Eastern Rivers and Mountains Network Stream Fish Community Monitoring

Sampling Reach Summaries and 2013-2014 to 2022-2023 Survey Comparisons: New River Gorge National Park & Preserve

Caleb Tzilkowski, Aquatic Ecologist, Eastern Rivers and Mountains Network

In collaboration with the U.S. Geological Survey (Pennsylvania Cooperative Fish and Wildlife Research Unit) and The Pennsylvania State University (PSU), the Eastern Rivers and Mountains Network surveyed fish communities in wadeable streams throughout six National Park Service units, once during 2013-2014 and once during 2022-2023.

This document contains (1) summaries of electrofishing surveys and in-stream habitat assessments throughout New River Gorge National Park & Preserve during 2022-2023 and (2) descriptions of observed reach-scale fish community differences between survey periods.

To account for imperfect detection of fishes, and to estimate species occupancy and detection probabilities, 100-meter-long reaches (n = 31) were sampled using pulsed-DC backpack electrofishing during summer 2022 and 2023, typically on three independent occasions with as few days as logistically possible between visits. All captured fish were counted and identified to species before releasing them throughout the sampled reach. At least one representative individual of each species, sex (when distinguishable), and age class (i.e., young-of-year, adult) were photographed as photo-vouchers. In-stream and riparian habitat metrics, characterized for use as occupancy modeling covariates, included: basic water quality (e.g., pH, specific conductance), discharge, substrate size and embeddedness, channel morphology, fish cover, riparian vegetation type and cover, and human disturbance. Stream water temperature statistics were calculated from continuous (1 hr interval) data logger measurements that were deployed from April 2022 – present, within 100 m of sampling reaches.

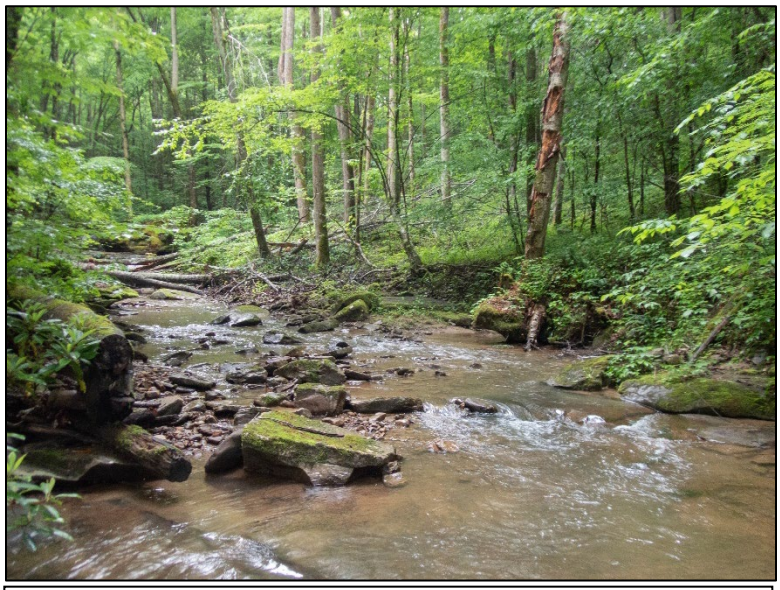
Morgan Zazworsky (Stum) contributed substantially and was invaluable to this research as a PSU graduate student. ERMN Fish Community Monitoring resources, including data packages, peer-reviewed publications, and Standard Operating Procedures are available here.

NERI.3064 – Batoff Creek 07



Reach Downstream End – 2015 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	20.5
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	8
Avg. Julian Day of Annual Max. Temp.	209
Avg. DO (mg/L)	10.35
Avg. pH	7.6
Avg. Specific Conductance (µS/cm)	179.0
Avg. Discharge (m^3/s)	0.043



Reach Downstream End – 2023: Changes in large woody debris (LWD) volume and location

Reach Habitat	
Avg. Width (m)	6.72
Avg. Depth (cm)	7.2
Max. Depth (cm)	19
Avg. % Substrate Embeddedness	33.2%
Mode Substrate Class	RS*
Avg. Substrate Diameter (mm)	290.5
% Sand/Fines	12%
% Substrate > Fine Gravel	76%
% Canopy Cover	91.2%
% Mixed Veg. (non-deciduous)	100%
% Natural Fish Cover (all types)	51.5%
LWD Density (m^3/m^2)	0.041
EPA RBP Score	92.5%

*RS = Smooth bedrock

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
8.9	3	431.8	0.067	1775.1	83.6%	14.5%	0.69%

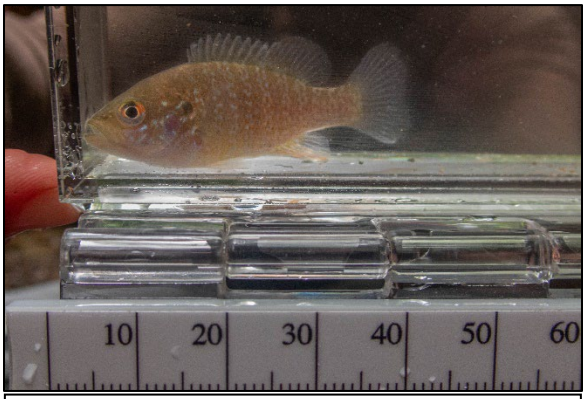
Fish Counts (Total over 3 visits)		
Species (Nativity*)	**2013**	**2022**
Clinostomus funduloides (*N*)	4	0
Lepomis cyanellus (*N*)	0	41
Rhinichthys atratulus (*N*)	583	172
Semotilus atromaculatus (*N*)	28	0

*N = native; I = introduced



Reach upstream end 2023: Bedrock waterfall and pool filled with fine sediment; water was turbid after moderate rain

Batoff Creek 07 was the only reach on Batoff Creek, which drains a portion of the Piney View residential area and flows down a steep ravine along West Virginia Route 41 before joining Piney Creek, a New River tributary. Due to its proximity to the road and slope, the area was a popular location for dumping trash. Runoff from the road, dumping site, and upstream development may have been responsible for elevated specific conductance. The reach was heavily forested with cold water temperatures, rarely exceeding 20°C. There were several large, new fallen trees near the midpoint that created the only substantial opening in the canopy throughout the reach. Most of the stream channel was shallow bedrock runs and pools with small cascading waterfalls. Slower sections had notable sand and fine sediment accumulations.



Green sunfish YOY were common

Species diversity at Batoff Creek 07 was low in 2023, with only two tolerant species caught, that were indicators of habitat degradation, extreme hydrologic conditions (e.g., floods/droughts), and/or relatively poor water quality. Blacknose dace *Rhinichthys atratulus* was the most abundant species, although many fewer were caught than during 2014. Green sunfish *Lepomis cyanellus* was the other species observed in 2023, and all individuals were young of year (YOY), which was unexpected since none were captured in 2014. Although green sunfish are considered native to New River drainage and are tolerant to a wide variety of conditions, it was somewhat surprising to find them in a relatively small, cold, stream, as adults typically prefer sluggish backwater areas of rivers or lakes and a warm thermal regime (26 - 31°C)[1]. Given the relatively short distance to New River and Piney Creek—where green sunfish have been previously documented—it is possible that they colonized this reach and are reproducing. While there are a few upstream ponds that could have been sources of the sunfish, they are farther away and only connected to Batoff Creek intermittently. It is possible that Rosyside Dace *Clinostomus funduloides* was present and not captured in 2023, because few were caught in 2014. Similarly, creek chub *Semotilus atromaculatus* were caught in low numbers (less than 10 individuals per visit) in 2014, but not capturing any in 2023 was surprising given the species' relatively high detection probability (0.88, 90% CI = [0.79, 0.95])[2].

[1] Beitinger et al. 1975; Allen 2019
[2] Stum 2024

NERI.3024 – Big Branch 10



Reach Upstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	20.5
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	10
Avg. Julian Day of Annual Max. Temp.	211
Avg. DO (mg/L)	10.24
Avg. pH	7.51
Avg. Specific Conductance (µS/cm)	62.3
Avg. Discharge (m^3/s)	0.060



Reach Upstream End – 2022: Some new LWD; majority of flow shifted towards opposite bank

Reach Habitat	
Avg. Width (m)	2.98
Avg. Depth (cm)	8.0
Max. Depth (cm)	26
Avg. % Substrate Embeddedness	72%
Mode Substrate Class	GF*
Avg. Substrate Diameter (mm)	22.4
% Sand/Fines	20%
% Substrate > Fine Gravel	52%
% Canopy Cover	92.5%
% Mixed Veg. (non-deciduous)	0%
% Natural Fish Cover (all types)	67%
LWD Density (m^3/m^2)	*NA***
EPA RBP Score	88.5%

*GF = Fine Gravel

**LWD not measured correctly (but similar to DEWA.3072)

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
2.1	2	536.5	0.135	971.0	94.07%	5.13%	0.71%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
N/A	0	0

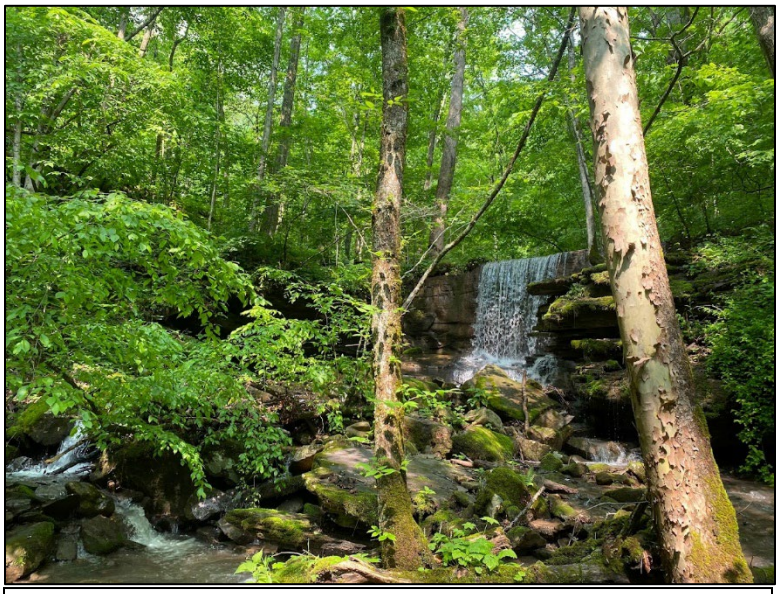
Big Branch 10 was the upstream reach on Big Branch, which is a small, high gradient, heavily forested tributary to New River, just above Brooks Falls. The reach was steep and relatively straight with shallow riffles and plunge pools, leading to some erosion, which was evident due to the abundance of sand and fine sediment throughout the gravel and cobble substrate.

The Big Branch hiking trail crosses the stream near the downstream end of the reach, just upstream from a moderate waterfall (~2 m) that separates it from the downstream reach (Big Branch 09; NERI.3072). The water temperatures were cold (rarely > 20°C), typical of a forested headwater stream. The water quality was good, and the stream supported many native crayfish and stream-breeding salamanders, which thrived without predation from fish.

Big Branch remained "fishless" since 2014, with no fish being captured during the first sampling visit in 2022 and was therefore sampled only once. The waterfall below the reach start, as well as several larger natural barriers further downstream, likely prevent river species from colonizing. Also, this reach may be subject to drought and flash flooding that are inhospitable for a stream fish community, given the steep gradient, high elevation, and shallow nature of the reach.



Reach Downstream End – 2022: Some erosional



Waterfall below reach separating Big Branch 09 and 10

NERI.3072 – Big Branch 09



Reach Downstream End – 2015 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	21.8
Avg. # Annual Days with Daily Mean Temp. > 20 °C	4
Avg. # Annual Days with Daily Max. Temp. > 20 °C	52
Avg. Julian Day of Annual Max. Temp.	209
Avg. DO (mg/L)	10.5
Avg. pH	7.46
Avg. Specific Conductance (µS/cm)	81.9
Avg. Discharge (m^3/s)	0.058



Reach Downstream End – 2023: Some newer LWD

Reach Habitat	
Avg. Width (m)	2.95
Avg. Depth (cm)	11.4
Max. Depth (cm)	28
Avg. % Substrate Embeddedness	55.6%
Mode Substrate Class	GC*
Avg. Substrate Diameter (mm)	88
% Sand/Fines	16%
% Substrate > Fine Gravel	80%
% Canopy Cover	100%
% Mixed Veg. (non-deciduous)	0%
% Natural Fish Cover (all types)	69.5%
LWD Density (m^3/m^2)	0.014
EPA RBP Score	88.5%

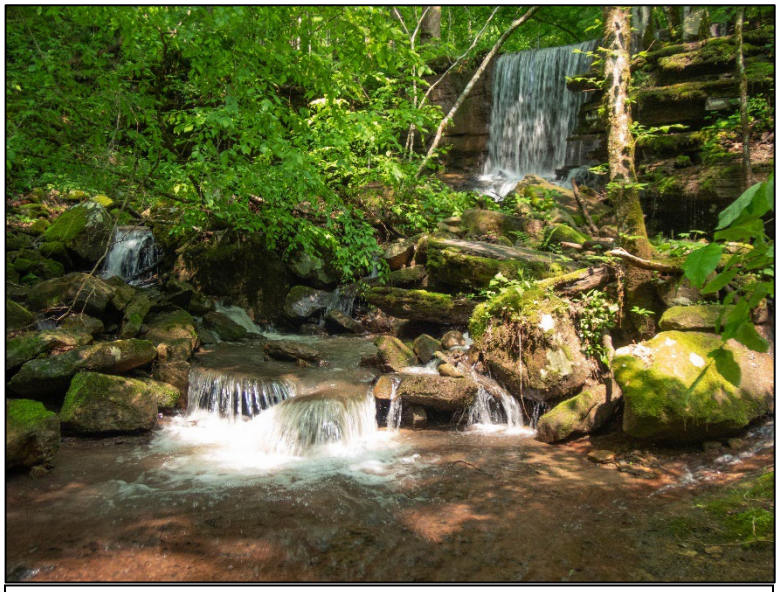
*GC = Coarse gravel

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
2.2	2	525.7	0.135	874.7	84.2%	4.98%	0.69%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
N/A	0	0

Big Branch 09 was immediately downstream of Big Branch 10 (NERI.3024) and had similar habitat. However, the reach contained more bedrock and cobble substrate, creating a few slightly deeper pools. Moderately high waterfalls (~1-2 m) bounded the reach, with several larger (~3 m) waterfalls downstream, including Big Branch Falls. Water temperatures were relatively cold, but slightly warmer than upstream.

Like NERI.3024, fish were not captured at Big Branch 09 during either sampling period, indicating the downstream waterfalls likely prevent colonization. However, Faulk (2015) noted blacknose dace captured in a pool below the next downstream waterfall.



Reach Upstream End 2023



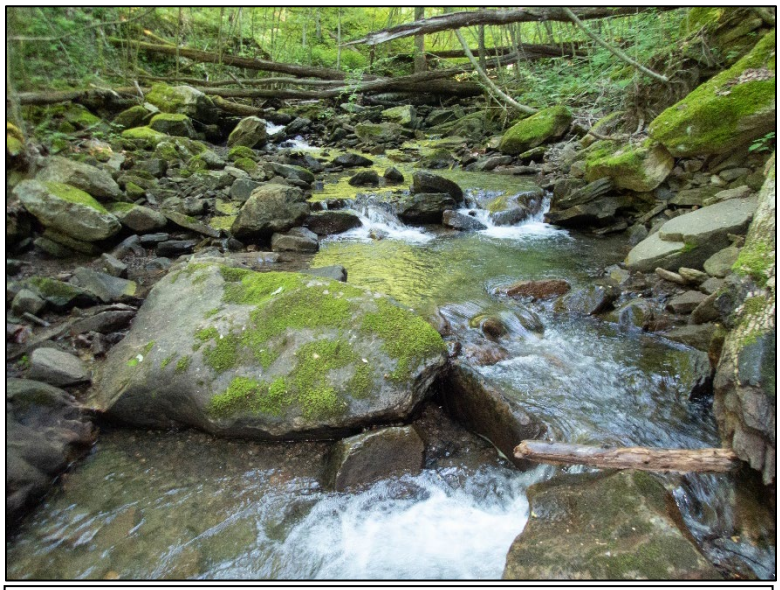
Big Branch Falls, just downstream of reach

NERI.3005 – Buffalo Creek 16



Reach Upstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	19.8
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	0
Avg. Julian Day of Annual Max. Temp.	241
Avg. DO (mg/L)	10.1
Avg. pH	7.04
Avg. Specific Conductance (µS/cm)	49.4
Avg. Discharge (m^3/s)	0.119



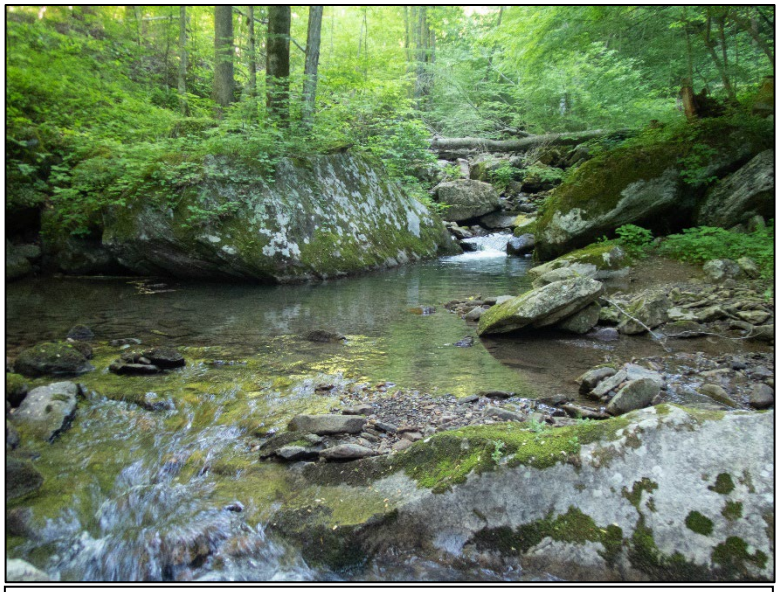
Reach Upstream End – 2022: Changes in LWD; slightly increased erosion

Reach Habitat	
Avg. Width (m)	5.08
Avg. Depth (cm)	12.9
Max. Depth (cm)	36
Avg. % Substrate Embeddedness	50.4%
Mode Substrate Class	SB*
Avg. Substrate Diameter (mm)	59
% Sand/Fines	4%
% Substrate > Fine Gravel	76%
% Canopy Cover	96.1%
% Mixed Veg. (non-deciduous)	60%
% Natural Fish Cover (all types)	89.5%
LWD Density (m^3/m^2)	0.032
EPA RBP Score	89.5%

*SB = Small boulder

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
10.4	3	460.1	0.096	1578.0	97.8%	1.68%	0.17%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
Salvelinus fontinalis (*N*)	4	0



Reach Downstream End – 2022: Large pool, difficult to electrofish

Buffalo Creek 16 was the upstream reach on Buffalo Creek, which flows through a heavily forested, steep ravine. The stream was swift and cold, with many boulders creating continuous sections of riffles and cascades ending in plunge pools. One plunge pool near the downstream end of the reach was deep and difficult to electrofish.

