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Benthic Macroinvertebrate 5 Year Historical Data Assessment for Lake James Watershed Lake James Environmental Association 15 August 2022

Overview

The Lake James Environmental Association (LJEA) performed aquatic macroinvertebrate sampling and completed North Carolina Division of Water Resources (NCDWR) Habitat Assessment forms at 11 sites in the Lake James watershed. These assessments were completed in July 2022 using NCDWR modified “Qual 4” sampling techniques (NCDWR SOP 2016). These assessments have been conducted annually since 2018 in order to collect and maintain long-term data.

Collection Methods

Sites were sampled using a modified version of the NCDWR “Qual 4” methodology. The collection procedure includes 1 kick net sample and 1 leaf pack sample. Specimens were hand picked using trays and forceps and field preserved in site specific vials with 90% ethanol. Not all specimens were collected, rather, picking was accomplished based on relative abundance of taxa present and restricted to a total of 40 total work minutes. This was generally accomplished with 2 individuals picking for a total of 20 minutes. Samples were taken back to the laboratory at Reece Environmental Consulting and identified to genus/species using NCDWR “taxonomic effort levels”.

Metrics

Tolerance values for each taxa have been assigned by NCDWR. Using these tolerance values, some biotic indices are able to be determined and assigned for sampled areas. These results represent aspects of water quality, quality and quantity of in-stream habitat, and other environmental factors. North Carolina Biotic Index (NCBI) values range from 0-10 with lower numbers representing positive environmental factors for aquatic insects, while higher numbers may represent negative environmental impacts to the aquatic ecosystem. Due to the size of most

of the sampled watersheds and the month that collections were conducted, the EPT criteria is the most appropriate scoring method for the assigned “Theoretical Bioclassifications”. This criteria classifies an aquatic ecosystem by measuring the total diversity of EPT species. EPT represents the Orders Ephemeroptera, Plecoptera, and Trichoptera (Mayflies, Stoneflies, and Caddisflies).

Table 1. NCDWR EPT Criteria Bioclassification Thresholds		
Bioclassification	<u>Mountain</u>	<u>Piedmont</u>
Excellent	> 35	> 27
Good	28 - 35	21 - 27
Good - Fair	19 - 27	14 - 20
Fair	11 - 18	7 - 13
Poor	0 - 10	0 - 6

These Orders are the most intolerant to environmental stress and are used worldwide as indicator species for water quality, habitat, and ecosystems. These bioclassifications are not absolute and are based on some criteria not met by LJEAs methodology. They serve as a reference point only and will therefore not be greatly discussed in this report. For historical data and bioclassifications of these 11 sites,

see [LJEA Annual Macroinvertebrate Data Comparison '18 -'22](#).

The additional metrics below, taken as a whole, provide a clearer assessment of the state of these aquatic ecosystems. Nomenclature for the full metrics assigned to each watershed are listed below:

- **Total Taxa Richness** - Total number of different types of specimens
- **EPT Taxa Richness** - Total number of different types of EPT specimens
- **Total Abundance** - Total number of specimens
- **EPT Abundance** - Total number of EPT specimens
- **Intolerant Species (< 2.5TV)** - Number of different types of specimens that are intolerant to environmental stress
- **NCBI** - Total biological score for sample site; represents environmental factors and ranges from 0-10

These metrics convey the state of an ecosystem with greater clarity than the isolated use of NCBI or EPT metrics. It is important to note that the species and EPT richness, abundance, and number of intolerant taxa present are often a more organic way to examine an aquatic ecosystem as these criteria are often more intricately tied together than a tabled bioclassification threshold. The above metrics have been calculated for each site and will be the foundation of discussion in this report.

It must also be noted that data analysis across these years must be taken with a degree of consideration due to the shifting seasonalities in sampling sessions. Data has been collected in

the winter and summer seasons. This seasonality affects aquatic characteristics such as temperature, dissolved oxygen, flow levels, etc. Depending on the season, these characteristics may also increase or decrease the stressors on aquatic macroinvertebrates. Data collected during the summer season generally reflects the “worst case” conditions for these habitats This allows for the establishment of a foundational baseline that generally improves in the cooler months.

