Northeast Ohio Regional Sewer District

Plum Creek native fish translocation to support fish community biology attainment

Introduction

Plum Creek is a small headwater stream tributary to the West Branch of the Rocky River in Cuyahoga and Lorain counties. Historically, this stream has experienced biological impairment dating back to the Ohio EPA's first water quality assessment in 1981. Gross organic enrichment from multiple Publicly Owned Treatment Works (POTWs) were identified as the primary cause of impairments (Ohio EPA 2020). Increased nutrient enrichment (nitrate-nitrite, total phosphorus, and ammonia-N) was observed at all stream locations during the 1997 Ohio EPA assessment, resulting in a nutrient-based TMDL for Plum Creek in 2001. Later in 1997, three POTWs were eliminated (Brentwood, Western Ohio Utility, and ODOT Park 3-39), leaving one operating small POTW, Plum Creek WWTP, with an average design flow 0.04 MGD. During the 2014 Ohio EPA Rocky River study, nutrient enrichment was not listed as a cause leading to non-attainment. However, nutrient concentrations were elevated compared to regional reference locations and dissolved oxygen swings indicated stimulated productivity. Plum Creek displayed similar levels of nutrient enrichment during the 2019 and 2020 NEORSD bioassessments, although nitrate-nitrite and total phosphorus geomean concentrations did meet the 2001 TMDL target concentrations. With Plum Creek's generally low gradient and its primary headwaters (<1.0 sq. mi. drainage) historically rheopalustrine or of wetland origin, lower dissolved oxygen concentrations in the watershed seems to be a natural occurrence and the aquatic biota may continue to experience acute stress during low flow and extremely hot summer days.

During the years of gross organic enrichment and poor chemical water quality in the 1980s-2000s, it is expected that many of the native fish species were extirpated from upper Plum Creek. The Plum Creek Gorge (Figure 1) at the confluence with the Rocky River West Branch acts as a natural fish barrier. In 2014, 86% of the Rocky River watershed met its aquatic life attainment (Ohio EPA 2020). The only streams left in the Rocky River watershed within the NEORSD service area that do not meet full Aquatic Life Use (ALU) attainment are Plum Creek, Abram Creek, Blodgett Creek, and a small section of Baldwin Creek (Figure 2). All impaired sections are negatively affected by a physical barrier that isolates a historically degraded fish community.

Figure 1. Plum Creek Gorge (The Waterfall Record)

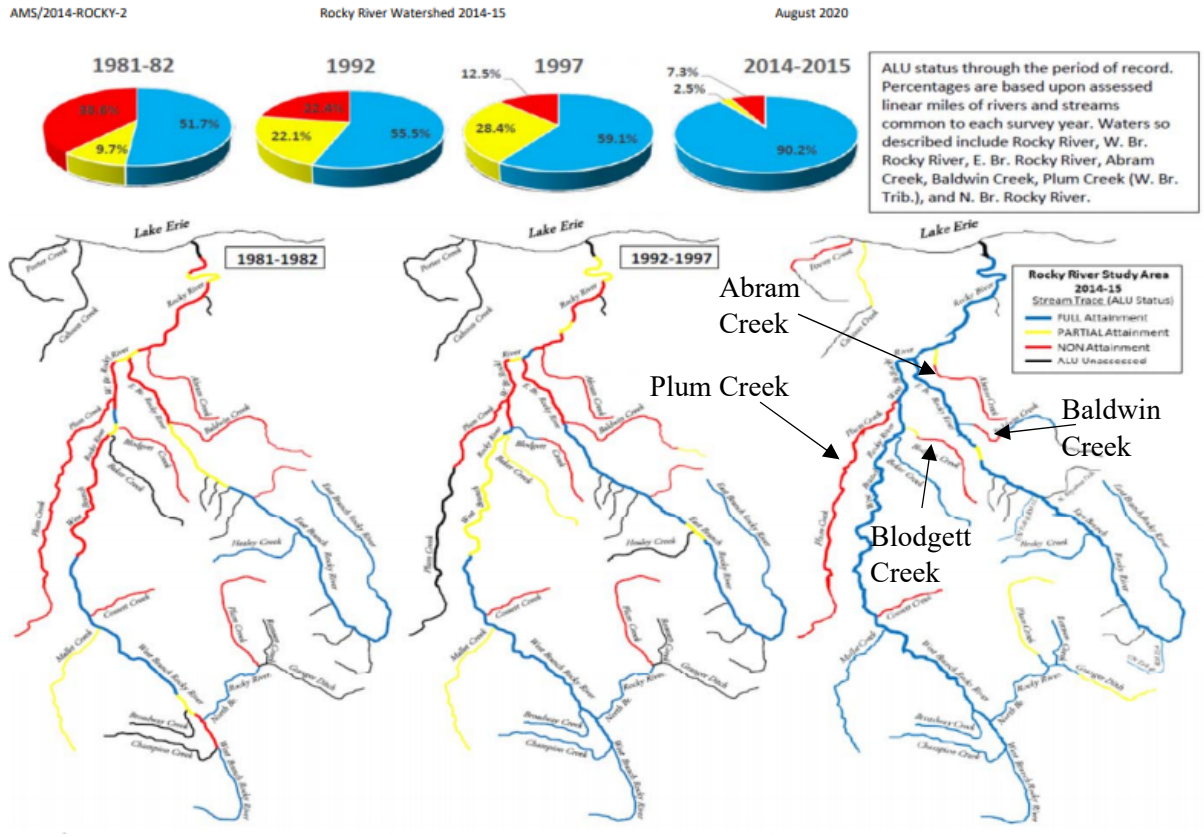
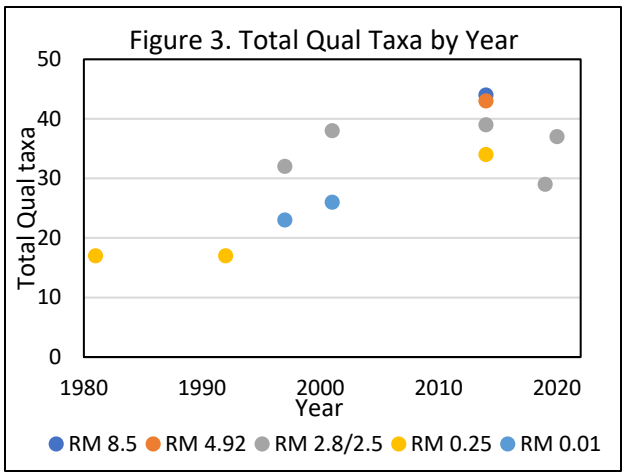
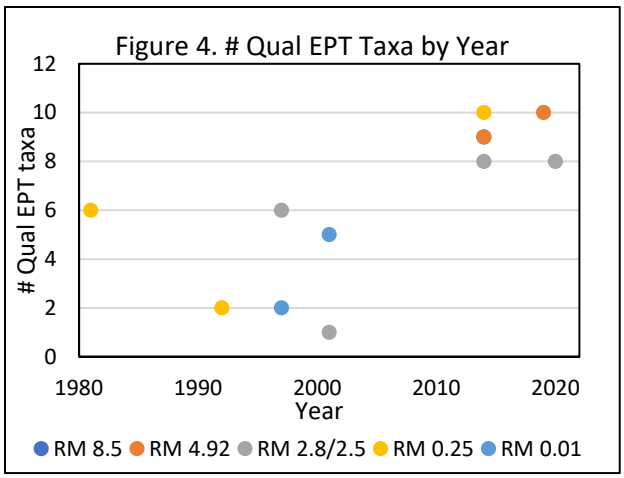
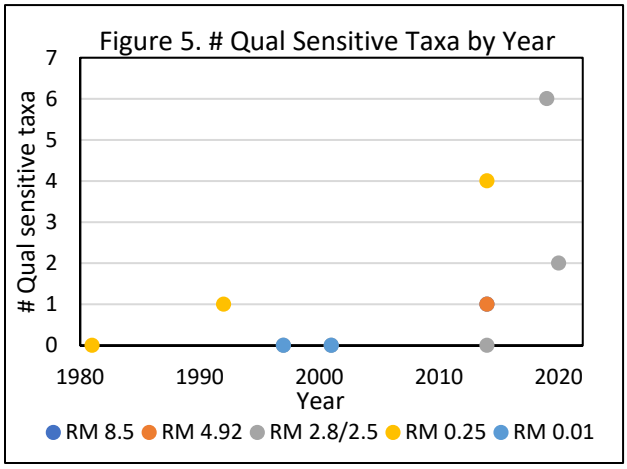


