of the stream at a specific sample site. On the first sampling date, 2 September 2008, fishes were permanently removed from the stream because of their presumably non-native status and to observe their potential re-immigration into the stream. Otherwise, fishes were captured, photographed, identified, and then released back into the stream. In two cases fishes were observed visually from the bank and were confidently identified without capture. Due to their presumably small populations, voucher specimens were not collected and archived. At each site, seine hauls were performed until no new species were obtained.

Amphibians
Amphibians were observed on several occasions throughout the stream and were intentionally sampled on 28 September 2010 at site 1 by looking under moist rocks within 2 m of each edge of the stream. Salamanders were identified and then each rock was slowly lowered back down in its original position. Amphibians were also sampled incidentally with a seine during fish sampling at all nine sample sites. Funnel traps were deployed upstream at sites -1 and -2, and downstream at sites 3 and 4 from 27 October 2010 – 28 October 2010 (See Macroinvertebrates sub-section below). Amphibians were identified with an ODNR field guide or photographed for future identification (ODNR 2008; Bartlett and Bartlett 2006). Due to their presumed small populations, voucher specimens were not collected and archived.

Macroinvertebrates
Macroinvertebrates were sampled upstream and downstream sites. They were also recorded if captured incidentally while seining fishes at other sites. Three main methods were used to sample macroinvertebrates in the stream; dip netting (D-frame and circular), funnel traps, and Hester-Dendy artificial substrate traps. For all three of these methods, invertebrates were preserved in 95% ethanol and vouchered at the Cleveland Museum of Natural History (catalog numbers pending). To get a general understanding of macroinvertebrate diversity in the stream, specimens were identified to the taxonomic level of family (Packarsky 1990; Thorp and Covich 2009).

The D-frame dip net was used on 17 October 2010 at sites -1 and -2 and at sites 3 and 4, and on 20 March 2011 at downstream sites 3 and 4. Dimensions of the D-shaped frame were 30 cm width x 30 cm height, and the netting had a standard mesh size of 500 microns. The circular dip nets had a 30 cm diameter. Nets were used in a variety of habitat types as kick nets or swept across the substrate. Dip net sampling continued at each downstream and upstream site until repetitive sampling produced no new taxa.

Funnel traps were constructed out of aluminum window screen. The cylinder was 45.7 cm long and 20.3 cm in diameter. The two funnel ends began 20.3 cm in diameter and tapered inward 12.7 cm to a 4.4 cm opening. A string handle running from end to end was attached to the two seams where the cylinder and funnels ends joined. The funnel traps were set on the substrate at a location deep enough to submerge them. Funnel traps were left for 24 hours from 27 October 2010 – 28 October 2010 at sites -1 and -2 and at sites 3 and 4 to capture macroinvertebrates with diurnal and nocturnal activity patterns (Ohio EPA 2004).

Hester-Dendy (HD) artificial substrate samplers were placed at each of four sites: -1, -2, 1, and 2. They were tied to metal weights with 20 – 40 cm of string. The samplers were left submerged in the stream for a period of three weeks, from 27 October 2010 – 17 November 2010. The synthetic substrate plates allowed the sampling of organisms which are slow to colonize, such as caddisflies.

Results

Fishes
Since the fall of 2008 five different fish species have been found in the Farm stream (Figure 2). Overall, stream-adapted cyprinid species, Creek Chub (*Semotilus atromaculatus*) and Western Blacknose Dace (*Rhinichthys obtusus*), were found at sample sites closer to the Chagrin River, and pond-adapted species, Yellow Bullhead (*Ameiurus natalis*, Ictaluridae), Bluegill, and Largemouth Bass, were found at sample sites farther away from the Chagrin River (Table 1).

Amphibians
Nine amphibian species were found in the Farm stream (Table 2). None were caught in the funnel traps and some were caught in seine hauls. Most were observed under rocks. A large number of salamanders (Plethodontidae),

Figure 2. Photographs of fishes captured in the stream at Squire Valleevue Farm. (A) Western Blacknose Dace (*Rhinichthys obtusus*), (B) Creek Chub (*Semotilus atromaculatus*), (C) Bluegill Sunfish (*Lepomis macrochirus*), (D) Largemouth Bass (*Micropterus salmoides*), (E) Yellow Bullhead (*Ameiurus natalis*).

including the Northern Dusky Salamander (*Desmognathus fuscus*), the Mountain Dusky Salamander (*Desmognathus ochrophaeus*), the Northern Two-Lined Salamander (*Eurycea bislineata*), the Redback Salamander *(Plethodon cinereus*), and the Northern Red Salamander (*Pseudotriton ruber ruber*) were observed. Frogs observed include the Northern Spring Peeper (*Pseudacris crucifer crucifer,* Hylidae), Green Frog tadpoles and adults (*Lithobates clamitans melanota,* Ranidae), the Pickerel Frog (*Lithobates palustris,*Ranidae), and the Bullfrog tadpole (*Lithobates catesbeianus,* Ranidae).