Fish were not captured during three visits in 2022, which was unfortunate but not unsurprising given that few brook trout were captured in 2014 (one and three individuals on the first two visits, respectively). However, brook trout may have been present but undetected in 2022, especially considering its rarity in 2014 and the difficult electrofishing in the deep pool where they were previously captured. Regardless, brook trout did not appear to be abundant enough to ensure a persistent population. Although the thermal regime was ideal for brook trout, spawning habitat (slower sections with gravel substrate) was very sparse. Additionally, the brook trout population may be limited by volatile stream flows (e.g., droughts and floods), given the steep gradient, large boulders, and evidence of erosion.

NERI.3069 – Buffalo Creek 04



Reach Downstream End – 2015 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	20.1
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	2
Avg. Julian Day of Annual Max. Temp.	220
Avg. DO (mg/L)	9.98
Avg. pH	7.38
Avg. Specific Conductance (µS/cm)	84.6
Avg. Discharge (m^3/s)	0.237



Reach Downstream End – 2022: Light penetration visible

Reach Habitat	
Avg. Width (m)	7.35
Avg. Depth (cm)	12.1
Max. Depth (cm)	76
Avg. % Substrate Embeddedness	44.8%
Mode Substrate Class	RS
Avg. Substrate Diameter (mm)	179
% Sand/Fines	12%
% Substrate > Fine Gravel	76%
% Canopy Cover	76.7%
% Mixed Veg. (non-deciduous)	0%
% Natural Fish Cover (all types)	42.5%
LWD Density (m^3/m^2)	0.029
EPA RBP Score	85%

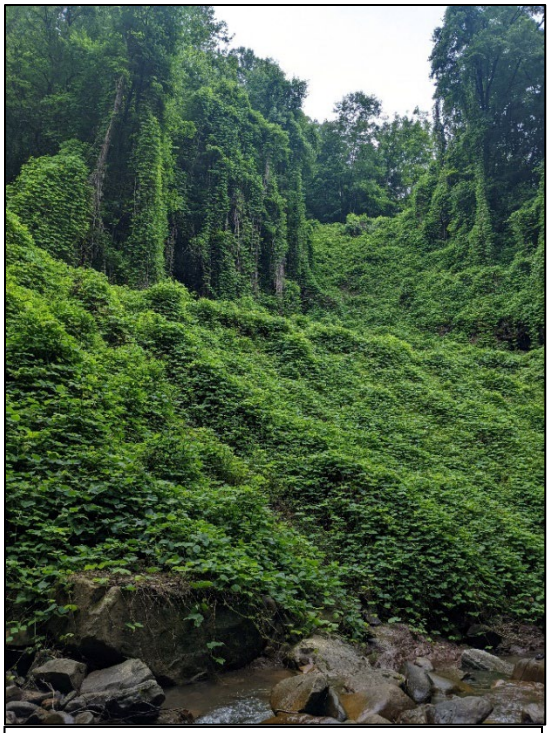
Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
13.8	3	357.9	0.076	411.8	97.5%	2.16%	0.13%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
Salvelinus fontinalis (*N*)	3	0



Reach Upstream End – 2022: More cobble, gravel, and sand than upstream reach (Buffalo Creek 16)

Buffalo Creek 04 was the downstream reach on Buffalo Creek, between the confluence with New River and McKendree Road. This reach had comparable water quality and temperatures to the upstream reach, Buffalo Creek 16 (NERI.3005). Near the reach's downstream end, the riparian area on the left bank (facing downstream) was very open with few trees; Kudzu dominated the entire bank, causing substantial light penetration. The rest of the riparian area was entirely deciduous trees, and the understory was dominated by invasive shrubs. The reach was bisected by a large bedrock waterfall (~3 m); upstream of that waterfall, the stream split into two channels for ~25 m. The substrate had more bedrock, cobble, and sandy gravel than NERI.3005, with fewer large boulders. The bank showed evidence of erosion, and there was little LWD throughout the reach. Frequent habitat disturbance from scouring floods and droughts likely limits stream fish population establishment and persistence.



Large open area covered in Kudzu near reach's downstream end; road visible

As with the upstream Buffalo Creek site (NERI.3005), fish were not captured during any of the three visits during 2022. It is possible that brook trout were present but not detected, but brook trout may have been extirpated from this reach, given the species' relatively high detection probability in NERI (0.63, 90% CI = [0.32, 0.88])[3], and that only one large individual was captured (once on each visit) during 2014. At the very least, the brook trout population in Buffalo Creek is likely suffering from low reproductive success, potentially leading to insufficient genetic diversity and reduced population viability. A recent study estimated the effective population size (i.e., the number of individuals that effectively participates in producing the next generation and maintains the same rate of genetic drift, inbreeding, and adaptive potential as the entire population) of brook trout in Buffalo Creek to be 11.8 individuals (95% CI = 7.3, 19.7) from a sample size of 30 individuals collected near Buffalo Creek 04 in 2008[4]. At the rate of capturing few to no brook trout and the apparent declining trend in counts, the classification of Buffalo Creek as a redundant population by the Eastern Brook Trout Joint Venture[5] requires reevaluation. More sampling is needed to verify the presence/absence of brook trout in this watershed, as well as the genetic variation and origin of the population, if one still exists.

[3] Stum, 2024
[4] Kazyak et al. 2022; https://bte.ecosheds.org/
[5] Brook Trout Conservation Portfolio and Range-wide Assessment

NERI.3077 – Dowdy Creek 02



Reach Downstream End – 2015 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	20.4
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	4
Avg. Julian Day of Annual Max. Temp.	219
Avg. DO (mg/L)	10.6
Avg. pH	7.24
Avg. Specific Conductance (µS/cm)	27.9
Avg. Discharge (m^3/s)	0.047



Reach Downstream End – 2023: New LWD

Reach Habitat	
Avg. Width (m)	5.68
Avg. Depth (cm)	8.9
Max. Depth (cm)	36
Avg. % Substrate Embeddedness	33.2%
Mode Substrate Class	RS
Avg. Substrate Diameter (mm)	589.4
% Sand/Fines	0%
% Substrate > Fine Gravel	92%
% Canopy Cover	98.8%
% Mixed Veg. (non-deciduous)	40%
% Natural Fish Cover (all types)	123.5%
LWD Density (m^3/m^2)	0.159
EPA RBP Score	94%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
6.5	2	372.2	0.192	169.3	98.7%	1.12%	0.07%

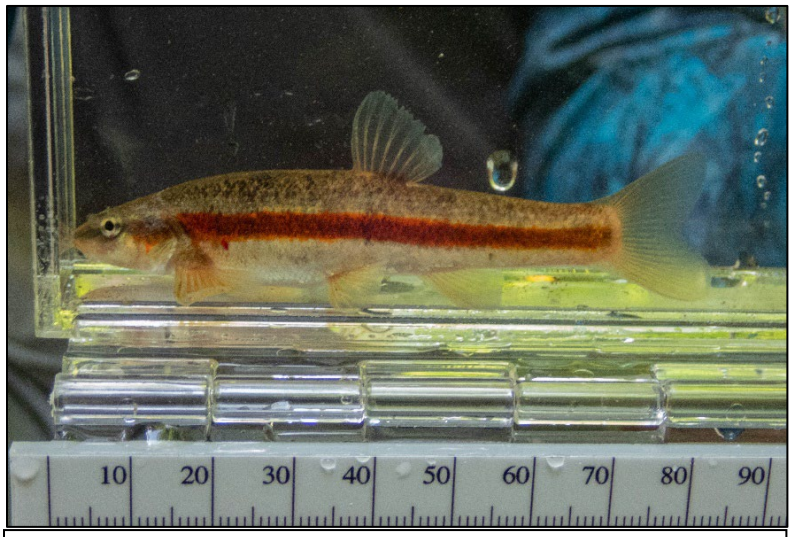
Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
Rhinichthys atratulus (*N*)	347	386

Dowdy Creek 02 was the only reach on Dowdy Creek, a very remote and heavily forested New River tributary located approximately halfway between Prince and Thayer. The reach was located between New River and McKendree Road, just upstream from a sizable waterfall (~15 m). The reach was relatively high gradient, with a mixture of bedrock and coarse substrate, and featured many riffles and shallow plunge pools. The thermal regime was cold, and specific conductance was very low, indicative of relatively pristine conditions.



Reach Upstream End – 2023: A mixture of pools, riffles, LWD, boulders, and other habitat present throughout the

Blacknose dace remained the only species detected at Dowdy Creek 02 in 2023 and was caught in comparable numbers to 2014. It is very doubtful that this reach was colonized naturally by individuals from the river due to the impassable downstream waterfall. The original introduction was very likely by human translocation (e.g., a bait bucket transfer).



Male blacknose dace in spawning colors captured in reach



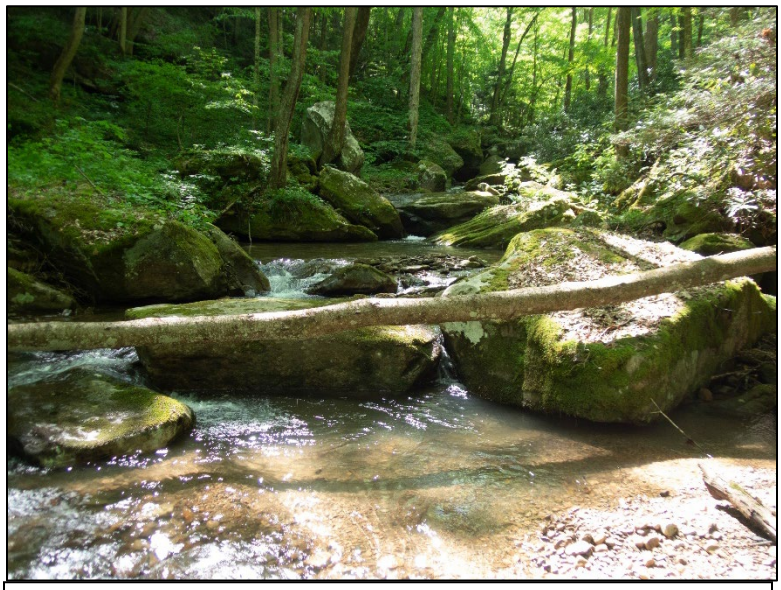
View from top of waterfall (looking downstream) just downstream of reach

NERI.3050 – Ephraim Creek 08



Reach Downstream End – 2015 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	N/A*
Avg. # Annual Days with Daily Mean Temp. > 20 °C	N/A*
Avg. # Annual Days with Daily Max. Temp. > 20 °C	N/A*
Avg. Julian Day of Annual Max. Temp.	N/A*
Avg. DO (mg/L)	10.4
Avg. pH	6.82
Avg. Specific Conductance (µS/cm)	28.5
Avg. Discharge (m^3/s)	0.138



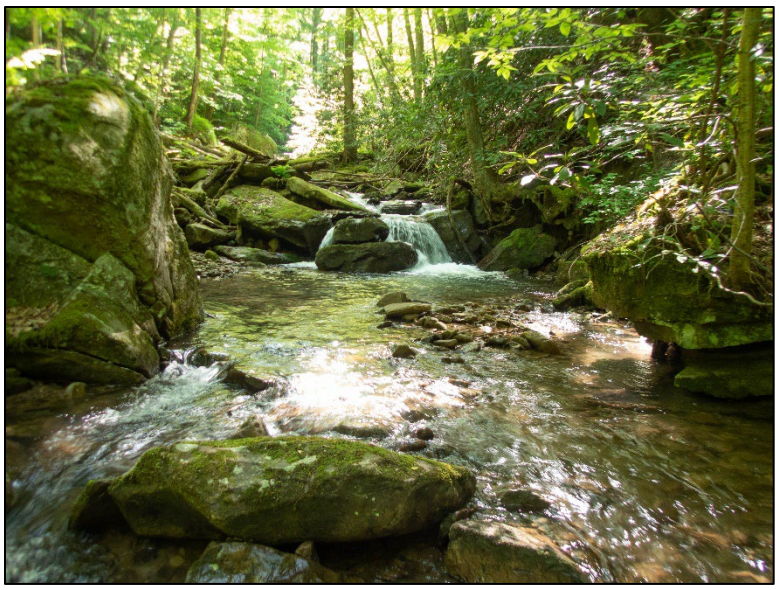
Reach Downstream End – 2022: Small shifts in LWD amount & placement; relatively unchanged

Reach Habitat	
Avg. Width (m)	5.2
Avg. Depth (cm)	9.1
Max. Depth (cm)	51
Avg. % Substrate Embeddedness	42.8%
Mode Substrate Class	CB**
Avg. Substrate Diameter (mm)	100.6
% Sand/Fines	4%
% Substrate > Fine Gravel	80%
% Canopy Cover	97.5%
% Mixed Veg. (non-deciduous)	80%
% Natural Fish Cover (all types)	97%
LWD Density (m^3/m^2)	0.175
EPA RBP Score	93.5%

*Temperature loggers were lost or unable to be retrieved during both years (2022 & 2023). The maximum water temperature during fish sampling was 14.68 °C on 05/25/2022 taken at approximately 12:00pm. **CB = Cobble

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
9.6	2	380.8	0.101	169.3	97.4%	2.01%	0%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
Semotilus atromaculatus (*N*)	0	33



Reach Upstream End – 2022: Many large boulders, small waterfalls, and deep plunge pools throughout the reach

Ephraim Creek 08 is the only monitored section of Ephraim Creek, a remote and heavily forested stream that flows from the Beury Mountain Wildlife Management Area. This stream flows through a ravine with steep banks and is not easily accessible by public roads. Although it is classified as a second-order stream, it is relatively wide and features many small waterfalls created by large boulders, as well as deeper plunge pools. The streambed consists mostly of cobble, with some gravel found in slower sections. Along the left bank (when facing downstream), the riparian area is a mix of deciduous trees and rhododendron.



A creek chub (possibly a gravid female) captured on the first visit

While we did not have data from temperature loggers, water temperatures were cold during sampling, suggesting that the thermal conditions were likely like those found in other nearby streams, such as Buffalo Creek and Slater Creek. The other water quality parameters indicate that the stream is relatively pristine.

In surveys conducted in 2014, Ephraim Creek 08 was considered "fishless" because no fish were captured or observed during three visits. Therefore, it was surprising to find creek chub during our visits in 2022, albeit in low numbers (between 9 and 13 individuals). It is unclear how these creek chub made their way to this section, especially considering the small waterfalls downstream that were thought to act as barriers, and the remoteness of the area, which would make human transport unlikely.

However, previous studies noted the presence of creek chub in Ephraim Creek near its confluence with the New River. Creek chub is often considered a sentinel species because of its ability to disperse and recolonize headwater streams after disturbance. Although unlikely, it is also possible that creek chub were present in 2014 but went undetected. Continued monitoring of this section will help determine if the creek chub population can persist and increase over time.