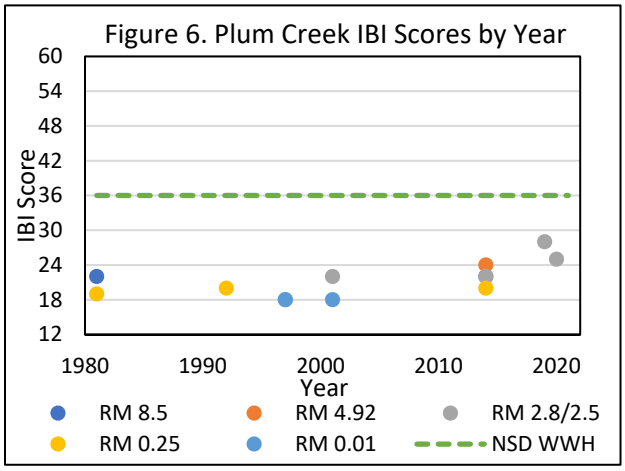
Figure 2. ALU Status Rocky River 1981-2014 (Ohio EPA, 2020)

The idea of achieving full biological attainment in the lower four miles of Plum Creek seems feasible. In the *2014 Ohio EPA Biological and Water Quality Study of the Rocky River and Select Tributaries study* (2020), all four Plum Creek stream locations (RMs 8.50, 4.92, 2.50, and 0.25) scored a benthic macroinvertebrate community narrative rating of *Marginally Good*, which is within *non-significant departure* of the Warmwater Habitat (WWH) biocriterion (Ohio EPA 2006). While the site assessed by NEORSD in 2019 received an Invertebrate Community Index (ICI) score of 26 (*Fair*), the 2020 ICI score was 34 (*Good*), and for the first time, in full attainment for the macroinvertebrate category. Macroinvertebrates are not affected by the Plum Creek Gorge, as aerial dispersal in their adult life form allows them to migrate without limitations. The number of total qualitative taxa, EPT (Ephemeroptera, Plecoptera, and Trichoptera) taxa, and sensitive taxa collected historically all display a positive correlation, indicating much improved water quality (Figures 3-5).









In contrast to the positive trend in macroinvertebrate community scores, the fish Index of Biotic (IBI) score has remained consistently low in the *Poor-Fair* narrative range (Figure 6) demonstrating the Plum Creek Gorge is inhibiting fish migration and may be the limiting factor in achieving full aquatic life attainment. All but one unimpeded headwater site on the Rocky River West Branch achieved fish community attainment based on IBI scores during the last 2014 Ohio EPA assessments (Figure 7). Cossett Creek RM 0.20 was the only other headwater site in the West Branch that failed to meet its fish community attainment and was likely due to periodic desiccation during dry summer months, with recolonization by tolerant headwater species.

