Brandywine Creek
Berrien County, T7S / R17W / Sec 2
Saint Joseph River watershed

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Environment

Brandywine Creek is located on the southern edge of the City of Niles and flows from east to west into the Saint Joseph River. Public access sites include the Brandywine Creek Nature Park off 3rd Street and Niles Township Memorial Park off Bond Street. Brandywine Creek is a second order stream (Strahler method) and is 8.2 miles long. Stream widths average 14 feet, with an average depth of 2 feet. Brandywine Creek falls about 110 feet from its headwaters to its confluence and is classified as a medium gradient cold stream.

Land use is primarily agricultural in the headwaters and shifts to urban as the stream flows through the City of Niles. Total watershed area is 18,224 acres (USDA HUC12 040500012209) of which 38% is agricultural, 33% is urban, 19% is forested/scrub/grassland, 8% is wetland, 2% is other (2011 National Land Cover Dataset). Surficial geology of the watershed is mostly coarse textured ice contact/ outwash/alluvium/fluvial (87%) with some moraine (13%). Most of the creek in Berrien County is underlaid with Oshtemo loamy sands, which are well drained. Further upstream the soil is composed of Cohoctah loamy sands, which are poorly drained.

Three dams exist on the Saint Joseph River downstream of the Brandywine Creek confluence (Niles, Buchanan, and Berrien Springs). Migration of potamodromous fish from Lake Michigan through the Saint Joseph River and Brandywine Creek was blocked since the construction of the Niles Dam in 1868. The dam is located approximately 0.6 miles downstream of the confluence of Brandywine Creek with the Saint Joseph River. A fish ladder was constructed at Berrien Springs Dam in 1975 that allowed passage of salmon and Steelhead and limited passage of native fish species. Due to the success of the Berrien Springs ladder in providing upstream fishing opportunities, fish ladders were installed at Buchanan Dam and Niles Dam and were opened in 1990 and 1991 respectively. Rainbow Trout (steelhead), Chinook Salmon and Coho Salmon have been able to enter Brandywine Creek since 1991. A weir was installed downstream of the Bond Street crossing just above the St. Joseph River confluence in 1992. The weir was placed to prevent migrating steelhead and salmon from entering Brandywine Creek during spawning runs. The goal was to prevent competition with Brown Trout and conserve the Brown Trout fishery. The weir was removed following the 2002 survey after it was evident that steelhead access was not being restricted to Brandywine Creek.

History

Brandywine Creek has been actively managed as a trout fishery by the Michigan Department of Natural Resources (DNR) Fisheries Division since 1933. Stocking records indicate Brook Trout were stocked earlier in 1895, 1896, 1905, and 1909 (Table 1). Brook Trout were stocked annually from 1933 through 1947 (except 1939 and 1940) at a variety of ages. Management shifted to stocking Brown Trout in 1971. Brown Trout have been stocked annually at the 15th Street and US-12 crossings while natural reproduction supports the population downstream near the 3rd Street crossing. Current management is

to annually stock yearling Brown Trout at US-12 and 15th Street at a target of 900 fish at each site (129 fish per acre). The Brown Trout strain switched to Sturgeon River in 2020 after the Gilchrist Creek strain was removed from DNR hatcheries.

The stream was heavily dredged in 1957 and DNR, assisted by the Bend of the River Conservation Club, conducted a fish rescue effort prior to dredging. The stream was electrofished on February 13, 16, and 17 from US-12 upstream approximately 9,570 feet. A total of 150 Brown Trout were removed ranging from 8 to 27 inches. It is unclear if these fish were stocked back into Brandywine Creek following dredging or relocated to another site. In addition, 31 Common Carp were removed and disposed.

Brown Trout surveys and population estimates have regularly been conducted on Brandywine Creek. The first survey effort on record is a hook and line survey that reported 3 anglers fishing for 8 hours capturing 5 Brook Trout. The first electrofishing survey was conducted on Brandywine Creek on September 11, 1969, using a backpack electrofisher upstream from the US-12 crossing. The substrate was reported as 90% sand and fine gravel and 10% silt and overhanging brush, logs, and undercut banks were reported as abundant. One Brown Trout was captured measuring 9.7 inches. This capture was notable, because Brown Trout were not stocked by DNR until 1971 and this fish either migrated from another tributary or was transplanted by anglers. Green Sunfish, Grass Pickerel, Pumpkinseed, White Sucker, Common Carp, Central Mudminnow and Mottled Sculpin were also captured in low numbers.

An electrofishing survey was conducted at two sites (15th Street and US-12 crossings) in August of 1975. Three Brown Trout were captured at the 15th Street site measuring 8.6, 11.2, and 11.4 inches. Substrate was 90% sand, 5% gravel, and 5% silt and the main habitat was overhanging brush, undercut banks, and pools. Eight White Suckers and one Mottled Sculpin were also collected. A total of two Brown Trout were captured at the US-12 site measuring 7.7 and 7.1 inches. The US-12 site had more gravel substrate at 20% but was primarily sand (70% with some silt (10%).

The bridge at the 3rd Street crossing washed out by flood flows in 1981. Initial bridge replacement plans were to alter the stream and straighten the watercourse resulting in the loss of 600 feet of stream. Fisheries Division worked to protect the habitat preventing alteration of the stream. The replacement bridge was constructed in 1981/1982 without rerouting the stream and filling the active channel. Two road crossing sites were surveyed in August of 1982 (15th Street and 3rd Street) following construction of the new bridge. Habitat was noted to be disturbed by siltation downstream of 3rd street for about 75 yards, but Brown Trout were reported to be in good shape. Greater numbers of Brown Trout were captured in 1982 than in previous surveys indicating improved stocking success and survival. A total of 30 Brown Trout ranging from 3.1 to 14.9 inches were captured at 3rd Street and 14 were captured at 15th Street ranging from 3.5 to 16.6 inches. Mottled Sculpin and White Suckers were captured at both sites. Three Common Carp were caught at 15th Street.

Electrofishing surveys were conducted at three sites in 1989. Brown Trout were captured at each site ranging from 3 to 16 inches and over 31% were legal size. A total of 88 Brown Trout were captured at 3rd street, 32 at 15th street and 19 at US-12. Young-of year sized fish were primarily caught at 3rd Street where excellent nursery habitat was reported. The majority of the fish captured at 3rd Street were determined to be of natural origin based on coloration and fin erosion. All fish observed at 15th Street and US-12 appeared to be of hatchery origin. The catch-per-effort of legal-sized brown trout (8 inches or larger) was higher at the 15th Street and US-12 sampling stations than at the 3rd Street sampling

station. Mottled Sculpin, White Sucker, Grass Pickerel, Pumpkinseed and Chestnut Lamprey were also present (Dexter 1991).