NERI.3036 – UNT to Fall Branch 02



Reach Upstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	20.7
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	21
Avg. Julian Day of Annual Max. Temp.	242
Avg. DO (mg/L)	10.1
Avg. pH	7.08
Avg. Specific Conductance (µS/cm)	68
Avg. Discharge (m^3/s)	0.035

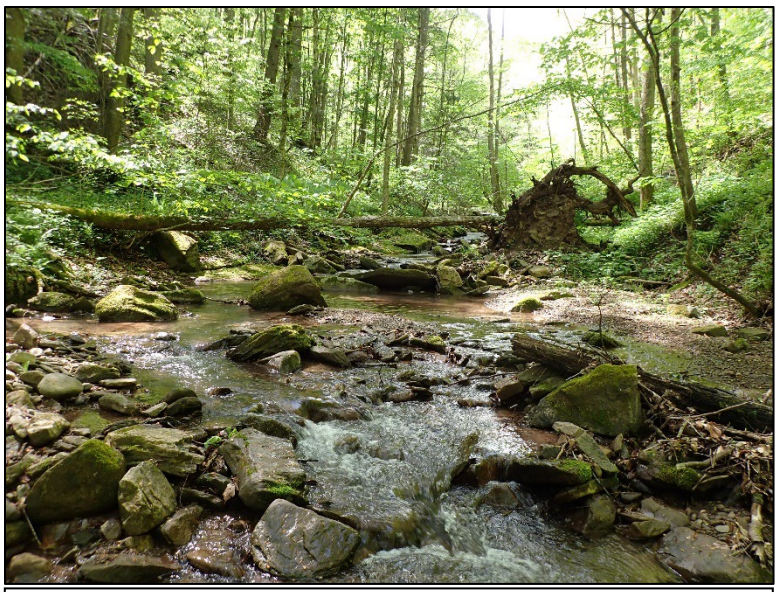


Reach Upstream End – 2022: Some increased bank erosion and new LWD

Reach Habitat	
Avg. Width (m)	5.0
Avg. Depth (cm)	7.3
Max. Depth (cm)	39
Avg. % Substrate Embeddedness	53.6%
Mode Substrate Class	GF
Avg. Substrate Diameter (mm)	51.8
% Sand/Fines	8%
% Substrate > Fine Gravel	64%
% Canopy Cover	93.7%
% Mixed Veg. (non-deciduous)	100%
% Natural Fish Cover (all types)	41%
LWD Density (m^3/m^2)	0.123
EPA RBP Score	91%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
3.7	2	471.6	0.076	2126.3	97.9%	1.17%	0.92%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
Rhinichthys atratulus (*N*)	304	196

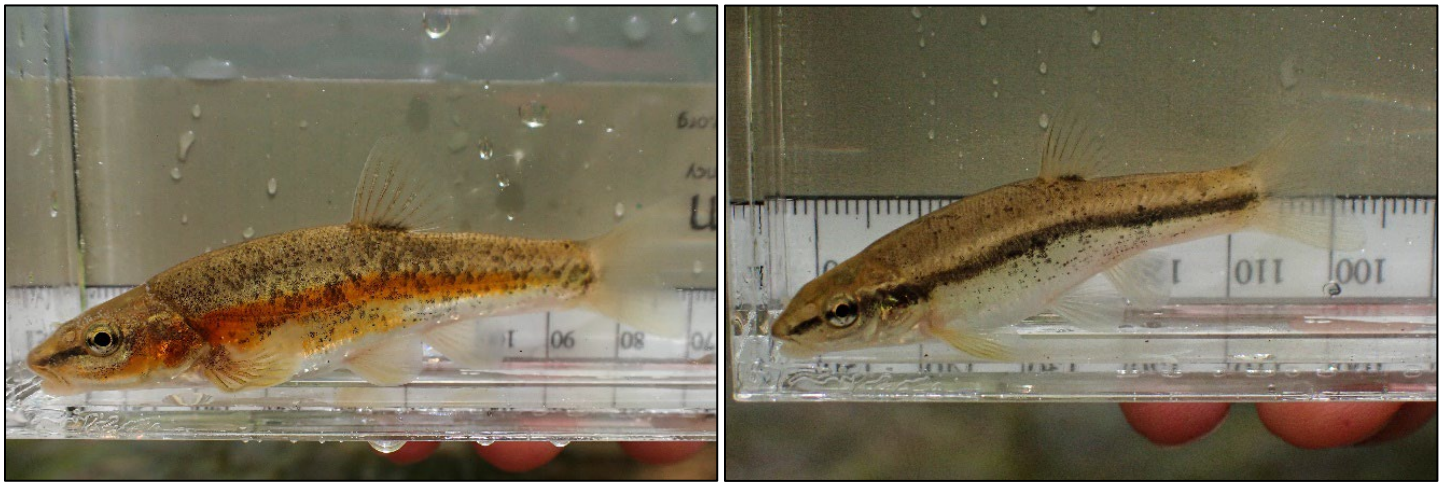


Reach start – 2022: Shallow and flat with gravel bars near banks and some LWD

This reach was on a small, unnamed tributary that flows into Fall Branch near the park boundary, located upstream from Fall Branch 07 (NERI.3052). The stream primarily consists of shallow runs and riffles, with one deeper pool situated below a small bedrock waterfall at the upstream end. The riverbed is mostly made up of cobbles in the riffle areas, while sandy gravel is abundant in the slower sections. Fine sediment has collected in the pool beneath the waterfall.

The water in this tributary is cold and clear. Along with the small waterfall within this reach, there is a taller waterfall (approximately 5 meters high) located downstream. In 2022, blacknose dace were the only fish species observed, although fewer were captured compared to 2014. Both adult fish and young-of-the-year were found, indicating that reproduction is ongoing in this stream.

It is uncertain how blacknose dace came to inhabit this tributary, especially because of the large waterfall downstream that could act as a barrier to their movement. Although the area is relatively remote, a nearby hiking trail makes it accessible, which raises the possibility of human introduction of the fish.



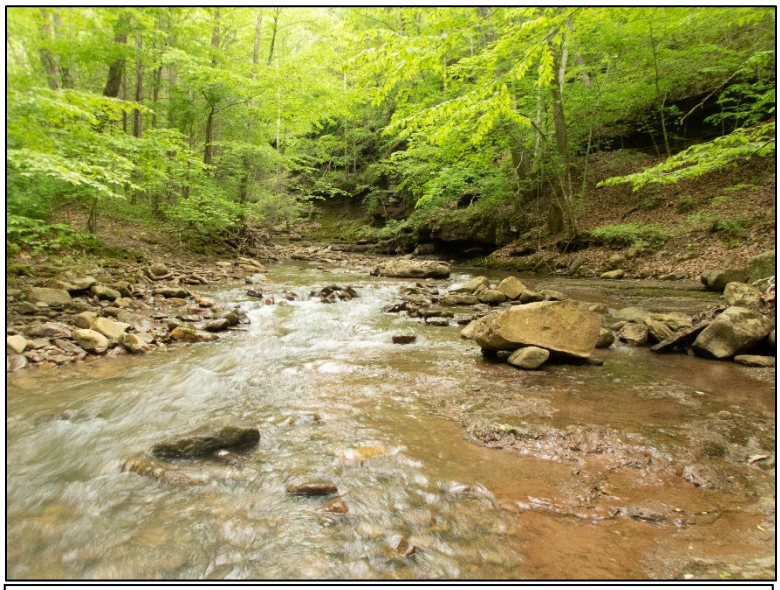
Blacknose dace (left – male in spawning colors; right – female) were common throughout the reach

NERI.3052 – Fall Branch 07



Reach Downstream End – 2015 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	21.3
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	48
Avg. Julian Day of Annual Max. Temp.	189
Avg. DO (mg/L)	9.98
Avg. pH	7.32
Avg. Specific Conductance (µS/cm)	67.2
Avg. Discharge (m^3/s)	0.155



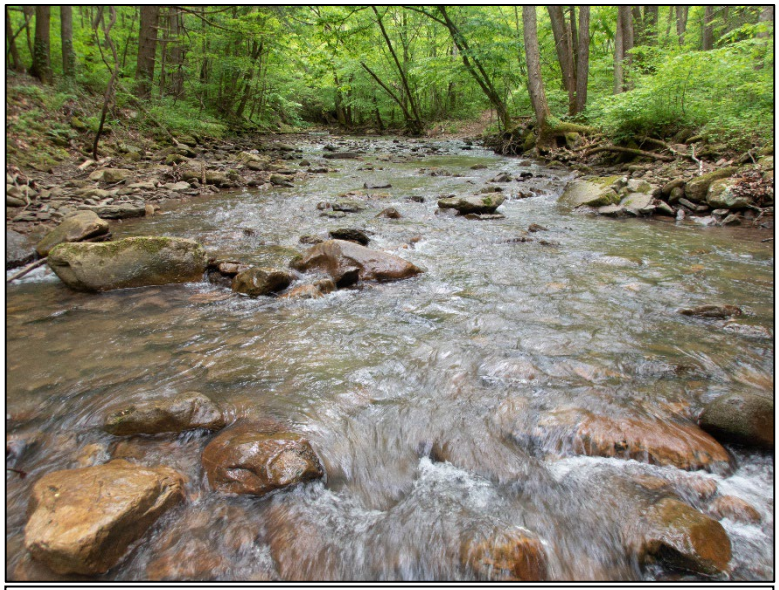
Reach Downstream End – 2022: Recent movement of boulders to new positions

Reach Habitat	
Avg. Width (m)	5.0
Avg. Depth (cm)	10.6
Max. Depth (cm)	37
Avg. % Substrate Embeddedness	47.6%
Mode Substrate Class	CB
Avg. Substrate Diameter (mm)	59.2
% Sand/Fines	8%
% Substrate > Fine Gravel	80%
% Canopy Cover	98.4%
% Mixed Veg. (non-deciduous)	80%
% Natural Fish Cover (all types)	30%
LWD Density (m^3/m^2)	0.00*
EPA RBP Score	91%

*only 0.021 m^3 of LWD present in the entire 100 m reach.

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
19.9	3	425	0.029	870.6	97.0%	1.18%	1.6%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
Rhinichthys atratulus (*N*)	189	131
Semotilus atromaculatus (*N*)	4	12
Etheostoma flabellare (*N*)	50	81



Reach Upstream End – 2022: Trail crossing visible on right bank (facing upstream)

Fall Branch 02 was the only monitored section of the mainstem of Fall Branch, located roughly halfway between an upstream, unnamed tributary and the New River. The Fall Branch hiking trail crosses the stream just upstream of this reach. As the stream name implies, there are several moderate waterfalls between this reach and the New River; however, Fall Branch 02 itself has a relatively low gradient and consists mainly of riffles and runs, with few deeper pools.

The water quality and cold conditions in this reach were like those in UNT Fall Branch 02, but the streambed here was less gravelly and featured more cobble, boulders, and bedrock. The instream habitat was relatively sparse, with limited large wood debris (LWD) throughout the reach. Some areas near trail crossings and root balls showed signs of moderate erosion along the banks.

In terms of fish species, the same three species were observed in comparable counts and relative abundance rankings as were recorded in 2014. Blacknose dace was the most common species, followed by fantail darter (*Etheostoma flabellare*). Creek chub were captured infrequently, with six individuals or fewer found during each visit. However, we did see an adult male with nuptial tubercles and some young-of-the-year, indicating that reproduction is happening in or near this reach.

While blacknose dace and darters are well-suited to the cold, fast-moving water, the limited pool habitat and lack of large wood debris to disrupt the swift current may be restricting the creek chub population.



Large adult male fantail darter in spawning colors displaying egg mimics on the first dorsal fin



Large adult male creek chub in spawning colors with nuptial tubercles on the snout and head

NERI.3021 – Fire Creek 17



Reach Downstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	18.6
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	0
Avg. Julian Day of Annual Max. Temp.	207
Avg. DO (mg/L)	10.52
Avg. pH	7.19
Avg. Specific Conductance (µS/cm)	46.7
Avg. Discharge (m^3/s)	0.045



Reach Downstream End – 2022: Some new LWD

Reach Habitat	
Avg. Width (m)	2.98
Avg. Depth (cm)	9.7
Max. Depth (cm)	60
Avg. % Substrate Embeddedness	56%
Mode Substrate Class	SB
Avg. Substrate Diameter (mm)	92
% Sand/Fines	16%
% Substrate > Fine Gravel	72%
% Canopy Cover	94.9%
% Mixed Veg. (non-deciduous)	100%
% Natural Fish Cover (all types)	81.5%
LWD Density (m^3/m^2)	NA*
EPA RBP Score	88%

*LWD was measured incorrectly; there were very few, short pieces of LWD in the stream and some thin pieces bridged above the stream.

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
2.6	2	578.9	0.153	1759.3	90.1%	5.8%	0.068%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
N/A	0	0

Fire Creek 17 is the only monitored section of Fire Creek, a short tributary that flows into the New River just upstream from Ephraim Creek. Access to this reach is via Beury Mountain Road, located at the stream's headwaters. The area nearby includes several residential properties and an energy transmission platform, contributing to a relatively high level of developed land use.

This section of the stream is very steep and features numerous boulders, cascades, and a notable plunge pool near the beginning. Along with the boulders and bedrock, gravel and sand have accumulated at the tails of the pools. The surrounding forest consists of a dense mix of hardwood and coniferous trees, with thick rhododendron growth along both banks in the immediate riparian zone.

The water temperature in this reach was very cold when surface water was present, but the stream often becomes isolated into pools or completely dries up during early to mid-summer. There is limited large wood debris (LWD) throughout the reach, with boulders serving as the primary habitat for fish.

During the two sampling efforts, no fish were captured; the site was sampled only once in 2022. In addition to frequent drying, the steep gradient of the stream, both in this reach and downstream, makes it very challenging if not impossible for fish to colonize the area.



Reach Upstream End – 2022: Gravel and sand in shallow pool a below small, bedrock waterfall; dense



Steep braided cascade over large boulders at the reach midpoint (looking upstream)

NERI.3082 – Keeney Creek 15



Reach Upstream End – 2015 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	20.7
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	14
Avg. Julian Day of Annual Max. Temp.	209
Avg. DO (mg/L)	10.6
Avg. pH	7.60
Avg. Specific Conductance (µS/cm)	154.2
Avg. Discharge (m^3/s)	0.085



Reach Upstream End – 2023: Some new LWD

Reach Habitat	
Avg. Width (m)	10.29
Avg. Depth (cm)	9.6
Max. Depth (cm)	37
Avg. % Substrate Embeddedness	51.6%
Mode Substrate Class	RS
Avg. Substrate Diameter (mm)	92
% Sand/Fines	20%
% Substrate > Fine Gravel	76%
% Canopy Cover	99.6%
% Mixed Veg. (non-deciduous)	100%
% Natural Fish Cover (all types)	88.5%
LWD Density (m^3/m^2)	0.012
EPA RBP Score	88%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
21.2	3	441.1	0.093	1466.4	87.95%	7.35%	0.86%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
Clinostomus funduloides (*N*)	*N/A*	44
Oncorhynchus mykiss (*I*)	*N/A*	3
Rhinichthys atratulus (*N*)	*N/A*	65
Semotilus atromaculatus (*N*)	*N/A*	21



Reach Downstream End – 2023: Very shallow section flowing over bedrock "steps"; rock retaining wall

Keeney Creek 15 was added as a new monitoring location since the 2014 survey. This stretch of Keeney Creek runs alongside Keeney Creek Road in the park and is near roads along its entire length. Recently, one section of the road just upstream had partially washed out, but the bank has since been stabilized with limestone riprap. This stabilization has caused some erosion and allowed light to penetrate to the stream.

Keeney Creek drains the small community of Winona, which includes residential and agricultural areas. This reach of the creek is mostly shallow, with water flowing over smooth bedrock and large boulders that create small waterfalls and plunge pools. Fine gravel and sediment have built up in the tail ends and eddies of these pools. The area is well-shaded by a mix of coniferous and deciduous trees, as well as dense rhododendron growth on both banks. The water temperature is consistently cold, rarely exceeding 20°C. The creek's higher specific conductance and slightly alkaline pH may be due to its proximity to the roadway. As 2023 was the first sampling occasion for this reach, we cannot directly compare fish counts and species to the 2014 survey. However, the species observed are similar to those found in the downstream section, Keeney Creek 10 (NERI.3018). Three native minnow species were the most common, including the pollution-sensitive Rosyside Dace.

During our sampling, we detected introduced Rainbow Trout, marking a new species record for Keeney Creek. All captured individuals were juveniles, likely stocked in the stream. A local person confirmed that Rainbow Trout fingerlings had been introduced, although it remains unclear which club or organization was responsible for this, as the West Virginia Department of Natural Resources does not list Keeney Creek as a stocked trout stream. Although the local contact claimed that the trout were reproducing in the stream, we found no evidence of wild trout reproduction—no young-of-the-year fish were observed, and all captured trout showed signs of being hatchery-raised, such as rounded dorsal and caudal fins.



Stocked fingerling Rainbow Trout (top) with rounded fins and underbite; adult "hold-over" Rainbow Trout captured below reach start (bottom)

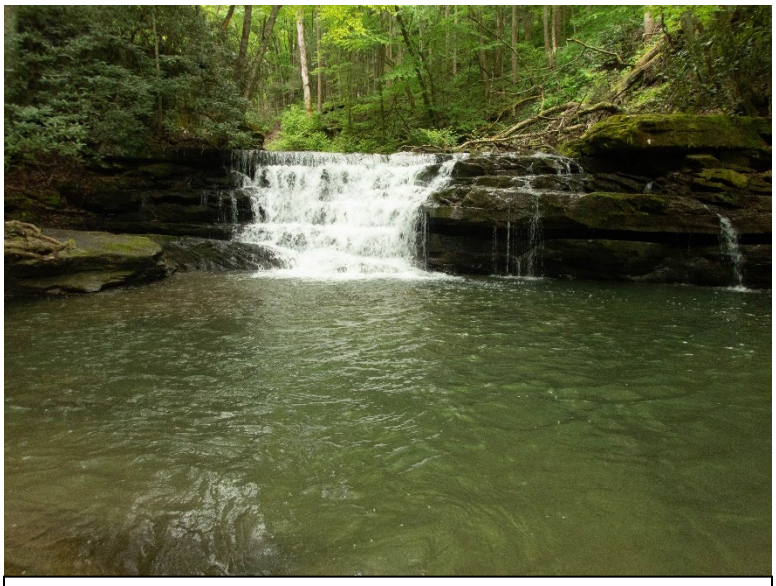
Interestingly, we did find one larger adult trout downstream during electrofishing tests. This indicates that the fingerlings might have survived for more than one season after being stocked, which is likely given the cold water temperatures. However, the ongoing stocking or establishment of a Rainbow Trout population in this stream could potentially harm the native minnow community.