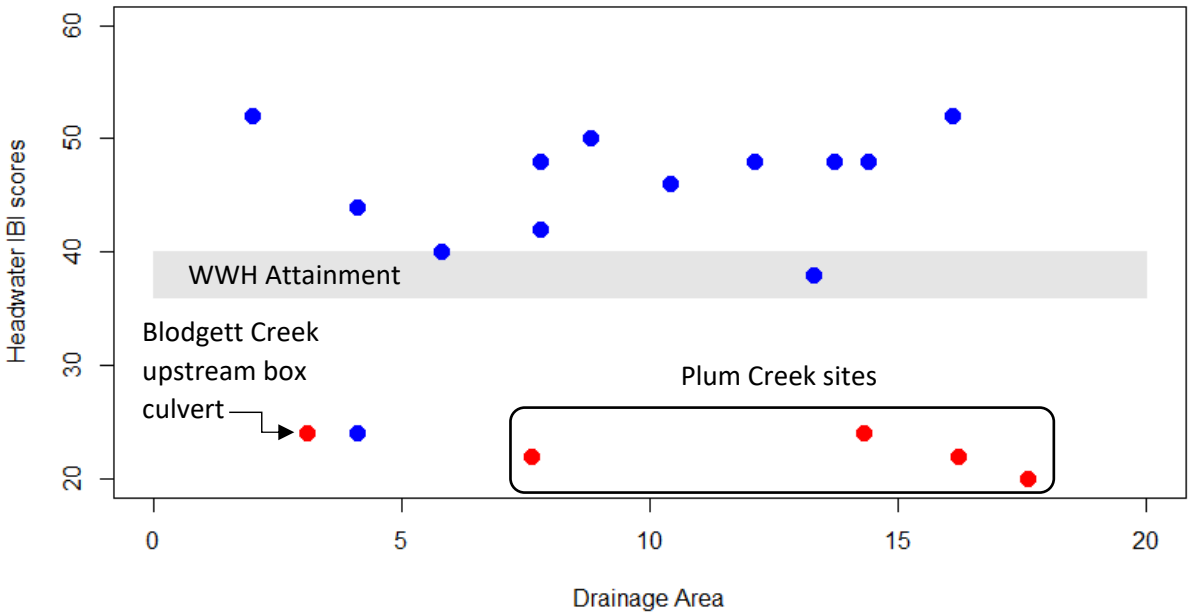


Figure 7. Rocky River West Branch 2014 headwater sites IBI scores. Red sites are isolated from the Rocky River by a fish barrier; blue sites are unimpeded from the Rocky River. Gray bar represents WWH biocriteria and non-significant departure for IBI attainment.

Without the possibility of fish recolonization to produce a fully functional and diverse community, the IBI score will likely never achieve the WWH goal. In the 2014-2015 Ohio EPA report, it was suggested that since this stream appeared to be limited by natural factors and not necessarily water quality or in-stream habitat issues, it may be eligible for an ALU redesignation through a Use Attainability Analysis (UAA). If the UAA demonstrates the stream will not be able to achieve WWH attainment, in part due to the natural fish barrier limiting community performance, a reclassification to a lower ALU subcategory may be warranted. The ALU reclassification from a WWH to a Modified WWH (MWH) comes with less stringent criteria for the protection of aquatic life, particularly a lower minimum dissolved oxygen requirement. Before going through this redesignation process, it was suggested to perform an experimental seeding of upper Plum Creek with a representative collection of headwater fish species from adjacent waters within the basin. If successful, a restoration of the WWH ALU would be achieved and an ALU redesignation would not be necessary during the next 2029 Ohio EPA watershed assessment.

(1) Objectives

The NEORSD manages wastewater conveyance and treatment as well as a regional stormwater management program, which includes the lower 3.80 river miles of Plum Creek. The NEORSD is involved in projects within the Plum Creek watershed, such as septic-to-sanitary conversions, streambank stabilizations, and assists local cities with sections of their municipal separate storm sewer system (MS4) general permit.

This project, if successful, will demonstrate the water quality benefits the NEORSD, Ohio EPA, and other local stakeholders have accomplished on this historically polluted stream. This will also

accomplish numerous NEORSD 2019-2021 Strategic Plan objectives outlined under the *Water Quality and Resource Management* topic as it identifies opportunities to enhance water quality by promoting fish community attainment for the first time. As the NEORSD continues to work on intercommunity issues within the Plum Creek watershed, success should be measured by the impact on water quality in the receiving waterways, which can only be achieved if a diverse and functional fish community can colonize and inhabit the stream. This project will also drive water quality protection, as the 2014 Ohio EPA Rocky River report suggested a redesignation of ALU designation with less protection will be re-assessed during their next watershed assessment. Without human intervention, the fish community in the upper Plum Creek will remain stagnant and likely support the decision for ALU re-designation, lowering criteria for aquatic life protection.

The objective of this study is to collect native fish species from within the Rocky River watershed, count, and relocate them to two Plum Creek locations. Locations of fish introduction to Plum Creek will be downstream of RM 3.80 as stream habitat complexity becomes limited (QHEI < 55) at the upstream Ohio EPA station, and Plum Creek enters the NEORSD service area at RM 3.80. Historical biological and habitat results are attached in appendix A.

(3) Parameter Coverage

A normal fish community biology survey will not be performed during this study. Rather, only the species collected, enumerated, and transported will be recorded.

Species selection

Table 1 provides a list of candidate species found in the Rocky River watershed and their biological characteristics used in the IBI score calculations. Table 2 lists how each candidate species will affect the IBI score if introduced and a viable population is established. None of these species have been documented in Plum Creek but would have likely recolonized Plum Creek when water quality improved if not for the Plum Creek Gorge.

Table 1. List of native candidate fish species for translocation

Species	Spc Grp	Feed Guild	TOL	IBI Grp	River Size	Brd Gld	Hab Pref	Statewide abundance in headwater streams
Northern hogsucker	R	**I**	M	**R**		**S**	R	18.6%
Blacknose dace	M	G	T	**N**	**H**	**S**	R	66.3%
Striped shiner	N	**I**		**N**		**S**	B	46.5%
Silverjaw minnow	M	**I**		N	P	M	B	46.2%
Sand shiner	N	**I**	**M**	N		M	B	13.6%
Rainbow darter	D	**I**	**M**	**D**		**S**	R	34.9%
Greenside darter	D	**I**	**M**	**D**		**S**	R	21.3%
Fantail darter	D	**I**		**D**	**H**	C	R	44.2%

Bold indicates positive IBI attributes
Underlined indicates negative IBI attributes
Note: this is not a complete list of fish that may be collected and relocated