A survey was conducted at 3rd Street in 1992 to evaluate Brown Trout and Rainbow Trout populations in Brandywine Creek prior to placing a blocking weir to restrict Steelhead from migrating upstream. Substrate was reported as 50% gravel, 25% sand, 15% cobble, 8% clay, and 2% silt. Most fish captured were wild with only a few stocked fish encountered. A total of 37 Rainbow Trout were captured ranging from 2 to 7 inches. The 7-inch fish was not aged, but all remaining fish (2 to 5 inches) were age 0. A total of 168 Brown Trout were captured over a mark and recapture electrofishing effort yielding a population estimate of 487 fish per acre. Brown Trout up to age 3 were caught ranging from 2 to 13 inches. Growth rates were reported to be slightly above the statewide average with a growth index of +0.8.

Habitat improvement work was conducted near Bond Street at Niles Park by the Township in between 1994 and 1996 surveys. This work consisted of dropping trees for habitat and bank stabilization. A study was implemented from 1992 through 2003 to monitor changes in Brown and Rainbow Trout populations. Electrofishing surveys were conducted on consecutive days at both the Bond Street and 3rd Street crossing. Fish were marked with a caudal fin clip on the first day and recaptured on the second day to calculate population estimates for each site. The number of marked and unmarked fish were recorded, and population estimates were calculated using the Chapman modification of the Peterson Mark recapture calculation (Chapman 1951).

Several Brown and Rainbow Trout population estimates were obtained for the Bond Street and 3rd Street sampling stations during 1992-2003 to evaluate the success of habitat projects (Table 2). During 1994-2003, Brown Trout population densities varied from 160 fish/acre to 330 fish/acre at Bond Street and 498 fish/acre to 1,474 fish/acre at 3rd Street. These sites are located within the high gradient portion of the river. Due to the abundance of spawning gravel, there continued to be considerable natural recruitment in this section. Young-of-year brown trout composed 16-71% of the population at Bond Street and 33-80% of the population at 3rd Street. Brown Trout ranged from 2 to 18 inches and Rainbow Trout were 3 to 11 inches. Growth rates were at or above the statewide average for Brown Trout and Rainbow Trout with index scores ranging from +0.3 to +0.8 and +0.5 to +1.9 respectively. Brown Trout captured were age 0 through 4 and Rainbow Trout were age 0 through 2. Brown Trout population estimates were the greatest for both sites in 2000 with 330 fish per acre at Bond Street and 1,474 fish per acre at 3rd Street. This was primarily due to a strong year class as 75% of the fish captured at 3rd Street were young-of-year fish in the 2 and 3-inch size bins. This 2000 year class was also evident in the 2001 survey where 56% of total catch were age 1 fish.

Bottom composition was characterized as approximately 50% cobble and gravel, and 50% sand and silt throughout the 1992 through 2003 surveys. Logs, pools, and overhanging vegetation were common. Some overly wide and shallow stretches provided poorer habitat with limited wood. More fish were consistently captured at the 3rd Street site indicating habitat restoration efforts had improved habitat. Populations fluctuated but did not trend in any direction indicating a relatively stable population.

It was apparent that the downstream weir was not blocking steelhead from moving into Brandywine Creek and reproduction of Brown and Rainbow Trout was occurring. In addition, 10 Chinook Salmon were captured at Bond Street and one at 3rd Street in the 2001 survey along with 12 Coho Salmon at

Bond Street and 4 Coho Salmon at 3rd Street in 2003 indicating successful passage and reproduction of these species. These species can impact local trout populations, but the Brown Trout population had not been evaluated since 2003. A survey was conducted in 2018 and the purpose of this report is to update the status of the fishery in Brandywine Creek.

Current Status

The Southern Lake Michigan Management Unit (SLMMU) of DNR - Fisheries Division conducted a fish survey in 2018 to evaluate Brown Trout stocking success and natural recruitment at three sites. All three sites were surveyed using a barge electrofisher with two probes. The stream was electrofished in an upstream direction and all species were collected, identified and measured for total length (inches). Brown and Rainbow Trout were measured to tenth of an inch and scales or anal spines were collected for age analysis.

Habitat sampling was also conducted during the 2018 survey using the Status and Trends Program (S&T) protocols (Wills et al. 2011). Thirteen cross-sectional transects were evaluated within the sampling station. Stream (wetted) width and general habitat type (run, riffle, or pool) was recorded for each transect. Riparian vegetation class and bank stability rating (1 = <25% bare soil; 2 = 25-50% bare soil, 3 = 51-75% bare soil, 4 = >75% bare soil) was assessed for the left and right banks and if an undercut was present, water depth and undercut length (perpendicular to stream flow) was measured. Water depth, dominant substrate, and percent coverage of wood (within a 1-foot x 1-foot square) were recorded at five evenly spaced intervals along each transect. Data for lineal and areal counts of woody structure were obtained using the methods outlined by Wills et al. (2011). Water depth and current velocity were measured at 1-foot intervals along a single transect within the sampling station and used to calculate discharge. Fish densities and habitat variables for Brandywine Creek were compared to mean values from stream surveys conducted using S&T protocols on small streams in the Lower Peninsula that were classified as cold or cold transitional (n = 76 surveys for habitat, 82 surveys for fish). Values for Brandywine Creek were considered different if they exceeded one standard deviation (sd) from the mean.

Temperature loggers were deployed at the 3rd Street and US-12 crossings of Brandywine Creek from June 12 through November 15, 2018. Hourly water temperatures were monitored using Onset Hobor Water Temp Pro v2 temperature loggers that were deployed within the sampling station. Temperature at 3rd Street ranged from 40.4 F to 70.2 F and averaged 57.7 F (Figure 2A). Mean monthly temperature was 62.2 in July and 62.3 in August. Water temperature was cooler at US-12 and ranged from 43.8 F to 68.1 F and averaged 57.2 F (Figure 2B). Mean monthly temperature was 60.0 F and 59.9 F in July and August, respectively.

3rd Street

The 3rd Street site was surveyed on July 30, 2018. This station was located within the Brandywine Creek Nature Park, beginning just upstream of the 3rd Street culvert and extending 940 feet upstream. Depth ranged from 0 to 4 feet. Wetted stream width averaged 25.8 feet, and the survey area totaled 0.56 acres. A total of 445 fish from nine species were captured, and coldwater species made up 92% of the fish captured by number (Table 5). Thirty percent of the species captured were classified as coldwater, 56% were warmwater and 11% were transitional. Mottled sculpins were captured in the highest number (188) followed by Rainbow Trout (142) and Brown Trout (82). Rainbow Trout CPUE was 278 fish per acre

with a mean length of 4.2 inches and a total length range of 1 to 11 inches. These fish were likely a mixture of age-0 and age-1 steelhead that will outmigrate to Lake Michigan and resident Rainbow Trout as larger fish were likely age 2 river residents. Brown Trout ranged from 2 to 14 inches and averaged 8.7 inches. CPUE was 161 fish per acre and growth was average with an index score of 0.7. Most of the fish were of legal size with 63% being above 8 inches. Age-0 fish were present indicating successful reproduction occurring. Age-2 fish were the most common making up 44.5% of the Brown Trout Captured. Age-3 fish were also present (18.5% of total catch) and averaged 11.8 inches. No age-4 fish were present.

