An Inventory of Stream Habitat, Macroinvertebrate Communities, Stream Sediment, and Channel Conditions in the Conasauga River and Jacks River, Cherokee National Forest, Tennessee, and Chattahoochee National Forest, Georgia

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Introduction

In 2000, the Consauga River watershed was selected to be a part of the U. S. Forest Service (USFS) large-scale watershed initiative. The large-scale watershed initiative encouraged collaborative approaches to watershed restoration and the Chattahoochee-Oconee and Cherokee National Forests have worked as members of the Conasuaga River Alliance to develop collaborative management, monitoring, and research projects in the Conasauga River watershed. The Alliance provides baseline data needed by Forest managers to assess current watershed conditions and future effects of management activities. In the spring of 2000, the USFS Center for Aquatic Technology Transfer (CATT) was asked by the Chattahoochee-Oconee National Forest to assess stream conditions in the Conasuaga River watershed. During 2000, the CATT worked with the Chattahoochee-Oconee National Forest, the Cherokee National Forest, and other members of the Conasauga River Alliance to develop and implement survey protocols for a nearly 17 km reach of the Conasauga River and two sites on the Jacks River, including both privately and publicly owned lands.

Study Sites

Conasauga River

The Conasuaga River study site was divided into four contiguous sections (Figure 1). Section 1 began at the furthest downstream USFS boundary on the Conasuaga River, just upstream of Minnewauga Creek on Dr. Good's property, and ended 4.1 km upstream, at the Consauga River Trail (old railroad bed) crossing. Section 2 started at the end of section 1 and ended 4.2 km upstream, at the confluence of Graham Branch. Section 3 started at the end of section 2 and ended 2.9 km upstream, at the USFS boundary just downstream of the County Road 103 crossing (Murray County, GA). Section 4 started at the end of section 3 and ended 5.3 km upstream, at the USFS boundary. Sections 1, 2, and 3 were entirely on USFS land, whereas section 4 was entirely on privately owned property.

Jacks River

The Jacks River study site consisted of two non-contiguous study areas, one on the mainstem of the Jacks River and one on South Fork Jacks River, separated by approximately 3.5 km (Figure 3). Area 1 was located on the South Fork of the Jacks River and consisted on two sites, one upstream of Forest Road 64, and one downstream of the road crossing. Site 1 started upstream of the Forest Road 64 crossing, just upstream of the confluence with a small, unnamed tributary and ended 100 m upstream. Site 2 started approximately 200 m downstream of the Forest Road 64 crossing and ended 100 m upstream (i.e. 100 m downstream of Forest Road 64). Area 2 also consisted of two sample sites, one upstream of a private land holding at Watson's Gap, and one downstream of the privately owned land.

Site 1 started downstream of the private land on the mainstem of the Jacks River, just upstream of its confluence with Bear Branch and ended 100 m upstream, at the USFS boundary. Site 2 started just upstream from the West Fork confluence, on the South Fork of the Jacks River, and ended 100 m upstream. The downstream end of site 2 was approximately 250 m upstream from the private land holding.

Methods

Habitat Survey

We used the basin-wide visual estimation technique (BVET) (Hankin and Reeves 1988, Dolloff et al. 1993) to inventory stream habitat in the mainstem of the Consauga River. Due to time constraints we did not perform a BVET habitat survey on the Jacks River.

Habitat in each section of the Consauga River was classified and inventoried by a two-person crew using two-stage visual estimation techniques. During the first stage, one crew member identified each habitat unit by type, estimated surface area, average and maximum depth, dominant and subdominant substrates (Table 1), and instream cover for each habitat unit, and estimated pool residual depth (average depth minus riffle crest depth), and the degree to which pool substrates were embedded. Habitat unit types included pools (areas in the stream with concave bottom profile, gradient equal to zero, greater than average depth, and smooth water surface), and riffles (areas in the stream with convex bottom profile, greater than average gradient, less than average depth, and turbulent water surface). Glides (areas in the stream similar to pools, but with average depth and flat bottom profile) were identified during the survey but were grouped with pools for data analysis. Runs (areas in the stream similar to riffles but with average depth, less turbulent flow, and flat bottom profile) and cascades (areas in the stream with > 12% gradient, high velocity, and exposed bedrock or boulders) were grouped with riffles for data analysis. 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. We visually estimated the linear meters of cover provided by rock, wood, and undercut banks. Cover was defined as structure within the wetted channel under which a 15 cm long object could be hidden from overhead view. We visually estimated the percent of the total substrate surface area that was embedded. We considered substrate to be embedded if interstitial spaces around large substrate particles were filled by smaller substrate particles.

The second crew member classified and inventoried large woody debris (LWD) within the stream channel, determined the Rosgen's channel type for each habitat unit, estimated bank instability, and recorded data on a Husky Hunter data logger. LWD was divided into seven classes (Table 2). All woody

debris less than 1 m long and less than 5 cm in diameter were omitted from the survey. Bank instability was estimated for both left and right banks. We defined bank instability as the percent of the bank between the wetted channel and bankfull channel that consisted of erodible materials. Rosgen channel type was estimated visually based on channel type descriptions found in Rosgen (1996) (Table 3).

The first unit of each habitat type selected for intensive (second stage) sampling (i.e. accurate measurement of surface area) was determined randomly. Additional units were selected systematically (every 10th unit for each habitat type). The width of each systematically selected habitat unit was measured with a 30-m measuring tape at intervals ranging from about 1 m to 15 m. Interval size was determined by the length and the morphology of the unit (i.e. interval of measured width increased with increasing unit length). In each of the systematically selected riffles we also estimated the bankfull stream channel width as described by Harrelson et al. (1994), and measured channel gradient with a clinometer. Surveys were terminated at predetermined locations.

The relationship between estimated surface area and measured surface area typically is strongly and positively correlated when the estimates are made by experienced personnel; thus we could correct visual estimates by multiplying them by a calibration ratio (Hankin and Reeves 1988). The calibration ratio, the estimated true total area, and the variance of the area estimator were calculated separately for each habitat type and each section. BVET calculations were computed with a Microsoft Excel spreadsheet using the formulas found in Dolloff et al. (1993). Data were summarized using Excel spreadsheets and SigmaPlot graphics software.

Macroinvertebrates

Macroinvertebrate samples for the study were taken using the rapid bioassessment protocols detailed in the standard operating procedures (SOPs) of the U. S. Environmental Protection Agency's (EPA's) Region 4 Science and Ecosystem Support Division (SCSD) (U. S. EPA Region 4 1999). This protocol calls for materials to be collected from five habitat types: 1) deep riffle, 2) shallow riffle, 3) pool bottoms, 4) leaf litter, and 5) LWD. We used a D-frame net to collect materials from each habitat type within a 100 m reach of stream. Habitat specific samples were then combined into a single sample for each 100 m reach. In the Conasauga River, the first sample site for each section was chosen randomly within the first kilometer, and additional sites were taken each kilometer thereafter (Table 9). In the Jacks River, four samples were collected, one at each study site (Table 10).

Samples were analyzed under the supervision of Dr. Reese Voshell, Department of Entomology, Virginia Polytechnic Institute and State University. A sub-sample of 200 organisms was selected from each sample and identified to the lowest possible taxonomic level. The lab calculated 17 metrics for each

sample and reported the results of the analysis to the CATT. We developed figures based on data in the report to aid in interpretation.

Sediment

We used EPA sediment sampling protocols to perform pebble counts and assess cobble embeddedness in the Conasauga River and Jacks River. Sediment sample sites corresponded to the 100 m reaches used for macroinvertebrate sampling. Where possible, we didn't collect sediment and macroinvertebrate samples from the same habitat units, to limit bias in either sample. Sediment measurements were assumed to be representative of each 100 m stream reach.

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 4). If detritus, LWD, or other organic materials were encountered, we sampled the rock substrate found directly below them. We only performed pebble counts in riffles.

We used the pebble count data to calculate the D_{50} (median particle diameter of entire sample), inflow D_{50} (median particle diameter from particles within the wetted channel only), D_{33} (33rd percentile of particle diameter sizes), D_{84} (84th percentile of particle diameter sizes), and percent fine sediment (<2 mm). D_{50} is typically calculated for particles taken from within the bankfull channel, however it can be difficult to distinguish the true boundaries of the bankfull channel. We compared D_{50} vs. inflow D_{50} to see if particles sampled from within the wetted channel were similar to those taken from within the entire bankfull channel. We calculated D_{84} and D_{33} to more completely describe the distribution of particle sizes within the bankfull channel.

Cobble embeddedness was measured by randomly selecting cobble size (64 mm - 256 mm) materials from the most downstream one-third of pools. After a cobble was selected, it was removed from the stream bed while maintaining its spatial orientation, and then measured for its total height and embedded height perpendicular to the streambed surface (Bunte and Abt 2001). Typically we selected cobbles from more than one pool, until 100 cobbles had been collected and measured. We used the cobble embeddedness data to determine percent embeddedness for each cobble and an overall site embeddedness (average percent embeddedness).

Channel Condition

We used the Pfankuch Channel Stability Rating form (Pfankuch 1975) and the EPA habitat assessment form (Barbour et al. 1999) to assess channel condition (Appendix D). Channel condition was assessed in the same 100 m reaches used for macroinvertebrate samples and sediment measurements. Both forms contained a series of questions asking the observers to rate the condition of the stream channel on a point scale. After walking through the entire 100 m reach, the crew members answered each of the questions on the forms. The overall Pfankuch and EPA ratings for each 100 m reach were determined by the total score (sum of scores for individual questions on each form).

Results

Habitat Survey

Conasauga River

Results of the BVET habitat survey on the Conasauga River revealed differences between the downstream sections (sections 1 and 2) vs. the upstream sections (sections 3 and 4). The bankfull channel in the downstream sections was wider and individual habitat units were larger and deeper compared to the upstream sections (Table 5). LWD counts in the downstream sections were greater than those in the upstream sections (Table 5, Figure A36). In contrast, LWD cover was more abundant in the upstream sections (Figure A40). Boulder and bedrock were the dominant substrates in the majority of habitat units in the downstream sections (Figures A5 and A13), whereas gravel and cobble were the dominant substrate in the majority of habitat units in the upstream sections (Figures A21 and A29). Sand, silt, clay, and organic materials were the dominant substrate in only a small proportion of the total habitat units in all sections. Section 3 contained the highest percent of pools with embedded substrate (Table 5). The highest amounts of rock cover were recorded in the downstream sections (Figure A40). Banks were generally less stable in the upstream sections (Figure A39). Banks were least stable from the middle of section 3 to the middle of section 4 in the upstream sections. Banks were the most stable in section 2 of the downstream sections.

Jacks River

No BVET habitat survey was performed on the Jacks River during summer 2000.

Macroinvertebrates

The final report produced by Dr. Reece Voshell's aquatic entomology lab at Virginia Tech, summarizing the macroinvertebrate survey results for both the Conasauga River and Jacks River is

attached to this report as Appendix B. Maps showing macroinvertebrate sample sites on the Conasauga River and Jacks River are displayed on Figures 2 and 3. Sample site descriptions can be found in Tables 9 and 10..

Conasauga River

We collected total of 16 macroinvertebrate samples from section 1 (six samples), section 2 (four samples), and section 3 (six samples) of the Consauga River during summer 2000. Section 4 was not sampled due to logistical considerations. Three sample sites on the Consauga River consistently ranked worse than other sample sites. Sample site CON3-04.5 ranked worse than sites downstream (Figure 4). Samples collected at the confluence with Halfway Branch (CON1-T02), and to a lesser degree those at the Bogden Creek confluence (CON1-T01), had consistently low metric scores.