SPC GRP (Species Group)[a]

O - Other
L - Gars
W - Large River Species
GS - Gizzard Shad
SA - Salmonid
WF - Whitefish
T - Tolerant
P - Pickerels
R - Round-bodied Suckers
C - Deep-bodied Suckers
G - Carp/Goldfish
N - Shiners
M - Minnows
F - Catfish, Drum
B - Blackbass, Crappie
S - Sunfish
V - Non-darter Percidae
D - Darters
SC - Sculpins

FEED GUILD (Feeding Guild)[b]

P - Piscivore
F - Filter Feeder
V - Invertivore
I - Specialist Insectivore
O - Omnivore
G - Generalist
H - Herbivore
C - Carnivore

TOL (Pollution Tolerance)

R - Rare Intolerant
S - Special Intolerant
I - Common Intolerant
M - Moderately Intolerant
T - Highly Tolerant
P - Moderately Tolerant

BRD GLD (Breeding Guild)[c]

N - Complex, no parental care
C - Complex with parental care
M - Simple, miscellaneous
S - Simple lithophils

IBI GRP (IBI Group)[b]

E - Exotic (non-native)
F - Sport Species
R - Round-bodied Sucker
C - Deep-bodied Sucker
W - White sucker
G - Carp/Goldfish
N - Cyprinidae
S - Sunfish (less Blackbasses)
D - Darters

RIV SIZ (River Size)

L - Large River Species
H - Headwaters Species
P - Pioneering Species

HAB PRF (Habitat Pref.)[c]

P - prefers pools
R - prefers riffles
B - prefers both

a these designations are not for use in any FINS analytical programs.
b designations are patterned after Karr et al. (1986).
c designations are patterned after Berkman and Rabeni (1987).

Table 2. IBI Metrics and effect of species introduction

IBI metric		Northern hogsucker	Blacknose dace	Striped shiner	Silverjaw minnow	Sand shiner	Rainbow darter	Greenside darter	Blackside darter	Fantail darter
Number of	Total sp.	+	+	+	+	+	+	+	+	+
	Minnow sp.		+	+	+	+				
	Headwater sp.		+							+
	Sensitive sp.	+				+	+	+		
	Darter sp.						+	+	+	+
	Simple lithophil sp.	+	+	+			+	+	+	
Percent of	Tolerants	+	-	+	+	+	+	+	+	+
	Omnivores	+	+	+	+	+	+	+	+	+
	Pioneering sp.	+	+	+	+	+	+	+	+	+
	Insectivores	+	-	+	+	+	+	+	+	+
	DELTs									
Rel. No.**		+	-	+	+	+	+	+	+	+

Positive effect on IBI metric (+)
Negative effect on IBI metric (-)
*Based on historical scores, drainage area, habitat, reproductive needs, and Best Professional Judgement
**per 0.30 km, minus tolerant and hybrid species

The abundance and presence of these species was then reviewed from other headwater streams in the Rocky River West Branch, listed in Table 3. All candidate species were found in at least three other West Branch headwater sites which met their fish community attainment. Almost all candidate fish are absent at impaired headwater stream locations. The select candidate species make up a large proportion of headwater fish in the Rocky River West Branch and are important indicators of overall stream health. Striped shiners were selected in favor of common shiners in this case because they are far more abundant in the West Branch headwater streams. Although sand shiners were only collected in three West Branch headwater locations, they are more common in larger headwater streams approaching the 20 mi^2 threshold and are very common along the entire Rocky River system.

Table 3. Species abundance in West Branch Headwater sites from 2014 EPA survey												
Station	**RM**	**DA**	**IBI**	Northern Hogsucker	Blacknose dace	Striped shiner	Silverjaw minnow	Sand shiner	Rainbow darter	Greenside darter	Blackside darter	Fantail darter
Blodgett Creek	0.17	4.1	44		15	2	40		4	122		
	1.61	3.1	24								37	
Champion Creek	0.01	7.8	48	4	19	39	1		104	4	3	3
Broadway Creek	0.28	2	52	2	70	3	4		74		2	9
Plum Creek	8.5	7.6	22									
	4.92	14.3	24									
	2.5	16.2	22									
	0.25	17.6	20									
Baker Creek	0.3	5.8	40	3	5	46	7		9	3		
Cossett Creek	0.2	4.1	24						25			
Mallet Creek	3.5	13.7	48	3	41	35	42	1	140	13		37
	0.72	16.1	52	9	7	41	30	4	135	34		12
Plum Creek (N. Br. Trib)	3.02	8.8	50		9	42	1		94	15	2	1
	2.5	10.4	46	15	10	168	25		72	8	18	1
	0.5	12.1	48	5	12	49	32	8	33	16	4	2
Remsen Creek	0.6	14.4	48	22	24	18	2		162	42	1	3
Granger Ditch	1.75	7.8	42	1	2	27			4	1	7	
	0.2	13.3	38	5	1	8	1		16	1	17	
% species found in other W. Br. HW streams in *full attainment*				83%	100%	100%	92%	25%	100%	92%	67%	67%
Median abundance in *full attainment* sites				5	11	37	7	4	73	13	4	3
Highlighted cells indicate non-attainment and *Poor* fish community scores												

Table 4 below lists the spawning habitats and biology of each candidate species. The 2019 and 2020 QHEI assessments at RM 2.84 demonstrate predominately cobble and gravel substrates, with boulder, sand, and bedrock making up the best types. Although in-stream cover was sparse throughout the zone, deep pools and riffles with varying velocities resulted in *Good* to *Excellent* overall stream habitat scores. This is common throughout Plum Creek, as assessments from 2014-2019 downstream of RM 4.92 have yielded QHEI scores averaging 68.7 and a *Good* narrative rating. QHEI scores of 55 on headwater streams suggest that sufficient habitat exists to support a warmwater fish assemblage (Ohio EPA 2006). A literature review study conducted by Cochran-Biederman et al. (2014) listed that confirming the presence of adequate physical spawning habitat was the most important factor to avoid spawning failure in translocated fish populations. Based on the spawning habits below and a review of in-stream habitat, there appears to be no limitations on reproductive success for the candidate species.

