

**Stream Habitat, Pebble Counts, and Aquatic Benthic
Macroinvertebrate Communities in Ten Streams of the Chattahoochee
River, Broad River, and Chattooga River Watersheds, Chattahoochee-
Oconee National Forest, Georgia**



United States Department of Agriculture Forest Service
Southern Research Station
Center for Aquatic Technology Transfer

1650 Ramble Road
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Table of Contents

List of Tables	3
List of Figures	4
Introduction.....	5
Study Sites	5
Methods.....	5
Macroinvertebrates	5
Habitat.....	6
Substrate.....	7
Results.....	7
Conclusion	8
Literature Cited	12
Appendix A: Stream Habitat Survey Summaries	14
Appendix B: Particle Size Distribution from Pebble Count Data.....	28
Appendix C: Macroinvertebrate Report.....	35

List of Tables

Table 1. Description of macroinvertebrate sample site locations.....	10
Table 2. Description of habitat types used during BVET habitat surveys.....	11
Table 3. Substrate size classes used during BVET habitat surveys.....	11
Table 4. Large woody debris (LWD) size classes.....	11
Table 5. Rosgen channel type descriptions.....	11
Table 6. Substrate size classes used during pebble count surveys.....	12
Appendix A	
Table A1: Stream habitat survey summary for site Chattahoochee River (lower).....	15
Table A2: Stream habitat survey summary for site Chattahoochee River (upper).....	16
Table A3: Stream habitat survey summary for site Jasus Creek.....	17
Table A4: Stream habitat survey summary for site Low Gap Creek.....	18
Table A5: Stream habitat survey summary for site Big Leatherwood Creek.....	19
Table A6: Stream habitat survey summary for site Middle Fork Broad River.....	20
Table A7: Stream habitat survey summary for site North Fork Broad River.....	21
Table A8: Stream habitat survey summary for site Cutting Bone Creek.....	22
Table A9: Stream habitat survey summary for site Gold Mine Branch.....	23
Table A10: Stream habitat survey summary for site Law Ground Creek (lower).....	24
Table A11: Stream habitat survey summary for site Law Ground Creek (upper).....	25
Table A12: Stream habitat survey summary for site Pounding Mill Creek (lower).....	26
Table A13: Stream habitat survey summary for site Pounding Mill Creek (upper).....	27
Appendix B: None	
Appendix C	
Table C1. Definitions of metrics used to interpret macroinvertebrate sample results.....	38
Table C2. Macroinvertebrates collected per site.....	39
Table C3. Metric results for macroinvertebrates collected per site.....	41

List of Figures

Figure 1: Map of macroinvertebrate sample site locations 9

Appendix B

Figure B1: Substrate occurrence for site Chattahoochee River (lower) 29

Figure B2: Substrate occurrence for site Jasus Creek 29

Figure B3: Substrate occurrence for site Low Gap Creek 30

Figure B4: Substrate occurrence for site Middle Fork Broad River 30

Figure B5: Substrate occurrence for site North Fork Broad River 31

Figure B6: Substrate occurrence for site Cutting Bone Creek 31

Figure B7: Substrate occurrence for site Gold Mine Branch 32

Figure B8: Substrate occurrence for site Law Ground Creek (lower) 33

Figure B9: Substrate occurrence for site Law Ground Creek (upper) 33

Figure B10: Substrate occurrence for site Pounding Mill Creek (lower) 34

Figure B11: Substrate occurrence for site Pounding Mill Creek (upper) 34

Introduction

In the past, resource managers of the Chattahoochee-Oconee National Forest (CONF) have used aquatic benthic macroinvertebrate communities as biological indicators to assess and monitor the health of wadeable streams within the forest (Whalen et al. 2002). The CONF requested the USFS Southern Research Station Center for Aquatic Technology Transfer (CATT) assist in collecting macroinvertebrate samples during the spring of 2002 to continue the ongoing stream monitoring process. Stream habitat and pebble count information associated with the macroinvertebrate samples were collected to describe the conditions of the sample locations.

Study Sites

Aquatic benthic macroinvertebrate samples were collected in ten streams (at thirteen separate sites) of the CONF during April 2002 (Figure 1, Table 1). Three streams with a total of four sites were located in the headwaters of the Chattahoochee River. Three streams with one site each were located in the headwaters of the Broad River watershed. Four streams with a total of six sites were located in the headwaters of the Chattooga River watershed.

Methods

Macroinvertebrates

Macroinvertebrate samples were collected using a methodology developed in collaboration with Dr. Reese Voshell, Department of Entomology, Virginia Polytechnic Institute and State University (Roghair et al. 2002). A 100 m-long sample site was randomly selected from within the first 100 m of stream (typically starting at a confluence, Forest Service boundary, or landmark). Samples were collected every three meters within the 100 m sample site, for a total of 33 samples per site. A random numbers table was used to determine the location of the sample within the wetted channel (distance from right bank) for each of the 33 samples. All 33 samples collected within the 100 m reach were combined to form a single composite sample for each site.

Samples were collected by a two-person crew using a D-frame dipnet. One individual held the dipnet with the opening facing upstream and timed the second individual, who disturbed the substrate within a 0.3 m² area in front of the dipnet. If the substrate in front of the net was completely sand, it was agitated to a depth of 5-10 cm (finger length) for 5 seconds. All other samples were collected by disturbing the area in front of the net for 15 seconds; cobbles, boulders, woody debris, and large organic materials were lifted and thoroughly rubbed, and smaller substrates were agitated, taking care to sweep sample materials into the dipnet.

When possible GPS points were recorded using a Garmin ColorTRAK handheld GPU at the start of each sample reach (Table 1). All points were recorded using the UTM coordinates system and NAD 27 CONUS map datum.

Habitat

Stream habitat was inventoried in each 100 m sample reach using a modified version of the basin-wide visual estimation technique (BVET) (Dolloff et al. 1993). The type of each habit unit within the 100 m sample reach was identified and wetted width, average and maximum depth, dominant and subdominant substrates, and the degree to which substrates were embedded were visually estimated. Habitat unit types included pools, glides, riffles, runs, and cascades (Table 2). The length (0.1 m) of each habitat unit was measured with a hip chain and wetted width was visually estimated. Average depth of each habitat unit was estimated by taking depth measurements at various places across the channel profile with a graduated staff marked in 5 cm increments. Substrate was categorized into nine size classes (Table 3). Dominant substrate (covering the greatest surface area in unit) and subdominant substrate (covering the 2nd greatest surface area in unit) were visually estimated. The percent of the total substrate surface area that was embedded was visually estimated for each habitat unit. Substrate was considered embedded if clay, silt, or sand filled the interstitial spaces between larger substrate. Large woody debris (LWD) within the bankfull stream channel was classified and inventoried for all sample reaches. LWD was divided into seven size categories (Table 4). All woody debris less than 1 m long and less than 5 cm in diameter was omitted from the survey.

Bank instability was visually estimated for both left and right banks. Bank instability was defined as the percent of the bank between the edge of the wetted channel and the top of the bankfull channel that consisted of erodible materials. Rosgen channel type for each sample reach was estimated visually based on channel type descriptions found in Rosgen (1996) (Table 5). All data were recorded using a Husky Fex21 data logger.

Substrate

Pebble count data were collected using methods described in Whalen et al. (2002) to characterize the substrate composition of sample reaches. Pebble counts were performed by walking perpendicular transects within the bankfull channel (Harrelson et al. 1994). The person walking the transect (caller) began at the edge of the bankfull channel on one side of the stream and walked heel-to-toe across the stream channel to the opposite bank. At each step the caller picked up the pebble at the tip of their toe and measured its intermediate axis. This procedure was repeated until 100 pebbles were measured. Due to difficulty in measuring their intermediate axis, clay, silt, sand, and bedrock were placed into categories (Table 6). If detritus, LWD, or other organic materials were encountered, the rock substrate found directly below them was sampled. All pebble counts were performed in riffles.

Results

Survey results are presented in the following appendices:

- A) Stream habitat survey summaries.
- B) Particle size distribution from pebble count data.
- C) Macroinvertebrate report, produced under supervision of Dr. Reese Voshell, Department of Entomology, Virginia Polytechnic Institute and State University, includes detailed sample and metric calculation results.

Pebbles counts were not collected at the sites Big Leatherwood Creek and Chattooga River (upper) due to time constraints. GPS points were not recorded at the Low Gap Creek site due to lack of satellite signal.

Conclusion

The sampling of the CONF streams was intended to provide baseline information on the condition of stream macroinvertebrate communities. Resource managers can use this information to evaluate overall stream health and the effects of management activities in forest watersheds. Sample site locations and descriptions are provided along with stream channel characteristics allowing the monitoring of macroinvertebrate communities at the same sites over time or comparisons to similar stream reaches within the forest.

We recommend the CONF continue to collect macroinvertebrate samples in a similar manner to provide resource managers with valuable inventory and monitoring information.