Jacks River

The CATT collected a total of four macroinvertebrate samples from area 1 (two samples) and area 2 (two samples) on the Jacks River during summer 2000. Percent EPT, NCBI score, percent tolerant organisms, and percent Chironomidae all ranked highest for the furthest upstream sites and lowest at the furthest downstream site (Figure 5). No other consistent patterns emerged in the metric results from the Jacks River sample sites.

Sediment

Conasauga River

We performed pebble count and cobble embeddedness measurements at a total of 16 sites in section 1 (six sites), section 2 (four sites), and section 3 (six sites) of the Conasauga River during summer 2000. Section 4 was not sampled due to logistical considerations. Median particle sizes (D_{50}) in sections 1 and 2 (downstream sections) were generally higher than those in section 3 (Table 6). The percent of pebbles ≤ 2 mm in diameter (sand, silt, or clay) was typically less than 15%, however site CON2-02 contained 21% of the small diameter particles. D_{84} was greater than 300 mm (boulder or bedrock) for the majority of sample sites in the Conasauga River. Inflow D_{50} was equal to or greater than total D_{50} for all sample sites. Figures showing the distribution of particle sizes at each sample site are found in Appendix C.

Jacks River

We performed pebble count and cobble embeddedness measurements at a total of four sites in area 1 (two sites) and area 2 (two sites) of the Jacks River during summer 2000. D_{50} was between 6 mm and 60 mm (small to large gravel) for all four sites (Table 6). Site JACK2-02, upstream of privately

owned property, had the lowest D_{50} and the highest proportion of pebbles ≤ 2 mm. Inflow D_{50} was equal to or greater than total D_{50} for all sample sites. Figures showing the distribution of particle sizes at each sample site are found in Appendix C.

Channel Condition

Conasauga River

We used EPA and Pfankuch protocols to assess channel condition at a total of 16 sites in section 1 (six sites), section 2 (four sites), and section 3 (six sites) of the Conasauga River during summer 2000. Section 4 was not sampled due to logistical considerations. Site CON 3-04.5 (section 3, near Cottonwood Patch Horse Campground) ranked worst in condition on both the EPA and Pfankuch assessments (Table 7). The other sites on the Conasauga River all scored similarly to each other.

Jacks River

We used EPA and Pfankuch protocols to assess channel condition at a total of four sites in area 1 (two sites) and area 2 (two sites) of the Jacks River during summer 2000. Sites JACK1-02 and JACK2-02 scored much worse than the other two sample sites on the Jacks River for both the EPA and Pfankuch assessments (Table 7).

Discussion and Recommendations

Conasauga River

Current land use in sections 1 and 2 was limited to recreation, mostly on the Conasauga River Trail. The lands around section 3 contained several unpaved Forest and state roads and several trails and parking lots used for a variety of recreational activities. The Cottonwood Patch Horse Campground was located near the river in section 3 and Jacks River, a major tributary, entered the Conasauga River in section 3. Section 4 was entirely on private lands. Lands around the first 3.5 km of section 4 were used for mixed agriculture and timber production. State road 103, which crossed the stream at the beginning of the section, was located parallel to the stream within about 500 m. After 3.5 km the stream turned away from the road and increased in gradient, running through relatively undisturbed private land. Results from our surveys reflect both natural changes in stream morphology and the differences in land-use between the sections.

From downstream to upstream, the channel became more narrow, habitat unit size and depth decreased, and the number of habitat units increased. Downstream sections contained more LWD, but less LWD cover. During high water events LWD is likely more easily transported down the stream

channel and floated to the stream banks in the wider, deeper downstream sections. Although these pieces do not provide cover during baseflow, they can be important refuges during bankfull events. Changes such as these are typical as one moves from downstream to upstream within stream networks.

We also observed conditions attributable to differences in land-use between sections. Pebble count and BVET results indicated that the downstream sections (sections 1 and 2) contained larger size substrates than upstream sections (sections 3 and 4). BVET results also indicated that section 3 contained the highest proportion of pools with embedded substrates. In addition, we noted during our BVET survey that the first 3.5 km of section 4 contained many embedded pools. (This was masked in our summary results by a high number of small, unembedded pools in the upstream reaches of the section.) Banks were also less stable in upstream sections than in the downstream sections. Unpaved roads near the river, concentrated recreational activity, and other land-uses within portions of the upstream sections likely contributed to increased sedimentation and decreased bank stability within these sections. Smaller substrate sizes and increased embeddedness in upstream vs. downstream sections may be attributed to such causes.

Within section 3, the sample site near the Cottonwood Patch Horse Campground (CON3-04.5) consistently ranked as one of the most disturbed sites within any of the survey sections. Metric scores from macroinvertebrate samples (with the exception of those taken at tributary confluences) and EPA and Pfankuch rankings were worse at this site than any other within the survey reaches.

In summary, stream habitat, macroinvertebrate, sediment, and channel condition assessments indicated that downstream sections of the survey reach were generally in better condition than upstream sections. Unstable banks, unpaved roads, and recreational and agricultural activities were all potential sources of fine sediments within portions of sections 3 and 4. Protecting banks and riparian areas and minimizing or eliminating sources of fine sediment may be the most efficient means of improving stream conditions in these areas.

Jacks River

Area 1 on the Jacks River was selected to investigate potential effects of a road crossing on the river. Area 1 was located approximately 3.5 km upstream of area 2 and no samples were collected between the two sites. No BVET habitat survey was performed on the Jacks River.

In area 1, the sample site downstream of the road crossing (JACK1-02) had a high proportion of sand substrate and low channel condition scores compared to the site upstream of the road (JACK1-01). In area 2, the sample site upstream from the private land (JACK2-02) had a high proportion of sand substrate and low channel condition scores when compared to the sample site downstream of the private land (JACK2-01). Persons performing the surveys at these sites commented that the sample site upstream

from the private land was ‘filled with sand’. Additional sampling or a habitat survey on the 3.5 km reach between Forest Road 64 and the private land holding may reveal the source of the sand and causes of low channel condition ratings for the two sample sites between Forest Road 64 and the private land.

In contrast to the sediment and channel condition assessments, the macroinvertebrate samples from the site downstream of the private land holding consistently ranked lower than the other sites on the Jacks River. An errant sample or poor water quality could explain the conflicting results. Only one macroinvertebrate sample was collected at each site. If the sample was not collected in a representative area, results could be biased. Poor water quality would not be detected by the sediment or channel condition assessments, but may be detected by the macroinvertebrate sampling. These results warrant further monitoring of the site.

Methodology Comparison and Discussion

We assessed the effectiveness of several methodologies for both collecting and interpreting data. For example, during pebble counts we recorded whether each pebble was in or out of the wetted channel to compare inflow vs. total D_{50} results. D_{50} is typically calculated for pebbles taken from within the bankfull channel, however it can be difficult for inexperienced personnel to distinguish the true boundaries of the bankfull channel. We compared inflow vs. total D_{50} to see if pebbles taken from within the wetted channel were similar to those taken from within the bankfull channel. Our results showed that inflow D_{50} was always equal to or greater than total D_{50}. Although it was easier to distinguish the boundaries of the wetted channel, measurements from within the entire bankfull channel may be necessary to fully describe particle size distributions.

During the habitat survey cover was defined as structure within the wetted channel under which a 15 cm long object could be hidden from overhead view. We did not feel that this adequately described the amount of cover available to the wide variety of fish found within the streams. Depending on the total area and orientation of the cover type, fish larger than 15 cm may or may not be afforded cover by these structures, and smaller fish could make use of smaller spaces not recorded as cover using this definition. The wide variety of species and life stages of fish occupying these rivers makes it difficult to truly estimate the amount of available cover. Embeddedness may be a usefull surrogate for rock cover, as unembedded substrates should provide a variety of interstitial space sizes for cover. LWD abundance is an indicator of the amount of LWD cover, however as shown by the results of the present surveys, there is not always a direct, positive relationship between LWD abundance and cover. The meters of undercut banks in each habitat unit could be estimated, provided that a definition of ‘undercut’ (is a bank considered undercut at 5 cm, 10 cm, etc.) was established prior to the survey.

Pfankuch and EPA channel condition assessments provided a different perspective from which to observe stream conditions. For example, on the Pfankuch form, question 2 assesses the debris jam potential of a stream reach. If a large amount of "floatable objects" (i.e. LWD) of "predominately larger sizes" are present in the stream channel the stream reach receives a "Poor" score for the question. While debris jams and large floatable objects may be objectionable to some, fisheries biologists typically consider LWD in the stream channel to be beneficial. The scoring system of such assessments needs to be understood to accurately interpret their results. In addition, without a reference reach in the watershed we had no standard against which to compare the total scores on the forms.

Performing pebble counts (EPA methodology) and visually estimating dominant and subdominant substrate (BVET methodology) on the same stream reaches allowed us to compare the methods. Pebble counts provided us with precise measurements of pebbles on a small reach of stream. They were very labor and data intensive. In contrast, BVET provided less precise visual estimates for a much larger area of stream. BVET included a category for organic substrates that was not used in the pebble counts, however for the most part results of the two methods were similar. Future surveys may want to select one method or the other based on project goals.

The Conasauga River and Jacks River watersheds contain one of the most diverse fish faunas in North America, including several threatened, endangered, and sensitive species such as the Conasauga logperch (*Percina jenkinsi*) and the blue shiner (*Cyprinella caerulea*). Future surveys could also include fish surveys to complement the stream habitat and macroinvertebrate surveys performed here.

The Conasauga River and Jacks River watersheds are multiple-use areas, important both ecologically and recreationally, and as such should continue to be monitored and studied by the Forest Service and its partners in the largescale watershed project. If collected repeatedly, and in a consistent manner, data such as those presented here may be compared with past and future surveys to identify trends in stream conditions.

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Table 1. Substrate size classes used during BVET habitat surveys on the Conasauga River, 2000. Diameter was estimated for the intermediate axis.

Size Class	Class Name	Diameter (mm)
1	organic debris	
2	clay	
3	silt	
4	sand	Silt – 2
5	small gravel	3 – 10
6	large gravel	11 – 100
7	cobble	101 – 300
8	boulder	>300
9	bedrock	

Table 2. Large woody debris (LWD) size classes used during BVET habitat surveys on the Conasauga River, 2000. Diameter was measured at thickest portion of LWD piece.

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 3. Rosgen (1996) channel type descriptions used during BVET habitat surveys on the Conasauga River, 2000.

	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 4. Substrate size classes used during pebble count and cobble embeddedness surveys on the Consauga River and Jacks River, 2000. 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	permanent underlying layer

Table 5. Summary data for the Conasauga River BVET habitat survey, July 2000. Section 1 began at the furthest downstream USFS boundary on the Conasuaga River and ended 4.1 km upstream. The other sections followed consecutively. Total stream is all four sections combined. Individual habitat summaries and figures can be found in Appendix A.