Habitat at 3rd Street was made up by 85% runs and 15% riffles. This was the most downstream site and as a result had the largest mean width (25.8 feet). Thalweg depth averaged 1.7 feet, average channel cross section velocity was 0.6 feet per second, and discharge was 20 cfs during the survey. Substrate was a mix of gravel (32%), sand (26%), small cobble (17%), and large cobble (17%), with some wood (6%) and silt (2%). Gravel was greater than 50% embedded at most sites (71%). Banks were not very stable with 50% of banks ranked as very poor, 46% ranked as poor, and only 4% ranked as good. Vegetation was almost entirely small (65%) and large (27%) deciduous trees with one site containing alder (4%) and another being a road (4%). Undercut banks were not common (23% of sites). Natural log jams covered 2,096 square feet, brush deposits covered 560 square feet, and stumps covered 36 square feet. A total of 480 linear feet of logs were present.

15th Street

The 15th Street site was surveyed on July 31, 2018 on the east side of the bridge and continued 800 feet upstream. Depth ranged from 0 to 4 feet and average width was 15.7 feet resulting in 0.29 acres electrofished. Mean thalweg depth was 2.4 feet. Average cross section velocity was 1.08 feet per second and discharge was 21.41 cfs during the survey. More species were captured at this site (n = 11) for a total of 211 fish. Coldwater fish made up 91% of the fish caught by number. Mottled Sculpin were captured in the greatest number (117), followed by Brown Trout (58). Fewer Rainbow Trout (14) were captured compared to 3rd Street, but two adult steelhead averaging 28 inches were captured. Catch per unit effort for Brown Trout was 161 fish per acre. Brown Trout ranged from 3 to 18 inches and averaged 9.4 inches. Almost half (48%) of Brown Trout were of legal size and larger fish up to 18 inches were available to anglers. Age-0 fish were only found in low numbers (3.6% of total catch). Age-1 fish made up the majority of the Brown Trout caught comprising 49.5% of fish. Fish of age 2, 3, and 4 made up the legal sized fish. Growth rates were at the upper end of the average range with an index score of 0.9. All age classes were slightly above the statewide average length-at-age.

The 15th Street site was primarily run (92%) with one of the 13 cross sections located in pool habitat (8%). Gravel substrate was prevalent making up 40% of the sample sites. Gravel was mostly exposed with 56% of sites being less than 50% embedded. Sand (29%), small cobble (15%), large cobble (8%), and silt (8%) were also present. Banks were mostly stable with 54% of banks rated as good, followed by 31% as fair and 12% as poor. The left bank ran along a mowed lawn (85% of sites), with limited grassland/forbes (8%) and small deciduous trees (8%). The right bank was a mix of tag alder (46%), grassland (31%), and small deciduous trees (23%). Undercuts were present at 42% of banks sites. Brush deposits cover 192 square feet and stumps covered 34 square feet. A total of 24 feet of linear logs were present.

US-12

US-12 survey was conducted on August 2, 2018 on the upstream side of the road crossing and continued 800 feet upstream. Mean stream width was 13.7 feet resulting in a total of 0.25 acres electrofished. A total of 216 fish of 9 species was captured at US-12. Cold water species made up 84% of the catch by number. Mottled sculpin were the most prevalent fish (49% of catch) followed by Brown Trout (33%). Only four Rainbow Trout were captured ranging from 6-7 inches. One Coho Salmon was caught that was 3.5 inches in length indicating reproduction at this site. Brown Trout ranged from 3 to 19 inches. The largest fish across all sites was captured at US-12 which was 19 inches and 63% of the fish captured were greater than 8 inches in length. Fish ranged from age-0 to age-4. Age-0 fish only composed 7.1% of total catch while age-1 fish were the most common making up 41.8% of total catch. Age-2 fish were also captured in numbers similar to age-1 (41.4%) indicating survival is likely high at this site. Age 3 and 4 fish were also present. Growth was average with an index score of 0.9 and mean length for all age classes was above the state average length-at-age.

The entire survey reach at US-12 was classified as run and averaged 13.7 feet wide and 1.6 feet deep in the thalweg. Mean velocity was 0.58 feet/second and discharge was 11.2 cfs during the survey. Substrate was primarily sand (77%), with some gravel (15%), small cobble (5%), and silt (3%). Gravel was mostly embedded with only 20% of gravel sites being less than 50% embedded. Banks had varying stability with 42% being classified as high stability, 31% as fair, and 23% as poor. Bank vegetation was a mix of grassland/forbes (23%), tag alder (38%), and small deciduous trees (38%). Undercut banks were present at 54% of sites. There was evidence of past cattle fields adjacent to the stream with some direct access to the stream. The site had 691 square feet of brush deposits, 108 square feet of log jam and 138 linear feet of logs.

Analysis and Discussion

Brandywine Creek mean monthly summer temperatures never exceeded 63 degrees at any site in 2018. Although warmwater and transitional species were present at all sites, coldwater fish dominated the catch. Brandywine Creek is appropriately classified as a coldwater stream.

The Brown Trout population in Brandywine Creek is maintained well under the current regulation and stocking plan. Catch rates of fish were acceptable ranging from the highest density of 288 per acre upstream at US-12 to 161 per acre at 3rd Street. Catch rates were higher than the statewide mean of 93 per acre (sd +/- 131) indicating good numbers of fish. Catch rates have varied through the survey history of Brandywine Creek (Figure 3). Catch rates peaked in the 2000 survey, but otherwise have fluctuated between 150 and 350 fish per acre with no apparent trend. Survival of fish is good with Brown Trout reaching age-4 at all sites except 3rd Street. Similar proportions of age-1 and age-2 fish also indicate high survival. The proportion of age-3 and 4 fish are much lower likely because they have fully recruited to the legal fishery and experience some level of harvest as well as natural mortality. The 3rd Street station has the best angling access and no age-4 fish were observed. The abundance of log jams and adequate water depth appear to provide good habitat for larger fish. Angling pressure is more likely the limiting the abundance of larger fish. We could consider returning to regulations that would protect fish to a larger size (type-2). Brandywine Creek was managed with type-2 regulations from April 2000 through March of 2011. However, it was returned to type-1 regulations due to lack of improvements to

the number of larger fish. Due to the good abundance of fish up to age-4 at most sites in 2018, a regulation change is not recommended at this time.