Long Term Results and Discussion

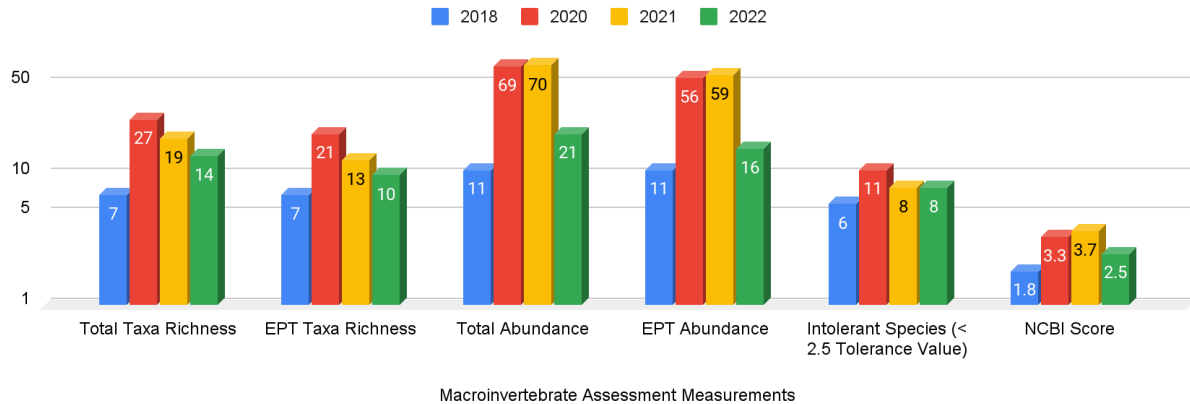
Eleven sites were sampled in 2022 and the majority of these sites have been sampled multiple times over the last 5 sampling sessions. Each site will be examined and briefly discussed to describe any relevant trends over time as well as any sites that, to date, illustrate a stable ecosystem. Below is a table with each of the sites that will be examined in this report along with dates in which data was collected.

<u>Name of Collection Site</u>	<u>Years of Data Collection</u>
White Creek off Rt 126	2018, 2020, 2021, 2022
Paddy’s Creek Off Trail at Recreational Area Bridge	2018, 2020, 2021, 2022
North Fork Catawba River at American Thread Road	2018, 2020, 2021, 2022
North Fork Catawba River at Old North Cove School Road	2018, 2020, 2021, 2022
Catawba River at Greenlee Park	2020, 2021, 2022
Mill Creek at Old Fort Museum	2018, 2019, 2020, 2021, 2022
Crooked Creek at McHone Drive	2018, 2019, 2020, 2021, 2022
Linville River at Newland Highway	2018, 2019, 2020, 2022
Linville River at Blue Ridge Parkway Picnic Area	2018, 2019, 2020, 2022 (Site Changed)
Armstrong Creek at US221 S Bridge	2018, 2020 (Site Changed), 2021, 2022
Forsyth Creek at Plantation Drive	2022 New Sampling Location