	Section 1	Section 2	Section 3	Section 4	Total Stream
Survey Date:	07/15/01	07/15/01	07/15/01	07/15/01	07/15/01
Total Distance Surveyed (km):	4.1	4.2	2.9	5.3	16.8
Percent of Total Area Pools:	74	56	67	72	67
Number of Pools:	44	31	28	94	197
Number of Pools per km:	11	7	10	18	12
Total Pool Area (m^2):	64537	53745	31279	45363	194783
± (m^2):	±3665	±10921	±4666	±3043	±11029
Mean Pool Area (m^2):	1467	1734	1117	483	989
Correction Factor:	1.07	0.95	0.97	0.85	0.96
Mean Maximum Depth (cm):	129	168	91	79	106
Mean Average Depth (cm):	70	116	45	45	62
Mean Residual Pool Depth (cm):	33	83	18	30	38
Percent of Total Area Riffles:	26	44	33	28	33
Number of Riffles:	30	35	28	71	164
Number of Riffles per km:	7	8	10	13	10
Total Riffle Area (m^2):	23018	41782	15560	17439	96341
± (m^2):	±1890	±8605	±2922	±4056	±15107
Mean Riffle Area (m^2):	767	1194	556	246	587
Correction Factor:	1.04	1.12	0.87	1.04	1.02
Mean Maximum Depth (cm):	57	81	38	40	52
Mean Average Depth (cm):	35	38	24	22	28
Number of LWD pieces per km:	90	45	18	7	65
LWD < 5 m, 5-10 cm:	44	18	1	1	21
LWD < 5 m, 10-50 cm:	9	8	4	2	11
LWD < 5 m, > 50 cm:	1	1	0	0	1
LWD > 5 m, 5-10 cm:	14	5	1	0	7
LWD > 5 m, 10-50 cm:	19	12	9	3	20
LWD > 5 m, > 50 cm:	3	2	2	0	3
Rootwads:	0	0	1	0	1
Mean Bankfull Channel Width (m):	30	31	21	20	24
Rosgen's Channel Type Frequency:					
% Type A:	0	0	0	37	19
% Type B:	100	100	20	6	55
% Type C:	0	0	80	57	26
% Type D:	0	0	0	0	0
% Type E:	0	0	0	0	0
% Type F:	0	0	0	0	0
% Type G:	0	0	0	0	0
Percent of Pool Habitat Surveyed as Glides:	39	10	18	37	30
Percent Pools with > 35% Embeddedness:	5	19	64	14	20
Average Channel Gradient (%):	8	2	2	7	6

Table 6. Total D_{50}, inflow D_{50}, D_{33}, D_{84}, percent substrate ≤ to 2 mm diameter, and percent cobble embeddedness obtained from the pebble counts and cobble embeddedness measurements taken at Conasauga River and Jacks River sites. Inflow D_{50} is the D_{50} of pebbles from within the wetted stream channel only; all other calculations were performed using all measured pebbles. The percent cobble embeddedness is the average embeddedness of all cobbles measured at each site.

	Inflow D_{50} (mm)	**D_{50}** (mm)	**D_{33}** (mm)	**D_{84}** (mm)	**%≤ 2mm** (%)	**Cobble Embeddedness** (%)
Conasauga River						
Section 1						
Con1-01	155	155	105	362	10	43
Con1-T02	173	123	46	bedrock	13	39
Con1-02	160	145	67	bedrock	14	58
Con1-T01	860	519	235	bedrock	15	56
Con1-03	190	190	95	693	8	56
Con1-04	455	385	240	bedrock	11	54
Section 2						
Con2-01	49	44	18	166	14	50
Con2-02	bedrock	305	49	bedrock	21	42
Con2-03	186	171	53	718	16	50
Con2-04	300	283	137	bedrock	8	30
Section 3						
Con3-01	352	241	59	bedrock	14	22
Con3-02	59	53	22	281	15	42
Con3-03	87	61	32	360	12	39
Con3-04	94	84	55	900	11	38
Con3-04.5	35	31	16	75	18	40
Con3-05	90	79	46	bedrock	8	41
Jacks River						
Area 1						
Jack1-1	27	24	15	75	21	22
Jack1-2	28	11	sand	78	40	55
Area 2						
Jack2-2	10	6	sand	60	45	47
Jack2-1	89	60	19	bedrock	16	32

Table 7. Individual question and total scores for the Pfankuch Channel Stability Rating form for each site in the Conasauga River and Jacks River. Highest scores indicate worst channel condition and lowest scores indicate best channel condition. A copy of the Pfankuch Channel Stability Rating form can be found in Appendix D.

Question #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	**Total**
Possible Score	(0-8)	(0-12)	(0-8)	(0-12)	(0-4)	(0-8)	(0-8)	(0-16)	(0-16)	(0-4)	(0-4)	(0-8)	(0-16)	(0-24)	(0-4)	(0-152)
Conasauga River																
Section 1																
CON1-01	6	3	2	3	1	2	2	4	4	2	2	4	4	12	1	52
CON1-02	6	3	2	3	1	2	2	4	8	1	2	2	4	6	1	47
CON1-03	4	3	3	3	2	2	2	4	8	1	2	2	4	6	1	47
CON1-04	6	3	2	6	3	2	2	4	8	1	1	2	4	6	1	51
CON1-T01	4	3	4	3	1	2	2	4	12	1	2	2	4	12	2	58
CON1-T02	8	3	4	3	1	2	2	4	8	2	2	4	4	12	1	60
Section 2																
CON2-01	6	3	4	3	2	2	2	4	4	2	1	2	8	12	2	57
CON2-02	6	3	4	3	1	2	4	4	12	1	1	2	4	12	1	60
CON2-03	8	3	4	3	1	2	4	4	8	2	1	2	4	6	1	53
CON2-04	8	3	4	3	2	2	4	4	4	2	1	2	4	6	1	50
Section 3																
CON3-01	4	9	4	6	1	2	2	4	6	2	1	2	4	6	1	54
CON3-02	2	3	2	3	3	5	3	4	8	2	1	4	8	8	1	57
CON3-03	3	3	2	3	3	5	3	4	4	3	1	4	12	12	3	65
CON3-04	4	3	2	3	2	6	4	8	8	3	1	4	8	13	2	71
CON3-04.5	2	3	2	3	3	6	3	8	11	3	2	5	12	22	4	89
CON3-05	2	3	6	6	1	2	2	4	8	2	1	2	4	6	1	50
Jacks River																
Area 1																
JACK1-01	2	2	3	5	2	3	3	3	5	1	1	3	6	8	1	48
JACK1-02	2	1	3	5	2	5	5	2	11	2	3	4	10	18	2	75
Area 2																
JACK2-02	2	6	4	6	2	6	6	4	12	2	3	6	12	18	3	92
JACK2-01	4	4	3	4	1	2	2	4	5	1	1	3	5	7	2	48

Table 8. Individual questions and total scores on the EPA habitat assessment form for each site in the Conasauga River and Jacks River. Questions 1-7 were scored from 0 to 20, with 0 indicating worst condition and 20 indicating best condition. Questions 8-10 are broken into left (A) and right (B) banks, and were scored from 0 to 10, with 0 indicating worst condition and 10 indicating best condition. A copy of the EPA habitat assessment form can be found in Appendix D.

Question #	1	2	3	4	5	6	7	8A	8B	9A	9B	10A	10B	**Total**
Possible Score	(0-20)	(0-20)	(0-20)	(0-20)	(0-20)	(0-20)	(0-20)	(0-10)	(0-10)	(0-10)	(0-10)	(0-10)	(0-10)	(0-200)
Conasauga River														
Section 1														
CON1-01	12	14	10	16	16	20	18	9	9	10	10	10	10	164
CON1-T02	16	14	16	15	14	20	17	10	9	10	9	10	9	169
CON1-02	16	14	14	14	19	20	18	9	9	10	10	10	10	173
CON1-T01	14	6	13	14	16	20	13	9	9	10	9	10	9	152
CON1-03	18	10	14	16	16	20	19	9	9	10	10	10	10	171
CON1-04	15	13	8	13	18	18	18	9	9	9	9	9	10	158
Section 2														
CON2-01	16	12	9	11	15	20	13	9	9	9	9	7	8	147
CON2-02	12	14	10	10	12	20	13	9	9	9	9	8	8	143
CON2-03	14	13	10	17	18	20	15	9	9	9	9	8	9	160
CON2-04	11	12	8	16	17	20	16	9	9	9	9	8	9	153
Section 3														
CON3-01	19	19	19	18	16	20	15	10	7	10	6	10	7	176
CON3-02	15	13	13	14	14	19	18	9	9	8	10	7	10	159
CON3-03	16	16	14	14	17	18	18	8	8	8	10	7	10	164
CON3-04	14	17	15	15	17	19	19	8	8	10	9	8	10	169
CON3-04.5	8	11	18	8	10	19	11	8	7	8	8	7	9	132
CON3-05	13	15	7	14	11	15	16	8	6	8	9	8	10	140
Jacks River														
Area 1														
JACK1-01	15	15	18	14	19	16	16	9	9	9	9	9	9	167
JACK1-02	10	11	15	9	19	16	16	9	9	9	9	9	9	150
Area 2														
JACK2-02	9	7	12	7	13	15	16	9	9	9	9	8	8	131
JACK2-01	18	15	15	15	16	16	18	9	9	9	9	8	8	165

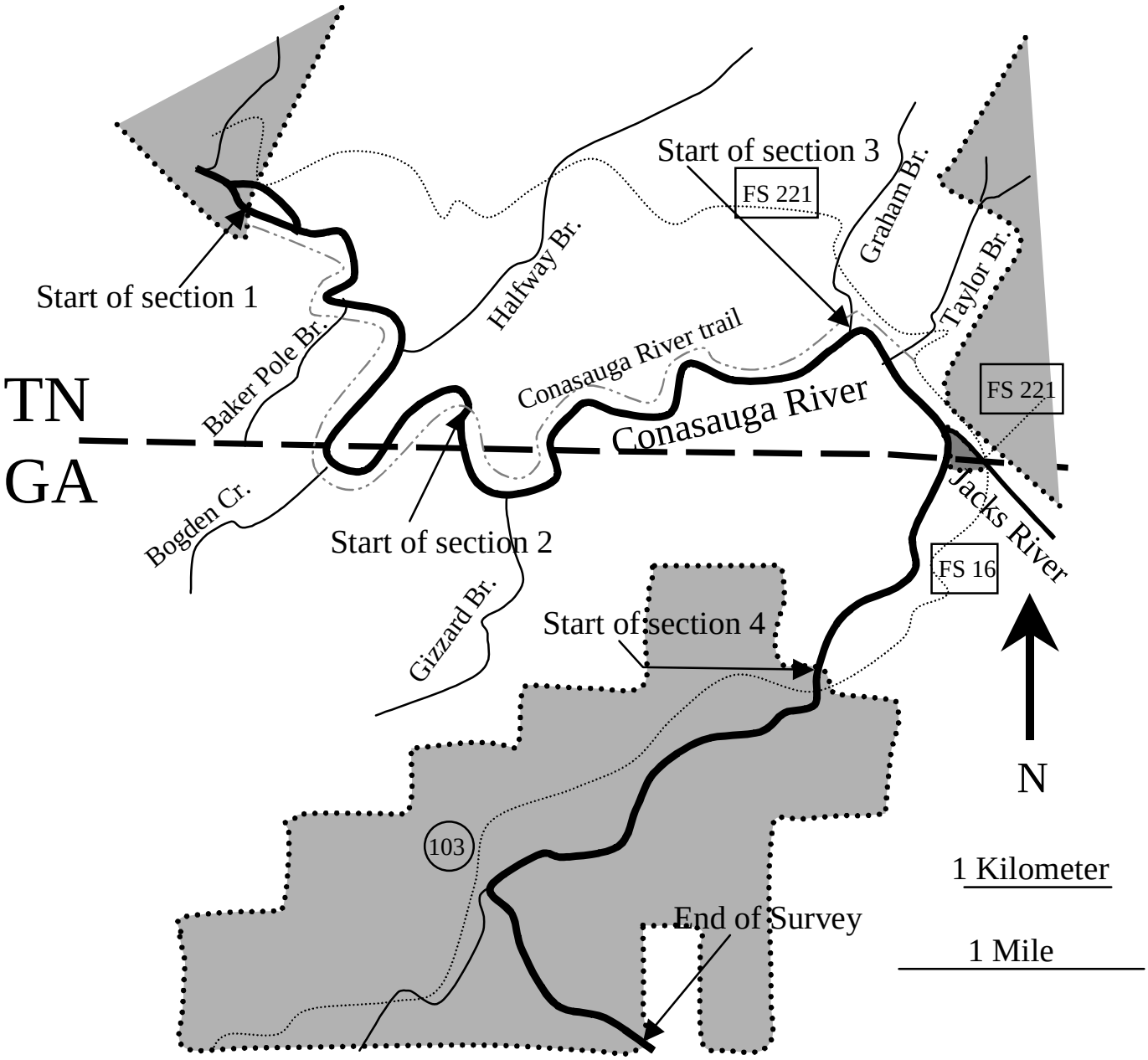

Figure 1. Conasauga River sections surveyed by the USFS CATT unit in summer 2000. Arrows show the starting points for each section. The area shaded in gray is private land. The main tributaries, roads, the Conasauga River trail, and the Georgia and Tennessee state line are also shown.