Natural recruitment is occurring in Brandywine Creek, but stocking is still required to maintain Brown Trout densities. Age-0 fish were found at all sites indicating that reproduction is occurring throughout Brandywine Creek. Relative abundance of age-0 fish was low as observed in past surveys. Age-1 fish consistently made up the majority of age classes captured. This could be a result of age-0 fish not fully recruiting to the electrofishing gear, but more likely is due to limited natural reproduction and the presence of stocked fish in the age-1 year class. Survival of stocked fish appears high with age-1 and older fish being abundant and fish surviving through age-4.

Brown Trout up to 19 inches were captured in Brandywine Creek. Length frequency shows the most abundant size classes for all sites are between 7 and 12 inches (Figure 4). No fish over 14 inches were caught at 3rd Street while larger fish up to 18 and 19 inches were captured at 15th Street and US-12 respectively. This was due to no fish observed over age-3 at 3rd Street. Survival at this site may be limited or larger fish may be seeking sites with better stability.

Mean lengths for Brown Trout of each age class at each site were 0.04 to 1.70 inches above statewide averages (Figure 5). This indicates acceptable growth rates and there is likely enough food available to maintain average to slightly above average growth. Growth rates have ranged from average to above average throughout the survey history in Brandywine Creek and the Brown Trout population continues to grow at similar rates.

Steelhead and Coho Salmon reproduce in Brandywine Creek. We captured young-of-year of both species in low numbers. Steelhead were most abundant at 3rd Street and it appears most steelhead were either using the lower section for spawning or young-of-year fish are recruiting to habitat in that station from further upstream. We captured two adult steelhead at 15th Street and one Coho at US-12 indicating that these fish can access the entire stream and some reproduction is occurring throughout. There is no evidence that Great Lakes access has led to declines in the Brown Trout fishery as growth and abundance have been relatively consistent through time.

Habitat is relatively good in Brandywine Creek. Gravel and cobble are limited in parts of the system and is often embedded. 15th Street and 3rd Street had the greatest proportions with 63% and 66% respectively of sites being gravel or coarser. This is similar to the state average of 33% (sd +/- 29%). Coarse substrates were limited at US-12 with only 20% being gravel or coarser. Although lower than the statewide average for similar streams, US-12 is still within one standard deviation of the mean.

Woody habitat was available at all sites, but densities varied. Brush piles were common at 3rd Street and US-12 covering 560 and 691 square feet respectively. This is close to the average of 605.2 square feet for similar streams statewide. Log jams were abundant at 3rd street covering 2,096 square feet. This is similar to the state average of 1,839 square feet (sd +/- 2710). US-12 had fewer logs and log jams, but habitat was still present. Linear feet of logs was lower than the statewide average of 1199 linear feet (sd +/- 1402) for all sites, but was within one standard deviation of the mean.

Bank stability continues to be an issue at 3rd Street. The stream runs along the road for a good distance and erosion of the embankment has been dealt with through hard armoring and sheet pile. This has

resulted in unstable banks at adjacent locations and erosion throughout the site. 15th street had suitable habitat for spawning with good amounts of gravel and cobble substrate. However, both young-of-year Brown Trout and Rainbow Trout were only observed in low numbers. Cover is limited at 15th Street due to one bank consisting of mowed yard and low abundance of brush piles and wood. Age-0 fish may be vulnerable to predation in this site and either experience poor survival or migrate to areas with better cover.

Anglers report good fishing on Brandywine Creek primarily due to multiple public access locations. Anglers travel from Chicago to the Niles area to fish due to it having some of the closest coldwater fisheries resources including Brandywine Creek. There is no recent creel conducted on this stream, but the Brown Trout population is acceptable even with the potential for high harvest rates. There are several Trout Unlimited chapters in Michigan, Indiana, and Illinois that provide feedback on the status of the fishery. All reports indicate anglers are satisfied with the resource.

Management Direction

SLMMU will continue to manage Brandywine Creek as a coldwater trout stream with good access. Current stocking densities and locations are adequate to support this popular fishery. No changes in management strategies are proposed. Habitat and watershed protection will continue to be priorities for maintaining this rare coldwater resource in southern Michigan.

References

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Table 1. Fish stocking record for Brandywine Creek in Berrien and Cass Counties.

Species	Strain	Date/Year	Stage	No Site Specified		15th Street		US-12	
				Number	Length (inches)	Number	Length (inches)	Number	Length (inches)
Atlantic Salmon	Penobscot	05/28/1873	Swim-up Fry	3,000	-	-	-	-	-
American Eel	Hudson R	06/07/1878	Sp. Fingerling	5,000	-	-	-	-	-
Brook Trout		02/26/1895		7,500	-	-	-	-	-
Brook Trout		02/11/1896		3,000	-	-	-	-	-
Brook Trout		1905	Fry	9,000	-	-	-	-	-
Brook Trout		1909	Fry	3,000	-	-	-	-	-
Brook Trout		1933	4, 7, 8 m, Yearling	10,425	-	-	-	-	-
Brook Trout		1934	7 m, Yearling	7,000	-	-	-	-	-
Brook Trout		1935	6 M	4,000	-	-	-	-	-
Brook Trout		1936	6 m, Yearling	4,400	-	-	-	-	-
Brook Trout		1937	8 m, Yearling	4,500	-	-	-	-	-
Brook Trout		1938	7 M	4,000	-	-	-	-	-
Brook Trout		1941	7 m, Yearling	3,800	-	-	-	-	-
Brook Trout		1942	5 m, Yearling	16,000	-	-	-	-	-
Brook Trout		1943	1 m, Yearling	17,000	-	-	-	-	-
Brook Trout		1944	2, 3 m, Yearling	12,800	1.25	-	-	-	-
Brook Trout		1945	2, 14, 16, 18 m	13,650	1	-	-	-	-
Brook Trout		1946	2, 14, 15, 18 m	6,100	8	-	-	-	-
Brook Trout		1947	Yearling	200	9	-	-	-	-
Brown Trout		1971	Yearling	800	-	-	-	-	-
Brown Trout		1972	Yearling	2,500	-	-	-	-	-
Brown Trout		1973	Yearling	-	-	800	-	800	-
Brown Trout		1974	Yearling	-	-	800	-	800	-
Brown Trout		1975	Yearling	-	-	800	-	800	-

Table 1 Cont.