Macroinvertebrates

A total of 16 different families of macroinvertebrates were observed in the stream. No macroinvertebrates were caught in the funnel traps. Most were caught with dip nets and the Hester-Dendy artificial substrate traps. Fifteen families were present in the fall, but only eight families were present in the spring (Tables 3, 4). Four of these taxa

Table 1. Fishes collected from the stream at Squire Valleevue Farm from 2 September 2008 to 20 March 2011. For sampling location, the higher the number assigned to the sampling site, the closer it is to the Chagrin River. Sample site -3 was the farthest upstream site, where the stream first enters Farm property at Cedar Road. Sample site 6 was the farthest downstream site.

Sample Site	Latitude	Longitude	Date	Bluegill	Yellow Bullhead	Largemouth Bass	Creek Chub	Blacknose Dace
-3	41.50054	-81.42494	9/25/2010	4	0	0	0	0
-2	41.49980	-81.42350	9/25/2010	3	1	0	0	0
-1	41.49881	-81.42221	9/25/2010	0	0	0	0	0
1	41.49794	-81.41891	9/2/2008	70	1	0	0	0
			4/24/2009	1	0	0	0	0
			3/20/2010	0	0	0	0	0
			9/4/2010	6	1	0	0	0
			3/20/2011	0	0	0	0	0
2	41.49762	-81.41680	9/4/2010	1	0	0	0	0
3	41.49748	-81.41582	9/4/2010	1	0	0	0	0
4	41.49752	-81.41496	8/11/2009	2	0	0	0	0
			9/4/2010	0	0	0	0	0
5	41.49772	-81.41286	9/4/2010	2	0	1	0	0
6	41.49819	-81.41161	3/20/2010	0	0	0	2	3
			9/4/2010	2	0	0	9	11
			3/20/2011	0	0	0	3	0

Table 2. Amphibians found in the Farm stream and the date they were observed.

Common Name	Scientific Name	Date Observed
Northern Dusky Salamander	*Desmognathus fuscus*	3/20/2010, 9/28/2010
Mountain Dusky Salamander	*Desmognathus ochrophaeus*	9/28/2010
Northern Two-Lined Salamander	*Eurycea bislineata*	4/27/2008, 9/28/2010
Redback Salamander	*Plethodon cinereus*	9/4/2010, 9/28/2010
Northern Slimy Salamander	*Plethodon glutinosus*	8/8/1981*
Northern Red Salamander	*Pseudotriton ruber ruber*	9/18/2010
Pickerel Frog	*Lithobates palustris*	3/20/2010
Northern Spring Peeper	*Pseudacris crucifer*	9/28/2010
Green Frog	*Lithobates clamitans melanota*	9/25/2010
Bullfrog tadpole	*Lithobates catesbeianus*	9/25/2010

*record of this species comes from a specimen cataloged at the Cleveland Museum of Natural History

were found in both the upstream and downstream regions of the Farm stream: one crustacean species of the genus *Gammarus*, one insect species of the family Simulidae, one insect species of the family Saldidae, and the leech *Erpobdella punctata* (Tables 3, 4). Downstream, where the sediment was rocky and the water moved more quickly, Trichoptera and Plecoptera larvae were found (Tables 3, 4). All taxa are vouchered at the Cleveland Museum of Natural History except the crayfish, *Cambarus* sp., which was captured while seining for fishes both on the invertebrate sampling dates and other dates and identified via photograph (Whitney G. Stocker pers. comm.). Anisoptera odonate larvae were also regularly captured incidentally while seining for fishes, but were not collected.

Discussion

Fishes

The ecological characteristics of each fish species and its geographical distribution within the stream indicate that there have been two sources for fish immigration into the stream. The two stream-adapted species, Creek Chub and

Table 3. Macroinvertebrates observed during the spring on 20 March 2011 at three downstream sites. Sites 3 and 4 were deliberately sampled using dipnets. Macroinvertebrates were identified to the family level and vouchered at the Cleveland Museum of Natural History, except for *Cambarus* sp., which was captured incidentally at site 6 while seining fishes and was not collected.

