Assessment of Fish and Macroinvertebrates in a Piedmont Stream Near a Historic Gold Mine, Uwharrie National Forest, NC

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Introduction

North Carolina was one of the leading gold producing regions from the early 1800's until the western gold rush in 1849 (Craig and Rimstidt 1998). The Carolina slate belt in piedmont North Carolina, portions of which are contained within the boundaries of the modern-day Uwharrie National Forest (UNF), was the source of several gold-rich deposits and the focus of considerable mining activity during this time period (Klein et al. 2007; Lecce et al. 2008; Lecce et al. 2011). Mining in the region decreased sharply after the Civil War and today overgrown mine pits, tunnels, and tailings are the only physical vestiges of most long-abandoned mine sites. Although hidden from sight, abandoned mines have the potential to impact watershed health as contaminants associated with mining and ore processing persist in tailings and soil and in the floodplain and bed sediments of streams that flowed through or near the mines (Lecce and Pavlowsky 2014).

In 2016, the Southern Region Remedial Project Manager and staff from the National Forests in North Carolina Supervisor's Office contacted the Forest Service Southern Research Station Center for Aquatic Technology Transfer (CATT) to request an assessment of stream biota in Big Creek near the abandoned Russell Mine Site (RMS). The stream biota assessment was part of a larger effort to characterize the impacts of the abandoned mine on watershed health (Zirps and Ward 2017). On April 11 – 17, 2017, we deployed a team of 4 technicians to collect fish and benthic macroinvertebrates from several sites near the abandoned mine following standard North Carolina Division of Water Resources aquatic community assessment methods. Our goal was to determine if the fish and benthic macroinvertebrate communities indicated degraded water quality or stream habitat in Big Creek at the RMS.

Methods

Sample site description

The RMS consists of approximately 119 acres located within the proclamation boundary of UNF in Montgomery County, North Carolina (Figure 1). The site was operated as a gold mine and ore processing area from 1842 until the early 1900s and consisted of 3 – 4 open pit mines on either side of Big Creek, as well as tunnels, a vertical shaft, and stamp mills. Big Creek, a tributary of the Uwharrie River in the Pee Dee River watershed, flows through the middle of the RMS (Figure 1). Detailed descriptions of the RMS and surrounding areas are available in Zirps and Ward (2017). We selected 6 sample sites in the vicinity of the RMS; 2 downstream, 1 within, and 3 upstream (Figure 1, Table 1). At each sample site we established a fish sample reach and collected benthic macroinvertebrates as described below.

Fish

We collected fish from a 183 m (600 ft.) sample reach at each sample location following established sampling procedures for North Carolina streams (NCDENR 2013). Dependent on stream width, we used 1 or 2 backpack electrofishers and 1 or 2 dipnetters to make 1 upstream and 1 downstream pass through the sample reach. All fish were field identified to species and examined for disease, fin erosion, lesions, tumors and other anomalies. The first 50 individuals for each species were measured and any additional individuals were tallied to obtain a total count for each species. All fish were released back to the sample reach.

Fish data were sent to Eric Fleek (Supervisor, Biological Assessment Branch, North Carolina Department of Environmental Quality) for entry into the North Carolina Fish Community database. The database calculated a North Carolina Index of Biotic Integrity (NCIBI) score, rating, and report for each sample site. Detailed NCIBI scoring and rating criteria are available in NCDENR (2013).

Benthic macroinvertebrates

We collected benthic macroinvertebrates following established “Full Scale” sampling procedures for North Carolina streams (NCDEQ 2015). The Full Scale approach uses a combination of 2 riffle-kick, 3 sweep, 1 leaf-pack, 2 rock- and log-wash, 1 sand, and visual inspection samples to collect benthic macroinvertebrates from a variety of habitats within each sample site. Invertebrates were separated ("picked") from the rest of the sample in the field using forceps and picking trays, and preserved in glass vials containing 95% ethyl alcohol. Organisms were picked roughly in proportion to their abundance, but no attempt was made to remove all specimens.

All vials were labeled with sample site identification information and the vials were given to Eric Fleek (Supervisor, Biological Assessment Branch, North Carolina Department of Environmental Quality), who then identified macroinvertebrates, rated each taxa as rare, common, or abundant then calculated the North Carolina Biotic Index (BI) based on the abundance ratings for each taxa. The BI was then used in combination with the number of Ephemeroptera, Plecoptera, and Tricoptera taxa (EPT), and a seasonal correction factor to calculate an overall site rating. Detailed scoring and rating criteria are available in NCDEQ (2015).

Results

Fish

We were able to obtain NCIBI scores for 5 of our 6 sample sites (Table 2). The watershed size for the most upstream site (site 6) was below the minimum allowable watershed size of 7.3 km^2 for application of NCIBI scoring. Of the remaining 5 sites, 1 was rated 'Poor', 3 were rated as 'Fair' and 1 was rated as 'Good'. Percent Diseased Fish (i.e. displaying disease, fin erosion, lesions, or tumors) was the only of the 12 metrics use to calculate the NCIBI that received a poor score for every sample site (Appendix A). Although rated as poor at all sites, Percent Diseased Fish was lowest upstream of the mine site and highest downstream of the mine site (Figure 2). Tumors were observed on darters and dace at several sample sites (Figure 3). Stomach lining anomalies (Figure 4) on Bluehead Chub (*Nocomis leptocephalus*) were common, and lesions (Figure 5) were also observed on one Bluehead Chub. A summary of fish collected at each sample site is presented in Table 3. The NCIBI score, rating, metric values, and report for each sample site are available in Appendix A.