Species	Strain	Date/Year	Stage	No Site Specified		15th Street		US-12	
				Number	Length (inches)	Number	Length (inches)	Number	Length (inches)
Brown Trout		1976	Yearling	-	-	800	-	800	-
Brown Trout		1977	Yearling	-	-	800	-	800	-
Brown Trout		1978	Yearling	-	-	500	-	500	-
Brown Trout		03/16/1979	Yearlings	-	-	600	5.94	400	5.91
Brown Trout		03/26/1980	Yearlings	-	-	800	5.83	800	5.83
Brown Trout	Harrietta	04/20/1981	Yearlings	-	-	500	4.25	600	4.29
Brown Trout	Harrietta	04/01/1982	Yearlings	-	-	800	5.24	800	5.24
Brown Trout	Harrietta	03/18/1983	Yearlings	-	-	800	6.26	800	6.02
Brown Trout	Harrietta	04/10/1984	Yearlings	-	-	800	5.55	800	5.55
Brown Trout	Harrietta	05/14/1985	Yearlings	-	-	800	7.17	800	7.13
Brown Trout	Wild Rose	04/17/1986	Yearlings	-	-	830	6.85	830	6.85
Brown Trout	Soda Lake	04/07/1987	Yearlings	-	-	840	5.04	840	5.63
Brown Trout	Plymouth Rock	03/29/1988	Yearlings	-	-	930	5.28	930	5.28
Brown Trout	Soda Lake	04/10/1989	Yearlings	-	-	900	5.98	900	5.83
Brown Trout	Soda Lake	03/29/1990	Yearlings	-	-	900	5.12	900	5.12
Brown Trout	Plymouth Rock	03/26/1991	Yearlings	-	-	900	6.38	894	5.83
Brown Trout	Plymouth Rock	04/01/1992	Yearlings	-	-	890	5.98	890	5.98
Brown Trout	Plymouth Rock	04/07/1993	Yearlings	-	-	900	6.06	898	6.06
Brown Trout	Saint Croix	04/01/1994	Yearlings	-	-	940	6.61	940	6.61
Brown Trout	Wild Rose	04/18/1995	Yearlings	-	-	870	6.57	868	6.57
Brown Trout	Wild Rose	04/18/1996	Yearlings	-	-	900	6.38	900	6.38
Brown Trout	Seeforellen	04/15/1997	Yearlings	-	-	958	5.83	960	5.83
Brown Trout	Seeforellen	03/30/1998	Yearlings	-	-	875	5.2	890	5.2
Brown Trout	Seeforellen	04/07/1999	Yearlings	-	-	900	5.83	900	5.83
Brown Trout	Gilchrist Creek	04/19/2000	Yearlings	-	-	900	3.66	990	3.66

Table 1 Cont.

Species	Strain	Date/Year	Stage	No Site Specified		15th Street		US-12	
				Number	Length (inches)	Number	Length (inches)	Number	Length (inches)
Brown Trout	Seeforellen	04/11/2001	Yearlings	-	-	910	5.75	910	5.75
Brown Trout	Gilchrist Creek	04/16/2002	Yearlings	-	-	910	5.04	910	5.04
Brown Trout	Gilchrist Creek	03/26/2003	Yearlings	-	-	900	5.22	900	5.22
Brown Trout	Gilchrist Creek	04/02/2004	Yearlings	-	-	1,000	4.74	1,000	4.74
Brown Trout	Seeforellen	04/12/2005	Yearlings	-	-	900	5.72	900	5.72
Brown Trout	Seeforellen	04/06/2006	Yearlings	-	-	960	6.08	960	6.08
Brown Trout	Seeforellen	05/01/2007	Yearlings	-	-	830	5.41	830	5.41
Brown Trout	Gilchrist Creek	04/22/2008	Yearlings	-	-	900	4.49	900	4.49
Brown Trout	Gilchrist Creek	04/06/2009	Yearlings	-	-	1,000	4.34	1,000	4.34
Brown Trout	Gilchrist Creek	04/20/2010	Yearlings	-	-	960	4.79	960	4.79
Brown Trout	Gilchrist Creek	05/09/2011	Yearlings	-	-	810	4.74	810	4.74
Brown Trout	Gilchrist Creek	04/11/2012	Yearlings	-	-	1,060	4.71	1,060	4.71
Brown Trout	Gilchrist Creek	05/09/2013	Yearlings	-	-	900	5.34	900	5.34
Brown Trout	Gilchrist Creek	04/22/2014	Yearlings	-	-	810	5.23	810	5.23
Brown Trout	Gilchrist Creek	05/19/2015	Yearlings	-	-	1,000	5.51	1,000	5.51
Brown Trout	Gilchrist Creek	05/03/2016	Yearlings	-	-	900	5.12	900	5.12
Brown Trout	Gilchrist Creek	04/26/2017	Yearlings	-	-	950	5.03	950	5.03
Brown Trout	Gilchrist Creek	04/11/2018	Yearlings	-	-	1,000	5.23	1,000	5.23
Brown Trout	Gilchrist Creek	04/25/2019	Yearlings	-	-	910	5.46	910	5.46

Table 2. Brown Trout captured in electrofishing surveys at the Bond Street and 3rd Street crossing of Brandywine Creek conducted in 1982 through 2018.

Year	Bond Street					3rd Street					Growth Index Combined
	Number	CPUE (fish/acre)	Population Estimate (fish/acre)	% > 8 inches	Growth Index	Number	CPUE (fish/acre)	Population Estimate (fish/acre)	% > 8 inches	Growth Index	
1982	-	-	-	-	-	30	158	-	37	-	-
1989	-	-	-	-	-	88	326	-	16	-	-
1992	-	-	-	-	-	92	219	487	24	0.8	0.8
1994	52	60	179	9	0.9	105	250	677	12	0.2	0.7
1996	83	97	167	31	-	120	286	545	25	0.1	0.3
1998	70	81	160	29	0.7	99	248	504	21	-	0.9
2000	110	128	330	11	0.5	247	588	1,474	9	-	0.3
2001	110	128	182	30	1.2	126	300	498	20	0.5	0.8
2003	58	82	160	31	0.7	96	300	557	17	0.6	0.6
2018	-	-	-	-	-	82	161	-	62	0.7	-

Table 3. Brown Trout captured in electrofishing surveys at the 15th Street and US-12 crossing of Brandywine Creek conducted in 1969 through 2018.

Year	15th Street				US-12			
	Number	CPUE (fish/acre)	% > 8 inches	Growth Index	Number	CPUE (fish/acre)	% > 8 inches	Growth Index
1969	-	-	-	-	1	14	100	-
1975	3	55	100	-	2	54	0	-
1982	14	100	86	-	-	-	-	-
1989	32	246	44	-	19	238	58	-
2018	58	201	48	0.9	72	286	63	0.9

Table 4. Rainbow Trout Captured in surveys conducted in Brandywine Creek at Bond and 3rd Street from 1992 through 2018. Rainbow Trout gained access to Brandywine Street after the opening of the Niles fish ladder in 1991.

Year	Bond Street				3rd Street				Combined Growth Index
	Number	CPUE (fish/acre)	Population Estimate (fish/acre)	Site Growth Index	Number	CPUE (fish/acre)	Population Estimate (fish/acre)	Site Growth Index	
1992	-	-	-	-	24	57	90	-	-
1994	43	50	237	1.7	40	95	129	-	1.9
1996	15	17	32	-	16	38	46	-	-
1998	64	74	124	0.6	28	67	103	-	0.5
2000	15	17	52	1.6	14	33	32	-	1.6
2001	110	128	182	2	79	188	562	-	2
2003	114	161	650	0.7	95	297	1,114	1.6	0.8
2018	-	-	-	-	142	278	-	-	-

Table 5. Fish captured in electrofishing surveys conducted on Brandywine Creek in 2018.