NERI.3018 – Keeney Creek 10



Reach Downstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	20.6
Avg. # Annual Days with Daily Mean Temp. > 20 °C	2
Avg. # Annual Days with Daily Max. Temp. > 20 °C	13
Avg. Julian Day of Annual Max. Temp.	209
Avg. DO (mg/L)	9.86
Avg. pH	7.48
Avg. Specific Conductance (µS/cm)	125.7
Avg. Discharge (m^3/s)	0.172

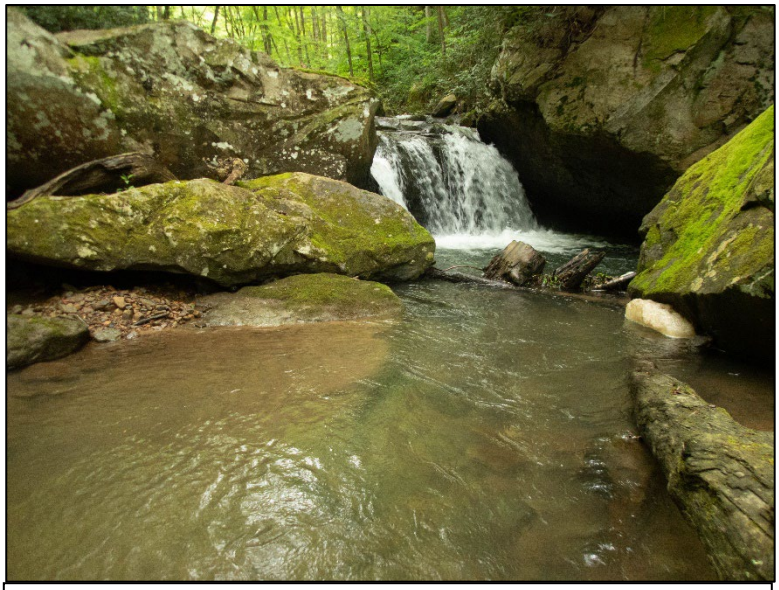


Reach Downstream End – 2022: Large boulders and cobble flushed downstream; pool mostly sand/fine sediment with cobble in tailout

Reach Habitat	
Avg. Width (m)	7.5
Avg. Depth (cm)	24.4
Max. Depth (cm)	83
Avg. % Substrate Embeddedness	38.8%
Mode Substrate Class	RS
Avg. Substrate Diameter (mm)	303.7
% Sand/Fines	8%
% Substrate > Fine Gravel	84%
% Canopy Cover	94.7%
% Mixed Veg. (non-deciduous)	100%
% Natural Fish Cover (all types)	56%
LWD Density (m^3/m^2)	0.059
EPA RBP Score	91.5%

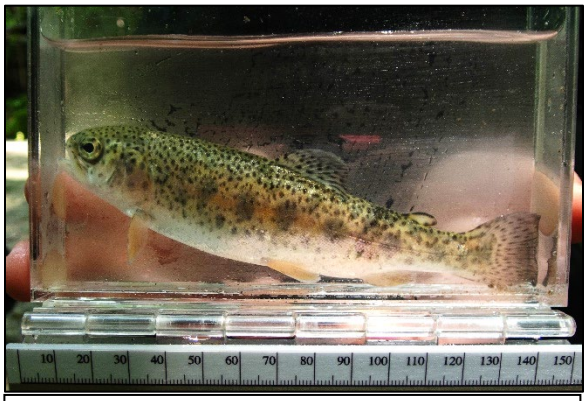
Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
21.7	3	403.4	0.093	982.4	88.16%	7.25%	0.84%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
Clinostomus funduloides (*N*)	10	12
Lepomis cyanellus (*N*)	5	0
Rhinichthys atratulus (*N*)	40	43
Semotilus atromaculatus (*N*)	117	40
Salmo trutta (*I*)	1	0
Oncorhynchus mykiss (*I*)	0	3



Reach Upstream End – 2022: Small waterfall and plunge pool with some LWD below large boulders

Keeney Creek 10 was the downstream reach of Keeney Creek and was the only reach sampled in 2014. It shared similar habitat, water quality, and temperatures with the upstream reach, Keeney Creek 15 (DEWA.3082). However, this reach was generally narrower, with deeper plunge pools that contained more large wood debris (LWD). The first approximately 25 m consisted of a large, deep pool located beneath a substantial bedrock waterfall, which made electrofishing challenging in some areas. Below this starting point, there was a very steep and fast chute that eventually led to a significant waterfall, likely preventing fish from migrating in from the New River.



Stocked Rainbow Trout fingerling (with rounded dorsal and caudal fins) captured on second visit

From 2014 to 2022, three native minnow species remained dominant in this reach. Blacknose dace was the most common species in 2022 and were captured in numbers like those in 2014. Creek chub were equally common, although the number captured was less than during 2014. Rosyside dace were captured less frequently than the other more tolerant minnow species, but their capture rates were similar to those in 2014.



Male Rosyside Dace displaying nuptial tubercles and spawning colors captured on first visit

No Green Sunfish were observed in 2022. However, given that fewer than five individuals were captured in 2014, it's possible they were present but simply went undetected in 2022. It seems unlikely that Green Sunfish could successfully colonize this area due to several natural barriers downstream. Future monitoring may help determine if a population of Green Sunfish is sustaining itself in the slower pools of this section of Keeney Creek.

Similarly, no Brown Trout were captured in 2022, although a large individual that may have been stocked had been recorded previously. Rainbow Trout were detected for the first time in Keeney Creek, with several fingerlings showing signs of hatchery origin. However, the source of the trout stocking remains unclear (see NERI.3082), and there was no evidence to suggest that either trout species was reproducing in the wild.

NERI.3042 – Bucklick Branch 03



Reach Upstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	18.6
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	0
Avg. Julian Day of Annual Max. Temp.	241
Avg. DO (mg/L)	9.83
Avg. pH	6.26
Avg. Specific Conductance (µS/cm)	24.5
Avg. Discharge (m^3/s)	0.030



Reach Upstream End – 2022: LWD and detritus incorporated into streambed

Reach Habitat	
Avg. Width (m)	3.38
Avg. Depth (cm)	10.3
Max. Depth (cm)	30
Avg. % Substrate Embeddedness	72%
Mode Substrate Class	SB
Avg. Substrate Diameter (mm)	54.2
% Sand/Fines	32%
% Substrate > Fine Gravel	64%
% Canopy Cover	100%
% Mixed Veg. (non-deciduous)	100%
% Natural Fish Cover (all types)	84%
LWD Density (m^3/m^2)	0.023
EPA RBP Score	86%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
2.43	3	748.0	0.049	10731.6	98.63%	0.04%	1.10%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
N/A	0	0



Reach Downstream End – 2022: A small cascade of boulders and cobble was the steepest and most prominent riffle with larger substrate in the reach

This was the only reach on Bucklick Branch, a small tributary to the headwaters of Laurel Creek, above Richlick Branch (NERI.3058). This was the second highest elevation reach and second farthest from New River, after NERI.3058. The reach was shallow with a few small pools and a mix of boulder to cobble substrate that was heavily embedded in fine sediment and sand. It was in a very remote area surrounded by mixed coniferous-deciduous forest with some rhododendron in the immediate riparian zone that provided complete canopy closure; consequently, the water was very cold with low specific conductance. However, it was slightly acidic, possibly due to natural causes or atmospheric deposition.

No fish were found in either sampling period at Bucklick Branch. From previous reports, the stream may dry up and become uninhabitable for fish in the summer. Additionally, despite the relative proximity of the reach to the confluence with Laurel Creek, a downstream barrier might exist that prevents colonization. More monitoring may reveal if a substantial barrier, the frequency of stream drying, periodic acidification below 6 pH, or a combination of these factors are affecting fish presence at this location.

NERI.3058 – Richlick Branch 17



Reach Upstream End – 2015 (no photo from 2014)



Reach Upstream End – 2023: Shifts in LWD and increased erosion on bank (right)

Water Quality	
Avg. Annual Max. Temp. (°C)	20.3
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	3
Avg. Julian Day of Annual Max. Temp.	189
Avg. DO (mg/L)	10.0
Avg. pH	6.74
Avg. Specific Conductance (µS/cm)	17.6
Avg. Discharge (m^3/s)	0.030

Reach Habitat	
Avg. Width (m)	3.79
Avg. Depth (cm)	10
Max. Depth (cm)	24
Avg. % Substrate Embeddedness	68.8%
Mode Substrate Class	FN*
Avg. Substrate Diameter (mm)	5.7
% Sand/Fines	48%
% Substrate > Fine Gravel	40%
% Canopy Cover	99.8%
% Mixed Veg. (non-deciduous)	0%
% Natural Fish Cover (all types)	80%
LWD Density (m^3/m^2)	0.057
EPA RBP Score	85.5%

* FN = Fine sediment

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
2.02	2	780.0	0.058	11053.6	95.11%	1.29%	3.29%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
Semotilus atromaculatus (*N*)	86	165



Reach Downstream End – 2023: Low gradient with heavy silt deposition and little substrate larger than gravel.

This was the only reach on Richlick Branch, a small headwater tributary that enters Laurel Creek just about the WV Route 41 bridge in Lawton. Despite having the highest elevation of all NERI reaches, it was located on the plateau of Backus Mountain and had a comparatively low stream gradient. The reach was very shallow, and the substrate was predominantly a mixture of fines, sand, and gravel, with a few sections of exposed cobble creating small riffles. The specific conductance of the stream was extremely low, indicative of clean water quality, and the thermal regime was cold. The riparian area was densely forested with almost complete canopy closer, although no coniferous trees were present. While the stream discharge was low during early summer, some increased erosion around root balls and recently fallen trees reflects instances of high water velocity and low structural integrity of the banks, possibly due to legacy sediment that settled in the stream valley from logging on the adjacent slopes.

Creek Chub was the only species detected in Richlick Branch during both sampling periods. Their numbers were greater in 2023, with ~40-60 individuals captured per visit, including many YOY. Given that Creek Chub is considered a sentinel species—one of the first species to colonize a stream after habitat disturbance—and is relatively tolerant to elevated levels of fine sediment, it was somewhat unsurprising that it was the only species persisting at this reach. However, it was interesting that this reach, which was even farther from the confluence of Laurel Creek than Bucklick Branch 03 (NERI.3042) and at a higher elevation, had abundant Creek Chubs, whereas Bucklick Branch had no fish. The remote location, clean water quality, and absence of competition or predation from other species may have aided in the growth of this Creek Chub population.



Large adult Creek Chub from reach



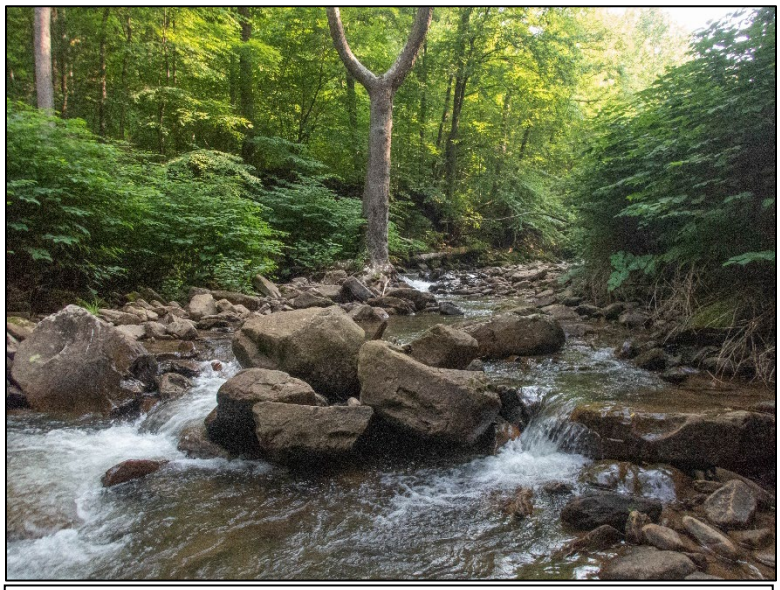
YOY Creek Chub were common

NERI.3085 – Laurel Creek 61



Reach Downstream End – 2015 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	21.7
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	27
Avg. Julian Day of Annual Max. Temp.	189
Avg. DO (mg/L)	10.13
Avg. pH	7.67
Avg. Specific Conductance (µS/cm)	115.1
Avg. Discharge (m^3/s)	0.220



Reach Downstream End – 2023: Few notable differences (photo taken slightly further downstream)

Reach Habitat	
Avg. Width (m)	9.94
Avg. Depth (cm)	13.8
Max. Depth (cm)	34
Avg. % Substrate Embeddedness	50.8%
Mode Substrate Class	SB
Avg. Substrate Diameter (mm)	84.3
% Sand/Fines	12%
% Substrate > Fine Gravel	84%
% Canopy Cover	86.1%
% Mixed Veg. (non-deciduous)	0%
% Natural Fish Cover (all types)	88%
LWD Density (m^3/m^2)	0.006
EPA RBP Score	88%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
49.3	4	571.3	0.035	7165.2	89.15%	3.86%	4.33%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
Clinostomus funduloides (*N*)	*N/A*	18
Etheostoma flabellare (*N*)	*N/A*	80
Rhinichthys atratulus (*N*)	*N/A*	112
Rhinichthys cataractae (N)	*N/A*	45
Salmo trutta (*I*)	*N/A*	3
Semotilus atromaculatus (*N*)	*N/A*	12



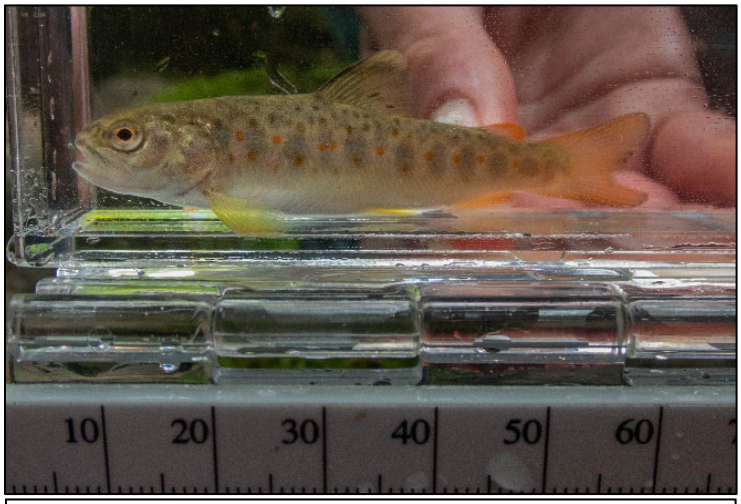
Reach Upstream End – 2023: A long run that was the widest and flattest part of the reach, before the stream narrowed again with a series of riffles upstream

Laurel Creek 61, which was not sampled for fish in 2014, is the most upstream section of the mainstem of Laurel Creek. It is located near the intersection of WV Route 41 and Backus Mountain Road. This reach is wide and shallow, with only a few deeper pools found beneath boulders and tree root balls. The streambed consists mainly of small to large boulders and cobble, with minimal sand and fine sediment.

There was limited fish cover and sparse large woody debris (LWD) throughout this reach. Evidence of erosion on both banks suggested that floods frequently wash away any accumulated LWD. The surrounding riparian area was primarily deciduous forest, but significant growth of invasive Japanese knotweed was present along both banks. Despite having a slightly more open canopy due to the stream's width, the water temperature remained cold, with daily mean temperatures never exceeding 20°C, though some daily maximums were higher. The water appeared clean and clear, but slightly elevated conductivity and an alkaline pH could be related to the reach's proximity to the road or upstream impacts, outside of the park.

The fish community was comparable to the next downstream reach (NERI.3037), albeit with slightly fewer species, which was expected due to the smaller catchment size. Almost all fish species were native and commonly seen in other NERI streams. Blacknose dace was the most common species, followed by fantail darter and longnose dace (*Rhinichthys cataractae*). Rosyside dace and creek chub were less frequently observed, with eight or fewer individuals captured in each visit.

Interestingly, one young-of-the-year (YOY) brown trout was found during each sampling visit, indicating that natural reproduction is occurring somewhere in the Laurel Creek watershed, although likely in low numbers or considerably upstream from this reach. This brown trout population was probably established from past stocking, but the stream no longer receives hatchery fish from the state. Previous records from the West Virginia Division of Natural Resources indicate that brown trout are present in other parts of Laurel Creek.



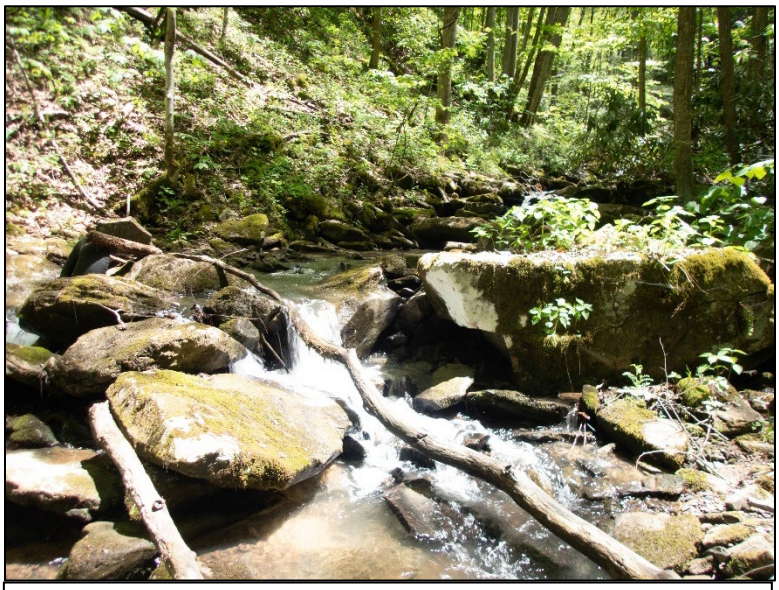
YOY Brown Trout captured on each visit

NERI.3026 – Little Laurel Creek 06



Reach Downstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	19.5
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	0
Avg. Julian Day of Annual Max. Temp.	208
Avg. DO (mg/L)	9.80
Avg. pH	7.09
Avg. Specific Conductance (µS/cm)	56.1
Avg. Discharge (m^3/s)	0.042

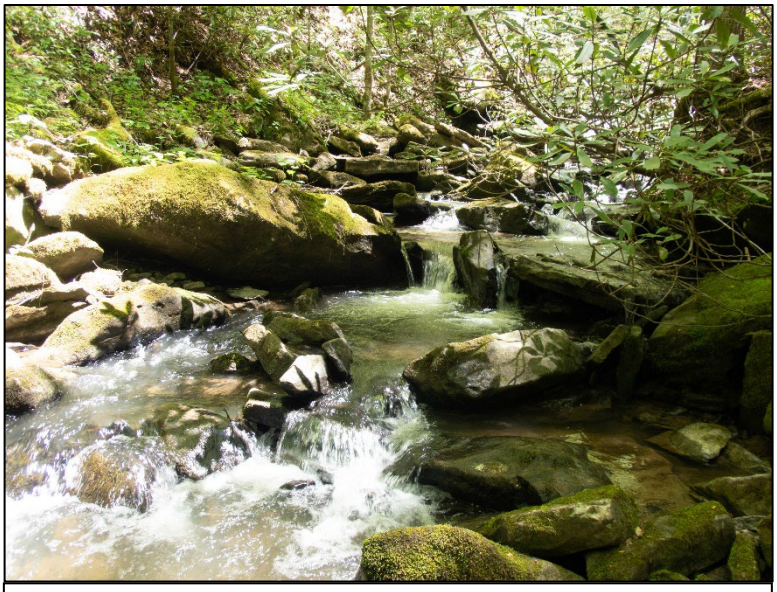


Reach Downstream End – 2022: Some new LWD

Reach Habitat	
Avg. Width (m)	4.96
Avg. Depth (cm)	15.1
Max. Depth (cm)	60
Avg. % Substrate Embeddedness	66%
Mode Substrate Class	CB
Avg. Substrate Diameter (mm)	96.2
% Sand/Fines	24%
% Substrate > Fine Gravel	72%
% Canopy Cover	98.0%
% Mixed Veg. (non-deciduous)	100%
% Natural Fish Cover (all types)	101.5%
LWD Density (m^3/m^2)	0.075
EPA RBP Score	91%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
3.91	2	671.0	0.113	7354.9	87.3%	4.54%	6.82%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
Lepomis cyanellus (*N*)	1	0
Rhinichthys atratulus (*N*)	11	16
Semotilus atromaculatus (*N*)	54	51



Reach Upstream End – 2022: Large boulders, shallow pools, and overhanging rhododendrons

This reach was on Little Laurel Creek, a small tributary that flows alongside Backus Mountain Road down a steep ravine before joining Laurel Creek, just downstream from Laurel Creek 61 (NERI.3085). The stream drains a small community that includes some agricultural land and residential development. Unfortunately, due to its proximity to the road, this stretch of the stream has become a popular dumping ground for trash, with numerous bags and piles of garbage scattered down the hillside. Despite this, water was cold, and the water quality was good based on the few measured parameters.