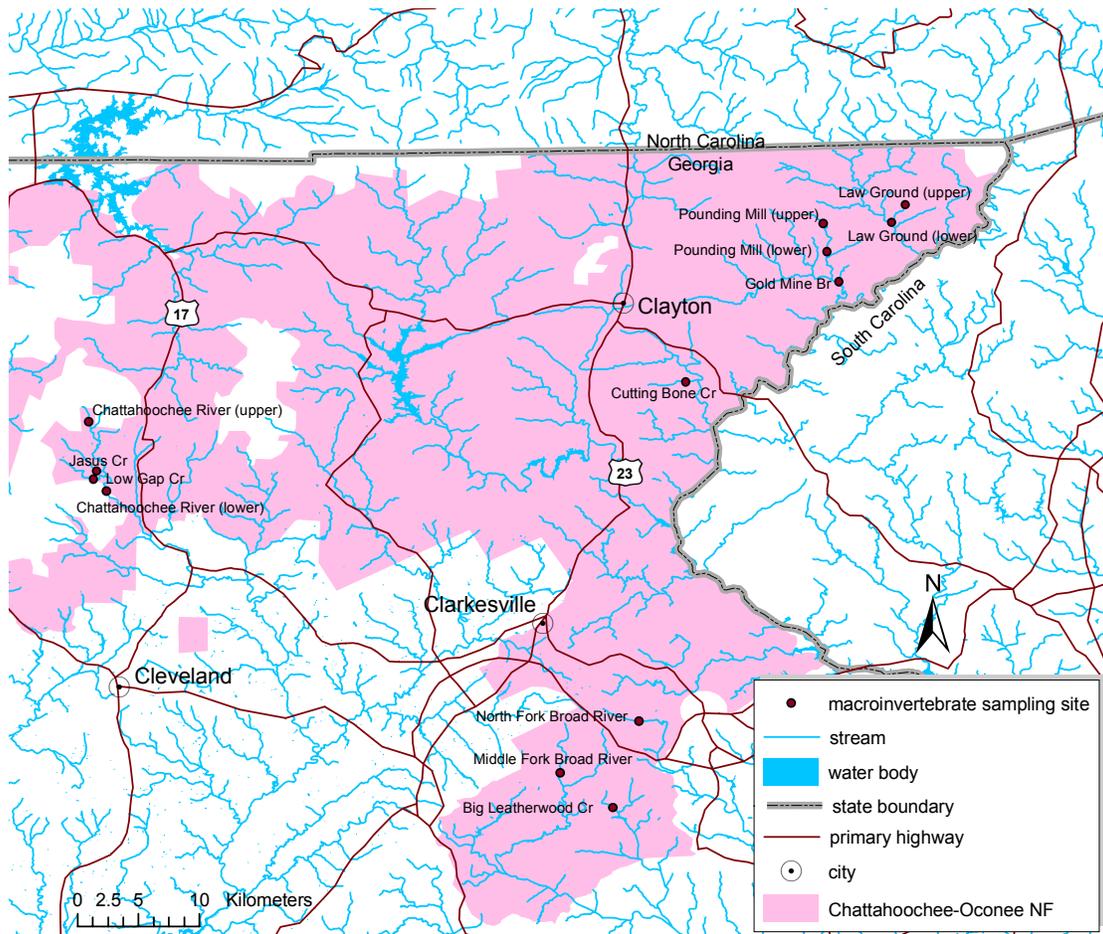


Figure 1: Map of macroinvertebrate sample site locations, April 2002.

Table 1. Description of macroinvertebrate sample site locations, Chatthahoochee-Oconee NF, April, 2002. NR = not recorded.

Site	Watershed	UTM Coordinates		USGS Quadrangle	Comments
		East	North		
Chattahoochee River (lower)	Chattahoochee River	246180	3847419	Cowrock	Site started approximately 400 m upstream of FS Rd 52 E bridge crossing.
Chattahoochee River (upper)	Chattahoochee River	245071	3853507	Jacks Gap	Site started 59 m upstream of Horse Trough Falls trail footbridge. Accessed from campground.
Jasus Creek	Chattahoochee River	245549	3849420	Jacks Gap	Site started approximately 250 m downstream of FS Rd 52 bridge crossing.
Low Gap Creek	Chattahoochee River	NR	NR	Jacks Gap	Site started approximately 800 m downstream of FS Rd 52 bridge crossing. Site is between bridge and confluence w/ Chattahoochee River
Big Leatherwood Creek	Broad River	279838	3820854	Ayersville	Accessed from FS 389-A. Site adjacent to old timber sale.
Middle Fork Broad River	Broad River	276327	3823793	Ayersville	Site started approximately 180 m upstream of FS Rd 89 ford and Toccoa pumping station.
North Fork Broad River	Broad River	281767	3827906	Ayersville	Site started 50 m upstream of railroad trestle. Accessed site from railroad tracks.
Cutting Bone Creek	Chattooga River	285608	3855725	Rainy Mountain	Site started 40 m upstream of old ford. Site located between 2 pieces of private property.
Gold Mine Branch	Chattooga River	296155	3863710	Satolah	Site started 33 m upstream of unnamed tributary. Accessed from FS Rd 157, horse trail.
Law Ground Creek (lower)	Chattooga River	299798	3868496	Satolah	Site started 111 m upstream of County Rd S884 crossing. Just above confluence w/ WF Chattooga River.
Law Ground Creek (upper)	Chattooga River	300770	3869951	Satolah	Site started approximately 800 m Rd distance upstream of highway 28 crossing. Site starts at top of bedrock cascade.
Pounding Mill Creek (lower)	Chattooga River	295294	3866278	Satolah	Site started 13 m upstream of FS boundary. Accessed from Hale Ridge Rd (FS Rd 7).
Pounding Mill Creek (upper)	Chattooga River	295171	3868534	Satolah	Start 205 m upstream of Hale Ridge Rd crossing (FS Rd 7).

Table 2. Description of habitat types used during BVET habitat surveys on Chattahoochee-Oconee NF, April, 2002, modified from Armantrout (1998).

Habitat Type	Stream Bed Profile	Gradient (%)	Surface Turbulence	Water Velocity
Pool	concave	<1	none	low
Glide	flat	<1	none	low
Run	flat	>1	low to none	high
Riffle	convex	>1	moderate to high	high
Cascade	convex	>12%	very high	very high

Table 3. Substrate size classes used during BVET habitat surveys on Chattahoochee-Oconee NF, April, 2002, based on modified Wentworth scale. Diameter was visually estimated for the intermediate axis.

Size Class	Class Name	Diameter (mm)
1	organic debris	--
2	clay	< 0.00024
3	silt	0.00024-0.0039
4	sand	0.0039-2
5	small gravel	3-16
6	large gravel	17-64
7	cobble	65-256
8	boulder	>256
9	bedrock	--

Table 4. Large woody debris (LWD) size classes used during BVET habitat surveys on Chattahoochee-Oconee NF, April, 2002. Diameter was measured at thickest portion of LWD piece. All woody debris less than 1 m long and less than 5 cm in diameter were omitted from the survey.

Size Class	Length (m)	Diameter (cm)
1	< 5	5 – 10
2	< 5	10 – 50
3	< 5	> 50
4	> 5	5 – 10
5	> 5	10 – 50
6	> 5	> 50
7	rootwad	rootwad

Table 5. Rosgen (1996) channel type descriptions used during BVET habitat surveys on Chattahoochee-Oconee NF, April, 2002.

	A	B	C	D	E	F	G
Entrenchment	< 1.4	1.4 – 2.2	> 2.2	n/a	> 2.2	< 1.4	< 1.4
W/D Ratio	< 12	> 12	> 12	> 40	< 12	> 12	< 12
Sinuosity	1 – 1.2	> 1.2	> 1.2	n/a	> 1.5	> 1.2	> 1.2
Slope	.04 - .099	.02 – 0.39	< .02	< .04	< .02	< .02	.02 - .039

Table 6. Substrate size classes used during pebble count surveys on Chattahoochee-Oconee NF, April, 2002. Diameter was measured on the intermediate axis.

Size Class	Diameter (mm)
Clay	< 0.002
Silt	0.002 – 0.05
Sand	0.05 – 2
small gravel	3 – 8
large gravel	9 – 64
small cobble	65 – 128
large cobble	129 – 256
small boulder	257 – 512
medium boulder	513 – 1024
large boulder	> 1024
bedrock	solid parent material

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Appendix A: Stream Habitat Survey Summaries

Table A1: Stream habitat survey summary for macroinvertebrate site Chattahoochee River (lower).

Site:	Chattahoochee River (lower)		
District:	Chattooga		
Quadrangle:	Cowrock		
Survey Date:	04/04/02		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	48		
Number of Pools:	2		
Total Pool Area (m ²):	632		
Mean Pool Area (m ²):	316		
Mean Maximum Depth (cm):	110		
Mean Average Depth (cm):	70		
Mean % Embeddedness (Pools):	25		
Percent of Total Area Riffles:	52		
Number of Riffles:	3		
Total Riffle Area (m ²):	678		
Mean Riffle Area (m ²):	226		
Mean Maximum Depth (cm):	67		
Mean Average Depth (cm):	42		
Mean % Embeddedness (Riffles):	15		
Number of LWD pieces per 100 m:	4		
LWD < 5 m, 5-10 cm:	1		
LWD < 5 m, 10-50 cm:	1		
LWD < 5 m, > 50 cm:	0		
LWD > 5 m, 5-10 cm:	0		
LWD > 5 m, 10-50 cm:	2		
LWD > 5 m, > 50 cm:	0		
Rootwad:	0		
Mean Wetted Channel Width (m):	13		
Rosgen Channel Type:	B		
Mean % Bank Unstable (Left)	13		
Mean % Bank Unstable (Right)	0		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
Riffle	1	8	7
Pool	1	8	6
Riffle	2	9	4
Pool	2	9	5
Riffle	3	9	7

Table A2: Stream habitat survey summary for macroinvertebrate site Chattahoochee River (upper).