Class	Order	Family	Genus	Species	Site	n
Crustacea	Amphipoda	Gammaridae	*Gammarus*	sp.	3, 4	16
Crustacea	Decapoda	Cambaridae	*Cambarus*	sp.	6	1
Hirudinea	Arhynchobdellida	Erpobdellidae	*Erpobdella*	*punctata*	4	1
Insecta	Diptera	Chironomidae	*Chironomus*	*plumosus*	3, 4	6 (larvae)
Insecta	Diptera	Tipulidae	-------	-------	4	1 (larva)
Insecta	Hemiptera	Gerridae	*Gerris*	sp.	3, 4	1
Insecta	Plecoptera	Perlodidae	-------	-------	4	1
Insecta	Trichoptera	Hydropsychidae	*Cheumatopsyche*	sp.	3	1 (larva)

Table 4. Macroinvertebrates observed in the Farm stream during the fall on 17 October 2010 (dipnet) and 17 November 2010 (Hester-Dendy). Sites -1, -2, 3, and 4 were deliberately sampled. Macroinvertebrates were identified to the family level and vouchered at the Cleveland Museum of Natural History, except for *Cambarus* sp., which was captured incidentally at sites 5 and 6 while seining fishes and was not collected.

Class	Order	Family	Genus	Species	Site	n
Crustacea	Amphipoda	Gammaridae	*Gammarus*	sp.	-1, -2, 3, 4	102
Crustacea	Decapoda	Cambaridae	*Cambarus*	sp.	5, 6	2
Hirudinea	Arhynchobdellida	Erpobdellidae	*Erpobdella*	*punctata*	-1	1
Insecta	Coleoptera	Dystiscidae	*Copelatus*	sp.	-2	1 (larva)
Insecta	Diptera	Simulidae	----	----	-2, 3, 4	4 (larvae)
Insecta	Diptera	Tipulidae	----	----	3	1 (larva)
Insecta	Hemiptera	Saldidae	----	----	-1, -2, 3, 4	9
Insecta	Hemiptera	Gerridae	*Gerris*	sp.	3, 4	7
Insecta	Odonata	----	----	----	-2	1 (larva)
Insecta	Plecoptera	Perlordidae	----	----	4	1
Insecta	Trichoptera	Hydropsychidae	*Cheumatopsyche*	sp.	4	6
Insecta	Trichoptera	Philopotamidae	*Chimarra*	sp.	4	2
Gastropoda	Basommatophora	Physidae	*Physella*	*integra*	-1	1
Gastropoda	Basommatophora	Planorbidae	*Planorbella*	*trivolis*	3	1
Turbellaria	Tricladida	----	----	----	-1	2

Western Blacknose Dace, were only caught at site 6, the sample site furthest downstream (Figure 1, Table 1). These species are typically found in cool water and appear to have colonized naturally from the Chagrin River, but they were limited in their movement upstream by the large waterfall. Surprisingly, three pond-adapted species (Bluegill, Largemouth Bass, and Yellow Bullhead) were found at sites upstream of the first waterfall, which would be difficult to reach through natural immigration. These fishes appear to be immigrating into the stream from anthropogenic sources, possibly coming from outside the Farm.

Western Blacknose Dace were only caught at one site, site 6, which was characterized by a large pool just downstream of the large concrete wall, which formed a waterfall into the pool (Table 1). They apparently made their way into the stream by migrating upstream from the Chagrin River. Western Blacknose Dace are known to be a cool water stream-adapted species that typically inhabits moderate to high flow brooks with clear waters and permanent flow (Trautman 1957). They require sand or gravel bottoms with distinct riffles in order to spawn, and rely on deep pools, brush, and roots to provide shelter from predators. Since the early 1900s there have been large decreases in the abundance of Western Blacknose Dace as populations were eliminated due to habitat modification. During the housing boom beginning in 1925 many natural sand and gravel bottomed streams that were bordered by forest and brush were converted into turbid silty streams of intermittent flow (Trautman 1957). Like the Western Blacknose Dace, the Creek Chub is a cool water stream-adapted species (Trautman 1957). It is abundant throughout Ohio, living mostly in creek habitats in the spring and moving downstream into deeper waters after spawning. Most Creek Chub populations seek shelter in the deep pools of larger streams during times of little rainfall and in the winter months. As temperatures approach 5° C in the spring, they move into smaller streams or smaller portions of a stream. The preferred habitat of the Creek Chub closely mirrors that of the Western Blacknose Dace: well scoured bottoms of sand, gravel, boulders, and bedrock with distinct riffles and deep pools with places to hide (Trautman 1957). Migration of Western Blacknose Dace and Creek Chub upstream of site 6 may have historically been blocked by the presence of an impassible barrier that was at some point converted to the large concrete wall that exists there today. If there ever were any Western Blacknose Dace or Creek Chub located at sites upstream of site 6 then they were at one time extirpated but unable to re-colonize after the formation of the barrier. It seems unlikely that these species ever existed at the muddy upstream sites (sites -1 through -3) due to their known requirement for the type of rocky substrate and deep pools that characterize the downstream portion of stream.