Table 4. Candidate Species Spawning Habits		
Species	Time of spawn; temp (ºC)	Spawning habits
Blacknose dace	May-July (15.6-22.0ºC)	Spawns in riffles on sand and gravel substrates in spring.
Northern hogsucker	Early spring (10-16ºC)	Substrate spawner: spawning occurs on gravel riffles where non-adhesive eggs are broadcast and then abandoned.
Striped shiner	May-July (15.5-18.3ºC)	Use nests of other cyprinids such as creek chub and central stoneroller. They will also use the spawning pits of white suckers. Reported by some to build their own nests by digging shallow pits in the gravel using their tail.
Silverjaw minnow	May-July	Spawns in schools over coarse sand and pea-sized gravel in shallow water near riffle.
Sand shiner	Late spring (~21ºC)	Broadcast spawner: adhesive eggs are scattered over sandy substrates in shallow water where they attach to lose gravel.
Rainbow darter	Early spring (~15ºC)	Substrate spawner: males congregate on gravel and cobble substrates at head of riffles. Females and male dive into loose gravel to deposit eggs.
Greenside darter	late March-April (11-19ºC)	Substrate spawner: males establish territories around algae covered rocks at head of swift riffles.
Fantail darter	April-May (19-24ºC)	Cavity nester: males move into areas of moderate currents above riffles to establish and defend territories, which are flat rock or some other object having space beneath the rock to allow a nest.
Blackside darter	Late March-April (~16ºC)	Substrate spawner: Spawning occurs over sand and gravel substrates in areas of moderate current. Males form shallow pit in which the fertilized eggs are deposited.
Obtained from Rice and Zimmerman, 2019; NS Lane et al. 1996		

Literature review of successful fish translocation/reintroduction

A literature review of successful fish translocation in Ohio typically yields results on threatened, endangered, and highly intolerant fish that were extirpated from their native ranges; ex: Bluebreast and Tippecanoe darters (rare intolerant), Longhead darters (special intolerant), Lake sturgeon (historical importance). Numerous native species translocation projects have been performed by the Ohio State University (OSU) stream and river ecology lab. The first being the Bluebreast darter translocation in 2016-2017, where 1,913 Bluebreast darters were translocated from the Muskingum River to six different locations on the Licking River, bypassing the physical barrier of Dillon Reservoir. Results have displayed movement of translocated fish between riffles by using visual implant elastomers to identify unique fish, as well as multiple years of reproductive success (OSU, Hornick et al., 2017). In the fall of 2018, 1,259 Tippecanoe darters were collected from the Scioto River and released at six localities on four rivers in the upper Muskingum River watershed. This translocation bypasses numerous lowhead dams on the Muskingum and its tributaries that were constructed for use as cooling water reservoirs in the steel industry. Juvenile Tippecanoe darters were collected later that year indicating successful reproduction.

McManamay et. al (2016) conducted a similar study on a watershed in Tennessee. Fourteen physical barriers were isolating and limiting fish community recovery on White Oak Creek and its tributaries. They reintroduced six native fish species from adjacent waters to seven locations upstream of the barriers, yet still isolated from each other on White Oak Creek. Table 5 below demonstrates the number and locations of fish reintroduced into White Oak Creek. Establishment was defined if either young-of-the-year were observed or adults were observed in increasing numbers in more than one year. Six of the seven species reintroduced to upper White Oak Creek established or possibly established fecundity in at least one isolated stream reach (Table 5).

Table 5. Number and size of fish tagged and released into areas of White Oak Creek watershed, 2008-2012.

Reach	Site	Species	Size (cm,TL)	2008	2009	2010	2011	2012
A	WCK2.3	Bluntnose minnow	4-9	90				217
A	WCK2.3	Northern hogsucker	4-33	47	21	49		
A	WCK2.3	Rock bass	4-23	120	19	22		
B1	MEK0.6	Stripetail darter	3-6	50	89			
B1	MEK0.6	Snubnose darter	3-6	83	75			
B1	MEK0.6	Striped shiner	3-17				51	19
B2	MEK1.4	Stripetail darter	3-6				1	
B2	MEK1.4	Snubnose darter	3-6				34	62
C	WCK3.4	Northern hogsucker	5-30				74	30
C	WCK3.4	Rock bass	6-19				55	62
D	WCK3.9	Striped shiner	3-17	183				
D	WCK3.9	Stripetail darter	3-6					36
D	WCK3.9	Snubnose darter	3-5					17
E1	WCK4.4	Striped shiner	3-15	88	145		75	96
E1	WCK4.4	Stripetail darter	3-6	63			6	
E1	WCK4.4	Snubnose darter	3-6	85				
F	WCK6.8	Snubnose darter	4-6					59

Six of the seven species reintroduced to upper White Oak Creek established or possibly established fecundity in at least one isolated stream reach (Table 6). In evaluating success of introduced species, extreme habitat fragmentation in terms of isolated stream segments (1.85 barriers/km^2) was listed as the leading cause of the unlikely evaluation of introduction success. The Striped shiner, which NEORSD is proposing to reintroduce as well, was evaluated as *established* in three reintroductions, with the fourth showing *possible* establishment. Even with the one-time introductions of 183 individuals, Striped shiners were able to successfully spawn and were collected in a higher abundance in successive introductive years. Both darter species demonstrated an established population in at least one location. No obvious physical barriers exist for 10+ miles in Plum Creek except at the Gorge, suggesting the candidate species will be able to disperse throughout the watershed with potential for fecundity to be established.

Table 6. Number of individuals captured each year within different stream reaches relative to the reach where each species was released. Reaches correspond to Figure SM1.