The stream itself is quite steep, featuring many small cascading waterfalls and chutes. There is plenty of fish cover, including large boulders, plunge pools, large wood debris (LWD), and overhanging vegetation. The streambed consists mainly of cobble and boulders, but these stones are somewhat buried in sand and fine sediment, with noticeable silt accumulation in slower pools, likely a result of upstream land use.

In 2022, creek chub were the dominant fish species observed, with several young-of-the-year and an adult male displaying nuptial tubercles and spawning colors. Blacknose dace were less common, with six individuals or fewer found during each visit. Both native minnow species were captured in numbers similar to those recorded in 2014.

No green sunfish were found in 2022, but it's worth noting that only one individual was observed in 2014. This suggests that green sunfish may have been present but not detected and occasionally move into the reach from Laurel Creek without establishing a stable population, possibly due to the lack of suitable habitat for sunfish species (i.e., warm water and slow stream flow).



Adult male Blacknose Dace



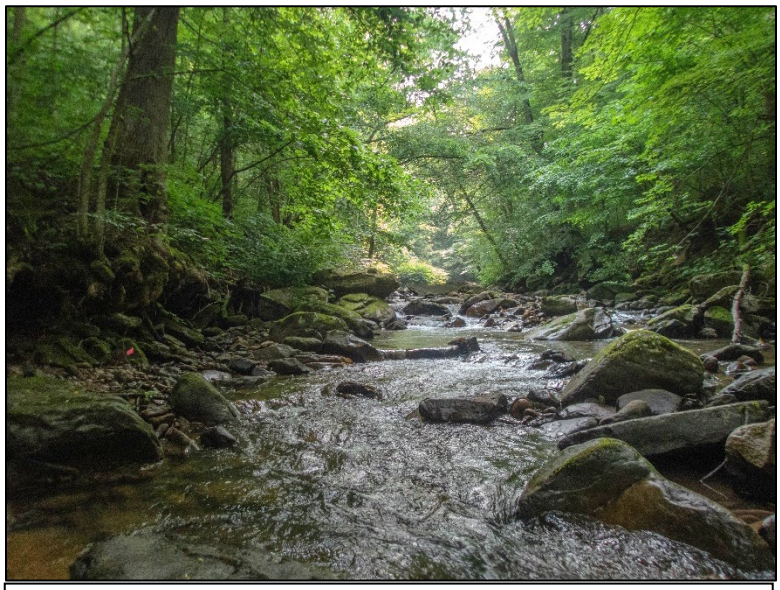
Adult male Creek Cub

NERI.3037 – Laurel Creek 47



Reach Upstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	21.7
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	47
Avg. Julian Day of Annual Max. Temp.	189
Avg. DO (mg/L)	10.31
Avg. pH	7.56
Avg. Specific Conductance (µS/cm)	113.9
Avg. Discharge (m^3/s)	0.252



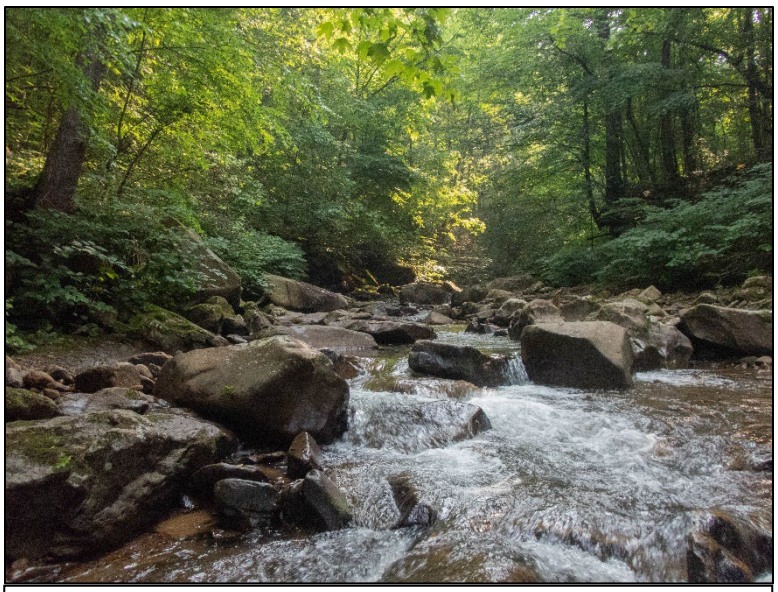
Reach Upstream End – 2023: LWD removed; slight increase in bank erosion and shifts in substrate

Reach Habitat	
Avg. Width (m)	8.26
Avg. Depth (cm)	22.3
Max. Depth (cm)	90
Avg. % Substrate Embeddedness	41.6%
Mode Substrate Class	CB
Avg. Substrate Diameter (mm)	92.0
% Sand/Fines	4%
% Substrate > Fine Gravel	84%
% Canopy Cover	97.1%
% Mixed Veg. (non-deciduous)	20%
% Natural Fish Cover (all types)	80%
LWD Density (m^3/m^2)	0.000*
EPA RBP Score	93%

*only 0.33 m^3 of LWD in entire reach

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
59.5	4	494.6	0.035	4600.9	89.88%	3.74%	4.06%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
Ambloplites rupestris (*N*)	0	1
Clinostomus funduloides (*N*)	2	58
Etheostoma flabellare (*N*)	88	51
Hypentelium nigricans (*N*)	13	5
Lepomis cyanellus (*N*)	8	8
Rhinichthys atratulus (*N*)	81	10
Rhinichthys cataractae (N)	57	29
Salmo trutta (*I*)	0	1
Semotilus atromaculatus (*N*)	60	3



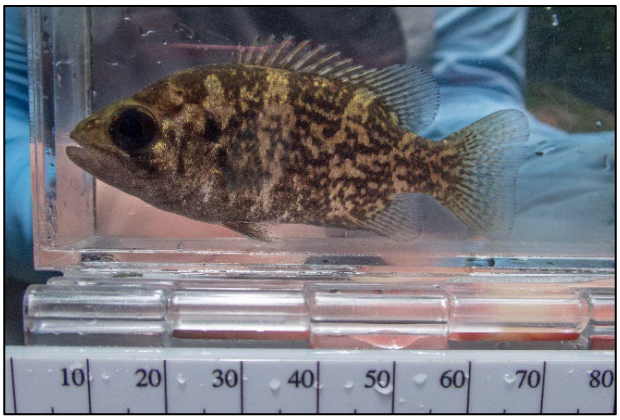
Reach Downstream End – 2023: Large boulders and plunge pools, some erosion and knotweed on both banks

Laurel Creek 47 is the middle reach on the mainstem of Laurel Creek. Although this reach has a larger catchment area than the upstream reach, Laurel Creek 61 (NERI.3085), it was on average, the narrowest and deepest section of Laurel Creek. The canopy was more closed here, compared to upstream, and while the water temperature remained cold, the frequency with which the maximum daily temperature exceeded 20°C increased.

In most of this reach, streamflow was swift between large boulders, creating chutes that lead into plunge pools. After crossing the midpoint, there was a long, deep run (approximately 25 m) that was challenging to electrofish in some areas. This section lacked riffles, and all centrarchid (sunfish) species were captured there. However, instream fish cover was limited; aside from boulders, large wood debris (LWD) was essentially absent. The streambed contained little sand or fine sediment, except in eddies or the larger pool, and this reach appeared to undergo frequent scouring during high stream flows.

Notably, the number of Rosyside Dace captured was substantially greater in 2023, making it the most frequently caught species, followed closely by Fantail Darter. In contrast, counts of Blacknose Dace and Creek Chub—species that typically dominated captures at most NERI reaches—were dramatically fewer, with fewer than five individuals captured per visit. The reason for these potential changes in fish populations was unclear, especially since Rosyside Dace are relatively intolerant of poor water quality, while Blacknose Dace and Creek Chub are more tolerant.

In 2023, Longnose Dace and Northern Hog Sucker (*Hypentelium nigricans*) were observed slightly less often than in 2014, while the number of Green Sunfish remained the same among years. A small Rock Bass (*Ambloplites rupestris*) was captured during the last visit, marking a new species record for this reach in 2023. Additionally, a young-of-the-year Brown Trout was captured during the first visit, also a new observation. This finding, like that in the upstream reach, Laurel Creek 61, suggested that a population of naturally reproducing Brown Trout exists in Laurel Creek.



Small Rock Bass caught during third visit

NERI.3041 – UNT to Laurel Creek 03



Reach Downstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	19.8
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	0
Avg. Julian Day of Annual Max. Temp.	219
Avg. DO (mg/L)	10.9
Avg. pH	7.13
Avg. Specific Conductance (µS/cm)	54.5
Avg. Discharge (m^3/s)	0.158

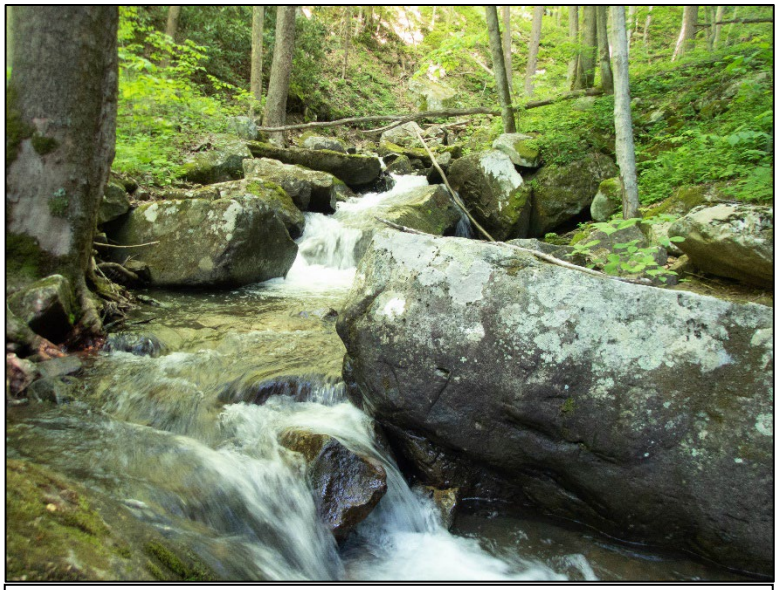


Reach Downstream End – 2022: Some smaller pieces of wood in LWD jam flushed out and replaced with other

Reach Habitat	
Avg. Width (m)	3.86
Avg. Depth (cm)	14.2
Max. Depth (cm)	64
Avg. % Substrate Embeddedness	40.8%
Mode Substrate Class	SB
Avg. Substrate Diameter (mm)	1047.1
% Sand/Fines	0%
% Substrate > Fine Gravel	92%
% Canopy Cover	97.8%
% Mixed Veg. (non-deciduous)	40%
% Natural Fish Cover (all types)	129%
LWD Density (m^3/m^2)	0.358
EPA RBP Score	91%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
3.65	2	485.5	0.161	3496.0	97.02%	2.86%	0.07%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
N/A	0	0



Reach Upstream End – 2022: Steep cascades over large boulders into plunge pools

This reach was on a short unnamed tributary that flows into Laurel Creek between Laurel Creek 47 (NERI.3037) and Laurel Creek 08 (NERI.3044), just after it crosses under WV Route 41. This tributary has one of the smallest drainage areas among all NERI sampling sites and features the second highest gradient, surpassed only by NERI.3077.

Due to its steep slope, most of this section consists of cascading water and shallow channels flowing over bedrock into small, moderately deep plunge pools. The streambed is primarily composed of boulders, including many very large ones. In some areas, sheared pieces of bedrock create a tunnel-like effect near the midpoint of the reach. Several large woody debris (LWD) jams are present, especially at the beginning of the reach. The water in this tributary is cold, clear, and well-oxygenated.

No fish were observed during either sampling period. Although there are many boulders and pieces of LWD providing habitat, there are very few slow, deep pools where fish could seek shelter from the swift current. The presence of shifting or replaced LWD jams, along with slight bank erosion and a lack of fine sediment, suggests that the high-water velocity frequently disrupts the habitat.

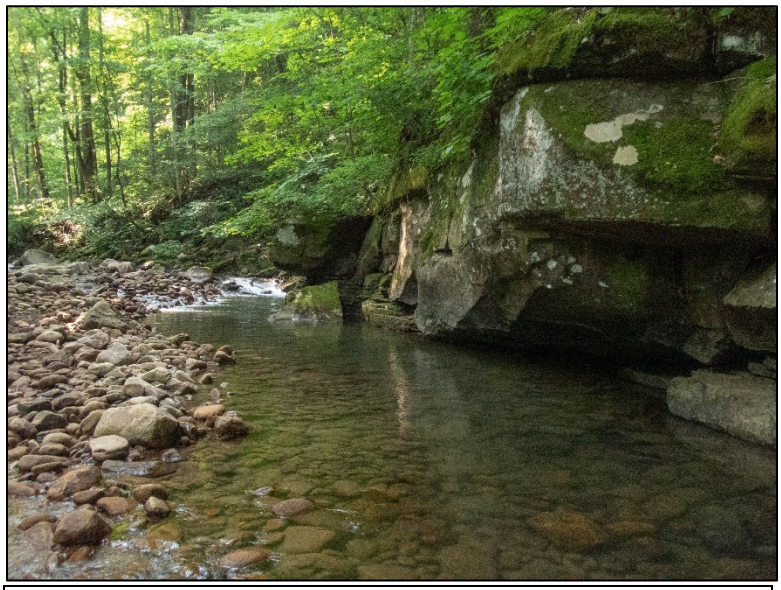
It is possible that this stream is intermittent, potentially drying up during summer months. This variability in stream flow likely makes the tributary uninhabitable for fish, and the steep gradient downstream creates natural barriers that make it difficult for fish to migrate into the area.

NERI.3044 – Laurel Creek 08



Reach Downstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	20.8
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	32
Avg. Julian Day of Annual Max. Temp.	189
Avg. DO (mg/L)	10.20
Avg. pH	7.56
Avg. Specific Conductance (µS/cm)	114.9
Avg. Discharge (m^3/s)	0.223



Reach Downstream End – 2023: LWD removed; slight increase in cobble bar formation (left)

Reach Habitat	
Avg. Width (m)	9.23
Avg. Depth (cm)	13.8
Max. Depth (cm)	44
Avg. % Substrate Embeddedness	34.4%
Mode Substrate Class	CB
Avg. Substrate Diameter (mm)	39.7
% Sand/Fines	16%
% Substrate > Fine Gravel	76%
% Canopy Cover	99.2%
% Mixed Veg. (non-deciduous)	40%
% Natural Fish Cover (all types)	51%
LWD Density (m^3/m^2)	0.001*
EPA RBP Score	94%

*only 0.67 m^3 of LWD in entire reach

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
70.0	4	380.3	0.027	881.9	91.04%	3.54%	3.46%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
Ambloplites rupestris (*N*)	1	0
Campostoma anomalum (*N*)	35	0
Clinostomus funduloides (*N*)	0	11
Cyprinella galactura (*I*)	1	0
Etheostoma caeruleum (*I*)	28	31
Etheostoma flabellare (*N*)	39	42
Etheostoma variatum (*I*)	10	23
Hypentelium nigricans (*N*)	2	5
Lepomis cyanellus (*N*)	2	3
Luxilus albeolus (*N*)	1	0
Micropterus dolomieu (*I*)	4	0
Rhinichthys atratulus (*N*)	52	8
Rhinichthys cataractae (N)	52	37
Salvelinus fontinalis (*N*)	0	1
Semotilus atromaculatus (*N*)	2	4

Laurel Creek 08 was the most downstream section of Laurel Creek and had habitat characteristics similar to other reaches along the stream. The first 25 m featured a long, deep run formed by the stream scouring against a bedrock cliff. The bedrock in this area was undercut, and the steep drop-off from the cobble bar at the start of the run made electrofishing difficult.

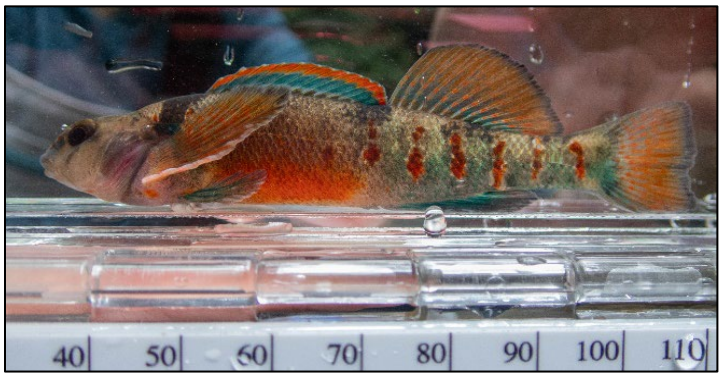
Interestingly, this reach was slightly colder than the upstream sections of Laurel Creek, possibly due to a visible spring seep located upstream from the long run on the left bank. This reach was the second-largest NERI site in terms of watershed area, following Meadow Creek 12 (NERI.3075). As expected, given its size and proximity to the New River, this reach was the most speciose among all Laurel Creek reaches. However, the number of species observed in 2023 was three fewer than during 2014, with a notable change being the absence of the Central Stoneroller (*Campostoma anomalum*) in 2023.