White Creek at Trail off Route 126

White Creek Biological Assessment Metrics Trends

Captured Watershed Size: 1.8 sq mi

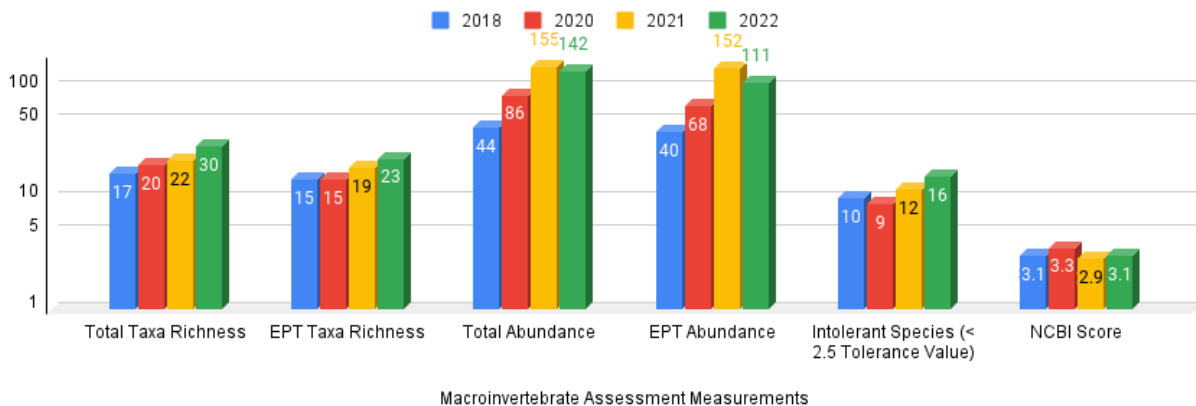


White Creek has had some historical sediment and forestry disturbances in the 1.8 mi² watershed. Although this site shows a trend of improvement since 2020 in the NCBI score, it is important to note the decrease in total and EPT species richness by ~50% across 3 years of data collection. These declines as well as the highly fluctuating abundance values likely indicate an unstable and strained aquatic ecosystem.

Paddy's Creek Off Trail at Recreational Area Bridge

Paddy's Creek Biological Assessment Metrics Trends

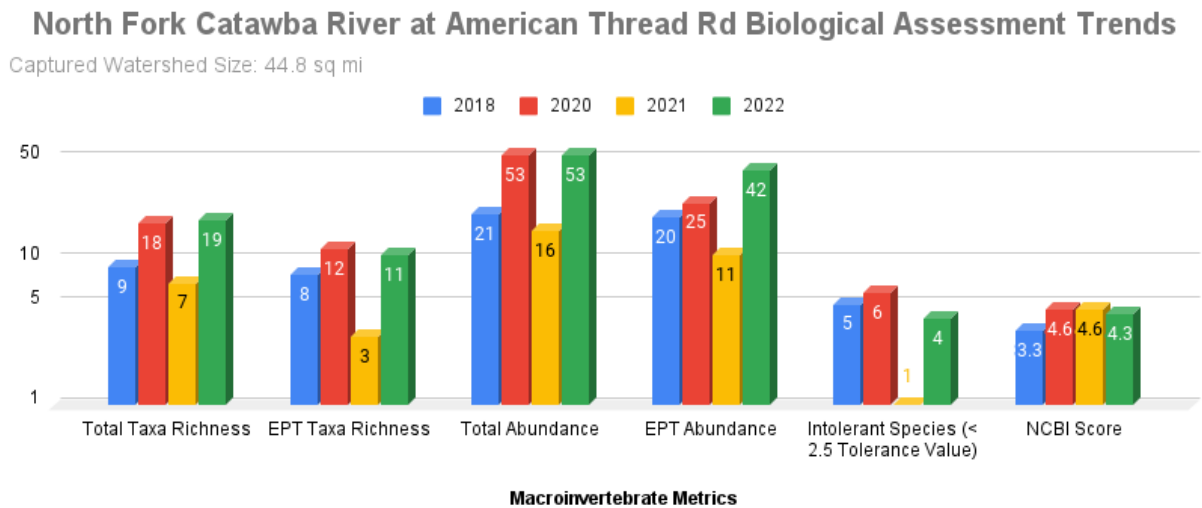
Captured Watershed Size: 9.9 sq mi



Paddy's Creek is generally trending upwards across all metrics. This site has the highest diversity of Heptageniidae (Flat Headed) mayflies and Hydropsychidae (Net Spinner) caddisflies in the Lake James watershed. The Summer 2020 to Summer 2022 data shows a significant

improvement across species diversity and the number of sensitive species present. This reflects a stable, improving ecosystem.