Release Reach	Capture Reach	Species	2008	2009	2010	2011	2012	2013	Eval[a]
A	A	Bluntnose minnow					18	2	U
A	A	Northern hog sucker	3	13	16	9	2	1	P
A	A	Rock bass	3	1	2	5	1	7	P
B1-2, D	A	Stripetail darter				1		2	P
B1-2, D	A	Snubnose darter	1	42	64	70	117	76	E
B1	B1	Striped shiner					21	68	P
B1	B1	Stripetail darter	2	13	4	18	23	24	E
B1	B1	Snubnose darter	22	47	97	111	111	100	E
B2	B2	Stripetail darter				1			U
B2	B2	Snubnose darter				2			U
C	C	Northern hog sucker				13	1		U
C	C	Rock bass							U
D,E1	C	Striped shiner	39	67	319	324	354	449	E
D,E1	C	Stripetail darter							U
D,E1	C	Snubnose darter	1	5	50	81	110	67	E
D	D	Striped shiner	13	10	182	285	274	92	E
D	D	Stripetail darter			3	8	32	35	E
D	D	Snubnose darter		1	3	2	32	33	E
E1	E1	Striped shiner		3		11	29	45	E
E1	E1	Stripetail darter					1	1	U
E1	E1	Snubnose darter		1			3	3	U
F	F	Snubnose darter					8		U

[a]Eval = evaluation of introduction success: U = unlikely, P = possible, E = established.

A local project closely related to this Plum Creek translocation was one performed by the Cleveland Metroparks in 2019 and 2020. The Cleveland Metroparks sought to translocate additional fish to Euclid Creek at Acacia Reservation where a stream restoration project recently improved stream habitat and increased floodplain connectivity (Cuyahoga Soil & Water Conservation District 2020). Post monitoring showed the stream restoration project improved instream habitat and increased fish abundance; however, a physical barrier downstream halted fish migration of new species upstream. Over three sampling dates, Cleveland Metroparks staff collected a total of 387 individual fish of ten different species and relocated them upstream of the physical barrier into the stream restoration area. All fish were collected from within the watershed. Pre-monitoring water quality parameters were not measured in this stream to determine if conditions would support additional aquatic life. Instead, the abundance of Pumpkinseed sunfish, a moderately tolerant species (Ohio EPA 2006), indicated a "promising sign of the site's potential". Post monitoring has yet to occur.

Overall, other Ohio native fish translocation efforts have introduced between 210-387 individual fish at either the species' native range or locations within the same watershed where a physical stream barrier halts migration. When reintroducing native pollution-intolerant fish like the OSU Stream and River Ecology lab had done, more individual fish were introduced per species than the Cleveland Metroparks translocation of common Ohio headwater species upstream of a physical barrier. The Cleveland Metroparks relocated 387 individuals of ten species, averaging approximately 39 individuals per species.

For the Plum Creek fish translocation project, every effort will be made to collect a minimum of 100 individuals of each species listed in Tables 1-4 per year and introduce them to the two locations listed below in section 6. Brian Zimmerman of the OSU Stream and River Ecology lab and co-author of *A Naturalist's Guide to the Fishes of Ohio* agreed that 100-200 individuals per species should be sufficient in establishing a population given the smaller stream size and tolerances of the candidate species. He also recommended that this translocation be carried out for 3-5 successive years, or the lifespan of each species, to avoid negative environmental spawning factors and increase chances of fecundity. Mr. Zimmerman has seen best success in fish introductions when introducing gravid fish just before they spawn. This decreases time before spawn and increases the chances of a successful spawn in year one. This will take multiple sampling efforts from numerous source locations each year to collect enough individuals from each species. Source fish collection will begin on the Rocky River West Branch within 3-4 miles of the confluence of Plum Creek, as would naturally occur in an unimpeded system. If enough candidate species are not able to be collected within this section, source locations will expand throughout the Rocky River watershed. A large cooler with a bubbler system will be used to transfer fish from source to seed locations. The actual mix and numbers of individuals per species will be determined at the times of sampling. Additional supplemental information will be collected on the Ohio EPA fish community field sheet.

IBI score comparisons with newly introduced fish

A simulated bioassessment comparing each metric with the introduction of the nine candidate species is displayed in Table 7. The simulated fish community biology consisted of the same species and abundance that were collected by NEORSD on September 4, 2020, yielding an IBI score of 24 (*Poor*), with the addition of the nine species listed in Table 3 using the median abundance of fish at full attainment sites.

Table 7. IBI Metrics and effect of species introduction					
IBI metric		9/4/2020 Bioassessment	Simulated Bioassessment with new species	Approximate metric criteria for increased score	Achievable rank 1-12 (1=best)*
Number of	Total sp.	9(1)	18(5)	17 sp. for a 5	3
	Minnow sp.	1(1)	7(5)	7 sp. for a 5	6
	Headwater sp.	0(1)	2(3)	2 sp. for a 3	1
	Sensitive sp.	0(1)	4(3)	4 sp. for a 3	7
	Darter sp.	1(1)	5(5)	3 sp. for a 3	4
	Simple lithophil sp.	1(1)	7(5)	4 sp. for a 3	5
Percent of	Tolerants	59.9(1)	53.2(3)	<33% for 5 <56% for 3	2
	Omnivores	17.7(5)	15.5(5)	<16% for 5	--
	Pioneering sp.	69.3(1)	61.2(1)	<30% for 5 <55% for 3	9
	Insectivores	15.6(3)	25.3(3)	>22% for 3 >44% for 5	8
	DELTs	0.5(3)	0.4(3)	≤0.1 for 5 ≤0.30 for 3	10
Rel. No.**		876(5)	1168(5)	>750 for 5	--
IBI score (*narrative*)		**24 (*Poor*)**	**46 (*Very Good*)**		
Metric total (metric score 1, 3, or 5) *Based on historical scores, drainage area, habitat, reproductive needs, and best professional judgement **Relative number per 0.30 km, minus tolerant and hybrid species					

Establishing a small population of these nine candidate species increased the IBI score from 24 (*Poor*) to 46 (*Very Good*). The IBI score may continue to increase as the population of reintroduced fish continue to grow, spread throughout the Plum Creek watershed, and outcompete some of the more tolerant, generalist feeding, and pioneering species already present. This project, if successful, will demonstrate the improved water quality in Plum Creek, achieve fish community biology attainment similar to the recovery observed in Rocky River and its tributaries, and eliminate the need to perform a UAA and an ALU redesignation process. This project identifies a rare and unique opportunity to enhance measurable water quality in the upper Plum Creek by promoting fish community biology attainment for the first time.