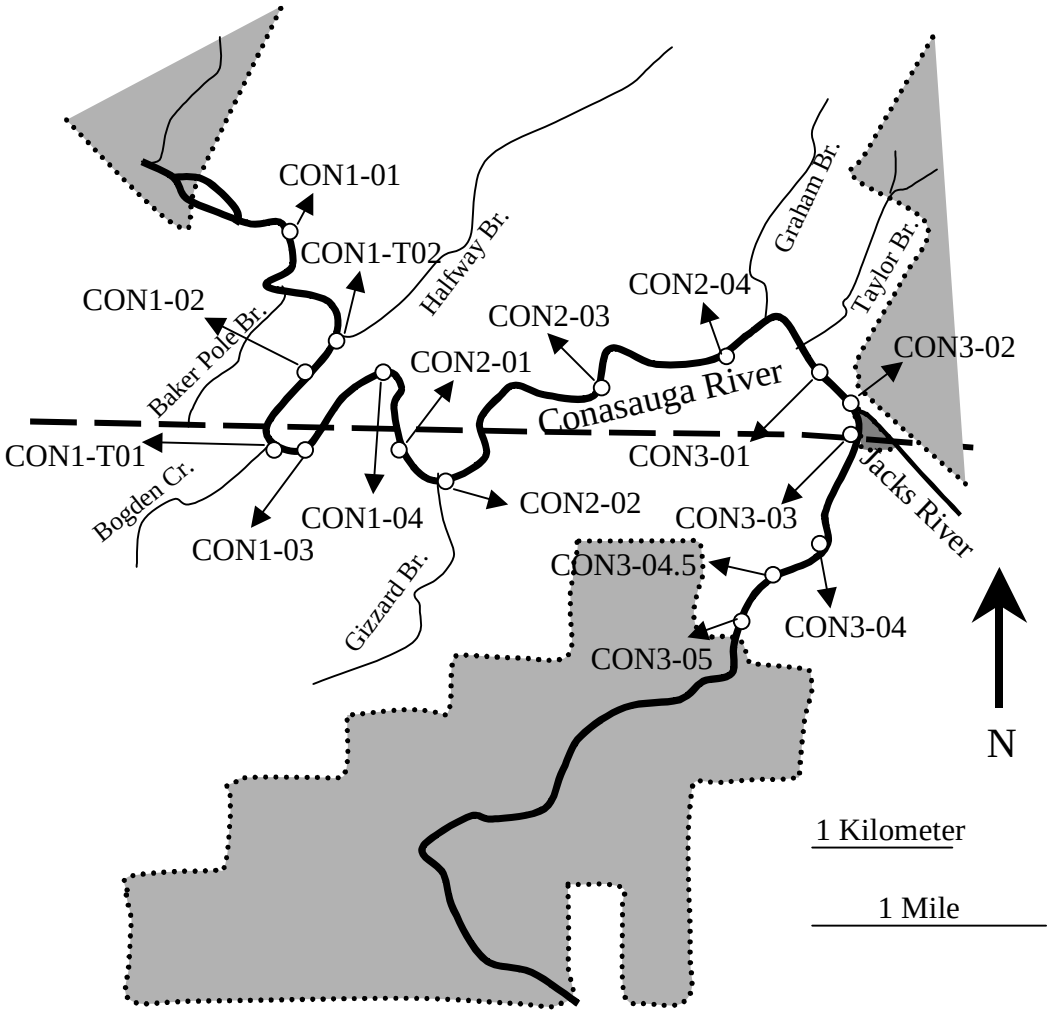

Figure 2. The Conasauga River study area showing the location of the macroinvertebrate, sediment sampling, and channel condition assessment sites.

Table 9. Location and description of the 16 sampling sites on the Conasauga River used for macroinvertebrate samples, sediment samples, and channel condition assessments. Distance is meters upstream from the start of section 1.

Site	Distance (m)	Comments
Section 1		
CON1-01	964.4	
CON1-T02	1785.7	Halfway Branch
CON1-02	1924.9	
CON1-T01	2851.0	Bogden Creek
CON1-03	3033.5	
CON1-04	3879.9	
Section 2		
CON2-01	4813.8	
CON2-02	4930.3	Gizzard Branch
CON2-03	6722.4	
CON2-04	7921.6	
Section 3		
CON3-01	9198.6	
CON3-02	9306.8	Downstream of confluence with Jacks River
CON3-03	9476.8	Upstream of confluence with Jacks River
CON3-04	10340.5	
CON3-04.5	10920.6	Cottonwood Patch Horse Camp
CON3-05	11301.8	

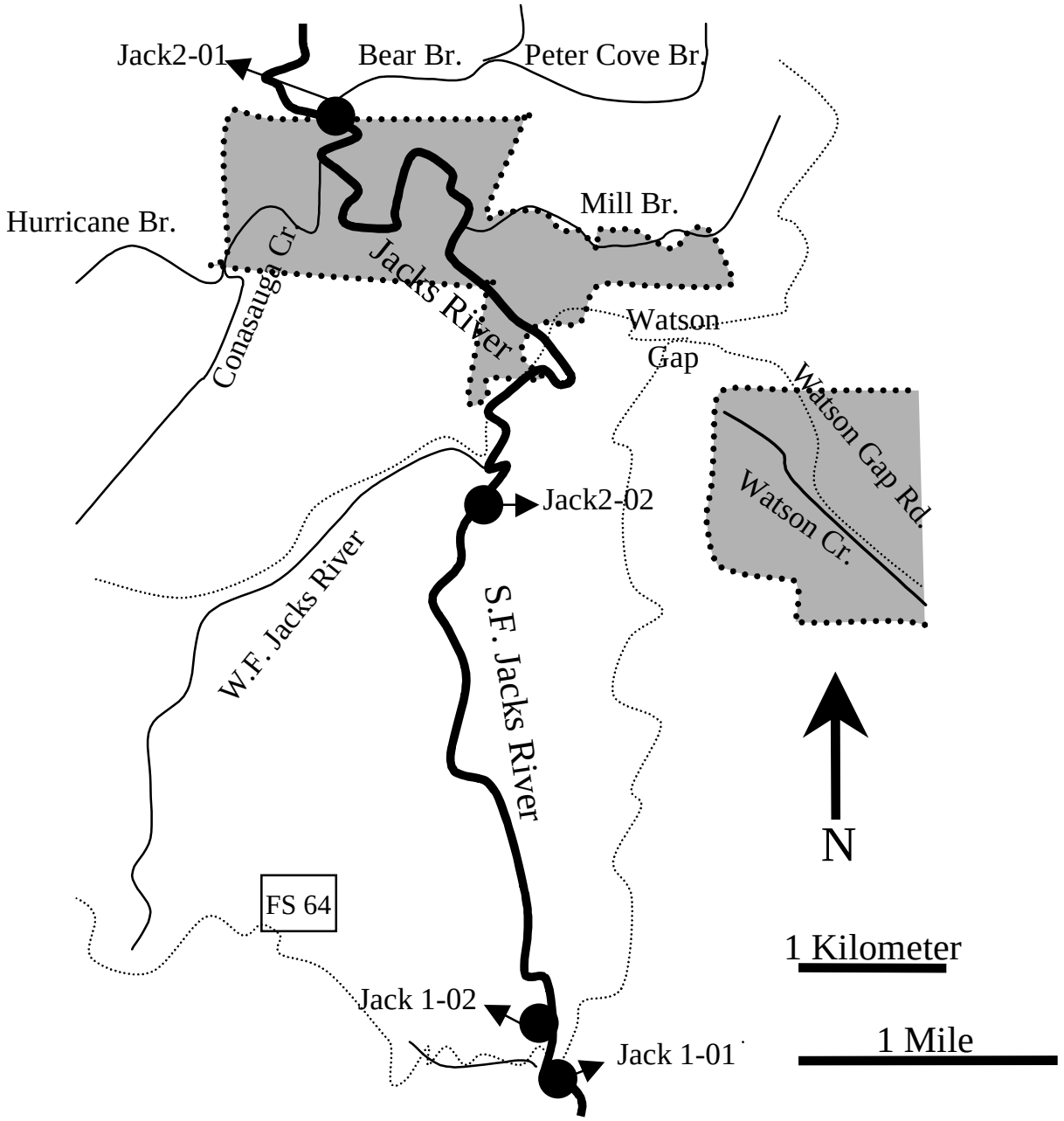

Figure 3. Jacks River sites surveyed by the USFS CATT unit in summer 2000. The closed circles represent the sampling sites. The area shaded in gray is private land. The main tributaries and roads are also shown.

Table 10. Location and description of the four sampling sites on Jacks River used for macroinvertebrate samples, sediment samples, and channel condition assessments.

Site	Comments
Area 1	
JACK 1-01	Start 100 m upstream of Forest Road 64, end 200 m upstream of Forest Road 64
JACK 1-02	Start 200 m downstream of Forest Road 64, end 100 m downstream of Forest Road 64
Area 2	
JACK 2-02	Start approximately 250 m upstream of private land, end 350 m upstream of private land
JACK 2-01	Start 100 m downstream of Forest boundary with private land, end at Forest boundary with private land