North Fork Catawba River at American Thread Road



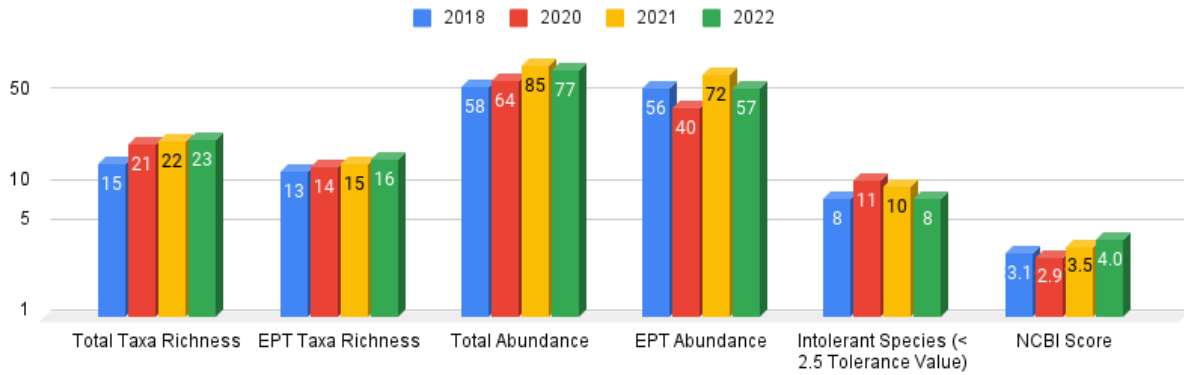
The North Fork Catawba River at this location is considered a downstream reach below the Baxter Healthcare manufacturing plant. The data at this location is highly variable, however, the summer (2020 and 2022) data and winter (2018 and 2021) data closely reflect each other. Interestingly, this decrease in richness and abundance in the winter is typically flipped in a healthy system with winter data reflecting better conditions rather than summer data. The abundance of filter feeding organisms is also higher at this site compared to upstream which may indicate greater levels of fine particulate organic material (FPOM) in the water column. These variable patterns are significant and may indicate a need to continue sampling to establish better trend analysis and eliminate any extraneous (storms, high flows, etc) circumstances. This opposite pattern of seasonality may also be a topic for further investigation as well as consideration for biannual (summer and winter) sampling at the North Fork locations.



North Fork Catawba River at Old North Cove School Road

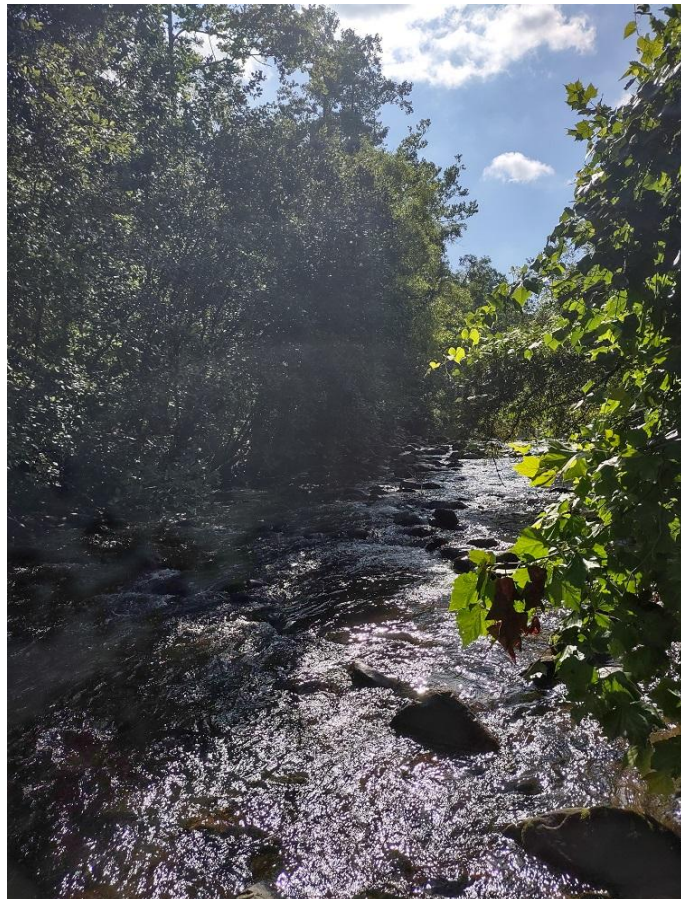
North Fork Catawba River at N Cove School Rd Biological Assessment Trends