US-12

Species	Number	Length Range (inches)	Mean Length (inches)	Thermal Classification
Bluegill	1	4 - 4	4.5	Warm
Brown Trout	72	3 - 19	9.1	Cold
Coho	1	3 - 3	3.5	Cold
Grass Pickerel	5	7 - 8	7.9	Warm
Green Sunfish	5	1 - 5	2.9	Warm
Mottled Sculpin	105	1 - 4	2.6	Cold
Central Mudminnow	11	2 - 3	2.6	Trans
Rainbow Trout	4	6 - 7	7.3	Cold
White Sucker	12	10 - 18	14.5	Trans

15th Street

Species	Number	Length Range (inches)	Mean Length (inches)	Thermal Classification
Black Crappie	1	4 - 4	4.5	Warm
Bluegill	4	3 - 4	3.8	Warm
Brown Trout	58	3 - 18	9.4	Cold
Golden Redhorse	2	18 - 18	18.5	Warm
Grass Pickerel	1	9 - 9	9.5	Warm
Green Sunfish	2	2 - 4	3.5	Warm
Mottled Sculpin	117	1 - 4	3.0	Cold
Central Mudminnow	1	2 - 2	2.5	Trans
Rainbow Trout	14	2 - 7	3.8	Cold
Steelhead	2	26 - 29	28.0	Cold
White Sucker	9	8 - 18	14.2	Trans

3rd Street

Species	Number	Length Range (inches)	Mean Length (inches)	Thermal Classification
Bluegill	22	3 - 4	3.9	Warm
Brown Trout	82	2 - 14	8.7	Cold
Golden Redhorse	2	15 - 18	17.0	Warm
Green Sunfish	1	3 - 3	3.5	Warm
Mottled Sculpin	188	1 - 3	2.6	Cold
Pumpkinseed Sunfish	1	3 - 3	3.5	Warm
Rainbow Trout	142	1 - 11	4.2	Cold
Rock Bass	1	6 - 6	6.5	Warm
White Sucker	6	2 - 11	7.5	Trans

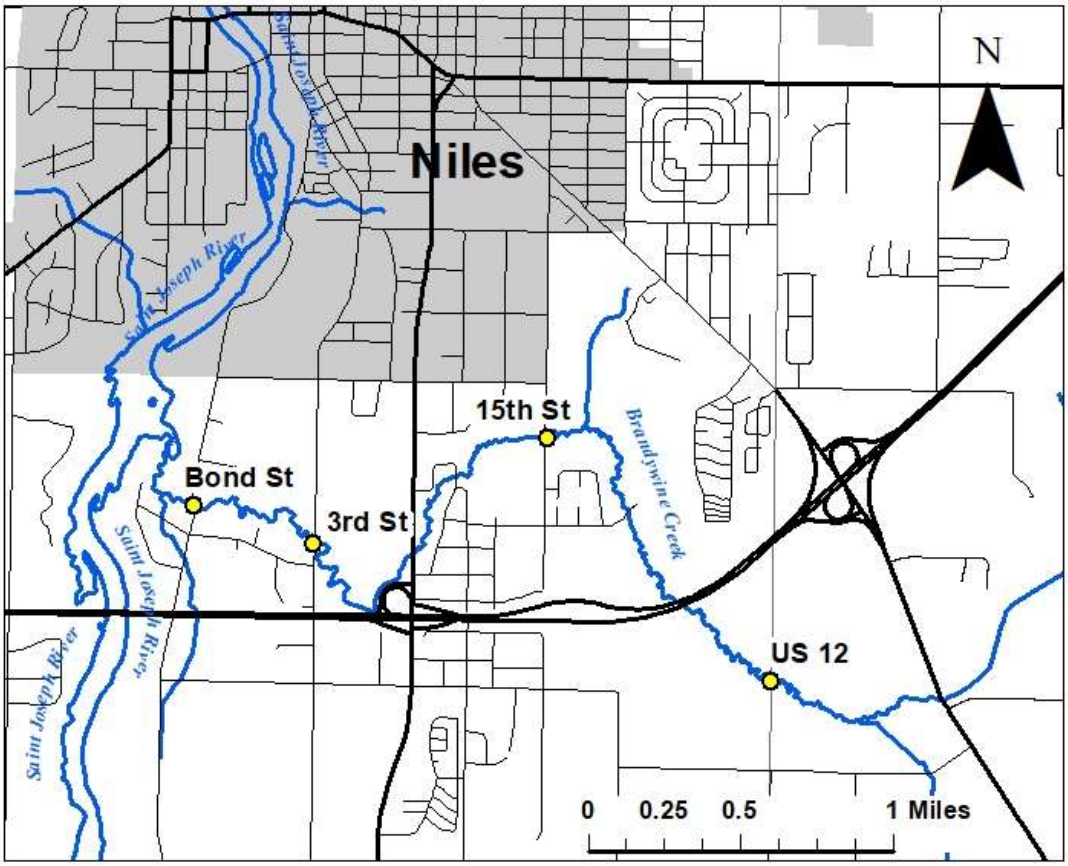
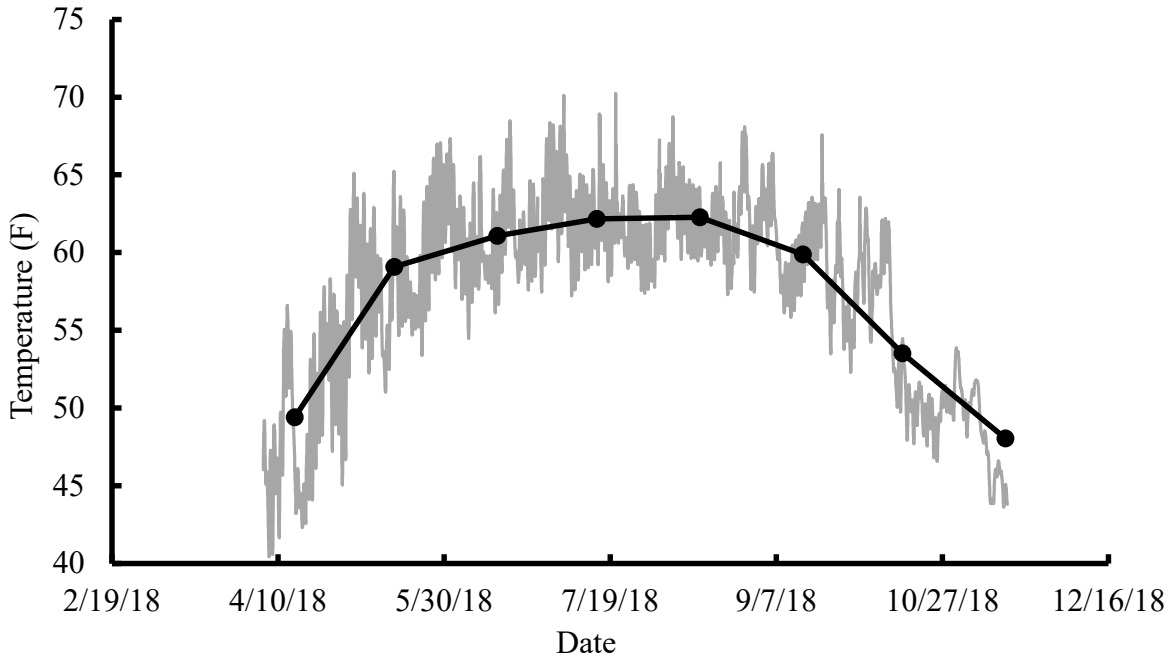