Macroinvertebrates

We obtained BI and EPT scores for all 6 samples sites (Table 2). The BI scores ranged from 4.41 – 5.20 and EPS scores ranged from 15 – 19. The EPT and BI scores corresponded to bioclassification ratings of 'Good' for all 6 sites (Table 2). A summary of macroinvertebrates collected from each sample site is presented in Table 4. A full listing of macroinvertebrates collected is available in Appendix B.

Discussion

Our one-time sampling of benthic macroinvertebrates yielded a rating of 'Good' for all sites, suggesting that water quality standards are being met in Big Creek. However, the average fish community rating was 'Fair', which indicates that the stream is not fully supporting its designated uses and may not be meeting water quality standards (NCDENR 2013). Differences in fish and macroinvertebrate results may be reflective of their relative sensitivity to a particular contaminant (Gensemer and Playle 1999), the spatial or temporal scale of disturbance (Freund and Petty 2007), or other watershed factors (e.g. habitat quality) not related to water quality (NCDENR 2013). The Big Creek watershed has attributes in addition to the abandoned mine site that could impact macroinvertebrates or fish. The watershed is within the boundary of the Uwharrie National Forest, but contains several private inholdings. We noted a recent clear cut on private land immediately upstream of the Coggins Mine Crossing Road. Also, streams within the watershed are prone to partial seasonal drying during the summer months and we observed several dry reaches within the RMS and areas downstream during summer 2017 (Kiley Coates, pers. obs.).

Our field team recorded a number of fish with tumors, lesions, or other physical anomalies. Fish with tumors included Tessellated Darters (*Etheostoma olmstedi*) and Rosyside Dace (*Clinostomus funduloides*) from several sample sites. Bluehead Chubs were noted to have stomach lining ruptures at several sites, and lesions were observed on at least one Bluehead Chub. The number of anomalies we observed is well above average for streams in the region (NCDEQ 2017) and was highest at sites within and downstream of the abandoned mine site. Although it was beyond the scope of our project, a more thorough physiological or histopathological investigation of fish in Big Creek could help shed light on the cause of these anomalies.

Previously reported concentrations of contaminants in the surface waters of Big Creek were, for the most part, below thresholds expected to cause biological effects. In their detailed 2016 assessment of the RMS, Zirps and Ward (2017) found that of 23 measured water quality parameters only aluminum, cyanide, and alkalinity exceeded proposed chronic United States Environmental Protection Agency (USEPA) freshwater screening values for biological organisms (USEPA 2015) at 1 or more sites, and none exceeded the USEPA acute screening value. Of these, only aluminum was above the chronic screening value at all tested sites. While aluminum can be toxic to aquatic macroinvertebrates and fish, adverse biological impacts are most commonly associated with acidic conditions (Gensemer and Playle 1999), not the neutral pH levels we encountered in Big Creek. However, it is worth noting that aluminum is not the only potentially toxic metal found in the surface waters of Big Creek, and additive or synergistic effects of metals are poorly understood (Gensemer and Playle 1999).

While present day surface water contamination levels associated with the RMS are relatively low, Zirps and Ward (2017) found several metals that exceeded USEPA freshwater sediment screening values for stream sediment samples within Big Creek or ecological soil screening levels for surface soil samples near Big Creek. Metals in stream sediments provide a direct pathway for exposure to aquatic macroinvertebrate taxa that are in contact with sediments during their larval life stages. Contaminated macroinvertebrates may be eaten by fish allowing for bioaccumulation of metals such as mercury. Metals in floodplain sediments can be stored for hundreds or even thousands of years until they are remobilized and enter stream channels through flooding and subsequent erosion or mass wasting (Lecce and Pavlowsky 2014). The potential for bioaccumulation, remobilization of metals from floodplain sediment and human health considerations should be weighed carefully when considering remediation options at the RMS.