Captured Watershed Size: 23.7 sq mi



Macroinvertebrate Metrics

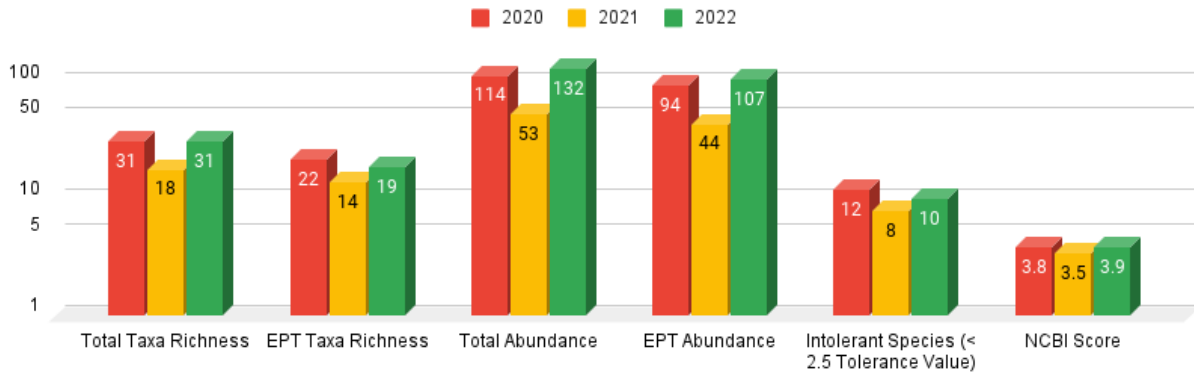
The North Fork of the Catawba River at this location is upstream of the Baxter Healthcare plant. Here the data reflects much less seasonal variation and more equalization across all macroinvertebrate metrics particularly when compared to its downstream counterpart. This site's data reflects ecosystem stability and potentially slight improvement across sampling sessions.



Catawba River at Greenlee Park

Catawba River at Greenlee Park Biological Assessment Trends

Captured Watershed Size: 154.0 sq mi



Macroinvertebrate Metrics

The Catawba River at Greenlee Park has been sampled across 3 years and has the least amount of data for trend analysis of any site that has been regularly sampled. The diversity collected at this site in 2022 is the highest of any watershed on the Catawba River side of Lake James and is worth recognition. This is particularly evident in the collection of *Brachycentrus lateralis* listed in NCDWR state literature as “Rare” and *Ocetis avara* which is listed as “Uncommon”. To date, the data for this site reflects a fairly stable and uniquely productive ecosystem, but does not have as much data collected to show long term trends or seasonal variation.