The Bluegill appears not to be native to the Farm stream. Bluegill have existed in both the Ohio River and Lake Erie drainages since post-glacial times (Trautman 1957). Previous to 1900, Bluegill were present in kettle and oxbow lakes formed by glacial overflow throughout Ohio (Garlick 1857). Man-made canals greatly aided in the spread of Bluegill, and farm ponds and other small lakes were stocked with millions of them between the 1920s and the 1950s (Whittier et al. 1999). The heartiest Bluegill populations are in non-flowing waters that tend to be clearer with only slight suspended clay silts and organic debris (Mittelbach 1981). Non-flowing water bodies are able to sustain at least patchy macrophyte beds which allow juvenile sunfishes to forage and avoid predation from Largemouth Bass. When juveniles grow larger in the summer they move out of the vegetation and into the open water to feed on *Daphnia* (Mittelbach 1981). Considering the habitat type in which Bluegill are typically found, and that they were found at downstream sites 1, 2, 3, 5, 6, as well as at upstream sites -2, and -3, upstream of several large migration barriers, it seems unlikely that they immigrated into the stream naturally from the Chagrin River. The fact that they were found at site -3, where the stream enters Farm property, suggests that they are entering the stream from locations off the Farm property, as well as possibly through the drainage ditches from the ponds located on Farm property.

The Largemouth Bass is a pond-adapted species that is not typically found in streams such as the one at the Farm. It typically occurs in non-flowing waters including ponds, lakes, impoundments, oxbows, and overflow ponds, which are clear and support extensive aquatic vegetation (Smith et al. 2004; Trautman and Gartman 1974). Largemouth Bass prefer a substrate of silt, organic debris, sand, or clay rather than the rocky substrate at site 5 downstream where one was found (Table 1). Historical records of the Largemouth Bass indicate that it was present before 1900 in the shallow waters of Lake Erie, and in small glacial lakes (Garlick 1857, Trautman 1957). As early as 1830 the species gained commercial importance and many ponds and canals were stocked with Largemouth Bass (Klippart 1877). This species was found only at downstream site 5. Because the fish was found downstream rather than upstream, the Farm pond confluence cannot be ruled out as a source of colonization. Largemouth Bass could be migrating into the stream from artificial populations located off of Farm property or from the Farm ponds.

It also seems unlikely that the Yellow Bullhead is native to the Farm stream. The species is adapted to live in areas of high aquatic vegetation, usually in larger bodies of water (Smith et al. 2004). It is not typically found in small

rocky streams, but may be able to succeed there in the absence of the Brown and Black Bullheads (Smith et al. 2004). Historically, the largest Yellow Bullhead populations have resided in the shallow portions of large bays, lakes, and ponds with clear water and abundant aquatic vegetation (Trautman and Gartman 1974). Between 1880 and 1900 the Yellow Bullhead was widely distributed throughout Ohio, more so in the Lake Erie drainage than in the Ohio River drainage (Trautman 1957). In the current study, it was found at the upstream site -2, and at one downstream site, site 1. Because the Yellow Bullhead was found so far upstream from the confluence with the Farm pond drainage ditch it seems likely that that species is colonizing from populations located off the Farm property. It is more likely that the fish swam downstream from property north of the Farm than swam all the way upstream from the confluence with the ditch. Moreover, there is no record of any catfish in the ponds located on Farm property.