Site:	Chattahoochee River (upper)
District:	Chattooga
Quadrangle:	Jacks Gap
Survey Date:	04/04/02
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	25
Number of Pools:	1
Total Pool Area (m ²):	144
Mean Pool Area (m ²):	144
Mean Maximum Depth (cm):	105
Mean Average Depth (cm):	75
Mean % Embeddedness (Pools):	5
Percent of Total Area Riffles:	75
Number of Riffles:	3
Total Riffle Area (m ²):	425
Mean Riffle Area (m ²):	142
Mean Maximum Depth (cm):	35
Mean Average Depth (cm):	18
Mean % Embeddedness (Riffles):	15
Number of LWD pieces per 100 m:	55
LWD < 5 m, 5-10 cm:	17
LWD < 5 m, 10-50 cm:	31
LWD < 5 m, > 50 cm:	0
LWD > 5 m, 5-10 cm:	0
LWD > 5 m, 10-50 cm:	7
LWD > 5 m, > 50 cm:	0
Rootwad:	0
Mean Wetted Channel Width (m):	7
Rosgen Channel Type:	B
Mean % Bank Unstable (Left)	10
Mean % Bank Unstable (Right)	0

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
Riffle	1	7	6
Run	2	7	8
Riffle	3	8	7
Pool	1	9	6

Table A3: Stream habitat survey summary for macroinvertebrate site Jasus Creek.

Site:	Jasus Creek
District:	Chattooga
Quadrangle:	Jacks Gap
Survey Date:	04/04/02
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	16
Number of Pools:	1
Total Pool Area (m ²):	86
Mean Pool Area (m ²):	86
Mean Maximum Depth (cm):	60
Mean Average Depth (cm):	30
Mean % Embeddedness (Pools):	10
Percent of Total Area Riffles:	84
Number of Riffles:	2
Total Riffle Area (m ²):	456
Mean Riffle Area (m ²):	228
Mean Maximum Depth (cm):	30
Mean Average Depth (cm):	13
Mean % Embeddedness (Riffles):	13
Number of LWD pieces per 100 m:	5
LWD < 5 m, 5-10 cm:	0
LWD < 5 m, 10-50 cm:	1
LWD < 5 m, > 50 cm:	0
LWD > 5 m, 5-10 cm:	0
LWD > 5 m, 10-50 cm:	3
LWD > 5 m, > 50 cm:	0
Rootwad:	1
Mean Wetted Channel Width (m):	5
Rosgen Channel Type:	B
Mean % Bank Unstable (Left)	0
Mean % Bank Unstable (Right)	17

Habitat type	Unit Number	Dominant Substrate	Subdominant Substrate
Riffle	1	7	9
Pool	1	9	7
Riffle	2	7	8

Table A4: Stream habitat survey summary for macroinvertebrate site Low Gap Creek.

Site:	Low Gap Creek
District:	Chattooga
Quadrangle:	Jacks Gap
Survey Date:	04/04/02
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	26
Number of Pools:	2
Total Pool Area (m ²):	151
Mean Pool Area (m ²):	75
Mean Maximum Depth (cm):	75
Mean Average Depth (cm):	50
Mean % Embeddedness (Pools):	5
Percent of Total Area Riffles:	74
Number of Riffles:	4
Total Riffle Area (m ²):	428
Mean Riffle Area (m ²):	107
Mean Maximum Depth (cm):	48
Mean Average Depth (cm):	29
Mean % Embeddedness (Riffles):	4
Number of LWD pieces per 100 m:	52
LWD < 5 m, 5-10 cm:	22
LWD < 5 m, 10-50 cm:	23
LWD < 5 m, > 50 cm:	0
LWD > 5 m, 5-10 cm:	2
LWD > 5 m, 10-50 cm:	5
LWD > 5 m, > 50 cm:	0
Rootwad:	0
Mean Wetted Channel Width (m):	6
Rosgen's Channel Type:	B
Mean % Bank Unstable (Left)	1
Mean % Bank Unstable (Right)	4

Habitat type	Unit Number	Dominant Substrate	Subdominant Substrate
Riffle	1	8	7
Run	2	6	7
Riffle	3	8	6
Pool	1	9	6
Pool	2	9	8
Riffle	4	9	6

Table A5: Stream habitat survey summary for macroinvertebrate site Big Leatherwood Creek.

Site:	Big Leatherwood Creek
District:	Chattooga
Quadrangle:	Ayersville
Survey Date:	04/03/02
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	80
Number of Pools:	5
Total Pool Area (m ²):	218
Mean Pool Area (m ²):	44
Mean Maximum Depth (cm):	72
Mean Average Depth (cm):	42
Mean % Embeddedness (Pools):	80
Percent of Total Area Riffles:	20
Number of Riffles:	2
Total Riffle Area (m ²):	55
Mean Riffle Area (m ²):	28
Mean Maximum Depth (cm):	25
Mean Average Depth (cm):	18
Mean % Embeddedness (Riffles):	25
Number of LWD pieces per 100 m:	37
LWD < 5 m, 5-10 cm:	15
LWD < 5 m, 10-50 cm:	18
LWD < 5 m, > 50 cm:	0
LWD > 5 m, 5-10 cm:	0
LWD > 5 m, 10-50 cm:	3
LWD > 5 m, > 50 cm:	0
Rootwad:	1
Mean Wetted Channel Width (m):	3
Rosgen's Channel Type:	G
Mean % Bank Unstable (Left)	49
Mean % Bank Unstable (Right)	34

Habitat type	Unit Number	Dominant Substrate	Subdominant Substrate
Pool	1	4	1
Pool	2	6	5
Pool	3	4	1
Riffle	1	6	5
Pool	4	5	6
Riffle	2	5	6
Pool	5	4	5

Table A6: Stream habitat survey summary for macroinvertebrate site Middle Fork Broad River.

Site:	Middle Fork Broad River
District:	Chattooga
Quadrangle:	Ayersville
Survey Date:	04/03/02
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	36
Number of Pools:	3
Total Pool Area (m ²):	183
Mean Pool Area (m ²):	61
Mean Maximum Depth (cm):	47
Mean Average Depth (cm):	27
Mean % Embeddedness (Pools):	97
Percent of Total Area Riffles:	64
Number of Riffles:	5
Total Riffle Area (m ²):	324
Mean Riffle Area (m ²):	65
Mean Maximum Depth (cm):	32
Mean Average Depth (cm):	23
Mean % Embeddedness (Riffles):	65
Number of LWD pieces per 100 m:	10
LWD < 5 m, 5-10 cm:	7
LWD < 5 m, 10-50 cm:	3
LWD < 5 m, > 50 cm:	0
LWD > 5 m, 5-10 cm:	0
LWD > 5 m, 10-50 cm:	0
LWD > 5 m, > 50 cm:	0
Rootwad:	0
Mean Wetted Channel Width (m):	5
Rosgen's Channel Type:	B
Mean % Bank Unstable (Left)	13
Mean % Bank Unstable (Right)	13

Habitat type	Unit Number	Dominant Substrate	Subdominant Substrate
Run	1	4	7
Riffle	2	7	4
Pool	1	4	5
Riffle	3	7	8
Run	4	8	4
Pool	2	4	8
Riffle	5	7	4
Pool	3	4	8

Table A7: Stream habitat survey summary for macroinvertebrate site North Fork Broad River.

Site:	North Fork Broad River
District:	Chattooga
Quadrangle:	Ayersville
Survey Date:	04/03/02
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	52
Number of Pools:	4
Total Pool Area (m ²):	283
Mean Pool Area (m ²):	71
Mean Maximum Depth (cm):	55
Mean Average Depth (cm):	21
Mean % Embeddedness (Pools):	0
Percent of Total Area Riffles:	48
Number of Riffles:	3
Total Riffle Area (m ²):	260
Mean Riffle Area (m ²):	87
Mean Maximum Depth (cm):	18
Mean Average Depth (cm):	8
Mean % Embeddedness (Riffles):	50
Number of LWD pieces per 100 m:	12
LWD < 5 m, 5-10 cm:	1
LWD < 5 m, 10-50 cm:	6
LWD < 5 m, > 50 cm:	0
LWD > 5 m, 5-10 cm:	1
LWD > 5 m, 10-50 cm:	2
LWD > 5 m, > 50 cm:	1
Rootwad:	1
Mean Wetted Channel Width (m):	5
Rosgen's Channel Type:	C
Mean % Bank Unstable (Left)	49
Mean % Bank Unstable (Right)	67

Habitat type	Unit Number	Dominant Substrate	Subdominant Substrate
Riffle	1	6	4
Pool	1	4	7
Riffle	2	9	5
Pool	2	4	1
Pool	3	4	1
Pool	4	4	1
Riffle	3	4	5

Table A8: Stream habitat survey summary for macroinvertebrate site Cutting Bone Creek.