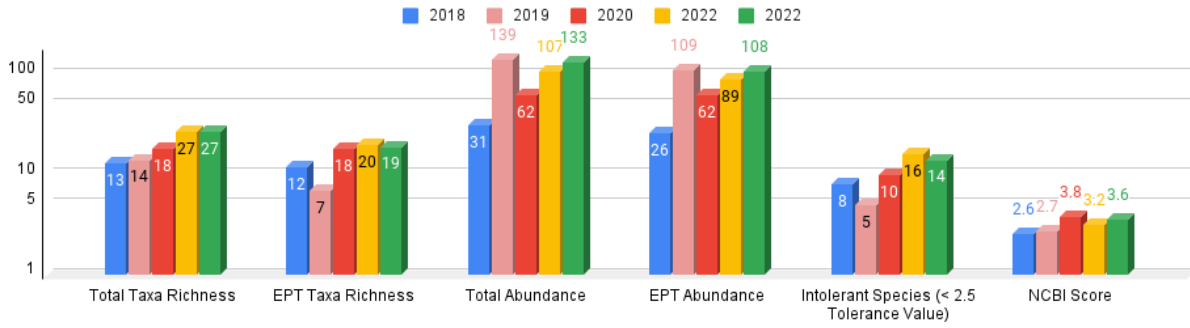


B. lateralis

Mill Creek at Old Fort Museum

Mill Creek at Old Fort Biological Assessment Trends

Captured Watershed Size: 21.1 sq mi

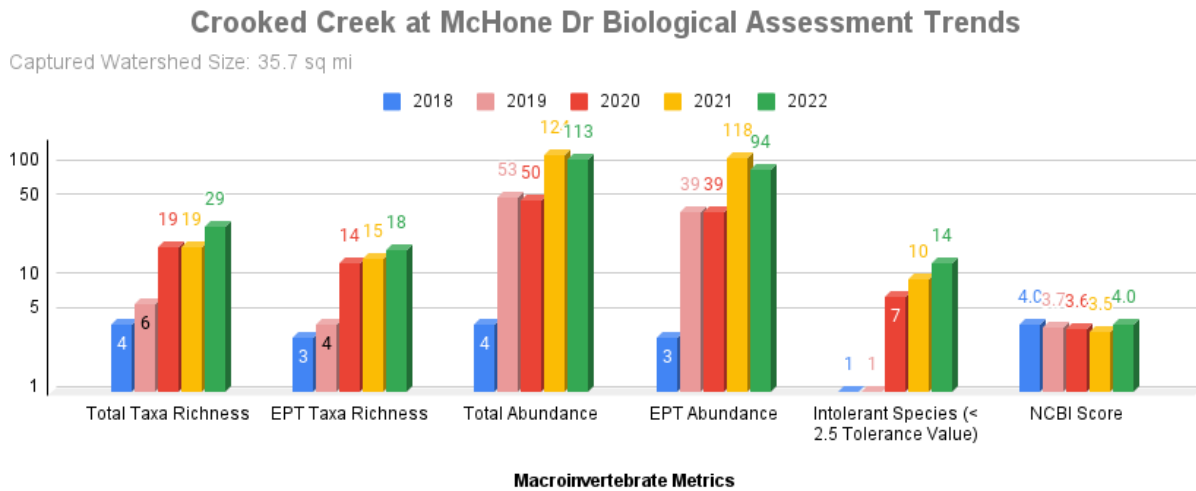


Macroinvertebrate Metrics



Mill Creek in Old Fort is 1 of 2 sites in the Catawba River side of Lake James that has 5 sample sessions worth of data. Collections from this site produced the greatest diversity of Plecopterans (Stoneflies) in 2022, and it has been a consistently diverse ecosystem during the last 3 collection sessions. This site has shown some historical fluctuation in species richness and intolerant species present, however it appears to be currently in a relatively stable state. Some bank stabilization and endemic botanical work was noted as ongoing during the 2022 sampling session.

Crooked Creek at McHone Drive



Crooked Creek at this location has exhibited historical instability in sediment load and substrate. Abundance and diversity have historically been exceedingly low, however, data from recent



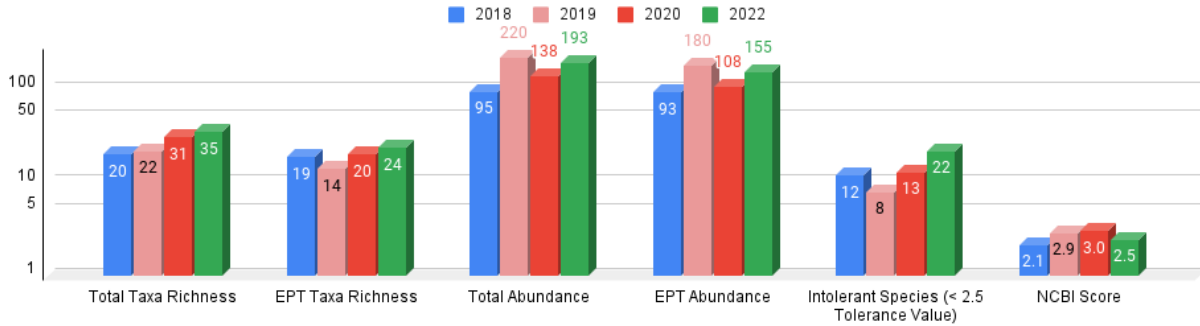
sampling sessions have shown a drastic increase in all relevant categories with the last 3 collections appearing to reflect a positive trend. The 2022 data for this site reflects a tie with Mill Creek in regards to the highest number of intolerant species present. Total taxa richness has increased by a factor of 7 and EPT diversity has increased by a factor of 6 over the sampling sessions. A unique and very rare species of Tanyderidae fly, *Protoplasia fitchii*, was collected from this site. This sampling location on Crooked Creek appears to be on a positive trend with the aquatic ecosystem stabilizing, and additional data points are needed to corroborate this.