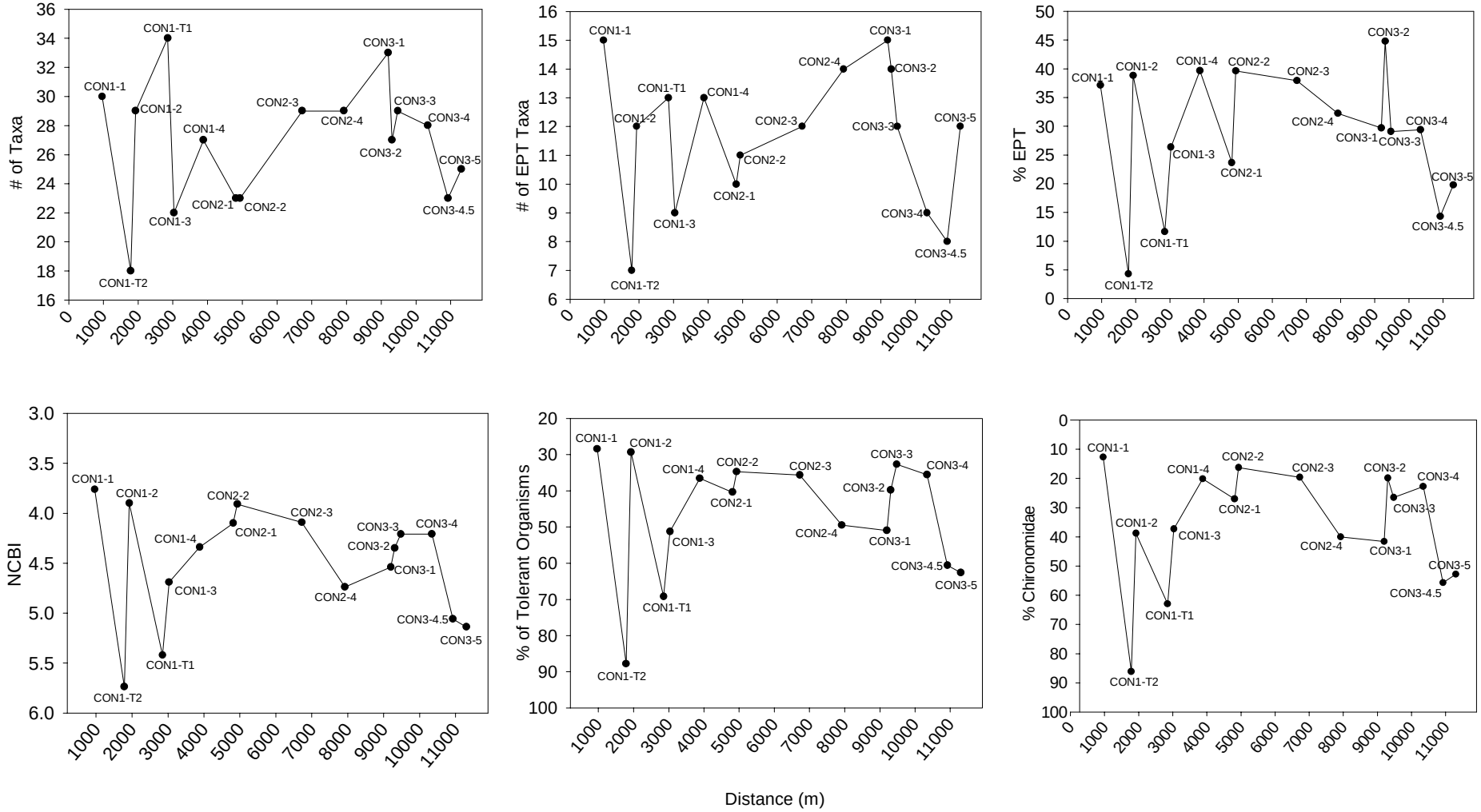

Figure 4. Total number of taxa, number of EPT taxa, percentage of EPT organisms, North Carolina biotic index (NCBI), percentage of tolerant organisms, and percentage of Chironomidae for Conasauga River sampling sites. Values on the y-axis are scaled to suggest increasing levels of biotic condition or diversity (bottom to top). Distance is meters upstream from the furthest downstream USFS boundary on the Conasuaga River, just upstream of Minnewauga Creek, Cherokee National Forest, Tennessee. Site locations are shown on Figure 2.

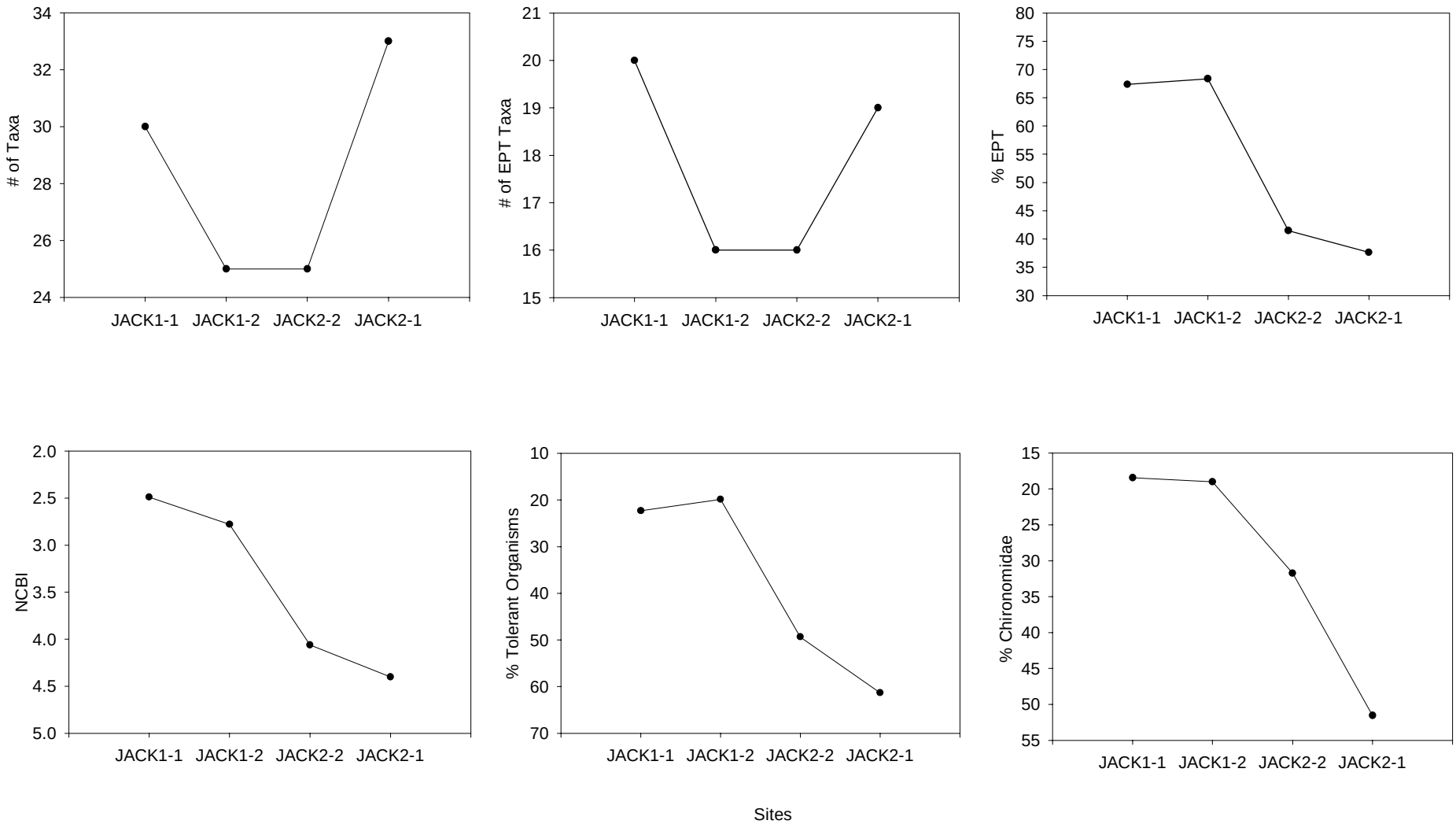

Figure 5. Total number of taxa, number of EPT taxa, percentage of EPT organisms, North Carolina biotic index (NCBI), percentage of tolerant organisms, and percentage of Chironomidae for Jacks River sampling sites Values on the y-axis are scaled to suggest increasing levels of biotic condition or diversity (bottom to top). Site locations are shown on Figure 3.

Appendix A: BVET Habitat Survey Results

Habitat Summary, Conasauga River, Section 1

District:	Ocoee (TN)
Quadrangle:	Parksville, Tennga
Survey Date:	07/15/00
Downstream Starting Point:	Forest Boundary, Cherokee NF, southwest of Forest Rd. 221
Total Distance Surveyed (km):	4.1
Percent of Total Area Pools:	74
Number of Pools:	44
Number of Pools per km:	11
Total Pool Area (m^2):	64537±3665
Mean Pool Area (m^2):	1467
Correction Factor:	1.07
Mean Maximum Depth (cm):	129
Mean Average Depth (cm):	70
Mean Residual Pool Depth (cm):	33
Percent of Total Area Riffles:	26
Number of Riffles:	30
Number of Riffles per km:	7
Total Riffle Area (m^2):	23018±1890
Mean Riffle Area (m^2):	767
Correction Factor:	1.04
Mean Maximum Depth (cm):	57
Mean Average Depth (cm):	35
Number of LWD pieces per km:	90
LWD < 5 m, 5-10 cm:	44
LWD < 5 m, 10-50 cm:	9
LWD < 5 m, > 50 cm:	1
LWD > 5 m, 5-10 cm:	14
LWD > 5 m, 10-50 cm:	19
LWD > 5 m, > 50 cm:	3
Rootwads:	0
Mean Bankfull Channel Width (m):	30
Rosgen's Channel Type Frequency:	
% Type A:	0
% Type B:	100
% Type C:	0
% Type D:	0
% Type E:	0
% Type F:	0
% Type G:	0
Percent of Pool Habitat Surveyed as Glides:	39
Percent Pools with > 35% Embeddedness:	5
Average Channel Gradient (%):	8

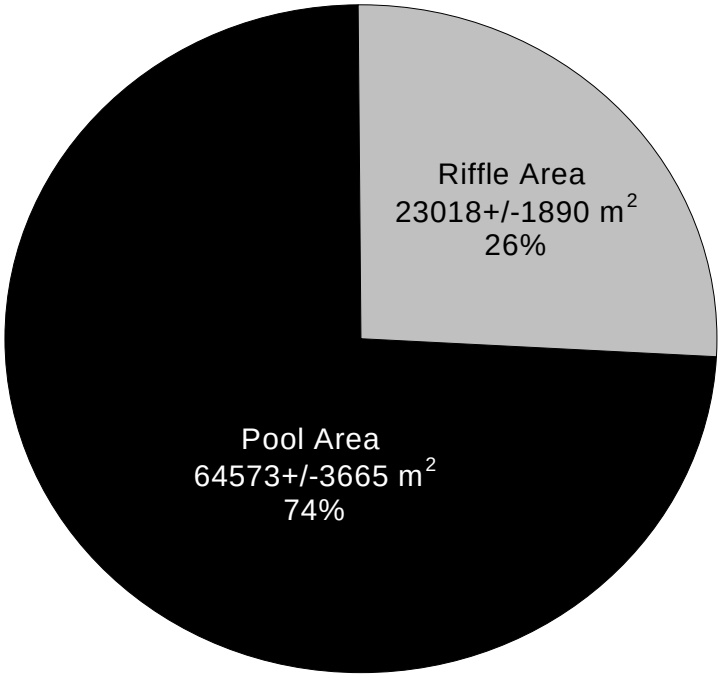

Figure A1. Percent pool and riffle surface area in section 1 of the Conasauga River.

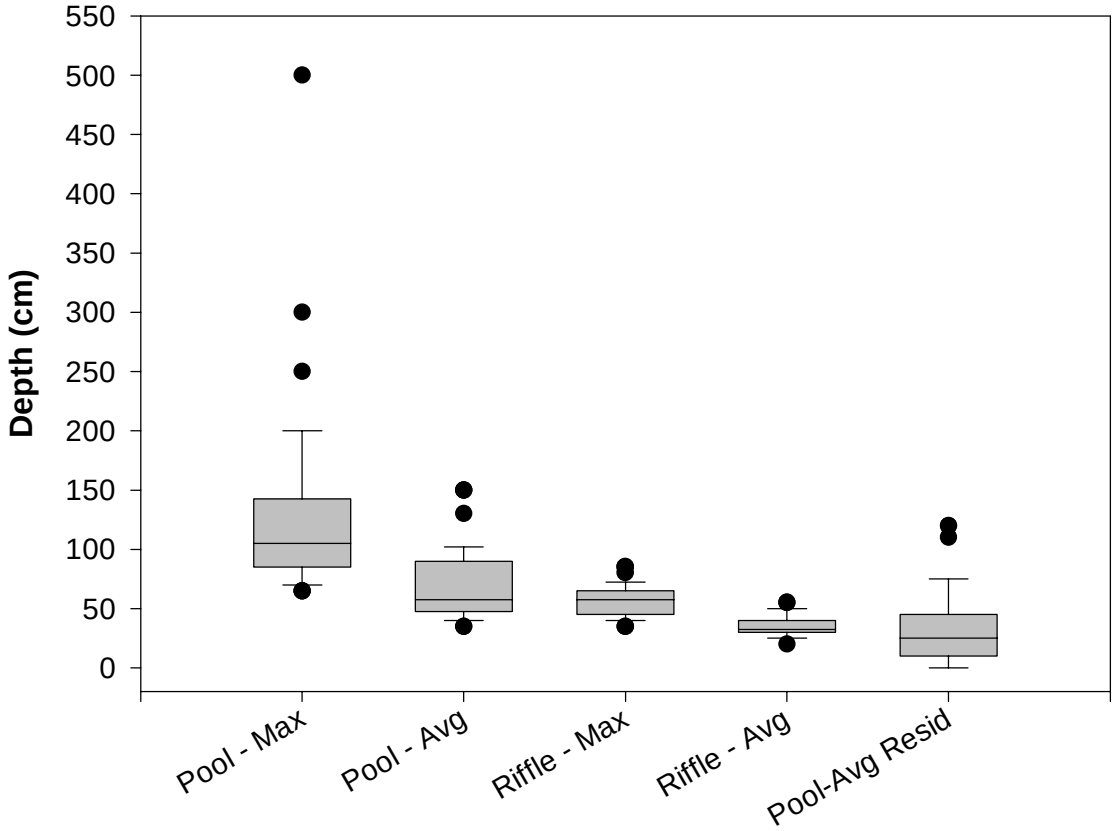

Figure A2. Maximum and average depths for pools and riffles, and average residual pool depths for Conasauga River section 1. The boxes enclose the middle 50% of the observations, the bar in the center of the boxes represent the median, and the capped lines extending above and below the boxes represent the 90% and 10% quantiles. Closed circles represent entire range of data.