The remaining species that were captured during only one sampling period were observed at rates of six individuals or fewer per visit. These species may have been present but undetected, or they could have been transient individuals that moved in from the New River. Like the upstream reach, Laurel Creek 47 (NERI.3037), there were fewer Blacknose Dace captured in 2023. In contrast, the proportion of the non-native Variegate Darter (*Etheostoma variatum*) compared to other darter species more than doubled.

During the first visit, an adult Brook Trout was captured near the beginning of this reach. This fish showed no signs of being hatchery-raised, marking a new species record for this section. While the cold-water conditions are suitable for Brook Trout, it remains unclear whether there is a resident population within the Laurel Creek watershed or if this individual migrated upstream from the New River, possibly originating from a nearby source population in Mill Creek.



Large Brook Trout from first visit



Male Variegate Darter in spawning colors

NERI.3059 – Meadow Creek 58



Reach Upstream End – 2017 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	21.7
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	50
Avg. Julian Day of Annual Max. Temp.	189
Avg. DO (mg/L)	10.18
Avg. pH	7.62
Avg. Specific Conductance (µS/cm)	147.1
Avg. Discharge (m^3/s)	0.190

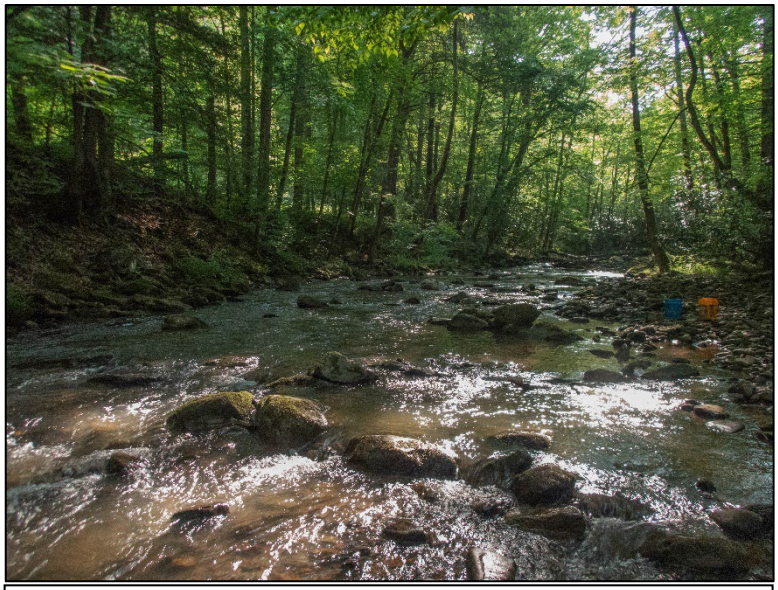


Reach Upstream End – 2023: New LWD and increased bank undercutting

Reach Habitat	
Avg. Width (m)	10.43
Avg. Depth (cm)	14.9
Max. Depth (cm)	70
Avg. % Substrate Embeddedness	56%
Mode Substrate Class	CB
Avg. Substrate Diameter (mm)	73.8
% Sand/Fines	4%
% Substrate > Fine Gravel	68%
% Canopy Cover	98.6%
% Mixed Veg. (non-deciduous)	100%
% Natural Fish Cover (all types)	84%
LWD Density (m^3/m^2)	0.016
EPA RBP Score	87%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
48.0	4	524.1	0.025	5682.4	77.52%	8.89%	7.93%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
Campostoma anomalum (*N*)	32	10
Catostomus commersonii (*N*)	3	0
Clinostomus funduloides (*N*)	180	89
Etheostoma flabellare (*N*)	119	65
Lepomis cyanellus (*N*)	0	1
Rhinichthys atratulus (*N*)	328	136
Semotilus atromaculatus (*N*)	170	73



Reach Downstream End – 2023: Wide and shallow, mostly cobble with some boulders

Meadow Creek 58 was the most upstream reach on Meadow Creek, which serves as a drainage area for the Claypool and Meadow Bridge communities. This reach had the highest proportion of agricultural land use and one of the highest levels of development among all NERI reaches. Throughout its length within the park, Meadow Creek closely followed Claypool Road, which in addition to the adjacent railroad, very likely contributed to its relatively high specific conductance.

At this point in the watershed, the thermal regime remained cool, although maximum temperatures occasionally exceeded 20°C. The reach was mostly shallow, with a deep pool located below a root ball and an undercut bank in the last approximately 25 m. The streambed primarily consisted of cobbles and small boulders, though there was some accumulation of sand and fine sediment in the pool at the end of the reach. Interestingly, the water always appeared moderately turbid, even without recent rainfall, possibly due to disturbance upstream.

In 2023, Blacknose Dace continued to be the dominant species, albeit in lower numbers. Fish counts for all other species, except for Green Sunfish, were also significantly reduced. While Green Sunfish was recorded for the first time in this reach, only one individual was captured from the pool at the end of the reach during the first visit. It is possible that this species was present but undetected during the 2014 survey.

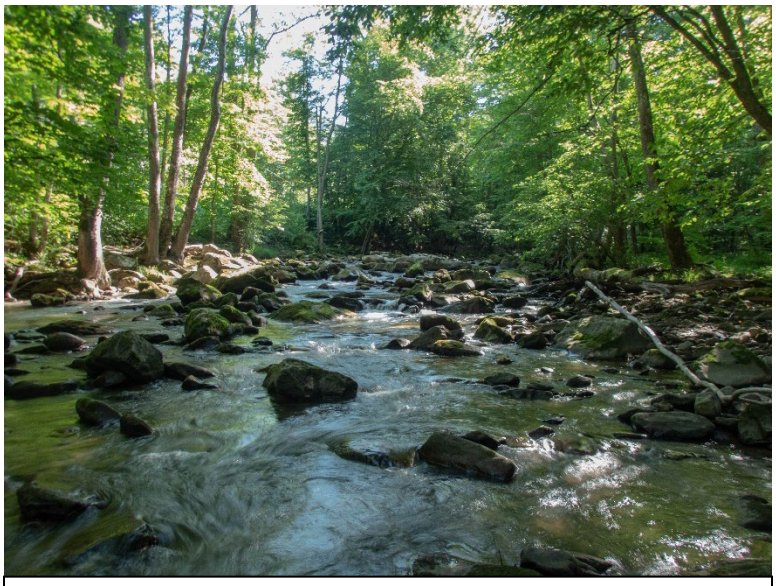
The decline in captured fish was surprising and somewhat concerning, as all species in this community are moderately tolerant to pollution and siltation. Continued monitoring of the fish community in Meadow Creek, particularly near the park boundary, may help determine whether fish populations continue to decline and identify potential upstream causes of habitat degradation.

NERI.3043 – Meadow Creek 39



Reach Downstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	21.9
Avg. # Annual Days with Daily Mean Temp. > 20 °C	1
Avg. # Annual Days with Daily Max. Temp. > 20 °C	55
Avg. Julian Day of Annual Max. Temp.	188
Avg. DO (mg/L)	9.72
Avg. pH	7.55
Avg. Specific Conductance (µS/cm)	121.4
Avg. Discharge (m^3/s)	0.319

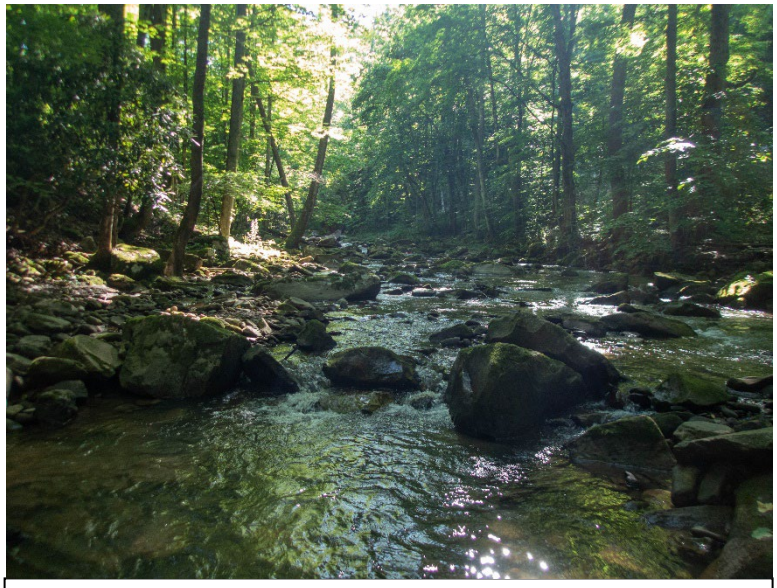


Reach Downstream End – 2022: LWD removed

Reach Habitat	
Avg. Width (m)	12.3
Avg. Depth (cm)	12.4
Max. Depth (cm)	39
Avg. % Substrate Embeddedness	50.8%
Mode Substrate Class	GF
Avg. Substrate Diameter (mm)	77.1
% Sand/Fines	0%
% Substrate > Fine Gravel	72%
% Canopy Cover	95.9%
% Mixed Veg. (non-deciduous)	60%
% Natural Fish Cover (all types)	78%
LWD Density (m^3/m^2)	0.017
EPA RBP Score	88%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
64.1	4	478.3	0.024	3887.1	80.91%	7.39%	7.06%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
Campostoma anomalum (*N*)	56	21
Clinostomus funduloides (*N*)	206	167
Etheostoma flabellare (*N*)	234	164
Oncorhynchus mykiss (*I*)	3	0
Rhinichthys atratulus (*N*)	503	340
Salmo trutta (*I*)	3	0
Salvelinus fontinalis (*N*)	2	0
Semotilus atromaculatus (*N*)	75	104



Reach Upstream End – 2022: Wide and flat with a few deeper pools; mixture of cobble and boulders

Meadow Creek 39 was the second most upstream reach on Meadow Creek, with similar habitat to the upstream reach (Meadow Creek 58), but was slightly wider and shallower. The substrate was a mixture of cobble and boulders, although the banks and slower areas were mostly fine gravel. The reach was still mostly shaded, and the thermal regime remained cool at this point in the stream. Other than boulders, in stream fish cover was somewhat lacking with little persistent LWD.

Again, Blacknose Dace were the dominant species, but at reduced numbers compared to 2014. The remaining species were also caught at slightly reduced rates, except for Creek Chub. The absence of all three trout species in 2022 was possibly due to reduced stocking efforts from WVDNR, rather than time of year during sampling, as dates closely overlapped between sampling periods.

NERI.3011 – Meadow Creek 17



Reach Downstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	23.5
Avg. # Annual Days with Daily Mean Temp. > 20 °C	20
Avg. # Annual Days with Daily Max. Temp. > 20 °C	89
Avg. Julian Day of Annual Max. Temp.	189
Avg. DO (mg/L)	9.73
Avg. pH	7.74
Avg. Specific Conductance (µS/cm)	125.2
Avg. Discharge (m^3/s)	0.297

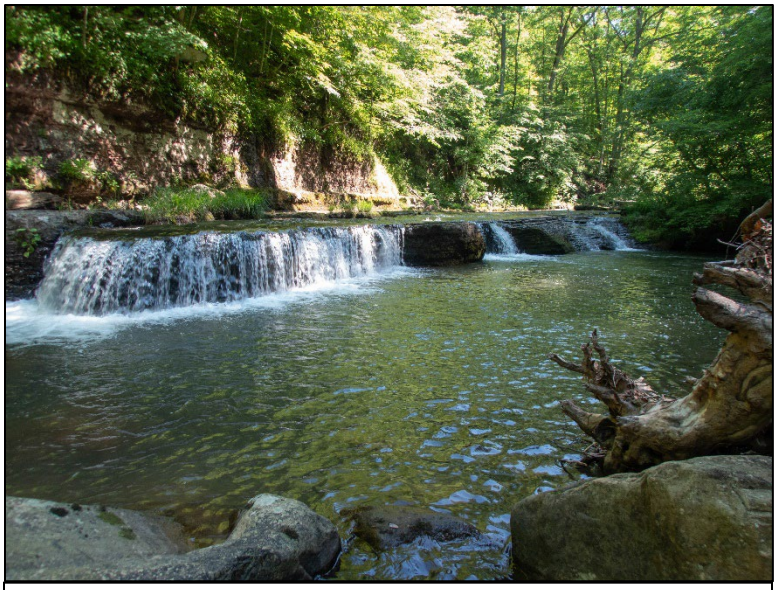


Reach Downstream End – 2022: New large woody debris

Reach Habitat	
Avg. Width (m)	12.7
Avg. Depth (cm)	14.0
Max. Depth (cm)	110
Avg. % Substrate Embeddedness	47.4%
Mode Substrate Class	GC
Avg. Substrate Diameter (mm)	92.0
% Sand/Fines	8%
% Substrate > Fine Gravel	84%
% Canopy Cover	81.8%
% Mixed Veg. (non-deciduous)	40%
% Natural Fish Cover (all types)	52%
LWD Density (m^3/m^2)	0.072
EPA RBP Score	86%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
70.5	4	421.6	0.012	1780.3	82.24%	6.97%	6.54%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
Campostoma anomalum (*N*)	445	345
Catostomus commersonii (*N*)	2	0
Clinostomus funduloides (*N*)	255	179
Etheostoma caeruleum (*I*)	1	0
Etheostoma flabellare (*N*)	231	266
Hypentelium nigricans (*N*)	9	2
Oncorhynchus mykiss (*I*)	2	0
Nocomis leptocephalus (*I*)	0	23
Rhinichthys atratulus (*N*)	729	418
Rhinichthys cataractae (N)	29	89
Semotilus atromaculatus (*N*)	49	67



Reach Upstream End – 2022: Deep pool below bedrock waterfall was difficult to electrofish in places; LWD pile

Meadow Creek 17 was the second most downstream reach on Meadow Creek and was in a steep ravine section just downstream of where it meets the Lefthand Fork of Meadow Creek. In this area, the stream widened, and the canopy opened; as a result, the water was warmer, with many days in which both the maximum and mean daily temperatures exceeded 20°C. The streambed primarily consisted of cobbles and small boulders, with some gravel and sand present, especially along the banks and in slower moving areas. The reach was mostly shallow, except for a long, deep section in the last approximately 25 m, which was located below a bedrock shelf that formed a small waterfall and scour pool. Fish cover was primarily boulders, along with a few pieces of large wood debris (LWD) and smaller debris piles in the eddy created by the deep pool.

As expected, this reach contained more species than the upstream Meadow Creek reaches during both sampling periods, and fish counts were somewhat more comparable across years. Blacknose Dace, Central Stoneroller, Fantail Darter, and Rosyside Dace remained common and abundant, despite a slight reduction in their numbers. In contrast, Longnose Dace and Creek Chub saw slight increases in counts.

A new species record for this reach was the Bluehead Chub (*Nocomis leptocephalus*). Both young-of-the-year (YOY) and adult breeding individuals were captured, indicating an established population was present. This suggested that Bluehead Chub, considered a potential non-native species in this part of the New River, might be expanding its range by colonizing upstream from downstream populations, as only a few individuals had been documented at Meadow Creek 12 (NERI.3075) in 2014. However, because the native status of this species is somewhat unclear, and since it is regarded as a keystone species due to its mound-building behavior that supports many nest-associates, the ecological impact of its spread remains uncertain. Several chub mounds were observed upstream of the reach on bedrock, creating the only coarse substrate in the immediate area, which was being used by minnows.

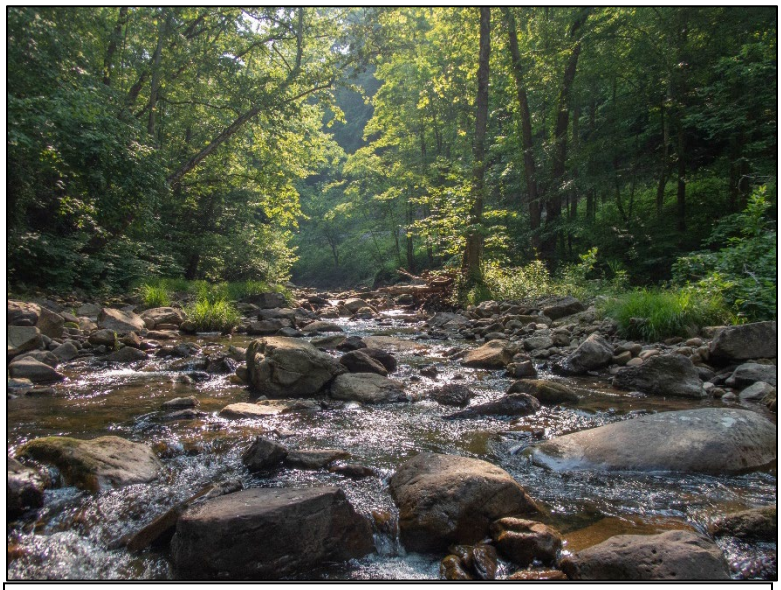
As with Meadow Creek 39 (NERI.3043), the Rainbow Trout captured in 2014 were likely stocked, and their absence in 2022 was not a cause for concern. Similarly, White Sucker (*Catostomus commersonii*) and Rainbow Darter (*Etheostoma caeruleum*) were found in low numbers in 2014 and may have either been transient migrants from the New River or were present in 2022 but undetected.