Linville River at Newland Highway

Linville River at Newland Hwy Biological Assessment Trends

Captured Watershed Size: 9.9 sq mi



Macroinvertebrate Metrics



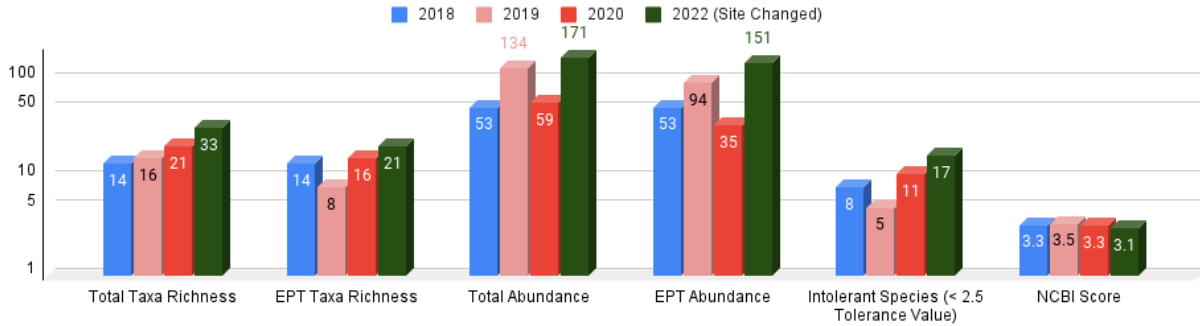
Linville @ Newland Hwy Upstream

The Linville River at Newland Hwy captures 9.9 mi² of its total watershed and has consistently been the most biologically diverse and abundant site among the 11 sites reviewed in this report. The taxonomic data reflects that this site contains over 30% more sensitive species than any other sample point in the Lake James watershed during 2022. The data for this site reflects a very stable and productive habitat. It was noted during the 2022 survey that construction on the bridge of Newland Hwy had been completed with bank vegetation planted. Additionally of note was that the morphology of the stream had been altered on the upstream side with a very long stretch of slow moving water in place of riffle and run sections. A berm of cobble and boulders appears to have been anthropologically placed to slow the movement of water.