Site:	Cutting Bone Creek
District:	Tallulah
Quadrangle:	Rainy Mountain
Survey Date:	04/03/02
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	57
Number of Pools:	6
Total Pool Area (m ²):	228
Mean Pool Area (m ²):	38
Mean Maximum Depth (cm):	48
Mean Average Depth (cm):	29
Mean % Embeddedness (Pools):	37
Percent of Total Area Riffles:	43
Number of Riffles:	4
Total Riffle Area (m ²):	173
Mean Riffle Area (m ²):	43
Mean Maximum Depth (cm):	31
Mean Average Depth (cm):	20
Mean % Embeddedness (Riffles):	18
Number of LWD pieces per 100 m:	14
LWD < 5 m, 5-10 cm:	5
LWD < 5 m, 10-50 cm:	3
LWD < 5 m, > 50 cm:	0
LWD > 5 m, 5-10 cm:	2
LWD > 5 m, 10-50 cm:	1
LWD > 5 m, > 50 cm:	3
Rootwad:	0
Mean Wetted Channel Width (m):	4
Rosgen's Channel Type:	B
Mean % Bank Unstable (Left)	0
Mean % Bank Unstable (Right)	0

Habitat type	Unit Number	Dominant Substrate	Subdominant Substrate
Pool	1	4	7
Riffle	1	7	4
Pool	2	4	7
Riffle	2	7	5
Pool	3	4	7
Riffle	3	7	6
Pool	4	7	4
Pool	5	4	5
Riffle	4	5	4
Pool	6	5	4

Table A9: Stream habitat survey summary for macroinvertebrate site Gold Mine Branch.

Site:	Gold Mine Branch
District:	Tallulah
Quadrangle:	Satolah
Survey Date:	04/05/02
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	64
Number of Pools:	6
Total Pool Area (m ²):	211
Mean Pool Area (m ²):	35
Mean Maximum Depth (cm):	36
Mean Average Depth (cm):	16
Mean % Embeddedness (Pools):	33
Percent of Total Area Riffles:	36
Number of Riffles:	5
Total Riffle Area (m ²):	117
Mean Riffle Area (m ²):	23
Mean Maximum Depth (cm):	18
Mean Average Depth (cm):	12
Mean % Embeddedness (Riffles):	28
Number of LWD pieces per 100 m:	33
LWD < 5 m, 5-10 cm:	8
LWD < 5 m, 10-50 cm:	0
LWD < 5 m, > 50 cm:	1
LWD > 5 m, 5-10 cm:	6
LWD > 5 m, 10-50 cm:	8
LWD > 5 m, > 50 cm:	9
Rootwad:	1
Mean Wetted Channel Width (m):	3
Rosgen's Channel Type:	C
Mean % Bank Unstable (Left)	75
Mean % Bank Unstable (Right)	25

Habitat type	Unit Number	Dominant Substrate	Subdominant Substrate
Pool	1	4	5
Run	1	5	4
Pool	2	4	5
Riffle	2	6	5
Pool	3	5	4
Pool	4	4	5
Run	3	4	5
Pool	5	4	5
Run	4	4	5
Run	5	7	4

Table A10: Stream habitat survey summary for macroinvertebrate site Law Ground Creek (lower).

Site:	Law Ground Creek (lower)
District:	Tallulah
Quadrangle:	Satolah
Survey Date:	04/02/02
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	39
Number of Pools:	8
Total Pool Area (m ²):	74
Mean Pool Area (m ²):	9
Mean Maximum Depth (cm):	31
Mean Average Depth (cm):	20
Mean % Embeddedness (Pools):	97
Percent of Total Area Riffles:	61
Number of Riffles:	8
Total Riffle Area (m ²):	116
Mean Riffle Area (m ²):	14
Mean Maximum Depth (cm):	14
Mean Average Depth (cm):	9
Mean % Embeddedness (Riffles):	51
Number of LWD pieces per 100 m:	26
LWD < 5 m, 5-10 cm:	12
LWD < 5 m, 10-50 cm:	13
LWD < 5 m, > 50 cm:	0
LWD > 5 m, 5-10 cm:	0
LWD > 5 m, 10-50 cm:	1
LWD > 5 m, > 50 cm:	0
Rootwad:	0
Mean Wetted Channel Width (m):	2
Rosgen's Channel Type:	F
Mean % Bank Unstable (Left)	28
Mean % Bank Unstable (Right)	18

Habitat type	Unit Number	Dominant Substrate	Subdominant Substrate
Pool	1	4	5
Riffle	1	6	5
Pool	2	4	6
Pool	3	4	5
Riffle	2	5	6
Pool	4	4	3
Run	3	6	4
Pool	5	4	5
Pool	6	4	5
Riffle	4	6	4
Run	5	4	5
Pool	7	4	5
Riffle	6	6	5
Run	7	6	4
Riffle	8	7	6
Pool	8	4	6

Table A11: Stream habitat survey summary for macroinvertebrate site Law Ground Creek (upper).

Site:	Law Ground Creek (upper)
District:	Tallulah
Quadrangle:	Satolah
Survey Date:	04/05/02
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	31
Number of Pools:	4
Total Pool Area (m ²):	54
Mean Pool Area (m ²):	14
Mean Maximum Depth (cm):	31
Mean Average Depth (cm):	13
Mean % Embeddedness (Pools):	58
Percent of Total Area Riffles:	69
Number of Riffles:	4
Total Riffle Area (m ²):	121
Mean Riffle Area (m ²):	30
Mean Maximum Depth (cm):	23
Mean Average Depth (cm):	10
Mean % Embeddedness (Riffles):	46
Number of LWD pieces per 100 m:	27
LWD < 5 m, 5-10 cm:	14
LWD < 5 m, 10-50 cm:	0
LWD < 5 m, > 50 cm:	2
LWD > 5 m, 5-10 cm:	1
LWD > 5 m, 10-50 cm:	4
LWD > 5 m, > 50 cm:	6
Rootwad:	0
Mean Wetted Channel Width (m):	2
Rosgen's Channel Type:	A
Mean % Bank Unstable (Left)	40
Mean % Bank Unstable (Right)	10

Habitat type	Unit Number	Dominant Substrate	Subdominant Substrate
Pool	1	4	5
Riffle	1	6	5
Pool	2	4	6
Pool	3	4	5
Riffle	2	5	6
Pool	4	4	3
Run	3	6	4
Pool	5	4	5
Pool	6	4	5
Riffle	4	6	4
Run	5	4	5
Pool	7	4	5
Riffle	6	6	5
Run	7	6	4
Riffle	8	7	6
Pool	8	4	6

Table A12: Stream habitat survey summary for macroinvertebrate site Pounding Mill Creek (lower).

Site:	Pounding Mill Creek (lower)
District:	Tallulah
Quadrangle:	Satolah
Survey Date:	04/02/02
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	51
Number of Pools:	8
Total Pool Area (m ²):	148
Mean Pool Area (m ²):	19
Mean Maximum Depth (cm):	37
Mean Average Depth (cm):	22
Mean % Embeddedness (Pools):	39
Percent of Total Area Riffles:	49
Number of Riffles:	6
Total Riffle Area (m ²):	141
Mean Riffle Area (m ²):	24
Mean Maximum Depth (cm):	26
Mean Average Depth (cm):	14
Mean % Embeddedness (Riffles):	35
Number of LWD pieces per 100 m:	5
LWD < 5 m, 5-10 cm:	2
LWD < 5 m, 10-50 cm:	2
LWD < 5 m, > 50 cm:	0
LWD > 5 m, 5-10 cm:	1
LWD > 5 m, 10-50 cm:	0
LWD > 5 m, > 50 cm:	0
Rootwad:	0
Mean Wetted Channel Width (m):	3
Rosgen's Channel Type:	B, C
Mean % Bank Unstable (Left)	0
Mean % Bank Unstable (Right)	30

Habitat type	Unit Number	Dominant Substrate	Subdominant Substrate
Pool	1	4	1
Riffle	1	8	4
Pool	2	8	4
Riffle	2	8	4
Pool	3	4	8
Riffle	3	8	4
Pool	4	4	8
Riffle	4	8	7
Pool	5	8	4
Riffle	5	8	3
Pool	6	7	4
Riffle	6	8	7
Pool	7	4	8
Pool	8	8	4

Table A13: Stream habitat survey summary for macroinvertebrate site Pounding Mill Creek (upper).