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Figures

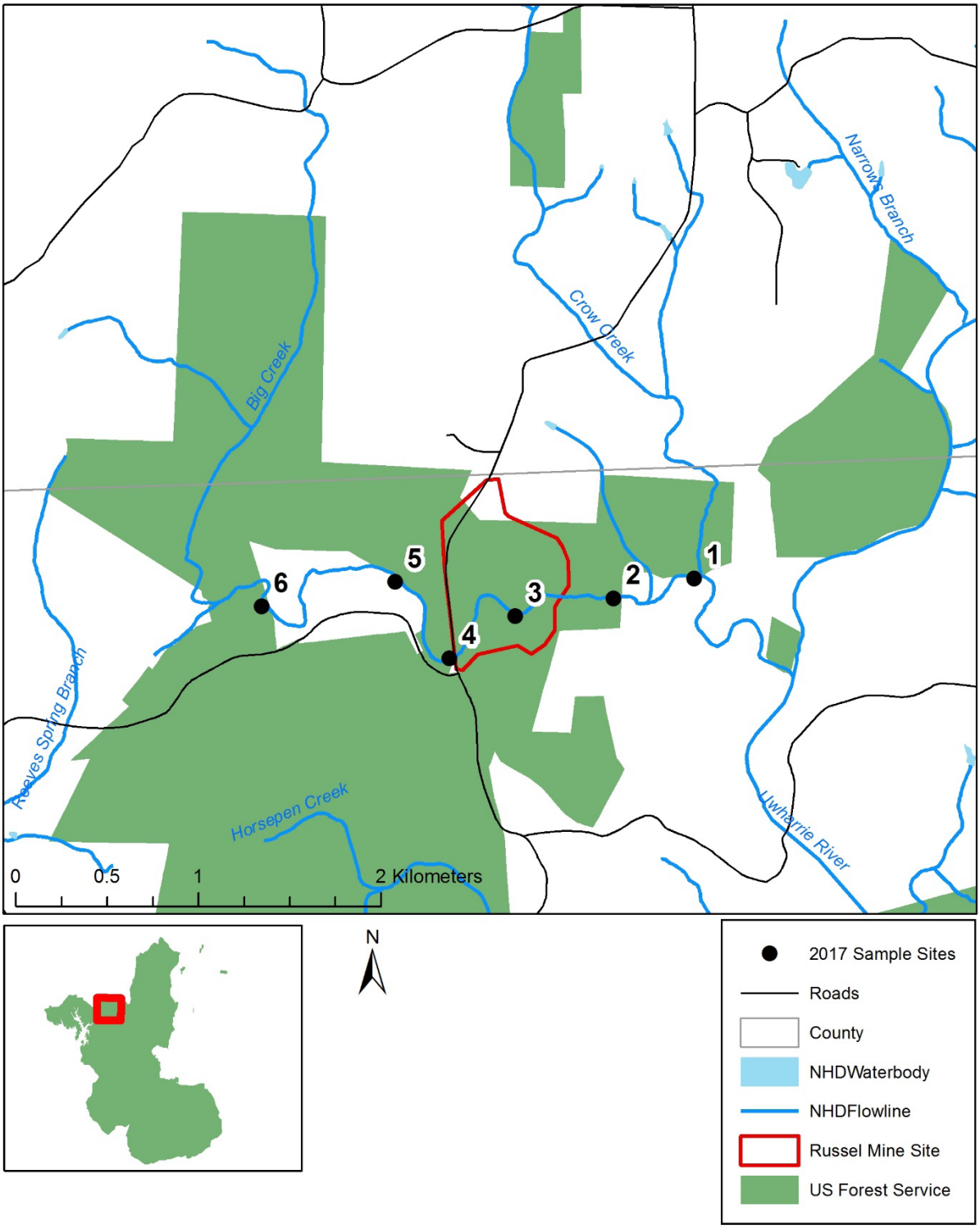

Figure 1. Fish and macroinvertebrate sample locations in Big Creek, April 11-17, 2017. Inset is extent of main map within the Uwharrie National Forest.

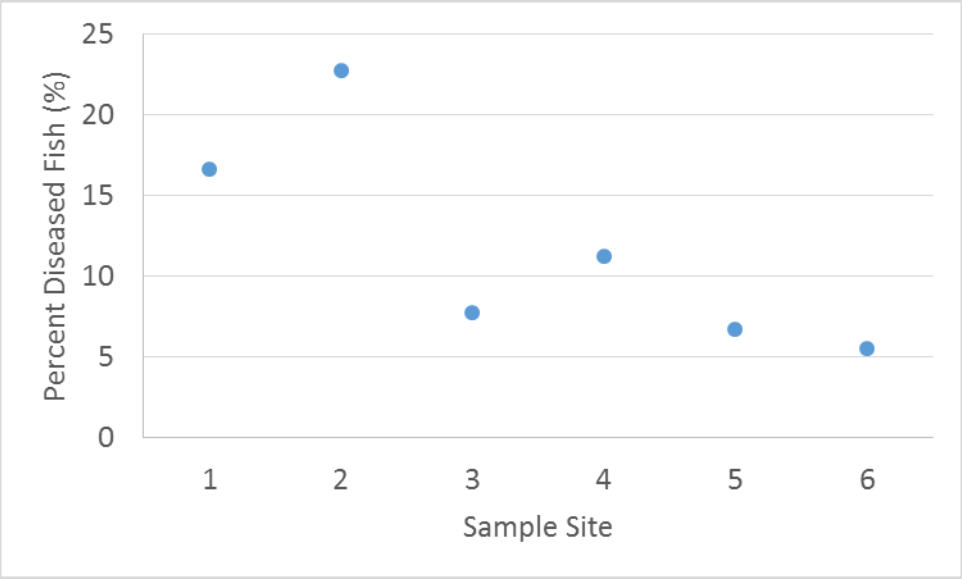

Figure 2. Percent Diseased Fish (i.e. displaying disease, fin erosion, lesions, or tumors) observed at sample sites in Big Creek, April 11-17, 2017. Site 1 is furthest downstream, site 3 is within the abandoned mine site and site 6 is furthest upstream.