Linville River at Blue Ridge Parkway Picnic Area

Linville River at BRP Picnic Area Biological Assessment Trends

Captured Watershed Size: 40.7 sq mi

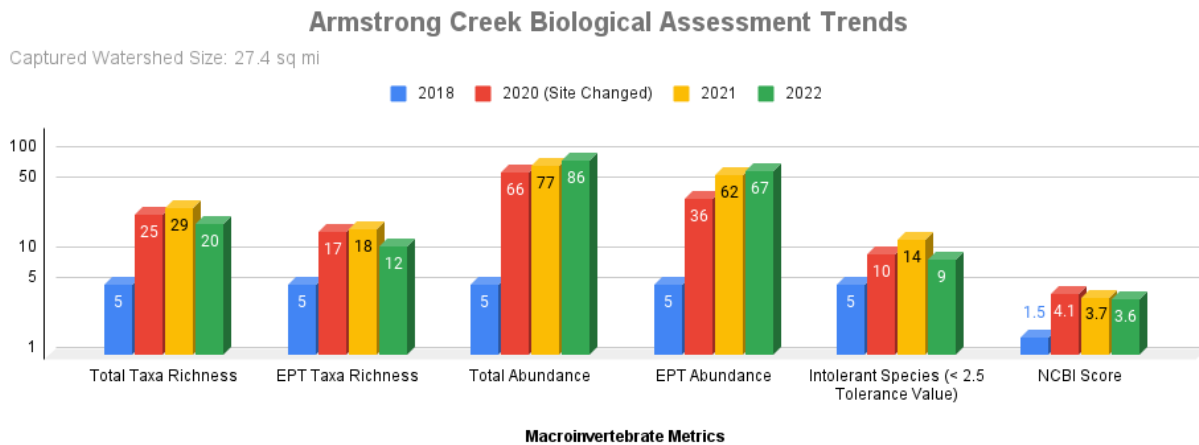


Macroinvertebrate Metrics



The sampled section of the Linville River at the Blue Ridge Parkway picnic area captures approximately 30 additional miles of the watershed. In 2022 a new location was established at the BRP picnic area - about 1 mile downstream from the sampling location of the previous 3 surveys. This site is downstream from Newland Hwy and captures biological data before the river enters the gorge. This region of the Linville River has had wider variation across sampling years, but since 2020, is currently reflecting a fairly productive and stable ecosystem on an upward trend. Further data for trend comparison is needed to clarify this assessment.

Armstrong Creek at US221 S Bridge



Armstrong Creek has also displayed indications of instability and ecologically disruptive attributes across the 4 surveys completed. Other than abundance, all relevant macroinvertebrate indicators are showing negative trends. Particularly concerning is the ~30% drop in EPT diversity and the number of sensitive species present. These insects are indicator species that respond the most quickly and severely in a degraded and stressed ecosystem. The biology of this stream is likely responding to stressors upstream as the habitat is present to support this ecosystem. The negative trend of biological indicators in this watershed suggest that further study and monitoring should be considered.

Forsyth Creek at Plantation Drive

<u>Macroinvertebrate Data for Forsyth Creek at Plantation Drive - 2022</u>	
Total Taxa Richness	18
EPT Taxa Richness	11
Total Abundance	72
EPT Abundance	57
Percent EPT	79.2%
Intolerant Species (< 2.5 Tolerance Value)	5
NCBI	4.61
Theoretical Bioclassification	Good



Forsyth Creek is a new addition to the LJEAs biological monitoring site list. The data collected in 2022 will be used as a tentative baseline for this ecosystem. Further study of this watershed is needed before any inferences from the data can be made soundly. From the initial survey, the data reflects a similarity to that of the North Fork Catawba River on American Thread Rd and White Creek. The species diversity and number of intolerant species present at this location are nearly equal to the Lower North Fork and indicate stress and potential ecosystem instability/impairment at this site. A fair composition of filter feeding organisms are present at this location also indicating higher levels of FPOM are likely. Further study and surveys are needed to develop an appropriate baseline view of this stream.

Summary

The 2022 data reflects mostly positive or at least stable indications in most of the Lake James watershed. The long term comparison of data allows for the observations of biological instabilities in some locations that are areas of concern. White Creek, North Fork Catawba River at American Thread Rd, Armstrong Creek, and Forsyth Creek all show biological data trends that are variable, showing ecosystem instability, or on a decline, showing ecosystem degradation and impairment. These areas may be considered the most likely areas of this assessment to contribute to water quality and biological issues. Some sites need more data for further analysis. The Catawba River at Greenlee Park shows some variability in species and EPT diversity as well as intolerant taxa present. Additional data will establish if this system is more unstable than it

currently appears to be with the data on hand. The same reasoning applies to Crooked Creek with baseline data reflecting highly disruptive issues on aquatic biology. Continued data will illustrate if this system shows further stabilization in aquatic biology. The Linville River around the BRP has shown indicators of ecosystem instability as well and further observations and data will aid with the long term analysis of the system.

References

North Carolina Division of Water Resources. "Standard Operating Procedures for the Collection and Analysis of Benthic Macroinvertebrates." North Carolina Department of Environmental Quality. February 2016