The presence of Bluegill and Yellow Bullhead so far upstream indicates that at least these two species are colonizing from an artificial population located off of Farm property. The fact that only Bluegill and Largemouth Bass are known to occur in the ponds located on Farm property indicates that at most these two of the three pond-adapted species present in the stream may be colonizing from the artificial ponds on Farm property. After 1940, hundreds of farm ponds were dug across Ohio. The majority of these ponds were stocked with Largemouth Bass and Bluegill. Individuals that escaped during flooding seem to be responsible for the widespread distribution of these species throughout Ohio streams where they were absent before 1887 (Trautman and Gartman 1974).

Amphibians

Nine amphibian species were found to inhabit the stream at the Farm. Of note was the Northern Red Salamander, which had not previously been observed at the Farm, but whose identity was confirmed independently by T. Matson, M. Benard, and K. Krynak from a series of photographs. Additional species have been observed at the Farm, although they were not observed in the current study. The American Toad (*Anaxyrus americanus*; Bufonidae) has been observed by Dr. Carl Anthony and the Red-spotted Newt (*Notophthalmus viridescens*; Salamandridae) has been observed by Dr. Martin Rosenberg (Anthony CD, pers comm.; Rosenberg MJ, pers. comm.). The Northern Slimy Salamander, *Plethodon glutinosus* (Plethodontidae) was caught at the Farm in 1981 and vouchered at the Cleveland Museum of Natural History (No. 00002297). There is no reason to believe that any of the amphibian species observed are not native to the stream (Bartlett and Bartlett 2006).

Macroinvertebrates

A large number of invertebrates were collected from the stream. In the fall, a total of 15 different families were collected and in the spring eight families were collected. The difference in number of taxa collected between spring and fall is most likely due to differential sampling effort. Only sites 3 and 4 were used both in the spring and in the fall. In the spring, seven families were collected with dipnets from sites 3 and 4. In fall, nine families were collected with dipnets and Hester-Dendy samplers from the same sites. More EPT (Ephemeroptera, Plecoptera, and Trichoptera) taxa were collected in the downstream portion than in the upstream portion of the stream. In the fall, upstream and downstream sites were sampled equally, and three EPT families were found at the rocky downstream sample sites, and none were found at the muddy upstream sites. Many EPT taxa are pollution intolerant and are often used as bio-indicators of habitat quality (OEPA 1987; Thorp and Covich 2009). This work serves as an initial survey of macroinvertebrates in this stream, which will provide a basis for future, species-level work.

A crayfish, *Cambarus* sp., was seined several times at downstream sample sites. The Rusty Crayfish, *Orconectes rusticus*, a known invasive species throughout the Lake Erie watershed, was not found in the stream (Jezerinac 1982, Jezerinac and Thoma 1984). However, observations of crayfishes were limited to individuals captured incidentally while seining for fishes, and voucher specimens were not collected. A more detailed analysis of the crayfishes present in the stream involving thorough collection and lab-based identification is warranted. Introduction of the Rusty Crayfish in northern Ohio has resulted in the displacement of native crayfish species and decreased macroinvertebrate species diversity (Klocker and Strayer 2004). McCarthy et al. (2006) have shown negative correlations between Rusty Crayfish populations and the abundance of Diptera, Ephemeroptera, Odonata, Trichoptera, and total zoobenthos.

Conclusions

The Chagrin River tributary located at Squire Valleevue Farm hosts a limited number of native fishes, but larger numbers of amphibians and macroinvertebrates. Overall, it was determined that three of the five fish species found in the Farm stream were non-native to the environment, and that they were most likely immigrating from outside of Farm property. This is significant because these species, Bluegill, Yellow Bullhead, and Largemouth Bass, are large-

growing predatory species and have the potential to negatively impact the stream's amphibian and macroinvertebrate communities. At this time it is not possible to determine the effect that the non-native fishes are having on the other organisms living in the stream. It is, however, possible that the effect is dampened by the seasonal pattern observed in the presence of the non-native fishes in the stream. In the spring when amphibian species are most active and susceptible to predation, the non-native fishes are found in very small numbers. By comparison, non-native fishes are found in the stream in much larger numbers during the fall. It is possible that by the time non-native fishes populate the stream in the fall, amphibians are less vulnerable to predation because they are not out in the open, breeding. Additional study is required to fully understand the interactions among the different species that occupy the stream. Nevertheless, it would seem prudent for future management decisions to consider options that would prevent the introduction of non-native species into the otherwise protected Farm stream in order to conserve the native aquatic biota found there.

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