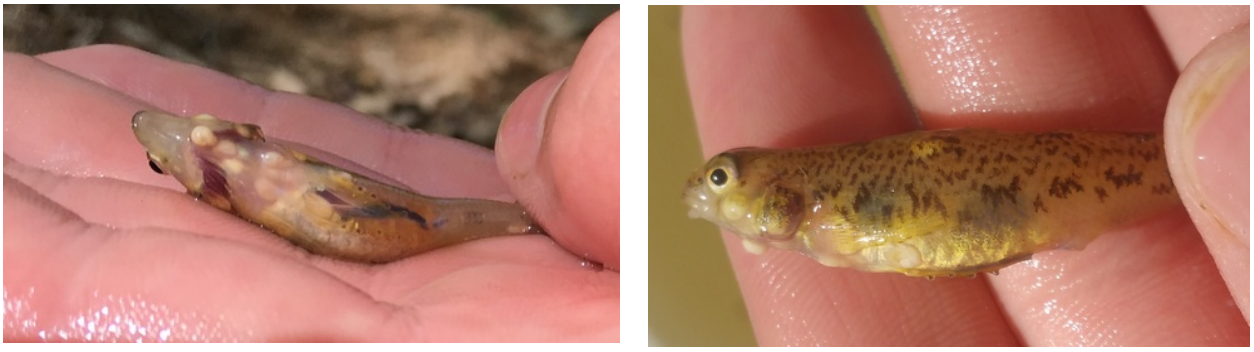

Figure 3. A Tessellated Darter with tumors at sample site 3. Similar tumors were also found on many other fish at other sites, including darters and Rosyside Dace.

Figure 4. Bluehead Chubs with internal ruptures in their stomach lining. This type of anomaly was common in Bluehead Chubs at many sample sites.

Figure 5. Bluehead Chub with lesions. This type of anomaly was rare, but was observed at site 3.

Tables

Table 1. Location of 2017 fish and macroinvertebrate sample sites in Big Creek, sampled April 11-17, 2017.

Sample site	Location	Drainage (km^2)	Latitude	Longitude
1	1 km downstream	10.6	35.50139	-80.0108
2	0.5 km downstream	9.8	35.50044	-80.0157
3	At mine site	8.8	35.49962	-80.0216
4	0.5 km upstream	8.5	35.49756	-80.0256
5	1 km upstream	7.5	35.50137	-80.0289
6	2 km upstream	6.2	35.50021	-80.037

Table 2. Fish and macroinvertebrate ratings for 6 sample sites on Big Creek. NR = Not rated due to insufficient upstream drainage area.

Sample site	Fish NCIBI	Macroinvertebrate
1	Poor	Good
2	Fair	Good
3	Good	Good
4	Fair	Good
5	Fair	Good
6	NR	Good

Table 3. Fish community attributes derived from samples collected at 6 sites in Big Creek, 2017. The values presented here were used to calculate the NCIBI site rating as described in NCDENR (2013). Detailed sample information is available in Appendix A.

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Number of Species	4	8	10	9	10	9
Number Fish	18	44	194	133	179	72
Number Darter Species	1	2	2	2	1	2
Number Sunfish, Bass, Trout	1	1	2	1	2	2
Number Sucker Species	0	1	2	1	2	1
Number Intolerant Species	0	1	1	1	0	1
Percent Tolerant Fish	39	11	23	41	37	33
Percent Omnivore + Herbivore	0	16	37	26	41	4
Percent Insectivores	100	84	63	74	59	96
Percent Piscivores	0.00	0.00	0.00	0.00	0.00	0.00
Percent Diseased Fish	16.67	22.73	7.73	11.28	6.70	5.56
Percent Species Multiple Ages	75	38	90	67	70	78

Table 4. Benthic macroinvertebrate community attributes derived from samples collected at 6 sites in Big Creek, 2017. The values presented here were used to calculate the macroinvertebrate site rating as described in NCDEQ (2015). Detailed sample information is available in Appendix B.

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Biotic Index	4.74	4.41	4.48	4.73	5.2	4.6
EPT Diversity	15	17	19	15	19	18

Appendix A – Detailed fish results

Site 1.

North Carolina Fish Community Report

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Waterbody	Big Creek	**No. Secs.**			
Station	Rt. 6513	**No. Units**			
County	Montgomery	**CPUE**			
Latitude	35.50100	**Width**	m		
Longitude	80.01259	**Depth**	m		
Ecoregion	P	**Drainage**	4.1 mi2		
8 Digit HUC	03040103	**Elevation**	393 ft		
8 HUC Name	Yadkin River				
Level IV Ecoregion	Carolina Slate Belt				
Stream Classification	C			**Data Entry JD**	
Stream Index No.	13-2-15-2			**Total Habitat Score**	