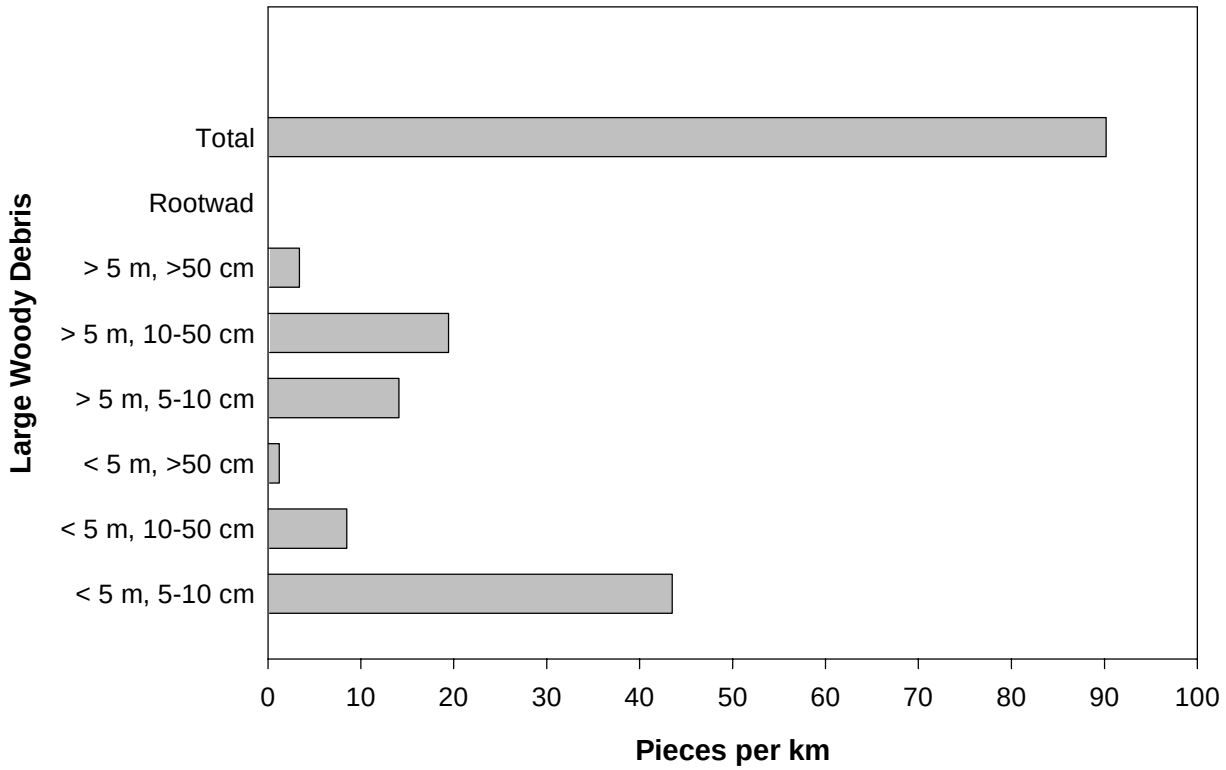

Figure A3. Pieces of large woody debris (LWD) per kilometer in section 1 of the Conasauga River.

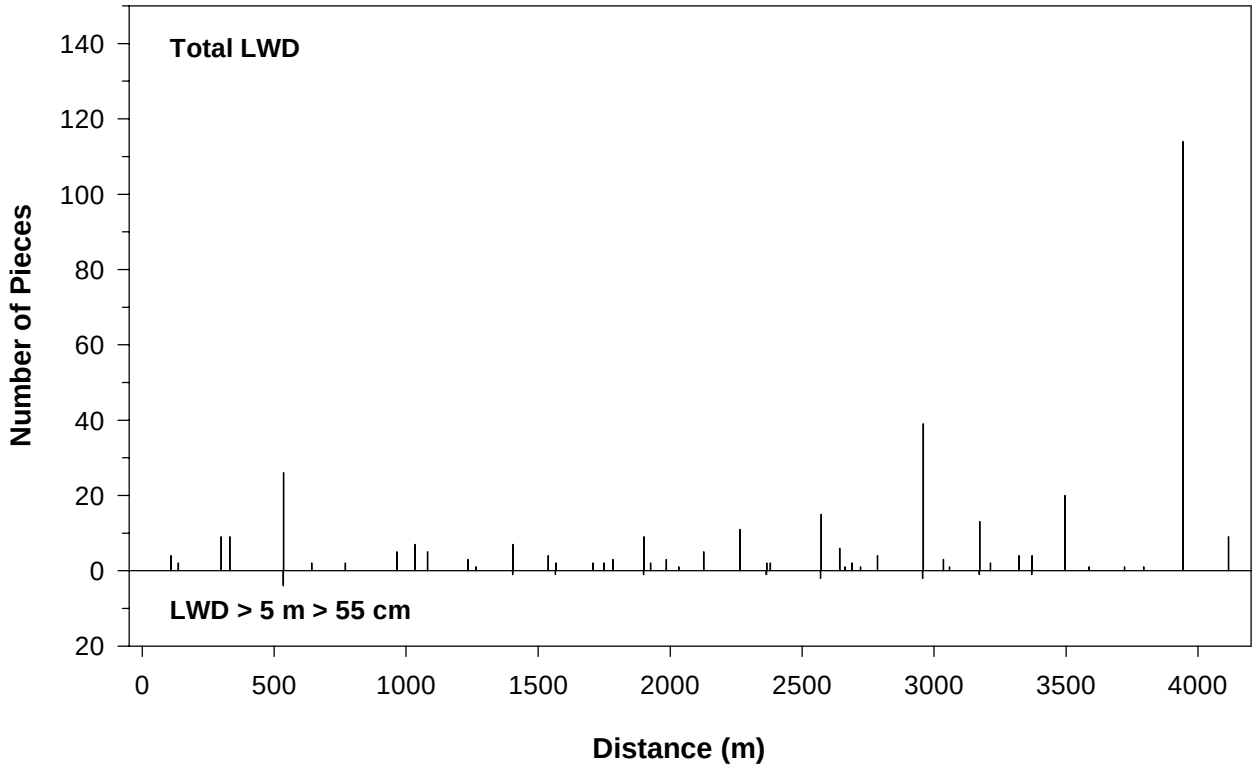

Figure A4. Distribution and abundance of LWD in section 1 of the Conasauga River. Section 1 extended from meter 0 to meter 4175.

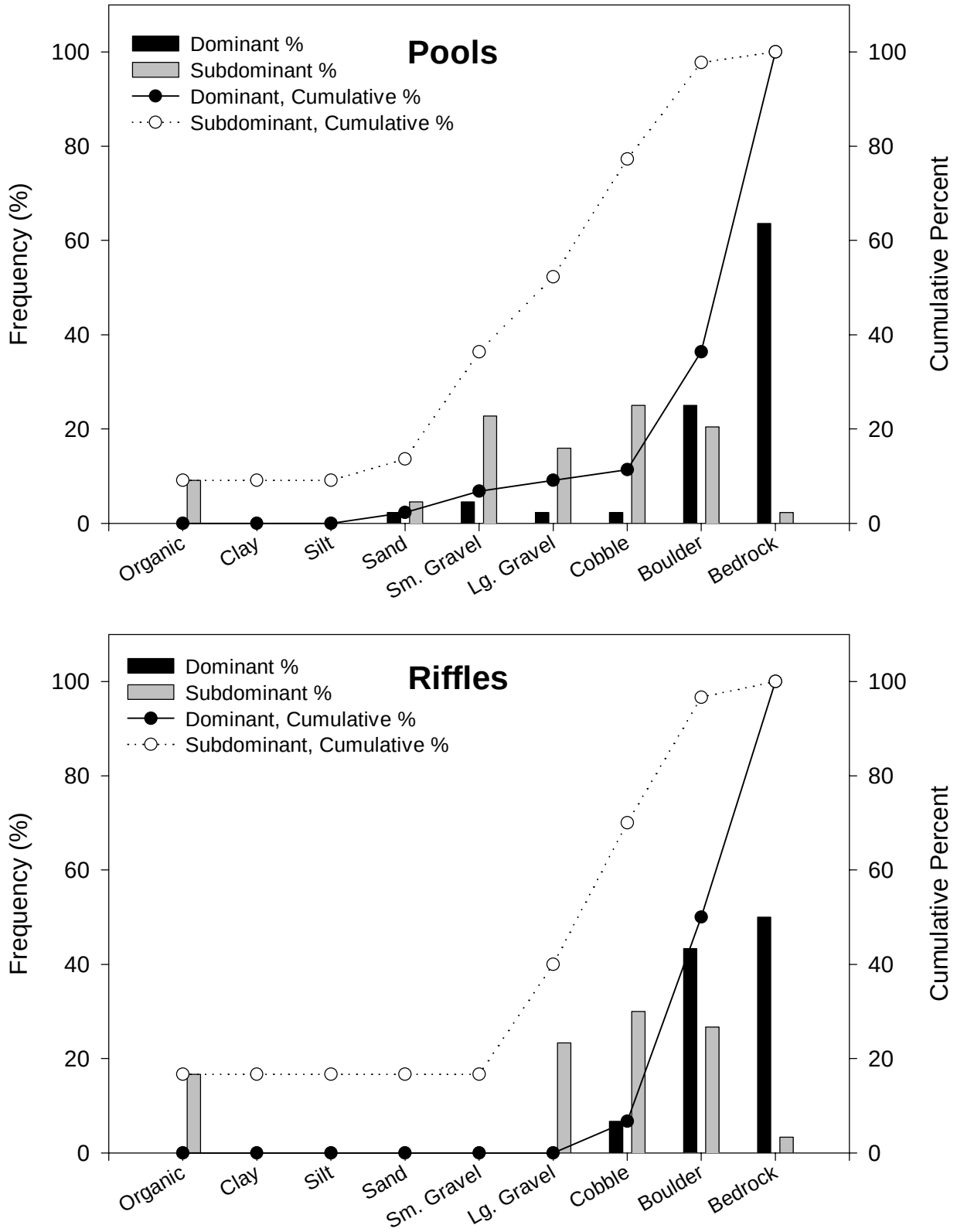

Figure A5. Frequency (percent) of dominant and subdominant substrate occurrence for pools and riffles in section 1 of the Conasauga River. Solid dots and bars represent percent and cumulative percent of dominant substrate, open dots and gray bars represent percent and cumulative percent of subdominant substrate.