Figure 1. Survey site locations on Brandywine Creek near Niles, MI surveyed in various years from 1969 through 2018.

A. 3rd Street



B. US-12

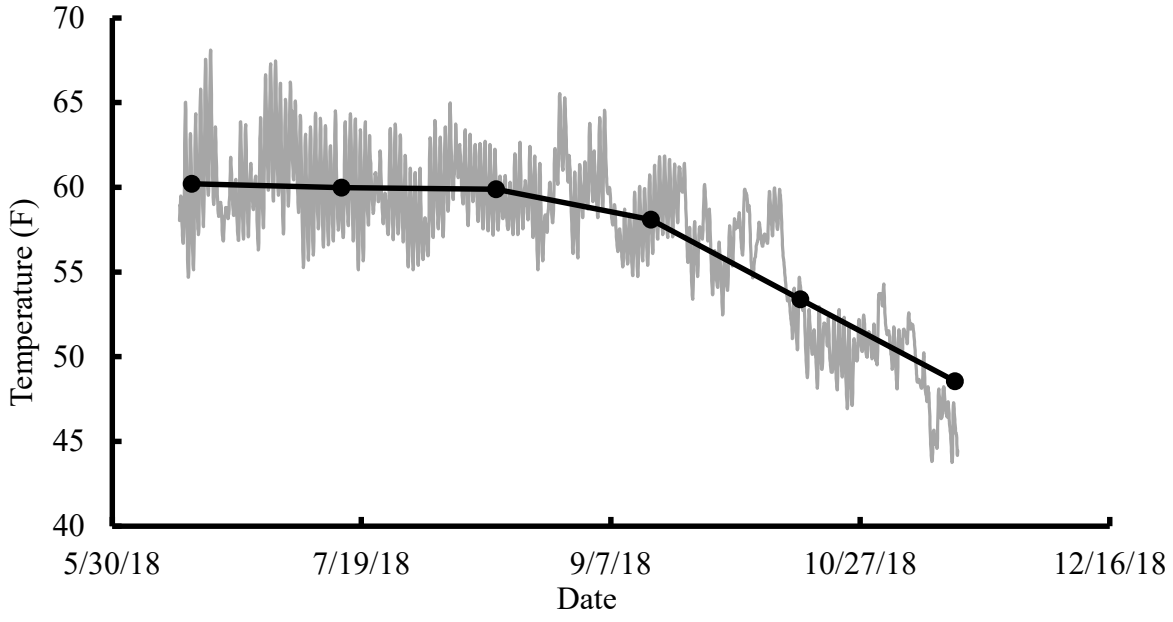


Figure 2. Hourly (grey line) and mean monthly temperature (black points/line) for Brandywine Creek at 3rd Street (A) and US-12 (B) recorded by in stream temperature loggers in 2018.

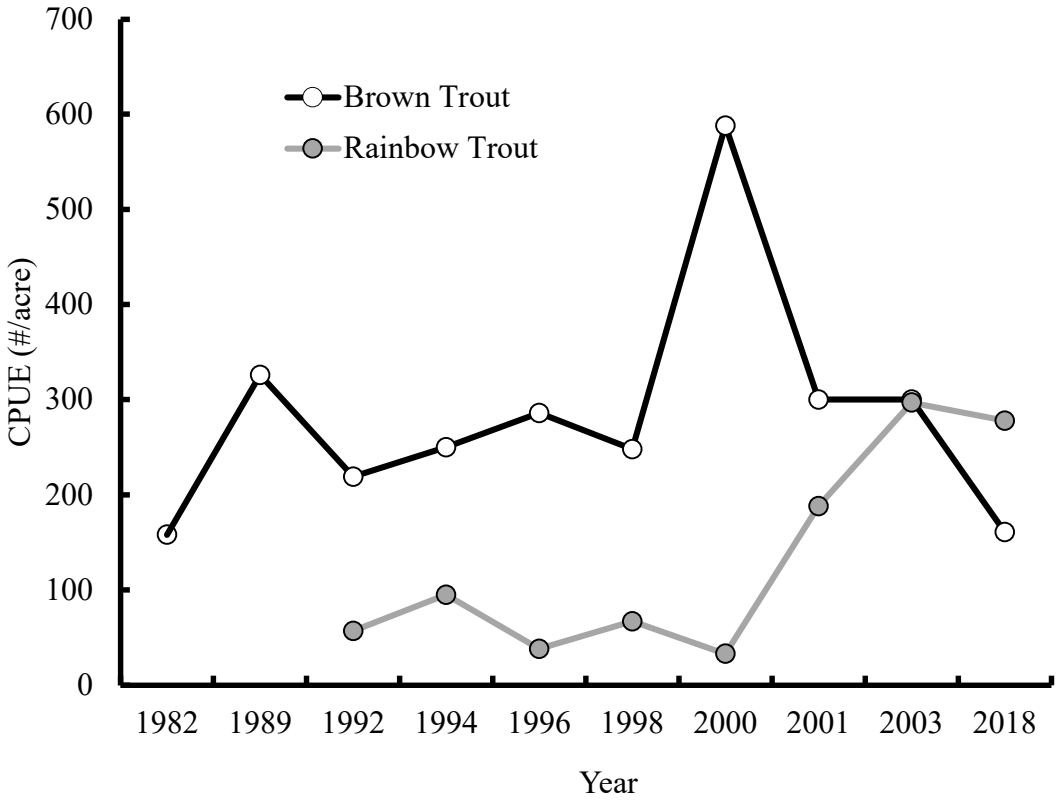


Figure 3. Catch per unit effort of Brown Trout (black line, open circles) and Rainbow Trout (grey line, closed circles) captured in electrofishing surveys in Brandywine Creek conducted at 3rd Street from 1982 through 2018.