NCIBI Score 22 **NCIBI Rating** Poor

Station ID	BIGCR1	**Basin**	YAD
Collection No.	USFS1	**Date**	4/17/2017

☐ Reference Site ☐ Basin Site
☐ Not Rated ☑ Special Study

Temperature	°C
Specific Conductance	µS/cm
Dissolved Oxygen	mg/L
pH	s.u.
Clarity	

Family	Scientific Name	Trophic Status	Tolerance	Multiple Age	No.	Exotic
Aphredoderidae	Aphredoderus sayanus	Insectivore	Intermediate	yes	9	☐
Centrarchidae	Lepomis cyanellus	Insectivore	Tolerant	yes	3	☑
Percidae	Etheostoma olmstedi	Insectivore	Intermediate	no	2	☐
Poecilidae	Gambusia holbrooki	Insectivore	Tolerant	yes	4	☐

Number Exotic Species 1 **Number Exotic Fish** 3

Metric	Value	Score
Number of Species:	4	3
Number Fish:	18	1
Number Darter Sp:	1	5
No. Sunfish,Bass,Trout:	1	1
Number Sucker Sp:	0	1
Number Intolerant Sp.	0	1
Percent Tolerant Fish:	39	1
Percent Omni + Herb:	0	1
Percent Insectivores:	100	1
Percent Piscivores:	0.00	1
Percent Diseased Fish:	16.67	1
Percent Sp Multiple Ages:	75	5

Site 2.

North Carolina Fish Community Report

8/1/2017 3:52:42 PM

Waterbody	Big Creek	**No. Secs.**		
Station	Rt. 6513	**No. Units**		
County	Montgomery	**CPUE**		
Latitude	35.50034	**Width**		m
Longitude	80.01564	**Depth**		m
Ecoregion	P	**Drainage**	3.8	mi2
8 Digit HUC	03040103	**Elevation**	403	ft
8 HUC Name	Yadkin River			
Level IV Ecoregion	Carolina Slate Belt			
Stream Classification	C			
Stream Index No.	13-2-15-2			

NCIBI Score 40 **NCIBI Rating** Fair

Station ID	BIGCR2	**Basin**	YAD
Collection No.	USFS2	**Date**	4/15/2017

☐ Reference Site ☐ Basin Site
☐ Not Rated ☑ Special Study

Data Entry JD

Total Habitat Score

Temperature	°C
Specific Conductance	µS/cm
Dissolved Oxygen	mg/L
pH	s.u.
Clarity	

Family	Scientific Name	Trophic Status	Tolerance	Multiple Age	No.	Exotic
Aphredoderidae	Aphredoderus sayanus	Insectivore	Intermediate	yes	12	☐
Catostomidae	Erimyzon oblongus	Omnivore	Intermediate	no	4	☐
Centrarchidae	Lepomis cyanellus	Insectivore	Tolerant	yes	5	☑
Cyprinidae	Clinostomus funduloides	Insectivore	Intermediate	no	3	☐
Cyprinidae	Clinostomus funduloides	Insectivore	Intermediate	yes	13	☐
Cyprinidae	Nocomis leptocephalus	Omnivore	Intermediate	no	3	☐
Percidae	Etheostoma olmstedi	Insectivore	Intermediate	no	1	☐
Percidae	Percina crassa	Insectivore	Intolerant	no	3	☐

Number Exotic Species 1 **Number Exotic Fish** 5

Metric	Value	Score
Number of Species:	8	5
Number Fish:	44	1
Number Darter Sp:	2	5
No. Sunfish,Bass,Trout:	1	1
Number Sucker Sp:	1	3
Number Intolerant Sp.	1	5
Percent Tolerant Fish:	11	5
Percent Omni + Herb:	16	5
Percent Insectivores:	84	5
Percent Piscivores:	0.00	1
Percent Diseased Fish:	22.73	1
Percent Sp Multiple Ages:	38	3

Site 3.

North Carolina Fish Community Report

8/4/2017 11:37:23 AM

Waterbody	Big Creek	**No. Secs.**		
Station	Rt. 6531	**No. Units**		
County	Montgomery	**CPUE**		
Latitude	35.49924	**Width**		m
Longitude	80.02146	**Depth**		m
Ecoregion	P	**Drainage**	3.4	mi2
8 Digit HUC	03040103	**Elevation**	422	ft
8 HUC Name	Yadkin River			
Level IV Ecoregion	Carolina Slate Belt			
Stream Classification	C			
Stream Index No.	13-2-15-2			

NCIBI Score 48 **NCIBI Rating** Good

Station ID	BIGCR3	**Basin**	YAD
Collection No.	USFS3	**Date**	4/14/2017

☐ Reference Site ☐ Basin Site
☐ Not Rated ☑ Special Study

Data Entry JD

Total Habitat Score

Temperature	°C
Specific Conductance	µS/cm
Dissolved Oxygen	mg/L
pH	s.u.
Clarity	

Family	Scientific Name	Trophic Status	Tolerance	Multiple Age	No.	Exotic
Aphredoderidae	Aphredoderus sayanus	Insectivore	Intermediate	yes	42	☐
Catostomidae	Erimyzon oblongus	Omnivore	Intermediate	yes	35	☐
Catostomidae	Scartomyzon sp. cf. lachneri	Insectivore	Intermediate	yes	7	☐
Centrarchidae	Lepomis auritus	Insectivore	Tolerant	yes	3	☐
Centrarchidae	Lepomis cyanellus	Insectivore	Tolerant	yes	13	☑
Cyprinidae	Clinostomus funduloides	Insectivore	Intermediate	yes	23	☐
Cyprinidae	Nocomis leptocephalus	Omnivore	Intermediate	yes	36	☐
Cyprinidae	Semotilus atromaculatus	Insectivore	Tolerant	yes	29	☐
Percidae	Etheostoma olmstedi	Insectivore	Intermediate	yes	4	☐
Percidae	Percina crassa	Insectivore	Intolerant	no	2	☐