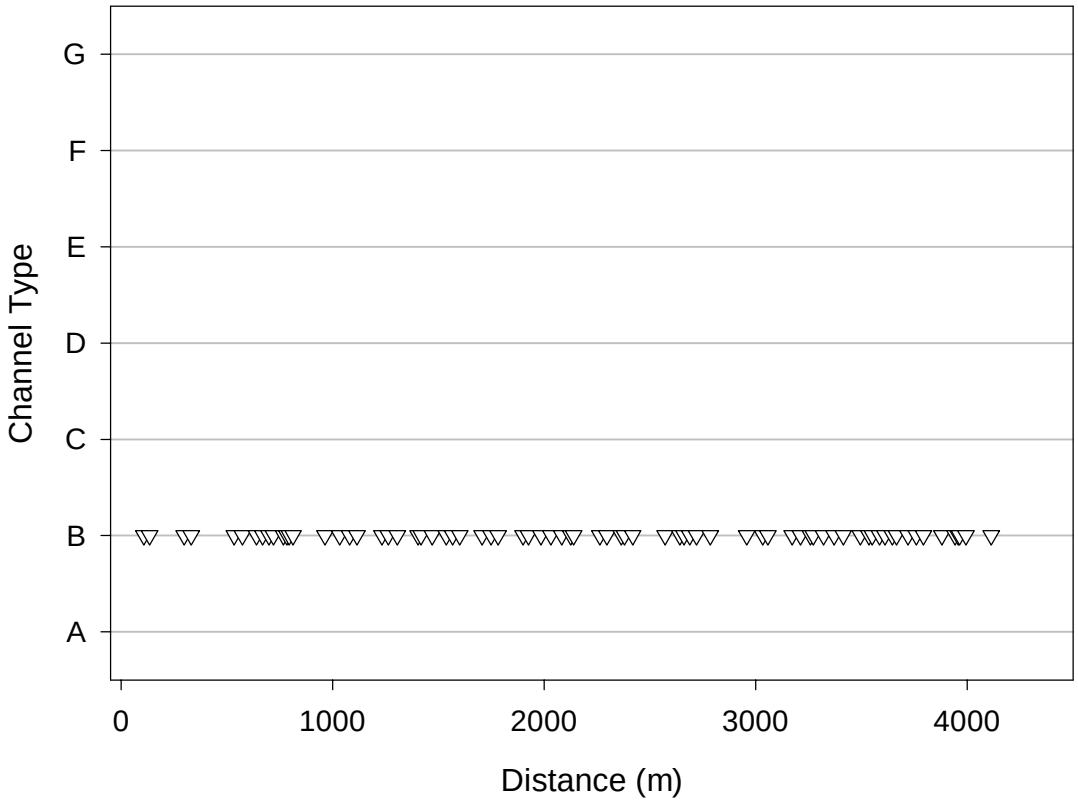

Figure A6. Rosgen's channel type distribution in section 1 of the Conasauga River. Section 1 extended from meter 0 to meter 4175.

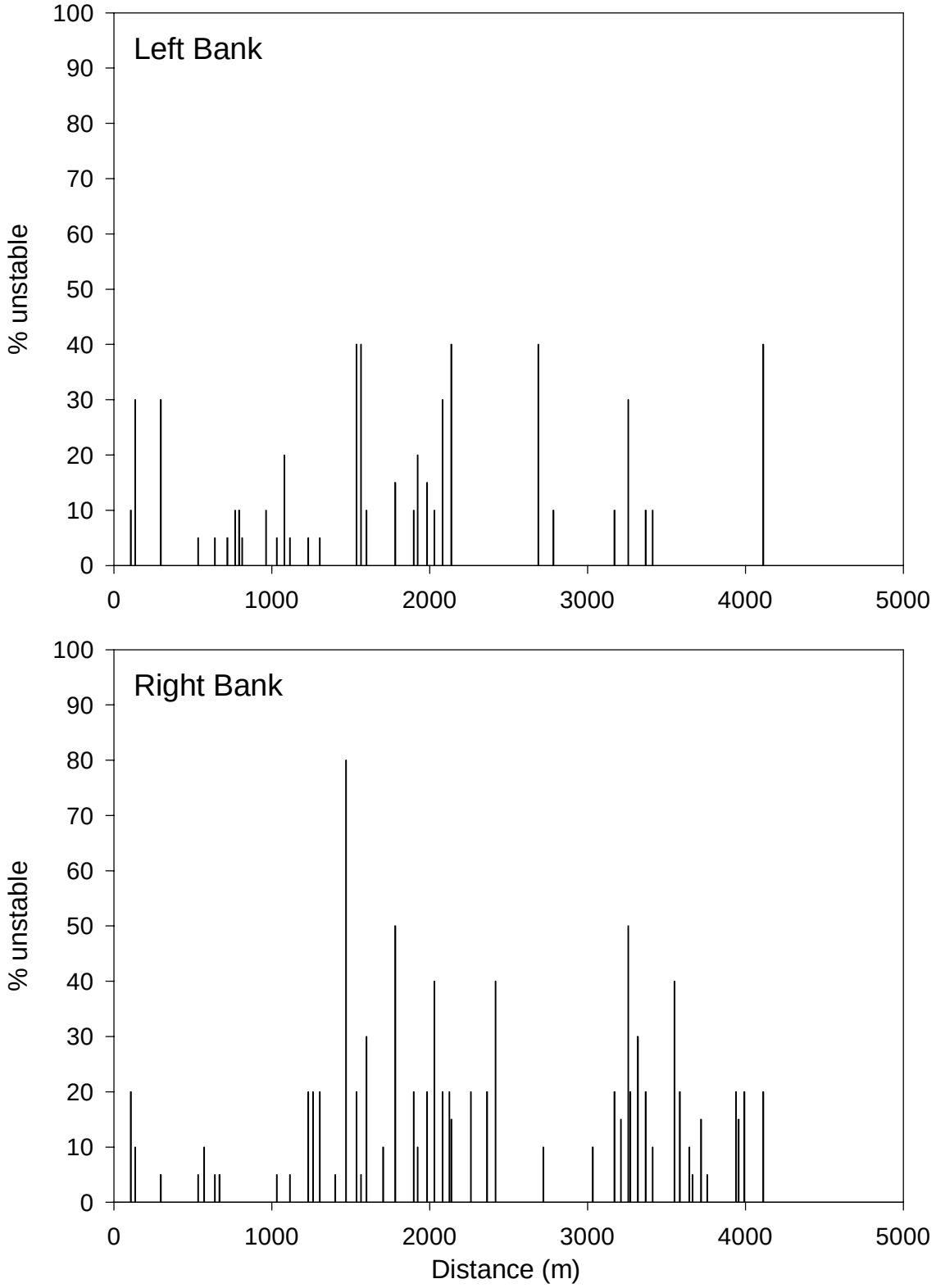

Figure A7. Percent of bank in the Conasauga River, section 1, considered to be unstable (% of bank composed of exposed erodible material from water's edge to bankfull). Estimated for every habitat unit.

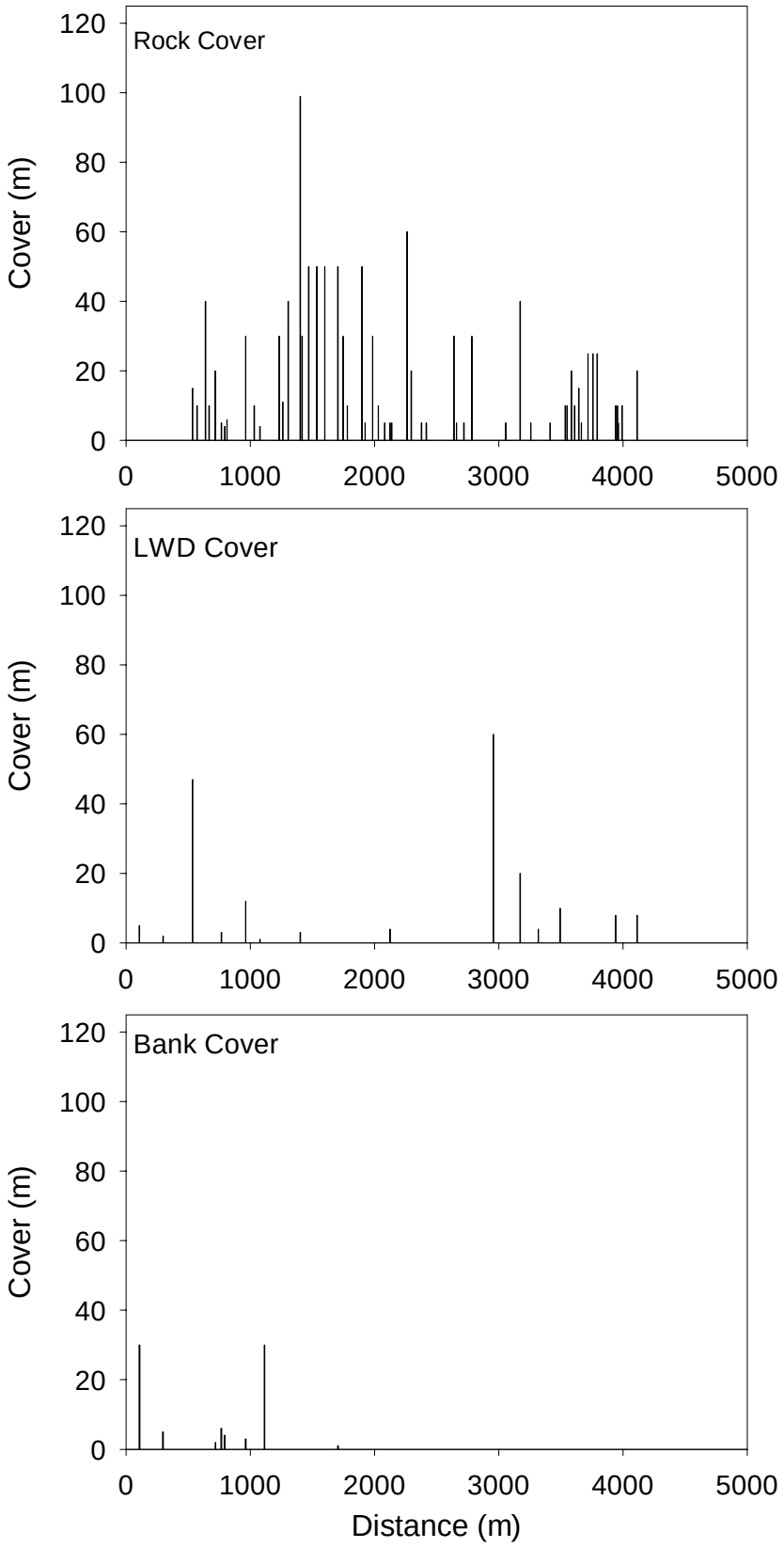

Figure A8. Estimated linear meters of overhead cover provided by rock, LWD, and undercut banks within the wetted stream channel for each habitat unit in section 1 of the Conasauga River. Cover was considered to be provided if a 15 cm object could be hidden beneath the cover type.