(4) Field Collection Techniques

A weighted seine net will likely be the only method used during this study to eliminate fatalities that may arise during a typical electrofishing survey. Electrofishing may be used at very low currents in conjuncture with the seine net to assist in collection. Collected fish will be identified, counted, and recorded by a level 3 QDC in fish community biology.

(6) Project Map of Planned Sample Locations

All sampling locations will be inside of the Rocky River watershed. A complete list of sample locations will be provided as sampling is completed.

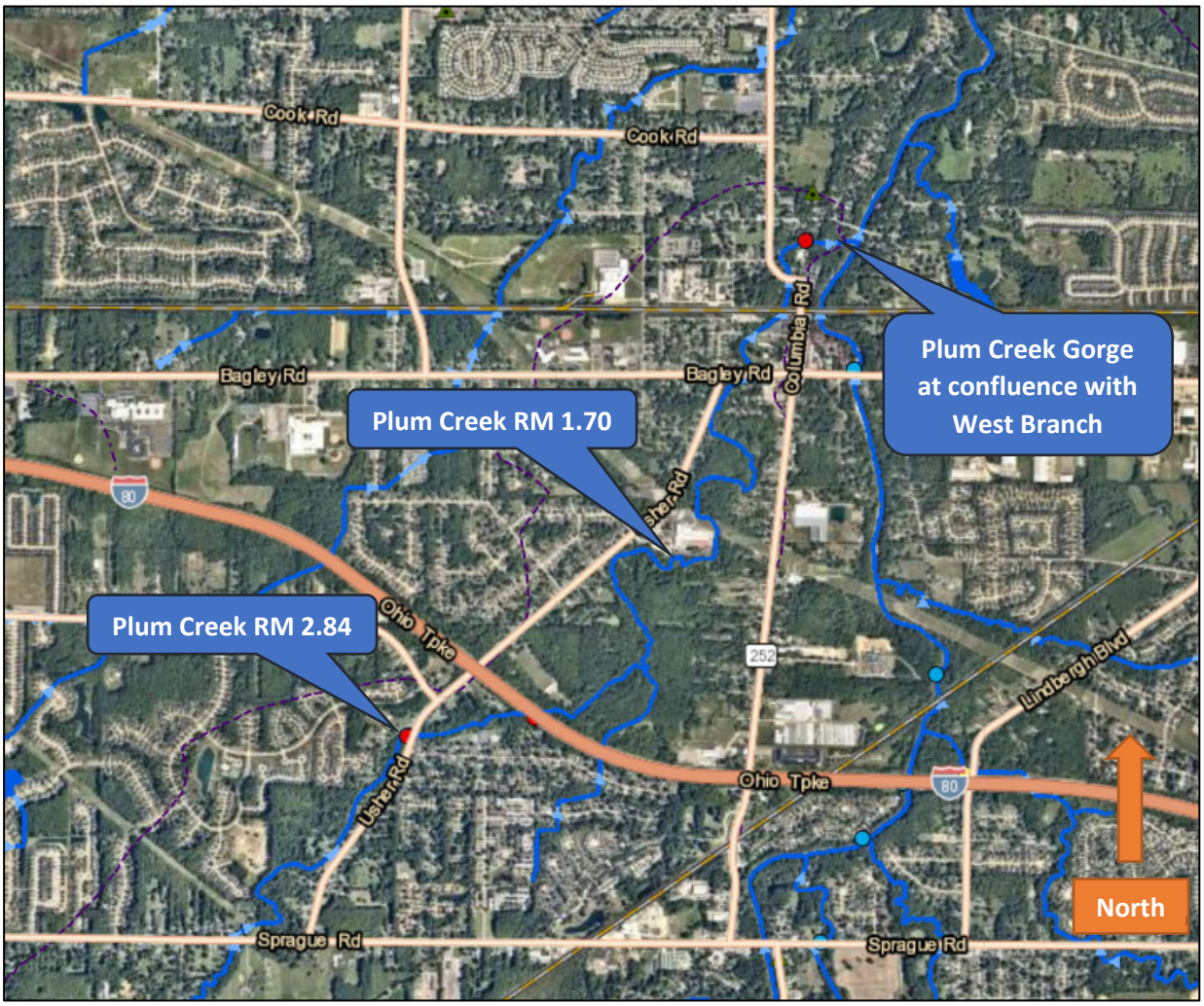


Figure 8. Project map of Plum Creek

Table 8. Sample Location Information

Sampling location	Lat	Lon	RM/ DA (mi²)	Location information	HUC-12	Purpose
Plum Creek	41.3585	-81.9220	2.84/ 16.50	Upstream Old Usher Road	041100010107	Reintroduction location bypassing the natural fish barrier and promote fish community biology integrity
Plum Creek	41.3655	-81.9085	1.70/ 17.10	8615 Usher Road. Station ID: T01G03	041100010107	Reintroduction location bypassing the natural fish barrier and promote fish community biology integrity
Reintroduction locations are tentative based on landowner permission						

(7) Schedule

Fish collection will most likely take place in the spring prior to June 15th with a second sampling period potentially in the fall, starting October 15th. These conditions offer cooler water temperatures and increased oxygen saturation rates, which would be least stressful to the fish. Ideally, translocation will occur directly before or during each species spawning period when females are gravid. This promotes successful spawning shortly after translocation. Plum Creek RMs 2.84 and 1.70, if landowner permission is granted, will be re-surveyed (IBI and QHEI per Ohio EPA protocols) in approximately one-two years from the final fish reintroduction date to determine if reintroduced fish have established fecundity within upper Plum Creek and determine changes in fish community population dynamics, as well as reassess attainment.