Number Exotic Species 1 **Number Exotic Fish** 13

Metric	Value	Score
Number of Species:	10	5
Number Fish:	194	5
Number Darter Sp:	2	5
No. Sunfish,Bass,Trout:	2	3
Number Sucker Sp:	2	5
Number Intolerant Sp.	1	5
Percent Tolerant Fish:	23	5
Percent Omni + Herb:	37	3
Percent Insectivores:	63	5
Percent Piscivores:	0.00	1
Percent Diseased Fish:	7.73	1
Percent Sp Multiple Ages:	90	5

Site 4.

North Carolina Fish Community Report

8/4/2017 12:10:07 PM

Waterbody	Big Creek	**No. Secs.**	
Station	Rt. 1301 Coggins Min	**No. Units**	
County	Montgomery	**CPUE**	
Latitude	35.49752	**Width**	m
Longitude	80.02601	**Depth**	m
Ecoregion	P	**Drainage**	3.3 mi2
8 Digit HUC	03040103	**Elevation**	449 ft
8 HUC Name	Yadkin River		
Level IV Ecoregion	Carolina Slate Belt		
Stream Classification	C		
Stream Index No.	13-2-15-2		

NCIBI Score 40 **NCIBI Rating** Fair

Station ID	BIGCR4	**Basin**	YAD
Collection No.	USFS4	**Date**	4/11/2017

☐ Reference Site ☐ Basin Site
☐ Not Rated ☑ Special Study

Data Entry JD

Total Habitat Score

Temperature	°C
Specific Conductance	µS/cm
Dissolved Oxygen	mg/L
pH	s.u.
Clarity	

Family	Scientific Name	Trophic Status	Tolerance	Multiple Age	No.	Exotic
Aphredoderidae	Aphredoderus sayanus	Insectivore	Intermediate	yes	15	☐
Catostomidae	Erimyzon oblongus	Omnivore	Intermediate	yes	20	☐
Centrarchidae	Lepomis auritus	Insectivore	Tolerant	yes	15	☐
Cyprinidae	Clinostomus funduloides	Insectivore	Intermediate	yes	25	☐
Cyprinidae	Nocomis leptocephalus	Omnivore	Intermediate	yes	14	☐
Cyprinidae	Notropis altipinnis	Insectivore	Intermediate	no	1	☐
Cyprinidae	Semotilus atromaculatus	Insectivore	Tolerant	yes	40	☐
Percidae	Etheostoma olmstedi	Insectivore	Intermediate	no	2	☐
Percidae	Percina crassa	Insectivore	Intolerant	no	1	☐

Number Exotic Species 0 **Number Exotic Fish** 0

Metric	Value	Score
Number of Species:	9	5
Number Fish:	133	3
Number Darter Sp:	2	5
No. Sunfish,Bass,Trout:	1	1
Number Sucker Sp:	1	3
Number Intolerant Sp.	1	5
Percent Tolerant Fish:	41	1
Percent Omni + Herb:	26	5
Percent Insectivores:	74	5
Percent Piscivores:	0.00	1
Percent Diseased Fish:	11.28	1
Percent Sp Multiple Ages:	67	5

Site 5.

North Carolina Fish Community Report

8/4/2017 12:39:32 PM

Waterbody	Big Creek	**No. Secs.**		
Station	Rt. 1300 Ctr Meth Ch	**No. Units**		
County	Montgomery	**CPUE**		
Latitude	35.50148	**Width**		m
Longitude	80.02905	**Depth**		m
Ecoregion	P	**Drainage**	2.9	mi2
8 Digit HUC	03040103	**Elevation**	462	ft
8 HUC Name	Yadkin River			
Level IV Ecoregion	Carolina Slate Belt			
Stream Classification	C			
Stream Index No.	13-2-15-2			

NCIBI Score 38 **NCIBI Rating** Fair

Station ID	BIGCR5	**Basin**	YAD
Collection No.	USFS5	**Date**	4/12/2017

☐ Reference Site ☐ Basin Site
☐ Not Rated ☑ Special Study

Data Entry JD

Total Habitat Score

Temperature	°C
Specific Conductance	µS/cm
Dissolved Oxygen	mg/L
pH	s.u.
Clarity	

Family	Scientific Name	Trophic Status	Tolerance	Multiple Age	No.	Exotic
Aphredoderidae	Aphredoderus sayanus	Insectivore	Intermediate	yes	21	☐
Catostomidae	Erimyzon oblongus	Omnivore	Intermediate	yes	20	☐
Catostomidae	Scartomyzon sp. cf. lachneri	Insectivore	Intermediate	no	2	☐
Centrarchidae	Lepomis auritus	Insectivore	Tolerant	yes	36	☐
Centrarchidae	Lepomis cyanellus	Insectivore	Tolerant	no	5	☑
Cyprinidae	Clinostomus funduloides	Insectivore	Intermediate	yes	9	☐
Cyprinidae	Nocomis leptocephalus	Omnivore	Intermediate	yes	53	☐
Cyprinidae	Semotilus atromaculatus	Insectivore	Tolerant	yes	25	☐
Ictaluridae	Noturus insignis	Insectivore	Intermediate	no	1	☐
Percidae	Etheostoma olmstedi	Insectivore	Intermediate	yes	7	☐