Site:	Pounding Mill Creek (upper)
District:	Tallulah
Quadrangle:	Satolah
Survey Date:	04/02/02
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	49
Number of Pools:	6
Total Pool Area (m ²):	93
Mean Pool Area (m ²):	15
Mean Maximum Depth (cm):	26
Mean Average Depth (cm):	13
Mean % Embeddedness (Pools):	99
Percent of Total Area Riffles:	51
Number of Riffles:	7
Total Riffle Area (m ²):	95
Mean Riffle Area (m ²):	14
Mean Maximum Depth (cm):	19
Mean Average Depth (cm):	8
Mean % Embeddedness (Riffles):	71
Number of LWD pieces per 100 m:	43
LWD < 5 m, 5-10 cm:	24
LWD < 5 m, 10-50 cm:	16
LWD < 5 m, > 50 cm:	0
LWD > 5 m, 5-10 cm:	1
LWD > 5 m, 10-50 cm:	2
LWD > 5 m, > 50 cm:	0
Rootwad:	0
Mean Wetted Channel Width (m):	2
Rosgen's Channel Type:	B
Mean % Bank Unstable (Left)	16
Mean % Bank Unstable (Right)	26

Habitat type	Unit Number	Dominant Substrate	Subdominant Substrate
Pool	1	4	3
Pool	2	4	3
Riffle	1	7	9
Pool	3	4	3
Riffle	2	6	4
Pool	4	4	7
Riffle	3	6	4
Pool	5	4	3
Riffle	4	5	4
Glide	6	4	5
Riffle	5	7	4
Run	6	5	4
Riffle	7	7	4

Appendix B: Particle Size Distribution from Pebble Count Data

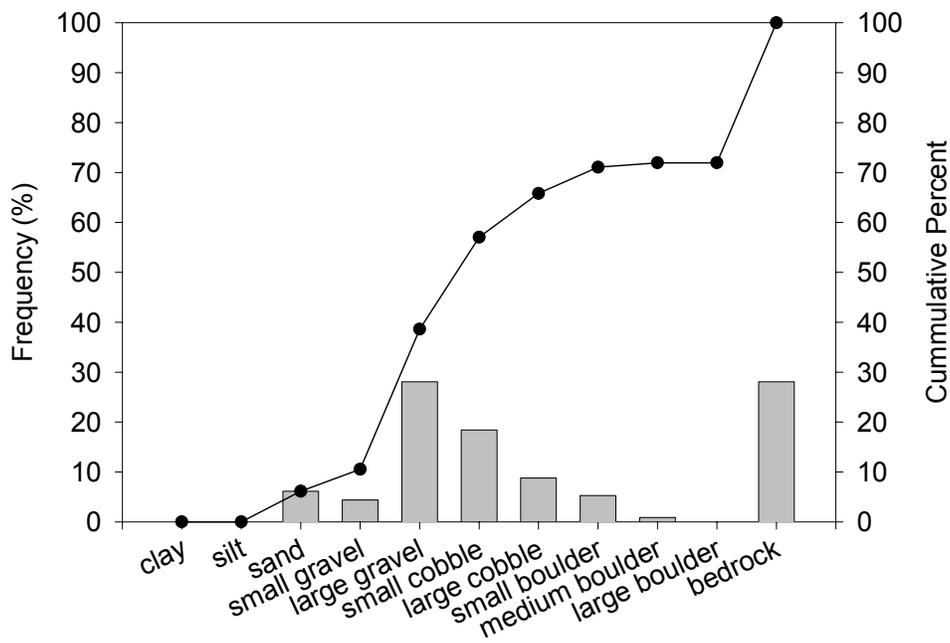


Figure B1: Frequency (percent) and cumulative percent of substrate occurrence for pebble counts performed in riffles at macroinvertebrate site Chattahoochee River (lower), April 2002. See Table 6 for category size classes.

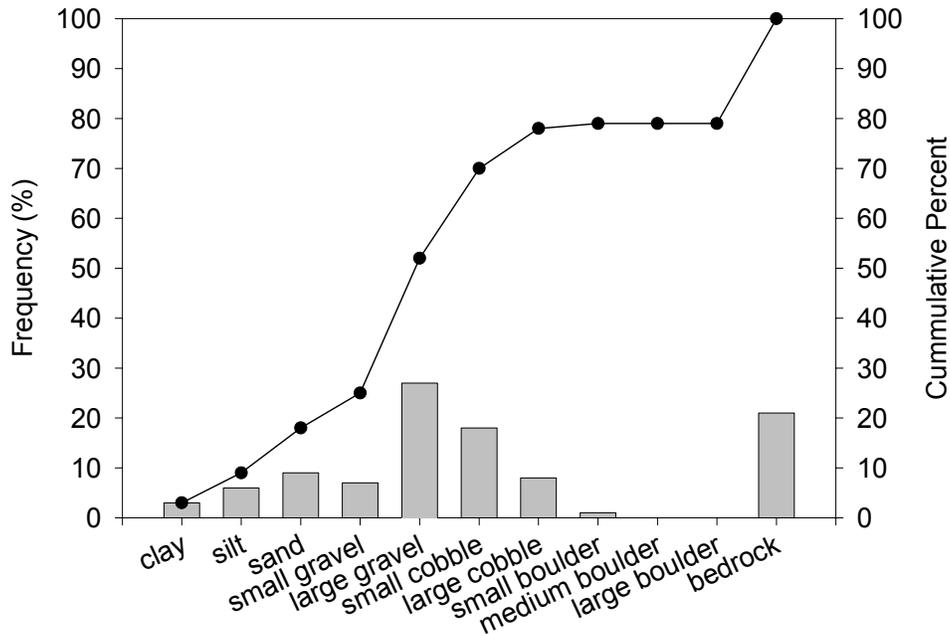


Figure B2: Frequency (percent) and cumulative percent of substrate occurrence for pebble counts performed in riffles at macroinvertebrate site Jasus Creek, April 2002. See Table 6 for category size classes.

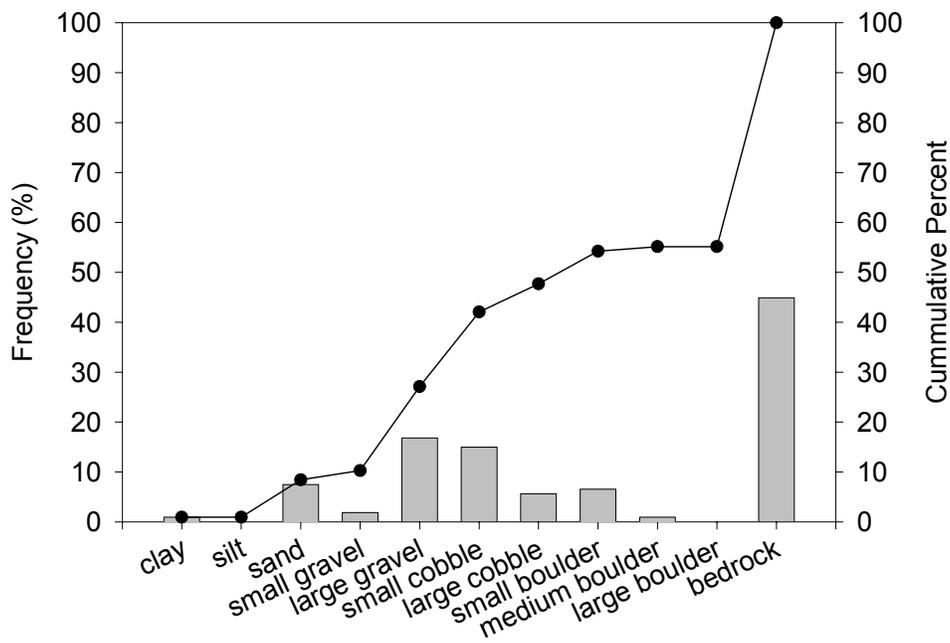


Figure B3: Frequency (percent) and cumulative percent of substrate occurrence for pebble counts performed in riffles at macroinvertebrate site Low Gap Creek, April 2002. See Table 6 for category size classes.

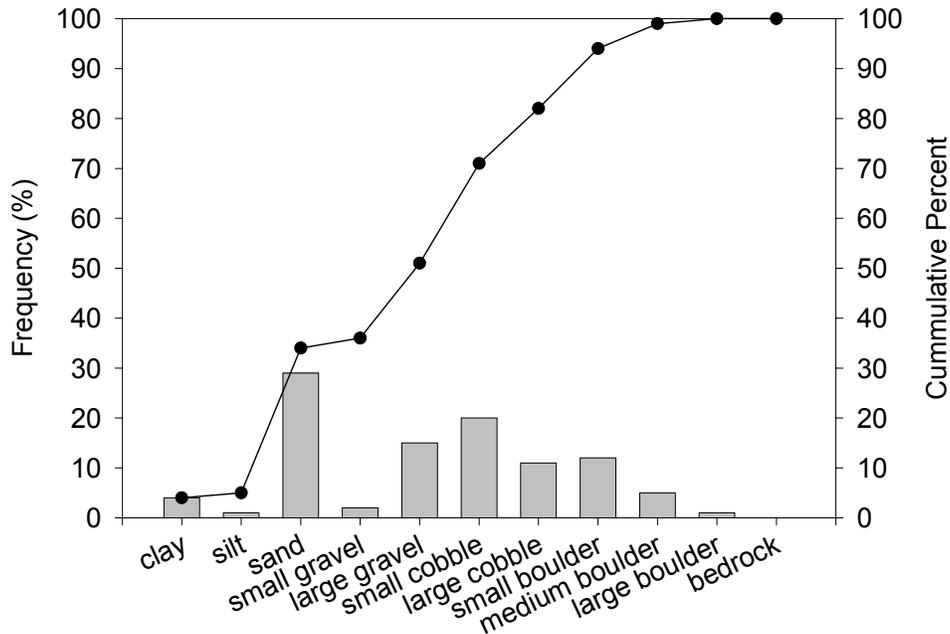


Figure B4: Frequency (percent) and cumulative percent of substrate occurrence for pebble counts performed in riffles at macroinvertebrate site Middle Fork Broad River, April 2002. See Table 6 for category size classes.