(8) QA/QC

Pictures of voucher specimens will be taken and kept on file.

(9) Work Products

A report summarizing efforts taken during this project to help the upper Plum Creek achieve fish community biology attainment will be written. A list and count of fish species from each location, as well as their destination location on Plum Creek will be provided.

(10) Sample Collectors
A level 3 Qualified Data Collector in fish community biology will act as a crew leader during all sampling activities to verify species identification. The following WQIS staff may be involved with this study:

Name	Email Address	QDC#	Phone Number
Hannah Boesinger	boesingerh@neorsd.org	1374	(216) 641-6000
Kevin Fitzgibbons	Fitzgibbonsk@neorsd.org	--	(216) 641-6000
Seth Hothem	hothems@neorsd.org	**010**	(216) 641-6000
Mark Matteson	mattesonm@neorsd.org	**1020**	(216) 641-6000
Daniel Neelon	neelond@neorsd.org	--	(216) 641-6000
John W. Rhoades	rhoadesj@neorsd.org	**008**	(216) 641-6000
Joseph Schiel	schielj@neorsd.org	--	(216) 641-6000
Eric Soehnlen	soenhlene@neorsd.org	1030	(216) 641-6000
Justin Telep*	telepj@neorsd.org	**1304**	(216) 641-6000
Other WQIS staff and interns will assist as needed Bold indicates Level 3 QDC FCB subspecialty *NEORSD Project Lead			

(12) Scientific Collector Permit

An ODNR Scientific Collector Permit and ODNR authorization to capture and relocate native non-sportfish species will be obtained for the purpose of this project. Both permits will be submitted once received from the ODNR.

(13) Voucher Specimens Statement

The NEORSD will maintain a fish voucher collection which includes two specimens, or appropriate photo vouchers, of each species or taxa collected during the course of biological sampling from any stream within the NEORSD's service area. When fish specimens from multiple surface waters are collected within the same year, one voucher collection will represent that specimen for all streams.

NEORSD will provide specimens or photo vouchers to the director upon request. This collection will be stored at the NEORSD laboratory in the Environmental Maintenance and Services Center.

Print/Signature: Date:

(14) Lead Project Manager Sampling Locations Statement

I attest that I will make available any and all sampling location information, including but not limited to; the name of the waterbody, sampling location latitude and longitude, sampling location river mile, general location information, USGS HUC 8 number and name, and the purpose for data collection at each sampling location.

(15) QDC qualified individual statement

The lead project manager for all stream locations is approved for level 3 fish community biology QDC.

(16) Criminal trespassing statement

I have not been convicted or plead guilty to a violation of section 2911.21 of the Revised Code (criminal trespass) or a substantially similar municipal ordinance within the previous five years.

Print/Signature: Seth Hothem/ Date:

Print/Signature: Mark Matteson/ Date:

Print/Signature: John W. Rhoades/ Date:

Print/Signature: Justin Telep/ Date:

Appendix A: Historical biological community and stream habitat assessment scores

Year assessed/ agency	River Mile	IBI	ICI[a]	QHEI	Status	Causes	Sources	ALU WQS Exceedances
2020 (NEORSD)	2.84	24*	28	69.25	NON			
2020 (NEORSD)	2.84	26*						
2019 (NEORSD)	2.84	30*	26*/F*	70.0	NON	Natural (fish passage) Flow regime alterations	HS Urban runoff Physical barrier (Plum Creek Gorge)	*E. coli*
2019 (NEORSD)	2.84	26*						
2014 (EPA)	8.50	22*	MG[ns]	51.5	NON	Low DO Habitat alterations	Natural sources (rheopalustrine) channelization	Dissolved oxygen Iron
2014 (EPA)	4.92	24*	MG[ns]	65.0	NON	Low DO Habitat alterations	Natural sources (rheopalustrine) Channelization	Dissolved oxygen Iron
2014 (EPA)	2.50	20*	MG[ns]	69.75	NON	Natural (fish passage) Other flow regime alterations	Natural sources (Plum Cr. Gorge) Urban runoff/storm sewers	No water chemistry sampled
2014 (EPA)	0.25	20*	MG[ns]	69.50	NON	Natural (fish passage) Other flow regime alterations	Natural sources (Plum Cr. Gorge) Urban runoff/ storm sewers	*E. coli* Lead
2012 (NEORSD)	2.90	22*	24*	70.75	NON	Low DO Natural (fish passage) Other flow regime alterations	HSTS Urban runoff Physical barrier (Plum Creek Gorge)	*E. coli* Dissolved oxygen
2012 (NEORSD)	0.30	16*	18*	64.25	NON	Natural (fish passage) Other flow regime alterations	HSTS Urban runoff Physical barrier (Plum Creek Gorge)	*E. coli*
2001 (EPA)	2.8	22*		71.5	NON			
2001 (EPA)	0.01	18*		72	NON			
1997 (EPA)	2.8	18*	MG[ns]	71.5	NON	Nutrient enrichment Organic enrichment	N/A	Fecal coliform
1997 (EPA)	0.1/0.2	18*	F*	70.5	NON	Nutrient enrichment Organic enrichment	Small POTWs Unsewered areas, construction runoff, polluted stormwater	Fecal coliform Lead (OMZA)
1992 (EPA)	0.3	18*	F*	43.5	NON	Organic enrichment Oxygen depletion Habitat limitations	Small POTWs (Brentwood WWTP and Western Utility WWTP)	Dissolved Oxygen (chronic), Fecal coliform
1981 (EPA)	8.5	22*	--	50	NON			
1981 (EPA)	0.25	18*	--	55.5	NON			

* - significant departure from biocriteria; poor and very poor results are underlined
ns – nonsignificant departure from biocriteria for WWH (4 IBI or ICI units)
a – Narrative evaluation used in lieu of ICI where quantitative sampling was not done or where artificial substrates were affected by slow current velocity (E=Exceptional; G=Good; MG=Marginally good; F=Fair; P=Poor; VP=Very poor)

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