Number Exotic Species 1 **Number Exotic Fish** 5

Metric	Value	Score
Number of Species:	10	5
Number Fish:	179	5
Number Darter Sp:	1	5
No. Sunfish,Bass,Trout:	2	3
Number Sucker Sp:	2	5
Number Intolerant Sp.	0	1
Percent Tolerant Fish:	37	1
Percent Omni + Herb:	41	3
Percent Insectivores:	59	3
Percent Piscivores:	0.00	1
Percent Diseased Fish:	6.70	1
Percent Sp Multiple Ages:	70	5

Site 6.

North Carolina Fish Community Report

8/4/2017 12:56:50 PM

Waterbody	Big Creek	No. Secs.		
Station	Rt. 1300 Ctr Meth Ch	No. Units		
County	Montgomery	CPUE		
Latitude	35.50014	Width		m
Longitude	80.03691	Depth		m
Ecoregion	P	Drainage	2.4	mi2
8 Digit HUC	03040103	Elevation	502	ft
8 HUC Name	Yadkin River			
Level IV Ecoregion	Carolina Slate Belt			
Stream Classification	C			
Stream Index No.	13-2-15-2			

NCIBI Rating: Not Rated

Station ID	BIGCR6	Basin	YAD
Collection No.	USFS6	Date	4/13/2017

☐ Reference Site ☐ Basin Site
☐ Not Rated ☑ Special Study

Temperature	°C
Specific Conductance	µS/cm
Dissolved Oxygen	mg/L
pH	s.u.
Clarity	

Data Entry JD

Total Habitat Score

Family	Scientific Name	Trophic Status	Tolerance	Multiple Age	No.	Exotic
Aphredoderidae	Aphredoderus sayanus	Insectivore	Intermediate	yes	24	☐
Catostomidae	Erimyzon oblongus	Omnivore	Intermediate	yes	2	☐
Centrarchidae	Lepomis auritus	Insectivore	Tolerant	yes	3	☐
Centrarchidae	Lepomis cyanellus	Insectivore	Tolerant	yes	4	☑
Cyprinidae	Clinostomus funduloides	Insectivore	Intermediate	yes	10	☐
Cyprinidae	Nocomis leptocephalus	Omnivore	Intermediate	no	1	☐
Cyprinidae	Semotilus atromaculatus	Insectivore	Tolerant	yes	17	☐
Percidae	Etheostoma olmstedi	Insectivore	Intermediate	yes	5	☐
Percidae	Percina crassa	Insectivore	Intolerant	no	6	☐

Number Exotic Species 1 Number Exotic Fish 4

Metric	Value	Score
Number of Species:	9	5
Number Fish:	72	1
Number Darter Sp:	2	5
No. Sunfish,Bass,Trout:	2	3
Number Sucker Sp:	1	3
Number Intolerant Sp.	1	5
Percent Tolerant Fish:	33	3
Percent Omni + Herb:	4	1
Percent Insectivores:	96	1
Percent Piscivores:	0.00	1
Percent Diseased Fish:	5.56	1
Percent Sp Multiple Ages:	78	5

Appendix B – Detailed macroinvertebrate results

Table B1. Benthic macroinvertebrates collected from 6 sites in Big Creek, 2017. 10 = abundant (10+ specimens) in, 3 = common (3 – 9 specimen), 1 = rare (1 – 2 specimens), null = not collected.