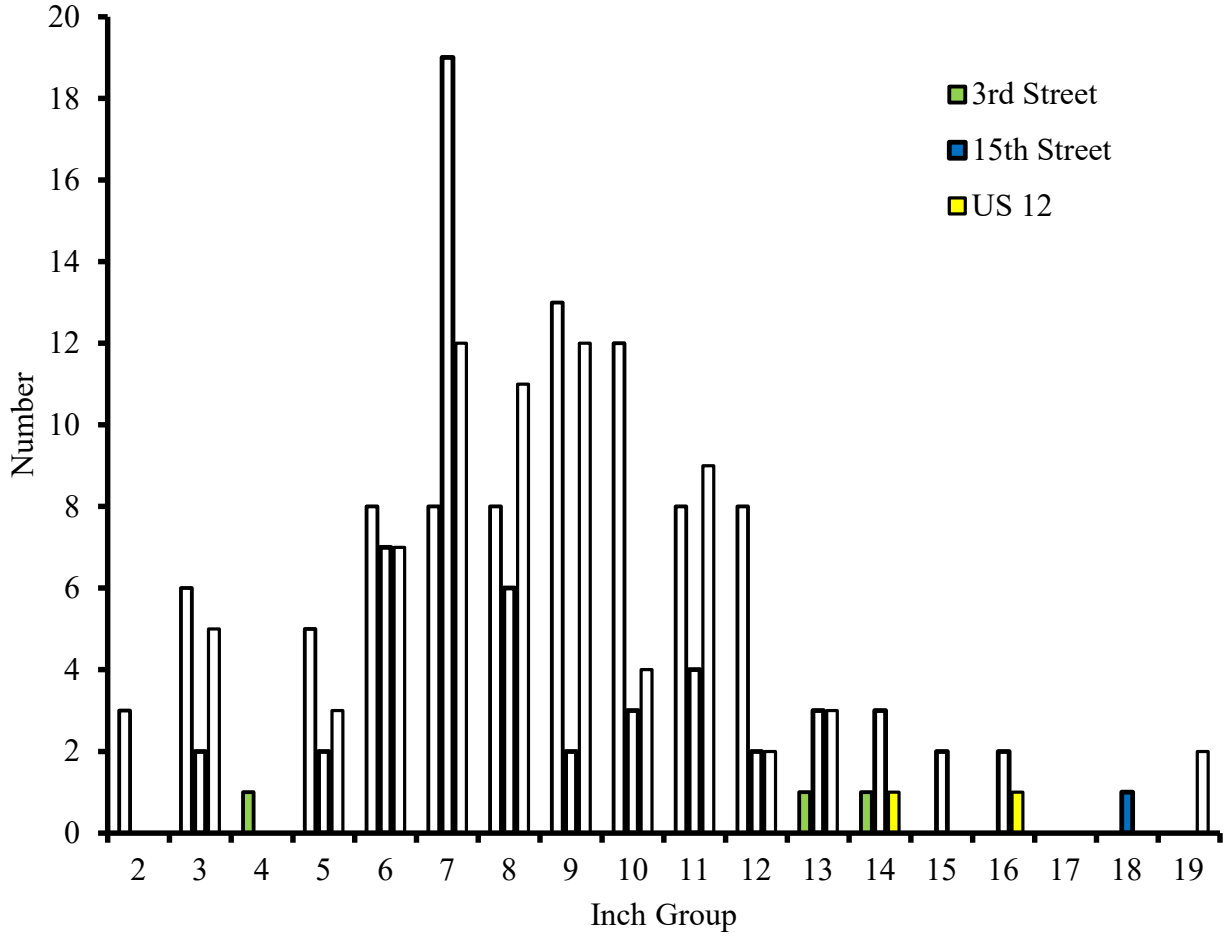


Figure 4. Length frequency of Brown Trout captured in Brandywine Creek from electrofishing surveys conducted at three sites in 2018.

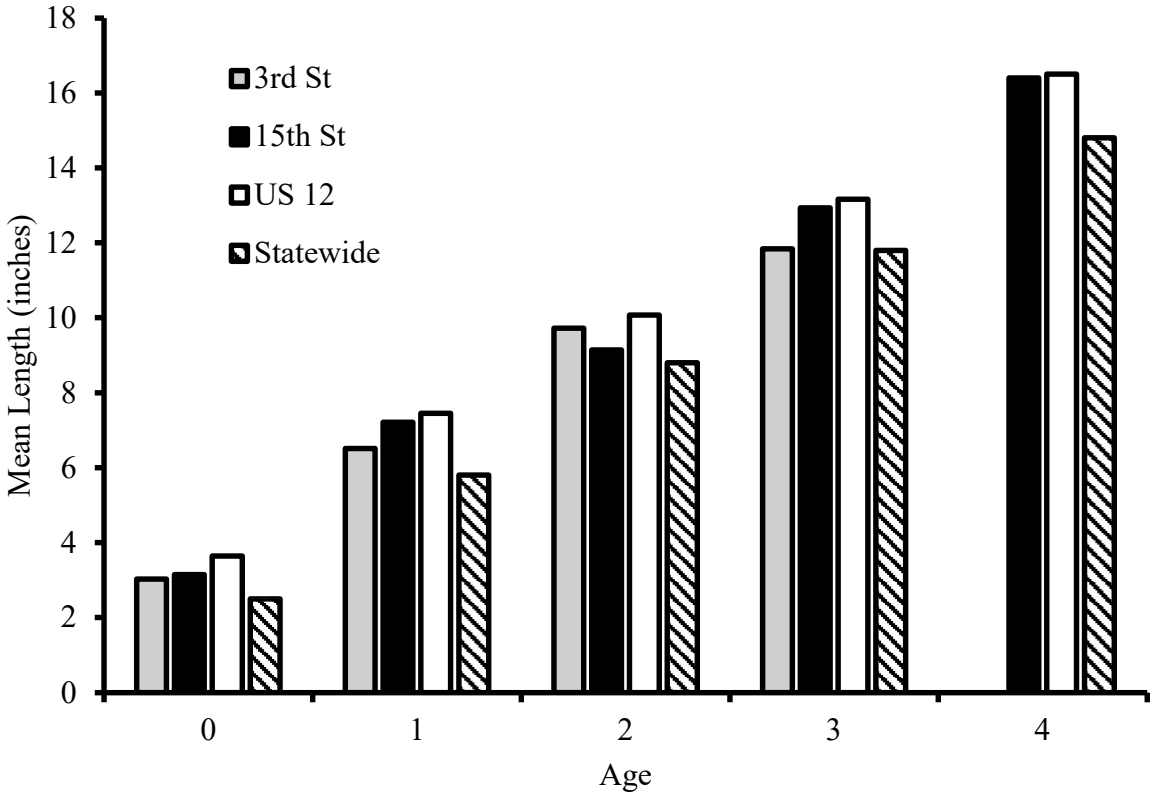


Figure 5. Mean length-at-age of fish captured in electrofishing surveys conducted on Brandywine Creek in 2018 compared to the statewide average length at age.

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