NERI.3075 – Meadow Creek 12



Reach Downstream End – 2015 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	23.4
Avg. # Annual Days with Daily Mean Temp. > 20 °C	26
Avg. # Annual Days with Daily Max. Temp. > 20 °C	80
Avg. Julian Day of Annual Max. Temp.	188
Avg. DO (mg/L)	10.4
Avg. pH	7.95
Avg. Specific Conductance (µS/cm)	149.8
Avg. Discharge (m^3/s)	0.171

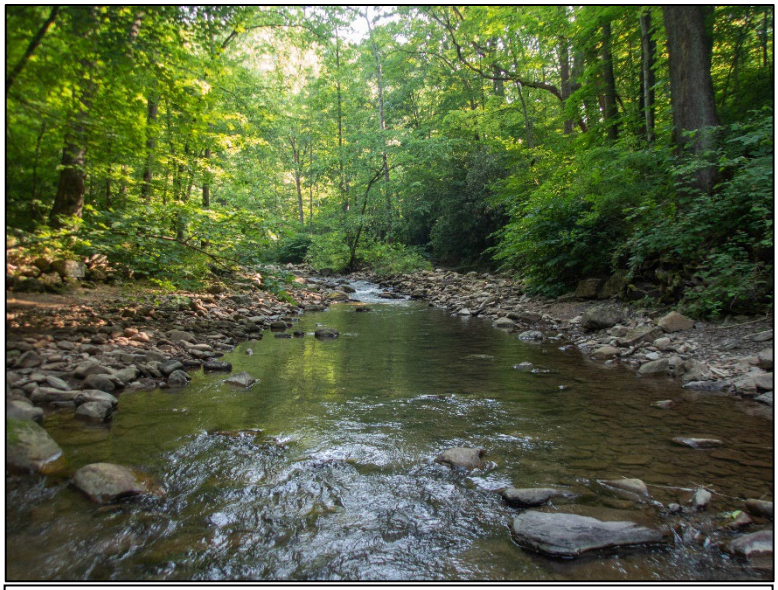


Reach Downstream End – 2023: Some shifts in LWD placement and increase in cobble bar formation (right)

Reach Habitat	
Avg. Width (m)	12.3
Avg. Depth (cm)	9.8
Max. Depth (cm)	38
Avg. % Substrate Embeddedness	40.4%
Mode Substrate Class	CB
Avg. Substrate Diameter (mm)	73.8
% Sand/Fines	16%
% Substrate > Fine Gravel	72%
% Canopy Cover	88.4%
% Mixed Veg. (non-deciduous)	40%
% Natural Fish Cover (all types)	89.5%
LWD Density (m^3/m^2)	0.031
EPA RBP Score	85.5%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
72.6	4	411.4	0.044	1307.9	82.6%	6.86%	6.40%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
Campostoma anomalum (*N*)	357	139
Catostomus commersonii (*N*)	1	0
Clinostomus funduloides (*N*)	56	121
Etheostoma flabellare (*N*)	67	76
Hypentelium nigricans (*N*)	8	0
Nocomis leptocephalus (*I*)	3	42
Rhinichthys atratulus (*N*)	199	177
Rhinichthys cataractae (*N*)	51	51
Semotilus atromaculatus (*N*)	14	28



Reach Upstream End – 2023: Wide, flat, and shallow with mostly cobble substrate

Meadow Creek 12 was the most downstream reach on Meadow Creek and the largest NERI reach by watershed area. However, its habitat was more like that of Meadow Creek 39 (NERI.3043), as it lacked the bedrock and deep pool habitats of the nearest upstream reach, Meadow Creek 17 (NERI.3011). The deepest section of this reach was located around a large woody debris (LWD) jam created by a tree in the middle of the channel, near the midpoint of the reach. This tree and the pile of LWD caused the stream to carve out a smaller side channel along the left bank (when looking downstream), which rejoined the main channel downstream of the reach.

Water temperatures were warm, and the water quality metrics were consistent with those of other Meadow Creek reaches. Notably, the average pH was the highest of all NERI reaches, possibly due to limestone ballast from the nearby railroad, which was visible from the reach.

In 2023, Blacknose Dace was the most frequently caught species, replacing the Central Stoneroller, which remained common but was captured in less than half the numbers observed in 2014. Many of the remaining species were found in similar or greater numbers, except for White Sucker and Northern Hog Sucker, which were rare (but captured) in 2014.

The Bluehead Chub captures increased significantly, with all year classes present. Similar to the Bluehead Chub detected upstream at NERI.3011, it remains unclear how its increased abundance may affect native species. Some studies have suggested that competition between Bluehead Chub and Central Stoneroller nests could lead to shifting of nest-associated species. Additionally, Bluehead Chub that guard nests sometimes display "selfish" behaviors, altering the mutualistic relationship between the nest builders and host species into a more parasitic one.

Ongoing monitoring may help determine whether the potentially increasing number of Bluehead Chub has any impact on other species within the Meadow Creek fish community.



Tuberculate male Central Stoneroller



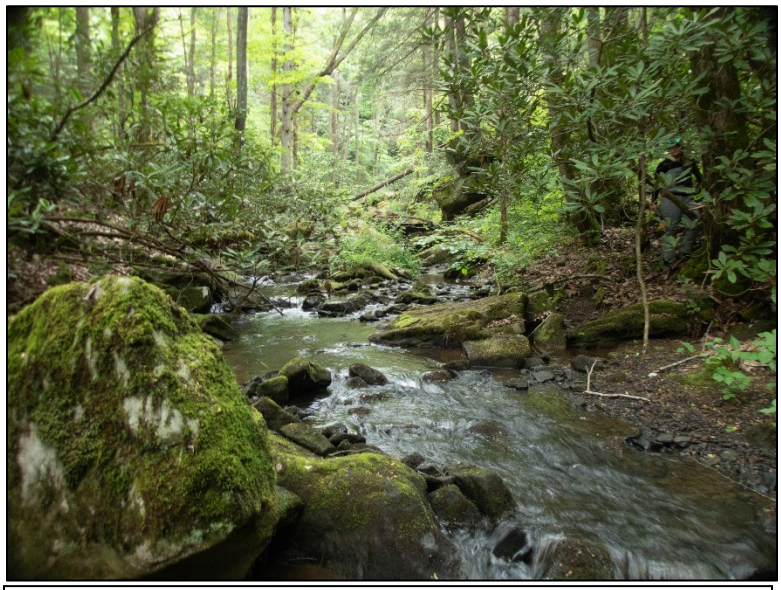
Tuberculate male Bluehead Chub

NERI.3065 – Meadow Fork 06



Reach Upstream End – 2015 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	20.6
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	16
Avg. Julian Day of Annual Max. Temp.	208
Avg. DO (mg/L)	10.34
Avg. pH	7.3
Avg. Specific Conductance (µS/cm)	189.0
Avg. Discharge (m^3/s)	0.026



Reach Upstream End – 2023: LWD removed

Reach Habitat	
Avg. Width (m)	4.1
Avg. Depth (cm)	14.6
Max. Depth (cm)	34
Avg. % Substrate Embeddedness	53.2%
Mode Substrate Class	CB
Avg. Substrate Diameter (mm)	73.8
% Sand/Fines	12%
% Substrate > Fine Gravel	80%
% Canopy Cover	100%
% Mixed Veg. (non-deciduous)	100%
% Natural Fish Cover (all types)	94.5%
LWD Density (m^3/m^2)	0.018
EPA RBP Score	89.5%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
10.0	3	420.4	0.110	2560.6	78.97%	12.76%	4.98%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
Lepomis cyanellus (*N*)	43	5
Lepomis macrochirus (*I*)	2	0
Micropterus salmoides (*I*)	0	1
Pimephales promelas (*I*)	1	0
Semotilus atromaculatus (*N*)	1	0



Reach Downstream End – 2023: Narrow and shallow with some deep pockets between large boulders

Meadow Fork 06 was the upstream reach of Meadow Fork, which drains the moderately developed area south of Oak Hill. Upstream of the park, Meadow Fork flows near several roads and has been altered significantly, including a lack of a riparian buffer in many areas. The elevated specific conductance likely reflected human land use impacts.

Inside the park, the riparian area was densely forested with a mix of vegetation, including dense rhododendron along the banks that created complete canopy coverage. The substrate primarily consisted of cobbles and boulders, but there were also deposits of sand and fine sediment in the pools and slower-moving areas. This reach had a high gradient, with fast-flowing water in nearly all sections except for a few deeper pools located below large boulders, where all fish were captured.

The fish community in this reach had relatively low species richness and abundance during both sampling periods, potentially due to poor water quality. The only two species identified in 2023 were centrarchids known to be tolerant of pollution and habitat degradation. Green Sunfish captures were much lower than 2014. Only one Largemouth Bass (*Micropterus salmoides*) was recorded during the third visit, marking a new species observation for this reach and across the NERI ERMN sites. This bass was quite large and may have contributed to the reduced numbers of other fish.

The other species observed in 2014 were found in low quantities, suggesting they may have been present in 2023 but went undetected. However, it is more likely that these tolerant species periodically migrated in from Dunloup Creek, which also has impaired water quality. It is also possible that an upstream impoundment may have flushed out the previously recorded Bluegill (*Lepomis macrochirus*) and/or Fathead Minnow (*Pimephales promelas*).



Largemouth bass



Green Sunfish

NERI.3001 – Meadow Fork 01



Reach Upstream End – 2014



Reach Upstream End – 2022: New LWD

Water Quality	
Avg. Annual Max. Temp. (°C)	20.8
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	20
Avg. Julian Day of Annual Max. Temp.	202
Avg. DO (mg/L)	10.27
Avg. pH	6.94
Avg. Specific Conductance (µS/cm)	172.6
Avg. Discharge (m^3/s)	0.087

Reach Habitat	
Avg. Width (m)	4.16
Avg. Depth (cm)	19.1
Max. Depth (cm)	44
Avg. % Substrate Embeddedness	40%
Mode Substrate Class	CB
Avg. Substrate Diameter (mm)	114.8
% Sand/Fines	16%
% Substrate > Fine Gravel	84%
% Canopy Cover	96.9%
% Mixed Veg. (non-deciduous)	60%
% Natural Fish Cover (all types)	109.5%
LWD Density (m^3/m^2)	0.096
EPA RBP Score	93.5%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
10.4	3	363.6	0.110	2090.7	79.71%	12.32%	4.81%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
Lepomis cyanellus (*N*)	14	0
Rhinichthys atratulus (*N*)	0	8
Semotilus atromaculatus (*N*)	1	3

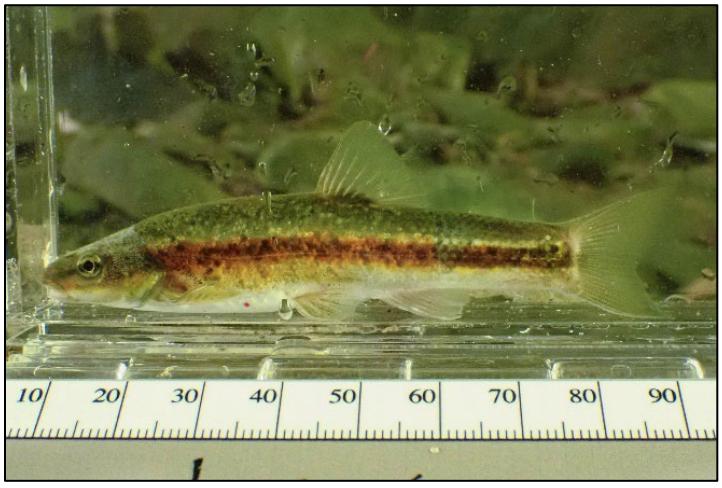


Reach Downstream End – 2022: Small boulder cascades between riffle/run/pool habitat

Meadow Fork 01 was the downstream reach on Meadow Fork, located near the confluence with Dunloup Creek but upstream of the Claypool Road crossing. The habitat in this reach was like that of the upstream reach, Meadow Fork 06 (NERI.3065), but it featured more large wood debris (LWD), which provided additional instream fish cover, including several newly fallen trees. Specific conductance remained considerably greater than expected, and the water was slightly turbid during the first visit following light precipitation, indicative of the land uses upstream of the park.

Like the upstream reach, NERI.3065, species richness in Meadow Fork 01 was very low during both sampling periods, although the composition of species did change. Blacknose Dace emerged as both the most abundant species and a newly observed one, likely having colonized from Dunloup Creek. However, only three or fewer Blacknose Dace were found during each visit. Three Creek Chub were discovered, but only during the second visit. No Green Sunfish were observed, even though several adults were captured upstream at NERI.3065. It was surprising to find such a low number of individuals, even among these pollution-tolerant species.

By the third visit, the water levels were fairly low, which may have further limited the species' ability to colonize and persist in this reach, in addition to the ongoing poor water quality.



Spawning male Blacknose Dace

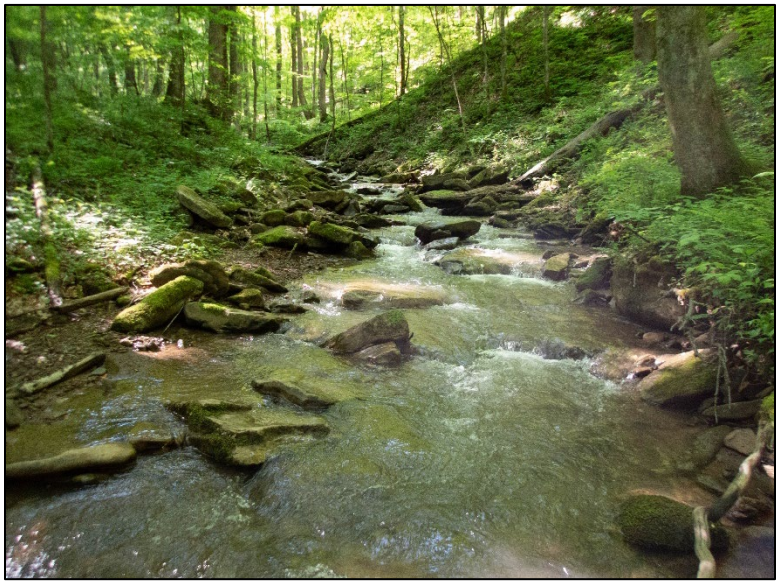


Juvenile Blacknose Dace

NERI.3032 – River Branch 06



Reach Downstream End – 2014



Reach Downstream End – 2022: Some changes in substrate placement

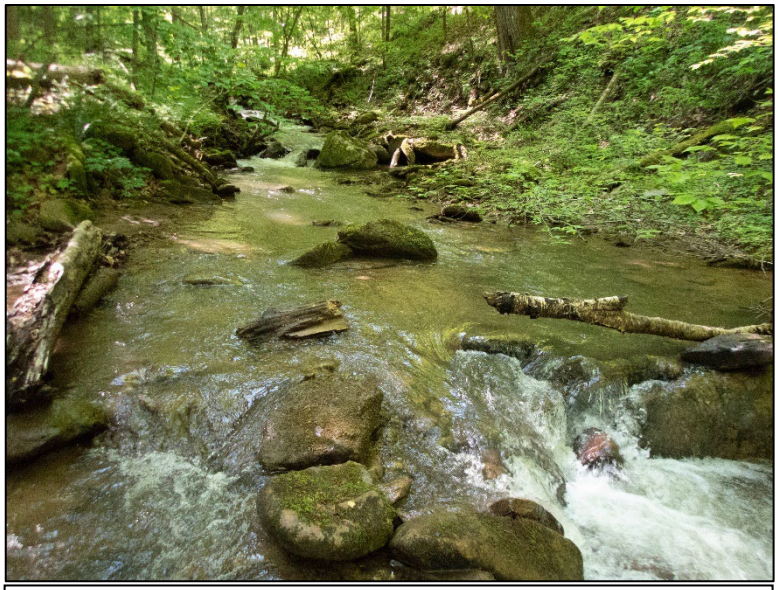
Water Quality	
Avg. Annual Max. Temp. (°C)	20.6
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	14
Avg. Julian Day of Annual Max. Temp.	208
Avg. DO (mg/L)	11.23
Avg. pH	6.98
Avg. Specific Conductance (µS/cm)	63
Avg. Discharge (m^3/s)	0.147

Reach Habitat	
Avg. Width (m)	5.76
Avg. Depth (cm)	8.4
Max. Depth (cm)	35
Avg. % Substrate Embeddedness	68.8%
Mode Substrate Class	SB
Avg. Substrate Diameter (mm)	38.0
% Sand/Fines	24%
% Substrate > Fine Gravel	56%
% Canopy Cover	97.8%
% Mixed Veg. (non-deciduous)	0%
% Natural Fish Cover (all types)	76%
LWD Density (m^3/m^2)	0.056
EPA RBP Score	89%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
4.6	2	467.4	0.123	1070.0	93.69%	0.74%	4.03%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2022**
N/A	0	0

River Branch 06 was the upstream reach of River Branch, a small tributary to Mill Creek that is heavily forested and mostly within park boundaries. This reach was relatively steep and shallow, predominantly consisting of riffle and run habitats, with only a few small pools. The substrate was a mix of cobble and boulders, interspersed with sections of bedrock and deposits of gravel to finer sediments along the banks and in eddies. The water in this reach was swift, clean, and cold.



Reach Upstream End – 2022: Shallow cobble and bedrock riffles and runs; some LWD

No fish were observed during either sampling period. A significant natural barrier located downstream, prior to the confluence with Mill Creek likely prevented fish from colonizing this reach.

NERI.3016 – River Branch 04



Reach Downstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	20.9
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	23
Avg. Julian Day of Annual Max. Temp.	219
Avg. DO (mg/L)	10.72
Avg. pH	7.14
Avg. Specific Conductance (µS/cm)	63
Avg. Discharge (m^3/s)	0.149



Reach Downstream End – 2022: Shifts in LWD volume and placement

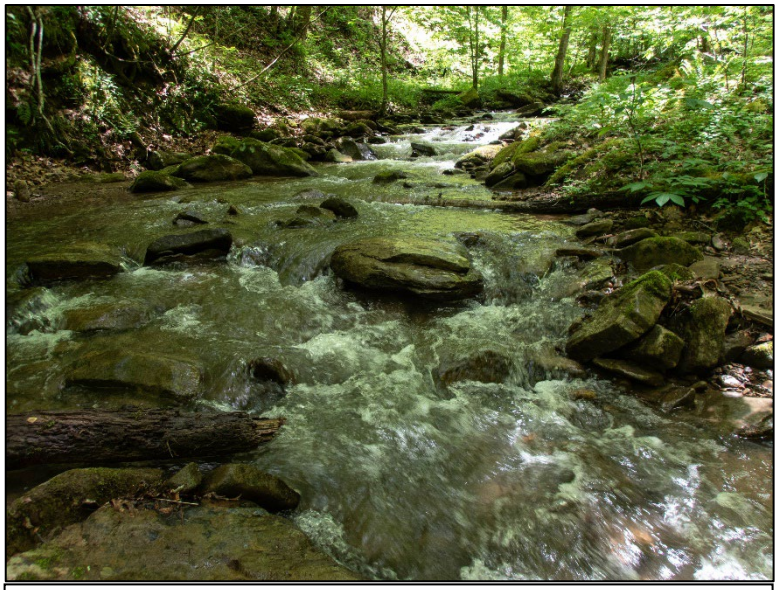
Reach Habitat	
Avg. Width (m)	3.86
Avg. Depth (cm)	13.1
Max. Depth (cm)	38
Avg. % Substrate Embeddedness	59.6%
Mode Substrate Class	CB
Avg. Substrate Diameter (mm)	67.5
% Sand/Fines	20%
% Substrate > Fine Gravel	64%
% Canopy Cover	99.0%
% Mixed Veg. (non-deciduous)	40%
% Natural Fish Cover (all types)	50.5%
LWD Density (m^3/m^2)	0.048
EPA RBP Score	84.5%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
4.7	2	453.46	0.123	873.8	93.79%	0.73%	3.97%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
N/A	0	0

River Branch 04 was just downstream from River Branch 06 (NERI.3032) with similar habitat and water quality. The main difference was a bedrock cascade and run throughout the first half of the reach.