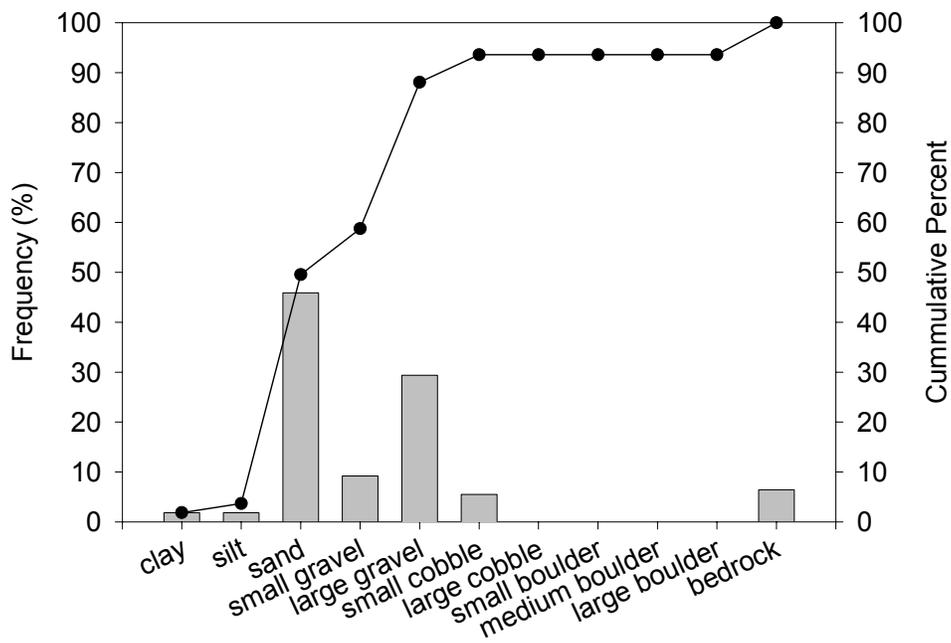


Figure B5: Frequency (percent) and cumulative percent of substrate occurrence for pebble counts performed in riffles at macroinvertebrate site North Fork Broad River, April 2002. See Table 6 for category size classes.

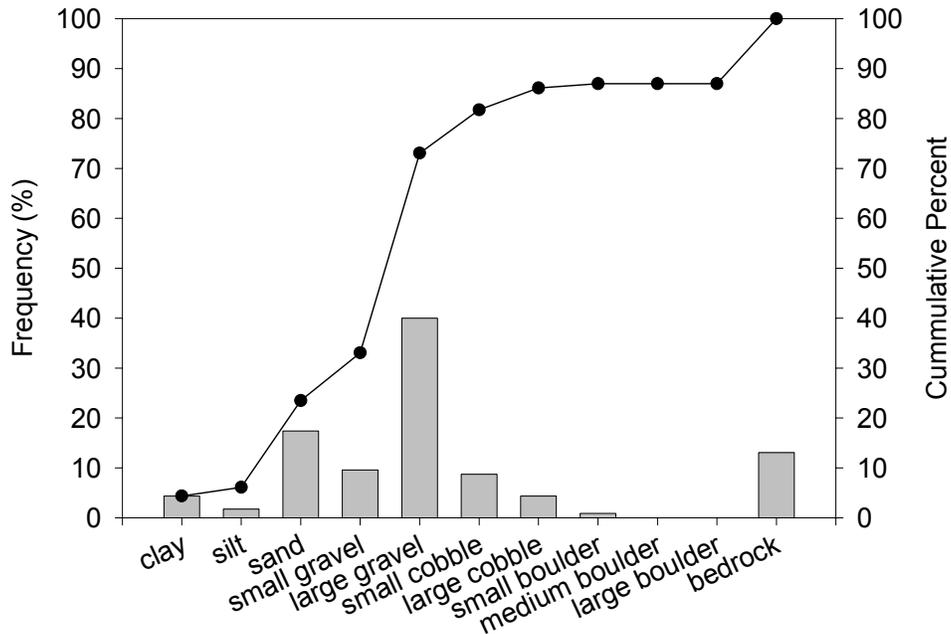


Figure B6: Frequency (percent) and cumulative percent of substrate occurrence for pebble counts performed in riffles at macroinvertebrate site Cutting Bone Creek, April 2002. See Table 6 for category size classes.

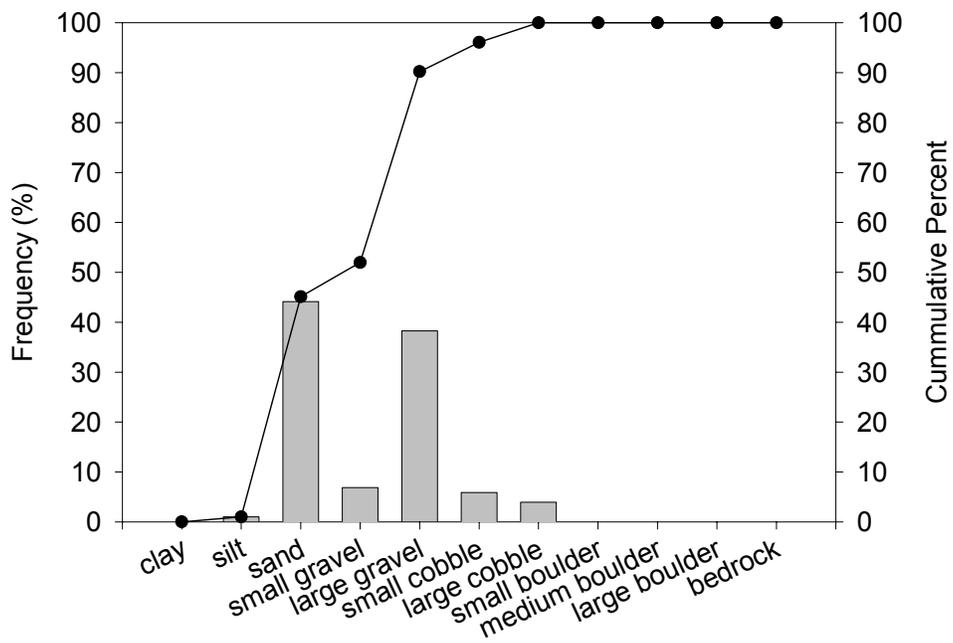


Figure B7: Frequency (percent) and cumulative percent of substrate occurrence for pebble counts performed in riffles at macroinvertebrate site Gold Mine Branch, April 2002. See Table 6 for category size classes.

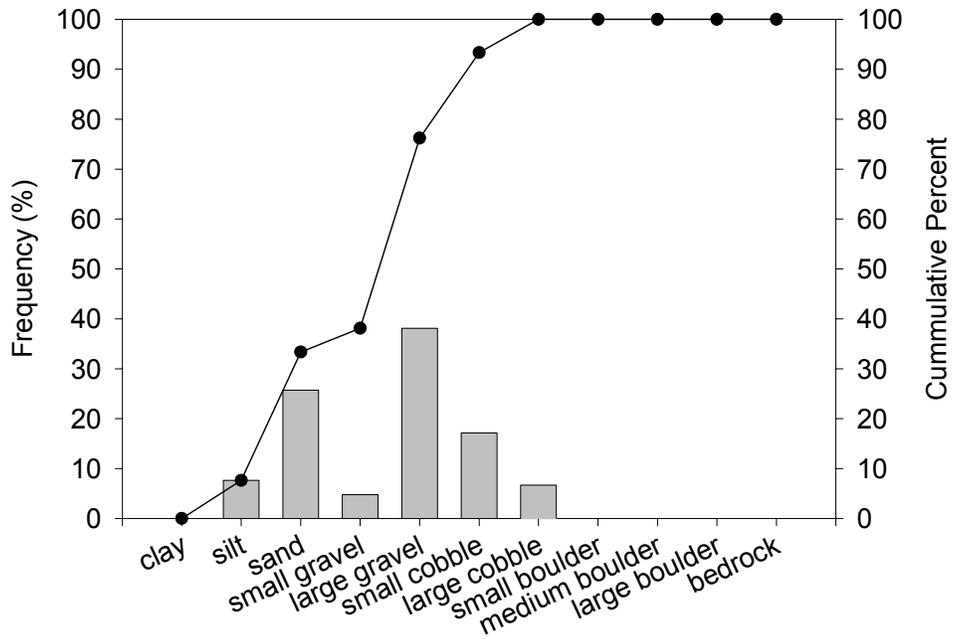


Figure B8: Frequency (percent) and cumulative percent of substrate occurrence for pebble counts performed in riffles at macroinvertebrate site Law Ground Creek (lower), April 2002. See Table 6 for category size classes.