Order	Family	Species	1	2	3	4	5	6
Amphipoda	Crangonyctidae	Crangonyx sp	10	10	3	10	10	10
Basommatophora	Basommatophora	Ferrissia sp			1			
Basommatophora	Lymnaeidae	Pseudosuccinea collumella	1					
Basommatophora	Planorbidae	Helisoma sp	1					
Basommatophora	Planorbidae	Menetus (Micromenetus) dilatus			1	3		
Coleoptera	Dryopidae	Helichus basalis				1		
Coleoptera	Dryopidae	Helichus fastigatus	3	1		1		
Coleoptera	Dryopidae	Helichus sp					1	3
Coleoptera	Dytiscidae	Neoporus sp	1	3	1	3	1	1
Coleoptera	Elmidae	Stenelmis sp	1	3		1	1	1
Coleoptera	Hydrophilidae	Enochrus sp					3	
Coleoptera	Psephenidae	Psephenus herricki	1	1	3		1	3
Diptera	Ceratopogonidae	Bezzia/Palpomyia Spp	1		1		1	1
Diptera	Chironomidae	Ablabesmyia mallochi			1			
Diptera	Chironomidae	Corynoneura sp	1	1		1	10	1
Diptera	Chironomidae	Microtendipes pedellus GR			3		1	
Diptera	Chironomidae	Microtendipes sp		1				
Diptera	Chironomidae	Paracladopelma sp						1
Diptera	Chironomidae	Parametriocnemus sp	3	3	3		1	1
Diptera	Chironomidae	Paratanytarsus sp			1			
Diptera	Chironomidae	Paratendipes albimanus	3					
Diptera	Chironomidae	Phaenopsectra flavipes	1					
Diptera	Chironomidae	Polypedilum flavum		1				
Diptera	Chironomidae	Polypedilum aviceps			1			
Diptera	Chironomidae	Polypedilum fallax			1			
Diptera	Chironomidae	Polypedilum flavum					1	1
Diptera	Chironomidae	Polypedilum illinoense GR					1	
Diptera	Chironomidae	Polypedilum scalaenum GR					3	
Diptera	Chironomidae	Procladius sp						1
Diptera	Chironomidae	Psectrocladius psilopterus gr			1			
Diptera	Chironomidae	Rheocricotopus robacki		1				
Diptera	Chironomidae	Tanytarsus sp 6	1					
Diptera	Chironomidae	Tanytarsus sp C			1			
Diptera	Chironomidae	Tanytarsus sp L					1	
Diptera	Chironomidae	Thienemaniella sp		1				
Diptera	Chironomidae	Thienemannimyia GR			3			1
Diptera	Chironomidae	Tvetenia bavarica GR		1				
Diptera	Chironomidae	Zavrelimyia sp	1	3	3	3		1
Diptera	Culicidae	Anopheles sp			1			
Diptera	Dixidae	Dixa sp						3
Diptera	Dixidae	Dixella sp	1				1	
Diptera	Simuliidae	Prosimulium sp					1	

Order	Family	Species	1	2	3	4	5	6
Diptera	Simuliidae	Simulium sp		10	10	10	10	10
Diptera	Tipulidae	Antocha sp	1	3		1	3	1
Diptera	Tipulidae	Hexatoma sp				1		
Diptera	Tipulidae	Pseudolimnophila sp	1	1			1	1
Diptera	Tipulidae	Tipula sp	3	3	1	10	3	3
Ephemeroptera	Ameletidae	Ameletus lineatus	3	3	1	3	1	1
Ephemeroptera	Baetidae	Baetis pluto		3			1	
Ephemeroptera	Baetidae	Centroptilum sp			1			1
Ephemeroptera	Baetidae	Heterocloeon amplum						1
Ephemeroptera	Baetidae	Plauditus dubius GR	3	10	10	3	3	3
Ephemeroptera	Baetidae	Procloeon sp	3	10	1	1	1	1
Ephemeroptera	Caenidae	Caenis sp			3		10	
Ephemeroptera	Ephemerellidae	Eurylophella bicolor			1			
Ephemeroptera	Ephemerellidae	Eurylophella doris						1
Ephemeroptera	Ephemerellidae	Eurylophella verisimilis		3	1		1	
Ephemeroptera	Heptageniidae	Leucrocuta sp	10	10	10	10	10	10
Ephemeroptera	Heptageniidae	Stenonema femoratum	1	1	3	1	10	1
Ephemeroptera	Leptophlebiidae	Paraleptophlebia sp	10	10	10	10	10	10
Hemiptera	Nepidae	Ranatra sp		1			1	
Hirudinida	Erpobdellidae	Erpobdella/Mooreobdella Sp	1			1	1	
Hirudinida	Glossiphoniidae	Placobdella papillifera				1		
Isopoda	Asellidae	Caecidotea sp	10	10	10	10	10	10
Megaloptera	Corydalidae	Nigronia fasciatus			1			
Megaloptera	Corydalidae	Nigronia serricornis	3	1	1		1	1
Odonata	Cordulegastridae	Cordulegaster sp						1
Odonata	Corduliidae	Macromia sp					1	1
Odonata	Corduliidae	Somatochlora sp		3	1	1	1	3
Odonata	Gomphidae	Gomphus sp			1			
Plecoptera	Chloroperlidae	Suwallia sp	3	3	10	10	3	10
Plecoptera	Leuctridae	Leuctra sp	1					3
Plecoptera	Nemouridae	Amphinemura sp	10	10	10	10	10	10
Plecoptera	Perlidae	Perlesta sp	10	10	10	10	10	10
Trichoptera	Limnephilidae	Ironoquia punctatissima	10	3	1	3	10	10
Trichoptera	Limnephilidae	Pycnopsyche sp	1	1				1
Trichoptera	Philopotamidae	Wormaldia sp	3	10	10	10	10	10
Trichoptera	Polycentropodidae	Polycentropus sp		1	1			
Trichoptera	Rhyacophilidae	Rhyacophila carolina			1			
Trichoptera	Rhyacophilidae	Rhyacophila ledra	3	10	1	1	1	10
Trichoptera	Uenoidae	Neophylax ornatus					1	
Tubificida	Naididae	Ilyodrilus sp			1			
Tubificida	Naididae	Limnodrilus hoffmeisteri					1	1