As with NERI.3032, fish were not found in either sampling period, likely due to the abundance of waterfalls and high gradient downstream. There were also several large culvert pipes from an old logging road crossing that had been blown out downstream and were causing significant erosion.



Reach Upstream End – 2022: Shallow riffles over cobble to boulder substrate

NERI.3048 – Mill Creek 12



Reach Downstream End – 2015 (No photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	20.7
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	7
Avg. Julian Day of Annual Max. Temp.	209
Avg. DO (mg/L)	10.29
Avg. pH	7.34
Avg. Specific Conductance (µS/cm)	62.1
Avg. Discharge (m^3/s)	0.054



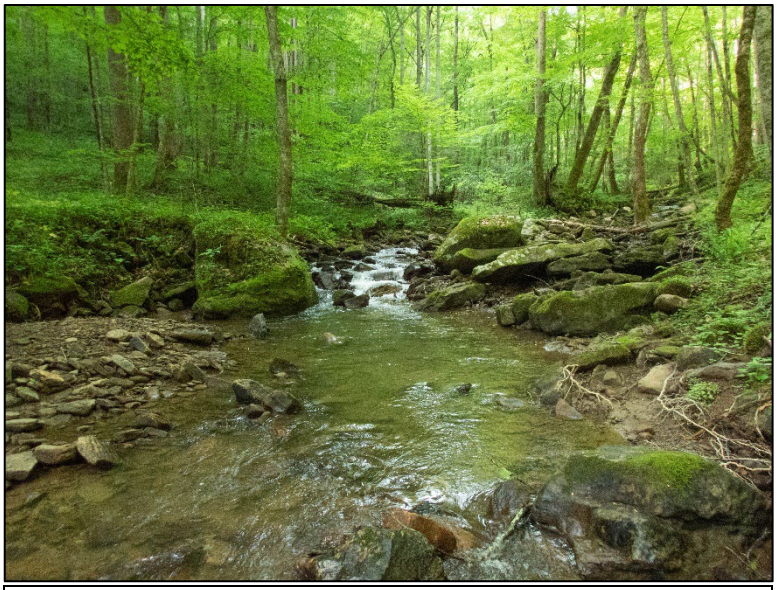
Reach Downstream End – 2023: Shifts in LWD; slight increase in erosion and cobble bar deposition

Reach Habitat	
Avg. Width (m)	5.9
Avg. Depth (cm)	11.6
Max. Depth (cm)	26
Avg. % Substrate Embeddedness	62.8%
Mode Substrate Class	GF
Avg. Substrate Diameter (mm)	51.8
% Sand/Fines	12%
% Substrate > Fine Gravel	68%
% Canopy Cover	99.8%
% Mixed Veg. (non-deciduous)	100%
% Natural Fish Cover (all types)	68.5%
LWD Density (m^3/m^2)	0.023
EPA RBP Score	93%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
10.3	2	458.8	0.075	1326.6	79.81%	7.85%	8.47%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
Rhinichthys atratulus (*N*)	429	197
Salvelinus fontinalis (*N*)	12	39

Mill Creek 12 was the upstream reach on Mill Creek, which drains the community of Grandview and includes some agricultural and developed land use. After the confluences with Slate Fork and Spruce Fork, Mill Creek is completely contained within the park through a densely forested riparian area. The reach maintained a cold thermal regime, with maximum daily temperatures rarely exceeding 20°C, which is ideal for trout. The water quality metrics indicated clean water and relatively low upstream human impact.



Reach Upstream End – 2023: Riffle/run habitat over cobble and boulders; bank erosion (exposed tree roots [right]) and cobble bar deposition (left)

The substrate in this reach was primarily composed of cobble and some boulders, although these were largely embedded in gravel and sand. There were several prominent cobble bars, along with silt deposits in the pools. Despite a few larger boulders and pieces of large wood debris (LWD), fish cover and deeper pools were somewhat lacking. By the third visit, stream flow had dropped significantly.

During both sampling periods, only two species were observed; Blacknose Dace remained the dominant species, although fewer were caught than during 2014. In contrast, Brook Trout were captured more frequently, with several young-of-the-year (YOY) individuals and adults of various sizes recorded during each visit. reach seemed to provide ideal habitat for a stable Brook Trout population, although it appeared that larger adult trout may have migrated out by the third visit, possibly in search of deeper pools as water levels decreased.



Adult Brook Trout



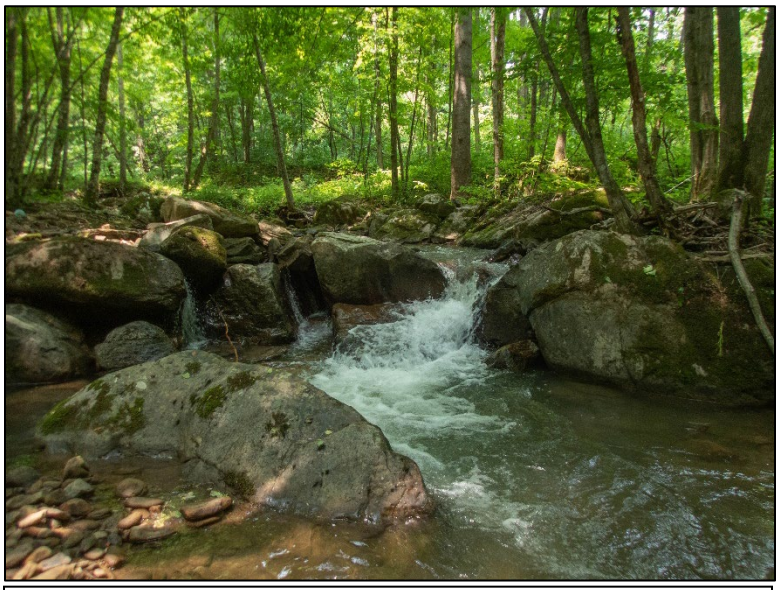
YOY Brook Trout

NERI.3080 – Mill Creek 01



Reach Downstream End – 2015 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	21.2
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	29
Avg. Julian Day of Annual Max. Temp.	209
Avg. DO (mg/L)	10.43
Avg. pH	7.16
Avg. Specific Conductance (µS/cm)	73.4
Avg. Discharge (m^3/s)	0.075



Reach Downstream End – 2023: Some increased bank erosion (exposed tree roots)

Reach Habitat	
Avg. Width (m)	6.26
Avg. Depth (cm)	17.7
Max. Depth (cm)	150
Avg. % Substrate Embeddedness	49.2%
Mode Substrate Class	CB
Avg. Substrate Diameter (mm)	105.1
% Sand/Fines	8%
% Substrate > Fine Gravel	84%
% Canopy Cover	100%
% Mixed Veg. (non-deciduous)	40%
% Natural Fish Cover (all types)	99.5%
LWD Density (m^3/m^2)	0.010
EPA RBP Score	91%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
16.2	3	374.4	0.058	285.5	84.97%	5.29%	6.80%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
Clinostomus funduloides (*N*)	0	2
Nocomis leptocephalus (*I*)	0	2
Rhinichthys atratulus (*N*)	35	73
Salvelinus fontinalis (*N*)	28	5
Semotilus atromaculatus (*N*)	1	2



Reach Upstream End – 2023: Deep pool filled with fine gravel below large boulder chute; overhanging

Mill Creek 01 was the downstream reach on Mill Creek, beginning just below Glade Creek Road. This reach was significantly deeper than the upstream reach, Mill Creek 12 (NERI.3048), featuring several large plunge pools that were too deep to effectively electrofish, especially in the downstream half of the reach. While the substrate mainly consisted of cobble and some sandy gravel, large boulders were much more common here. The thermal regime remained cool, though it was slightly warmer than NERI.3048, approaching the stress limit for Brook Trout. Additionally, specific conductance was somewhat elevated, and the water appeared turbid following light rainfall during two of the three visits. Instream fish cover was abundant, including one substantial pile of large wood debris (LWD) toward the end of the reach.

In 2023, Blacknose Dace remained the dominant species, showing a notable increase in abundance. In contrast, the number of Brook Trout decreased substantially, with only one young-of-the-year (YOY) individual captured during the first visit and four adults during the second visit. All adult Brook Trout were caught from a deep pool below the bridge, which was difficult to electrofish, suggesting that some may have been missed. Nonetheless, the reduction in Brook Trout numbers, particularly the fewer YOY individuals, could indicate pollution or some form of habitat degradation. During two visits, only one individual of each of the remaining minnow species was captured. Rosyside Dace and Bluehead Chub were newly observed species for this reach, likely having migrated upstream. Additionally, one Mountain Redbelly Dace (*Chrosomus oreas*) was captured just downstream during the electrofishing on the second visit. It was somewhat surprising that more species did not inhabit this reach, given the abundance of high-quality habitat and its proximity to the New River, especially considering that previous studies downstream documented much greater species richness.[6].



Large adult Brook Trout (top)
Small Bluehead Chub (middle)
Mountain Redbelly Dace (bottom)

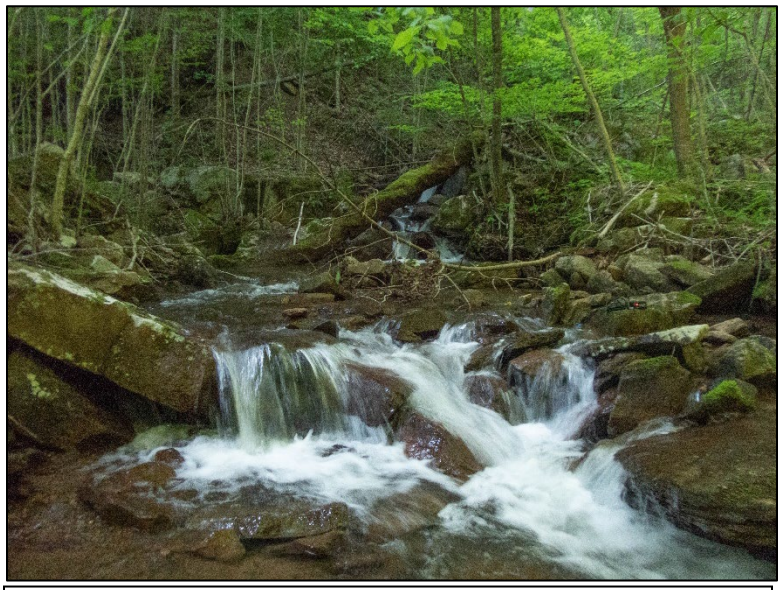
[6] Faulk 2015

NERI.3053 – Slater Creek 13



Reach Downstream End – 2015 (no photo from 2014)

Water Quality	
Avg. Annual Max. Temp. (°C)	19.7
Avg. # Annual Days with Daily Mean Temp. > 20 °C	0
Avg. # Annual Days with Daily Max. Temp. > 20 °C	0
Avg. Julian Day of Annual Max. Temp.	241
Avg. DO (mg/L)	10.63
Avg. pH	6.82
Avg. Specific Conductance (µS/cm)	50.0
Avg. Discharge (m^3/s)	0.252



Reach Downstream End – 2023: Shifts in LWD and substrate placement

Reach Habitat	
Avg. Width (m)	4.66
Avg. Depth (cm)	11.2
Max. Depth (cm)	39
Avg. % Substrate Embeddedness	44.8%
Mode Substrate Class	CB
Avg. Substrate Diameter (mm)	77.1
% Sand/Fines	4%
% Substrate > Fine Gravel	80%
% Canopy Cover	99.8%
% Mixed Veg. (non-deciduous)	20%
% Natural Fish Cover (all types)	120%
LWD Density (m^3/m^2)	0.085
EPA RBP Score	92.5%

Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
7.2	2	499.8	0.136	1333.4	97.58%	2.26%	0.02%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
Semotilus atromaculatus (*N*)	25	7

Slater Creek 13 was the only reach on Slater Creek and was the downstream reach in 2014 (the reach farther upstream was discontinued to due safety/access concerns). The reach was a small, heavily forested tributary that flowed into the New River in Thayer. This stream is situated in a steep ravine filled with many large boulders. The reach itself had a high gradient, featuring nearly continuous riffles that led into plunge pools. Some of these pools contained heavy deposits of fine sediment and were rather turbid.



Reach Upstream End – 2023: Substantial bank erosion

The area seemed prone to flash floods and had signs of damage from frequent high stream velocities, as both banks showed erosion scars and there was a significant amount of large wood debris (LWD). The understory was dense with new growth from deciduous saplings. The water in this reach was cold and clear, with low specific conductance.

During both sampling periods, only Creek Chub were observed, with three or fewer individuals found during each visit in 2023, including one young-of-the-year. The variable stream flows may be limiting the Creek Chub population, and the steep slope and distance to the New River would make natural recolonization very challenging and unlikely.

NERI.3034 – UNT 21 New River 01



Reach Downstream End – 2014

Water Quality	
Avg. Annual Max. Temp. (°C)	N/A*
Avg. # Annual Days with Daily Mean Temp. > 20 °C	N/A*
Avg. # Annual Days with Daily Max. Temp. > 20 °C	N/A*
Avg. Julian Day of Annual Max. Temp.	N/A*
Avg. DO (mg/L)	10.33
Avg. pH	4.71
Avg. Specific Conductance (µS/cm)	46.7
Avg. Discharge (m^3/s)	0.042



Reach Downstream End – 2022: Shifts in LWD volume and

Reach Habitat	
Avg. Width (m)	3.88
Avg. Depth (cm)	15.4
Max. Depth (cm)	62
Avg. % Substrate Embeddedness	50%
Mode Substrate Class	RS
Avg. Substrate Diameter (mm)	278.0
% Sand/Fines	4%
% Substrate > Fine Gravel	88%
% Canopy Cover	97.3%
% Mixed Veg. (non-deciduous)	0%
% Natural Fish Cover (all types)	95.5%
LWD Density (m^3/m^2)	0.083
EPA RBP Score	92.5%

*Temperature logger was unable to be retrieved during both years (2022 & 2023). The water temperature during fish sampling on 05/04/2022 was 13.7°C at approximately 12:30pm.

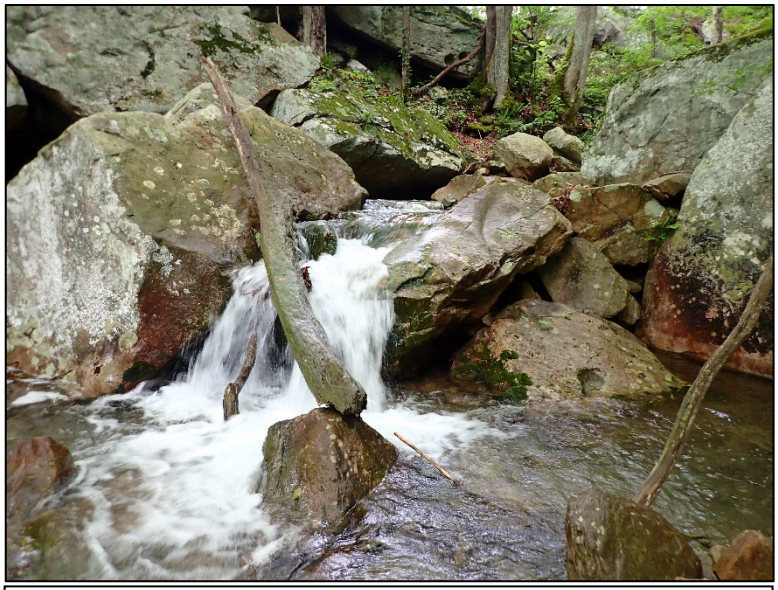
Landscape Habitat							
Watershed Size (km^2)	Stream Order	Elevation (m)	Slope	Distance to River (m)	% Forest	% Developed	% Ag
3.3	2	311.2	0.315	97.6	85.21%	2.32%	0.00%

Fish Counts (Total over 3 visits)		
Species (Nativity)	**2014**	**2023**
N/A	0	0

UNT 21 New River 01 was the only reach of a small unnamed tributary that flows into the New River, located across from the Brooklyn Mine reach and downstream of Ephraim Creek. The reach began just upstream of a railroad crossing. It had the highest gradient of all NERI reaches, featuring many cascades and small, deep plunge pools. Additionally, there was a very high waterfall (approximately 10 meters) just above the reach.

The substrate primarily consisted of sheared pieces of bedrock and extremely large boulders, while the pools were filled with sandy gravel. There was also a significant amount of large wood debris throughout the reach. The water was cold and clear, with low specific conductance. However, the pH was acidic, recording the lowest levels among all NERI reaches.

No fish were observed during either sampling period. The presence of the railroad culvert, along with the steep gradient, may be acting as barriers to fish colonization. Additionally, the low pH would render this reach uninhabitable for most fish species, although crayfish were abundant throughout the area. Additional upstream monitoring may help verify the source (i.e., past mining) of the low pH, providing an opportunity to potentially mitigate the issue.



Reach Upstream End – 2022: Very large boulder cascades with small, deep plunge pools



Large waterfall and LWD pile just above reach