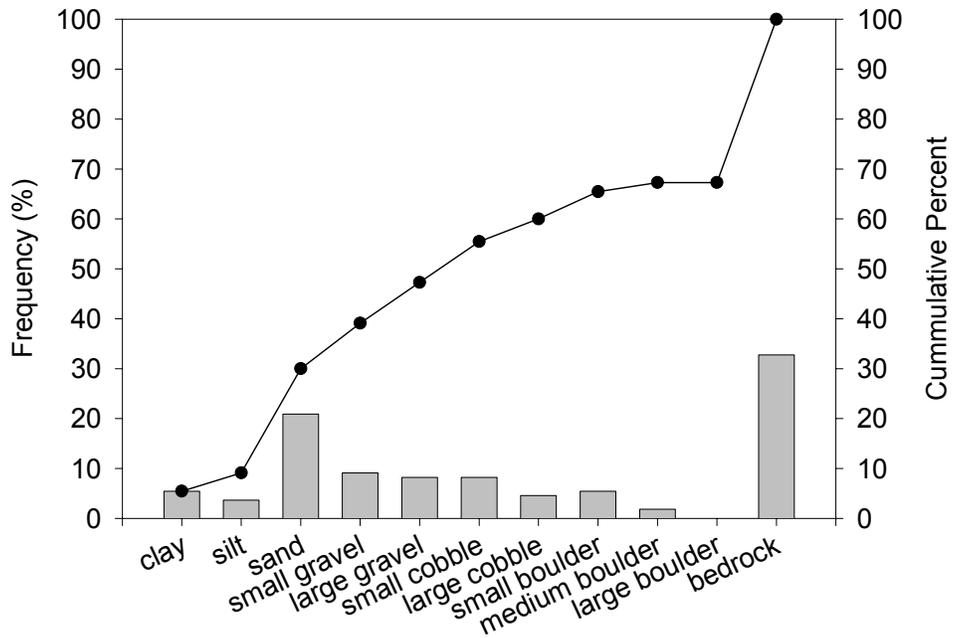


Figure B9: Frequency (percent) and cumulative percent of substrate occurrence for pebble counts performed in riffles at macroinvertebrate site Law Ground Creek (upper), April 2002. See Table 6 for category size classes.

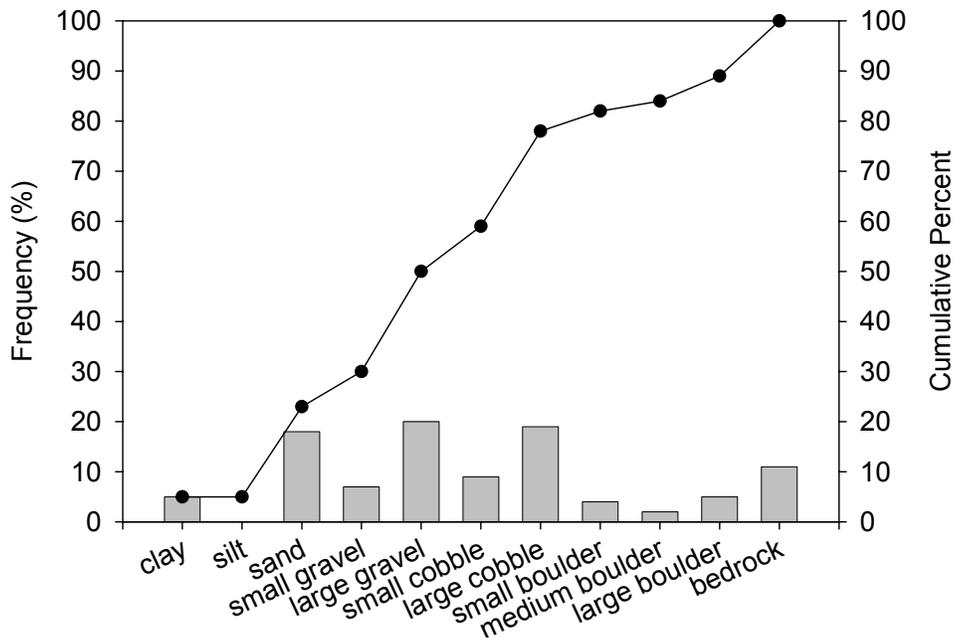


Figure B10: Frequency (percent) and cumulative percent of substrate occurrence for pebble counts performed in riffles at macroinvertebrate site Pounding Mill Creek (lower), April 2002. See Table 6 for category size classes.

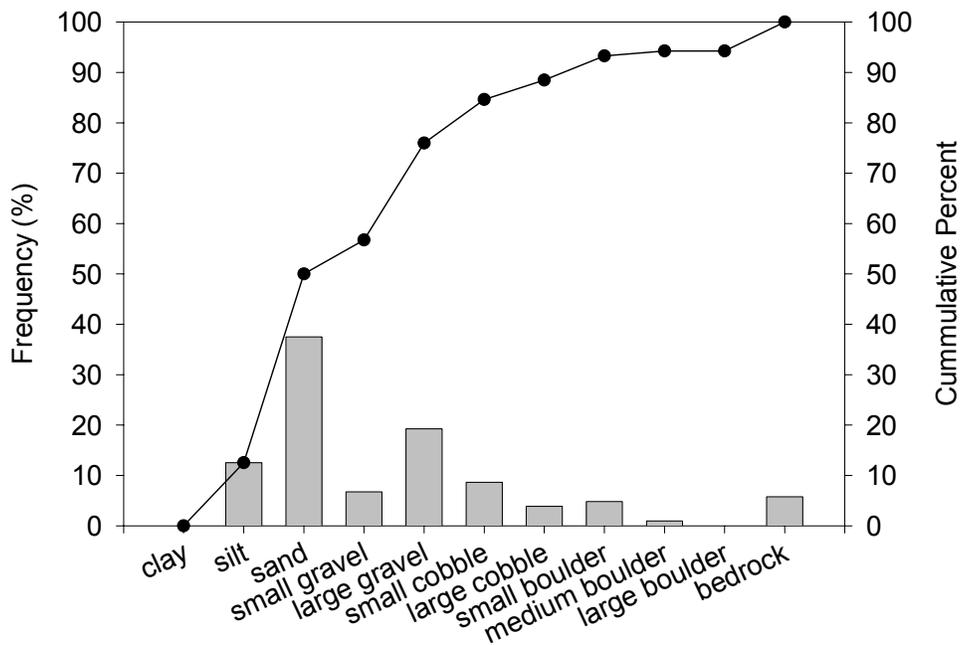


Figure B11: Frequency (percent) and cumulative percent of substrate occurrence for pebble counts performed in riffles at macroinvertebrate site Pounding Mill Creek (upper), April 2002. See Table 6 for category size classes.

Appendix C: Macroinvertebrate Report

INTERIM REPORT

Submitted: 31 March 2003

Macroinvertebrate Sample Analysis:
Spring 2003
USDA Forest Service
Southern Research Station (RWU4202)
Chattahoochee-Oconee National Forest

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In partial fulfillment of Agreement No. SRS 02-CA-11330139-295, USDA Forest Service, Southern Research Station (RWU4202), Virginia Tech Project No. 208-11-110A-007-332-1 and FRS No. 428030.

Samples of benthic macroinvertebrates that were collected in 2002 by the USDA Forest Service from the Chattahoochee-Oconee National Forest in Georgia were analyzed to the terms of the purchase order. Our analyses of each sample included:

- 1) washing fine detritus and preservative,
- 2) sorting and subsampling of 200 organisms from debris,
- 3) archiving of sample remains,
- 4) identifying all specimens to lowest possible taxonomic level,
- 5) enumerating specimens in each taxon,
- 6) recording counts, taxa names, and taxa codes on bench sheets
- 7) 17 metrics were calculated.
 - Total Taxa
 - Number of EPT Taxa
 - Number of Clinger Taxa
 - Percent Clingers
 - Percent 1 Dominant Taxon
 - Percent 2 Dominant Taxa
 - Percent Tolerant Organisms
 - Intolerant Taxa
 - Percent Diptera
 - Percent Chironomidae
 - Percent EPT
 - North Carolina Biotic Index (NCBI)
 - Percent Collectors
 - Percent Filterers
 - Percent Scrapers
 - Percent Shredders
 - Percent Predators

Taxonomic identifications were made by means of the following references:

Brigham, A. R., W. U. Brigham and A. Gnilka. Eds. 1982. Aquatic insects and oligochaetes of North and South Carolina. Midwest Aquatic Enterprises, Mahomet, Illinois.

Meritt, R. W. and K. W. Cummins, eds. 1984. An introduction to the aquatic insects of North America, 3rd ed. Kendall/Hunt, Dubuque, Iowa.

Pennak, R. W. 1989. Fresh-water invertebrates of the United States, 3rd ed. John Wiley and Sons, New York.

Stewart, K. W. and B. P. Stark. 1989. Nymphs of North American stonefly genera (Plecoptera). Volume 12, Thomas Say Foundation Series, Entomological Society of America, Hyattsville, Maryland.

Wiggins, G. B. 1996. Larvae of North American caddisfly genera (Trichoptera). 2nd ed. University of Toronto Press, Toronto, Ontario.

Each of the 13 samples has been stored in an individual vial. All samples will be returned to USDA Forest Service personnel.

Table C1. Definitions of metrics used to interpret macroinvertebrate sample results (adapted from Barbour et al. (1999)).

Metric	Definition
Total Number of Individuals	Count of total number of macroinvertebrates in sample; richness measure; generally decreases due to perturbation
Number of Taxa	Count of total number of different genera captured; richness measure; generally decreases due to perturbation
Number of EPT Taxa	Total number of Ephemeroptera, Plecoptera, and Tricoptera taxa collected; richness measure; generally decreases due to perturbation
Number of Clinger Taxa	Total number of taxa with 'clinger' habit (i.e. having fixed retreats or adaptations for attaching to surfaces in flowing water); habit measure; generally decreases due to perturbation
Percent Clingers	Percent of taxa with 'clinger' habit (i.e. having fixed retreats or adaptations for attaching to surfaces in flowing water); habit measure; generally decreases due to perturbation
Percent 1 Dominant Taxa	Number of individuals in the taxa with the greatest number of individuals divided by the total number of individuals; tolerance measure; generally increases due to perturbation
Percent 2 Dominant Taxa	Number of individuals in the two taxa with the greatest number of individuals divided by the total number of individuals; tolerance measure; generally increases due to perturbation
Percent Tolerant Organisms	Percent of individuals considered to be tolerant to various perturbations (here, rated >5 on scale from 0-10); tolerance measure; generally increases due to perturbation
Intolerant Taxa	Total number of genera considered to be sensitive to perturbation; tolerance measure; generally decreases due to perturbation
Percent Diptera	Number of 'true fly' individuals divided by total number of individuals; composition measure; generally increases due to perturbation
Percent Chironomidae	Total number of Chironomids divided by total number of individuals; composition measure; generally increases due to perturbation
Percent EPT	Total number of Ephemeroptera, Plecoptera, and Tricoptera divided by total number of individuals; composition measure; generally decreases due to perturbation
North Carolina Biotic Index	Index that evaluates biological health of stream based on macroinvertebrate community; rating based on scale from 0 to 10 with 0 representing the best water quality and 10 representing the worst
Percent Collectors	Total number of individuals that collect or gather fine particulate matter divided by total number of individuals; functional feeding group measure; variable response to perturbation
Percent Filterers	Total number of individuals that filter fine particulate matter divided by total number of individuals; functional feeding group measure; generally variable response to perturbation
Percent Scrapers	Total number of individuals that graze upon periphyton divided by total number of individuals; functional feeding group measure; variable response to perturbation
Percent Shredders	Total number of individuals that shred coarse particulate matter divided by total number of individuals; functional feeding group measure; variable response to perturbation
Percent Predators	Total number of individuals that feed on other organisms divided by total number of individuals; functional feeding group measure; variable response to perturbation

Table C2. Macroinvertebrates collected per site, Chattahoochee-Oconee NF, April, 2002.

Taxa	Gold Mine Br.	Jasus Cr.	Low Gap Cr.	Cutting Bone Cr.	Big Leatherwood Cr.	NF Broad River	MF Broad River	Pounding Mill Cr lwr	Pounding Mill Cr upr	Law Ground Cr lwr	Law Ground Cr upr	Chattahoochee R lwr	Chattahoochee R upr
Oligochaeta	4			17	13	16	13	4	4		1	2	2
Cambaridae			1	1		1	3						
Pteronarcys			1	1							2		3
Tallaperla		1						1	2		11		4
Amphinemura	17	3		1	2	7	2	5	4	4	5	1	12
Perlidae		1					1					3	5
Acroneuria	1	1	2	1			1	2		1		2	
Isoperla	3	3	3	4	1	4	1	2	1	10	3	1	6
Sweltsa	1			2		5			4		3	2	1
Suwallia							1						
Taeniopterygidae												1	
Leuctra	15	10	4	5		15	1	4	8	8	9	2	2
Ephemera				2	1	4	18	25	2	3	13	1	2
Hexagenia						4							
Serratella							2				1		
Drunella		8	3									3	4
Ephemerella	1	20	11	12	37	35	26	24	16	31	21	27	63
Eurylophella	11	1	5	2	4		2	3	2	3		8	
Baetisca					2	1	1						
Ameletus						1			3	1			
Leptophlebiidae												2	
Paraleptophlebia	4	3						1	6	3			16
Habrophlebiodes		3	3					2		1			
Baetis (complex)		1	2		17	1	5	1	1	1	6	11	5
Heptageniidae											3		
Stenonema	3	2	6	4	3	8	6	14		11	2	1	5
Epeorus		7	15			1	1	1			4	12	11
Cinygmula subaequalis		5	5			4			1			8	9
Leucrocuta	1	3	1					1					
Isonychia			1	1			1					1	
Cordulegaster	2			1		1		3	2	1	4		
Progomphus							1						
Stylogomphus albistylus						1							
Gomphus				1	2								
Lanthus	3			4	7			2	1			1	
Boyeria					1	1							
Planthemis					1								
Calopteryx				1				2					1
Argia							1						
Nigronia fasciatus											1		
Nigronia serricornis			2										
Helicopsychidae							5						
Hydropsyche	1											1	1
Cheumatopsyche	2	5	4	2	4	6	2					4	
Diplectrona modesta	6	6		1			1	5	6	10	13		2
Parapsyche									5				

Taxa	Gold Mine Br.	Jasus Cr.	Low Gap Cr.	Cutting Bone Cr.	Big Leatherwood Cr.	NF Broad River	MF Broad River	Pounding Mill Cr lwr	Pounding Mill Cr upr	Law Ground Cr lwr	Law Ground Cr upr	Chattahoochee R lwr	Chattahoochee R upr
Rhyacophila	13	1	1	3			1	3	2		4	6	4
Chimarra					1								
Dolophilodes distinctus		1						2				2	1
Lype diversa	1												
Setodes					1								
Psilotreta													1
Lepidostoma	1	3	3	3		1	1	3	7	1		1	4
Glossosoma													1
Pycnopsyche		1	2	5		1	2	3		14	4		
Goera	1						1						
Neophylax					1					1			
Nyctiophylax			1	1	2		1					1	
Cymellus								1					
Polycentropus		2	1	3				2		2	1		
Cernotina									1				
Hydrophilidae					1								
Psephenus herricki	2	2	2	6		5	1			4		6	
Ectopria		1	1					2	1				1
Helichus					1	1							
Stenelmis	6					1	3	2			3		
Optioservus	2	3	2	5	3	3	1	1	2	7	6	2	2
Dubiraphia					1								
Promoresia	2	2		1					1		1	1	
Oulimnius latiusculus	1			5	2				5	10	1		1
Blepharicera			1									1	
Protoplasa fitchii					3		1						
Tipulidae				1				2					
Tipula	6					7			1	5			
Antocha	2			2		1						1	
Dicranota	2	4					1		4	5	6		1
Hexatoma		5	11			3		1	5	2	1		12
Pilaria						2	1	3	1	2		1	
Molophilus												1	
Dixa		1						2			4		
Simulium	3	12	12	2	6		1	4	2	1		3	3
Chironomidae	50	73	59	37	67	18	29	39	83	28	37	44	31
Ceratopogonidae	8	6	10	9	6	1	2	8	7		4	21	3
Tabanidae				1		3							
Atherix								1					
Hemerodromia								2					
Chelifera		1				1		1			3		
Clinocera							3						
Ptychopteridae				1		2							
Collembola									1				
Pleuroceridae				22	1	2	24						
Sphaeriidae	2	6	3	12	2	6	4			4			

Table C3. Metric results for macroinvertebrates collected per site, Chattahoochee-Oconee NF, April, 2002.

Metric	Gold Mine Br.	Jasus Cr.	Low Gap Cr.	Cutting Bone Cr.	Big Leatherwood Cr.	NF Broad River	MF Broad River	Pounding Mill Cr lwr	Pounding Mill Cr upr	Law Ground Cr lwr	Law Ground Cr upr	Chattahoochee R lwr	Chattahoochee R upr
Total Number of Individuals (N)	177	207	178	182	193	174	174	182	191	174	177	185	219
Number of Taxa	32	35	31	37	29	36	40	37	32	28	30	35	32
Number of EPT Taxa (EPT Taxa)	17	23	20	18	13	16	23	21	17	17	17	23	22
Number of Clinger Taxa (Clinger Taxa)	13	14	13	12	11	12	12	11	10	10	10	14	13
Percent Clingers	18.08	29.38	29.94	30.51	22.60	19.21	27.68	19.77	15.25	27.12	22.60	30.51	24.29
Percent 1 Dominant Taxon	28.25	35.27	33.15	20.33	34.72	20.11	16.67	21.43	43.46	17.82	20.90	23.78	28.77
Percent 2 Dominant Taxa	37.85	44.93	41.57	32.42	53.89	30.46	31.61	35.16	51.83	33.91	32.77	38.38	42.92
Percent Tolerant Organisms	39.55	49.76	49.44	45.60	54.40	30.46	33.91	32.42	50.79	18.97	25.42	40.54	18.72
# Intolerant Taxa	25	29	26	27	19	28	29	30	27	25	26	29	26
Percent Diptera	40.11	49.28	52.25	29.12	42.49	21.84	22.99	33.52	53.93	24.71	31.07	38.92	22.83
Percent Chironomidae	28.25	35.27	33.15	20.33	34.72	10.34	16.67	21.43	43.46	16.09	20.90	23.78	14.16
Percent EPT (%EPT)	46.33	43.96	41.57	29.12	39.38	56.32	47.70	57.69	37.17	60.34	59.32	54.59	73.97
North Carolina Biotic Index (NCBI)	3.95	3.81	4.05	4.27	4.67	3.89	3.53	3.43	3.92	3.16	3.02	3.67	2.63
Percent Collectors	40.68	51.21	51.69	40.11	75.13	47.70	56.32	54.95	60.21	39.66	49.15	58.92	59.36
Percent Filterers	7.91	14.49	11.24	9.89	6.74	6.90	5.17	6.59	6.81	8.62	7.34	5.95	3.20
Percent Scrapers	10.73	14.01	13.48	23.63	6.22	14.37	23.56	12.09	6.81	20.11	9.04	11.89	10.96
Percent Shredders	22.03	8.70	5.62	8.79	1.04	17.82	3.45	9.89	11.52	18.39	17.51	2.70	11.42
Percent Predators	18.64	11.59	17.42	17.03	10.88	12.64	9.77	16.48	14.66	13.22	16.95	20.54	15.07