Habitat Summary, Conasauga River, Section 2

District:	Ocoee (TN), Cohutta (GA)
Quadrangle:	Tennga (GA)
Survey Date:	07/15/00
Downstream Starting Point:	Cherokee NF at Conasauga River Trail
Total Distance Surveyed (km):	4.2
Percent of Total Area Pools:	56
Number of Pools:	31
Number of Pools per km:	7
Total Pool Area (m^2):	53745±10921
Mean Pool Area (m^2):	1734
Correction Factor:	0.95
Mean Maximum Depth (cm):	168
Mean Average Depth (cm):	116
Mean Residual Pool Depth (cm):	83
Percent of Total Area Riffles:	44
Number of Riffles:	35
Number of Riffles per km:	8
Total Riffle Area (m^2):	41782±8605
Mean Riffle Area (m^2):	1194
Correction Factor:	1.12
Mean Maximum Depth (cm):	81
Mean Average Depth (cm):	38
Number of LWD pieces per km:	45
LWD < 5 m, 5-10 cm:	18
LWD < 5 m, 10-50 cm:	8
LWD < 5 m, > 50 cm:	1
LWD > 5 m, 5-10 cm:	5
LWD > 5 m, 10-50 cm:	12
LWD > 5 m, > 50 cm:	2
Rootwads:	0
Mean Bankfull Channel Width (m):	31
Rosgen's Channel Type Frequency:	
% Type A:	0
% Type B:	100
% Type C:	0
% Type D:	0
% Type E:	0
% Type F:	0
% Type G:	0
Percent of Pool Habitat Surveyed as Glides:	10
Percent Pools with > 35% Embeddedness:	19
Average Channel Gradient (%):	2

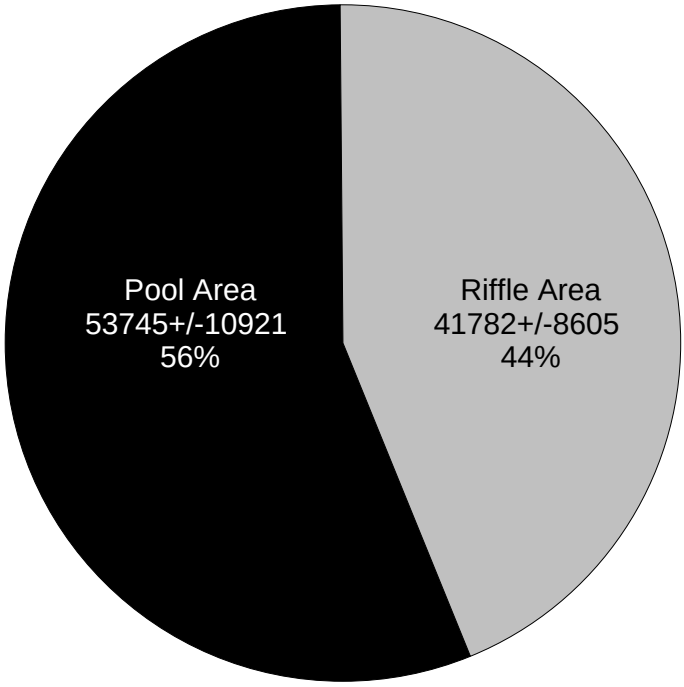

Figure A9. Percent pool and riffle surface area in section 2 of the Conasauga River.

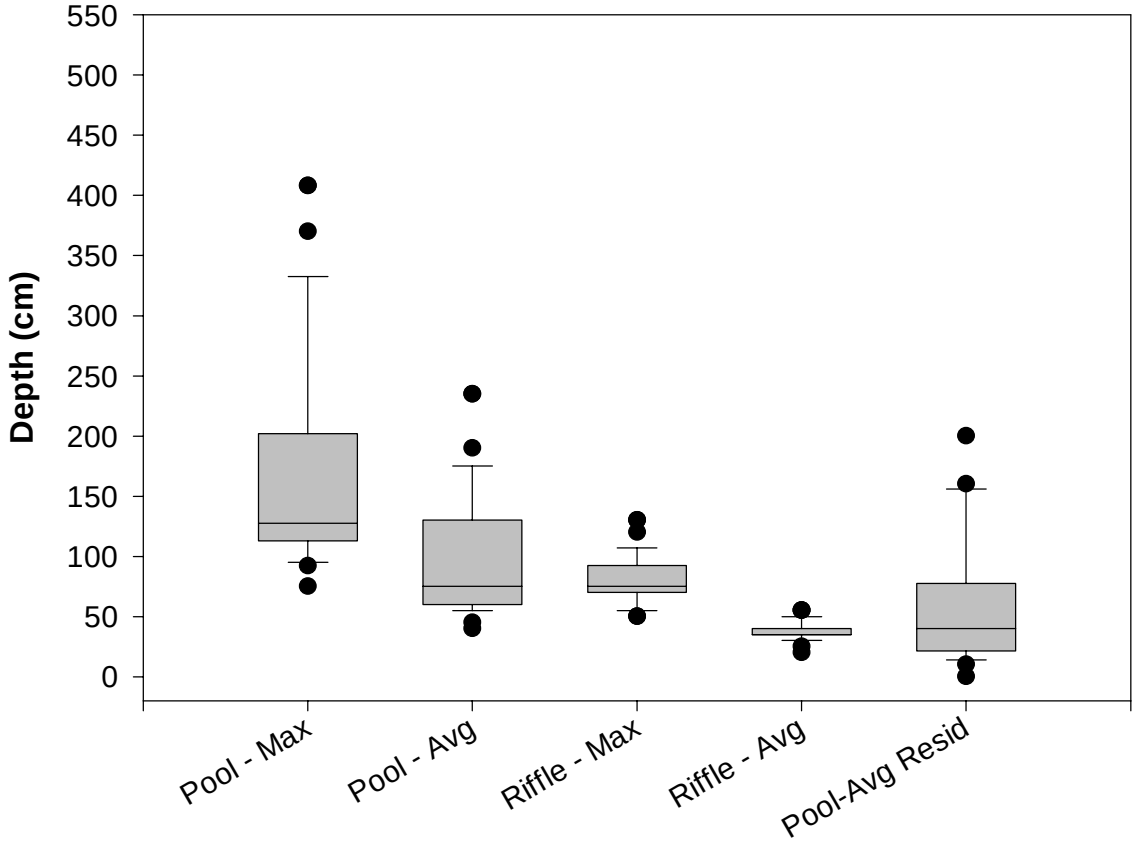

Figure A10. Maximum and average depths for pools and riffles, and average residual pool depths for Conasauga River section 2. The boxes enclose the middle 50% of the observations, the bar in the center of the boxes represent the median, and the capped lines extending above and below the boxes represent the 90% and 10% quantiles. Closed circles represent entire range of data.

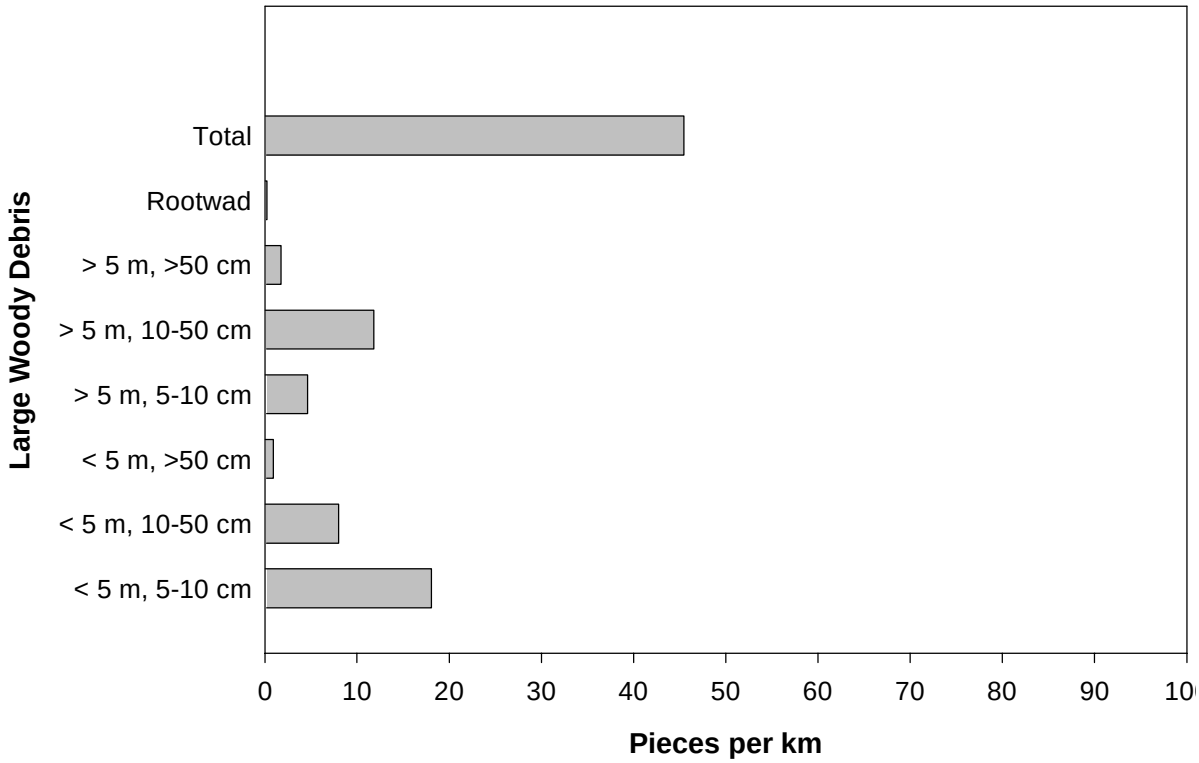

Figure A11. Pieces of large woody debris (LWD) per kilometer in section 2 of the Conasauga River.

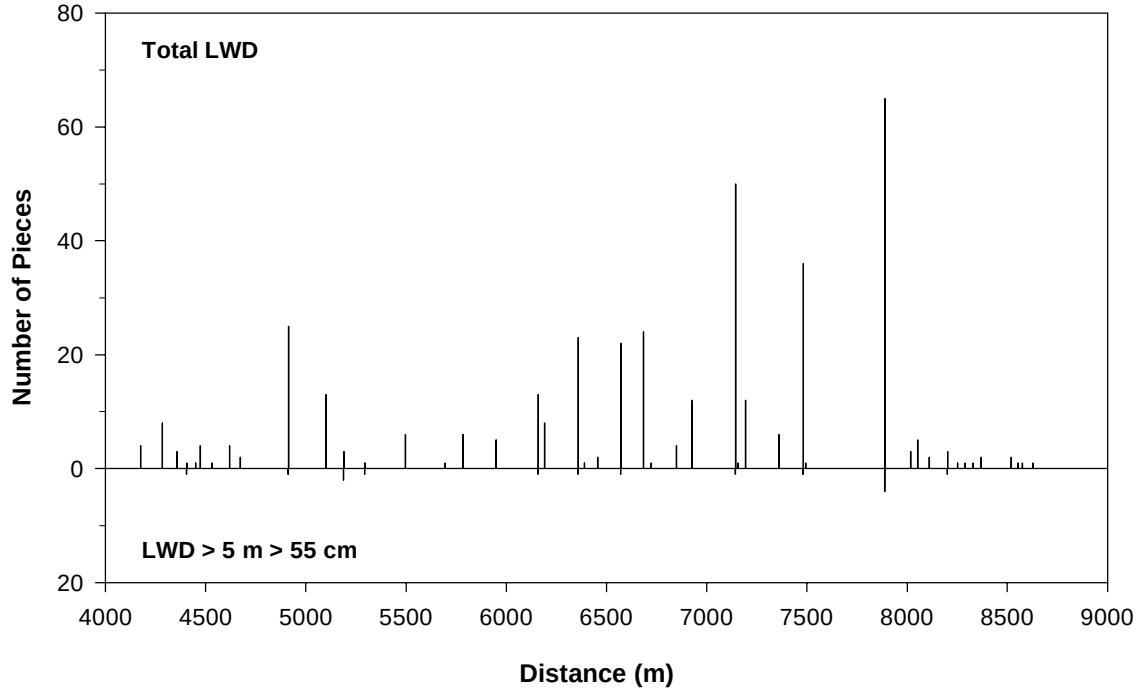

Figure A12. Distribution and abundance of LWD in section 2 of the Conasauga River. Section 2 extended from meter 4175 to meter 8626.

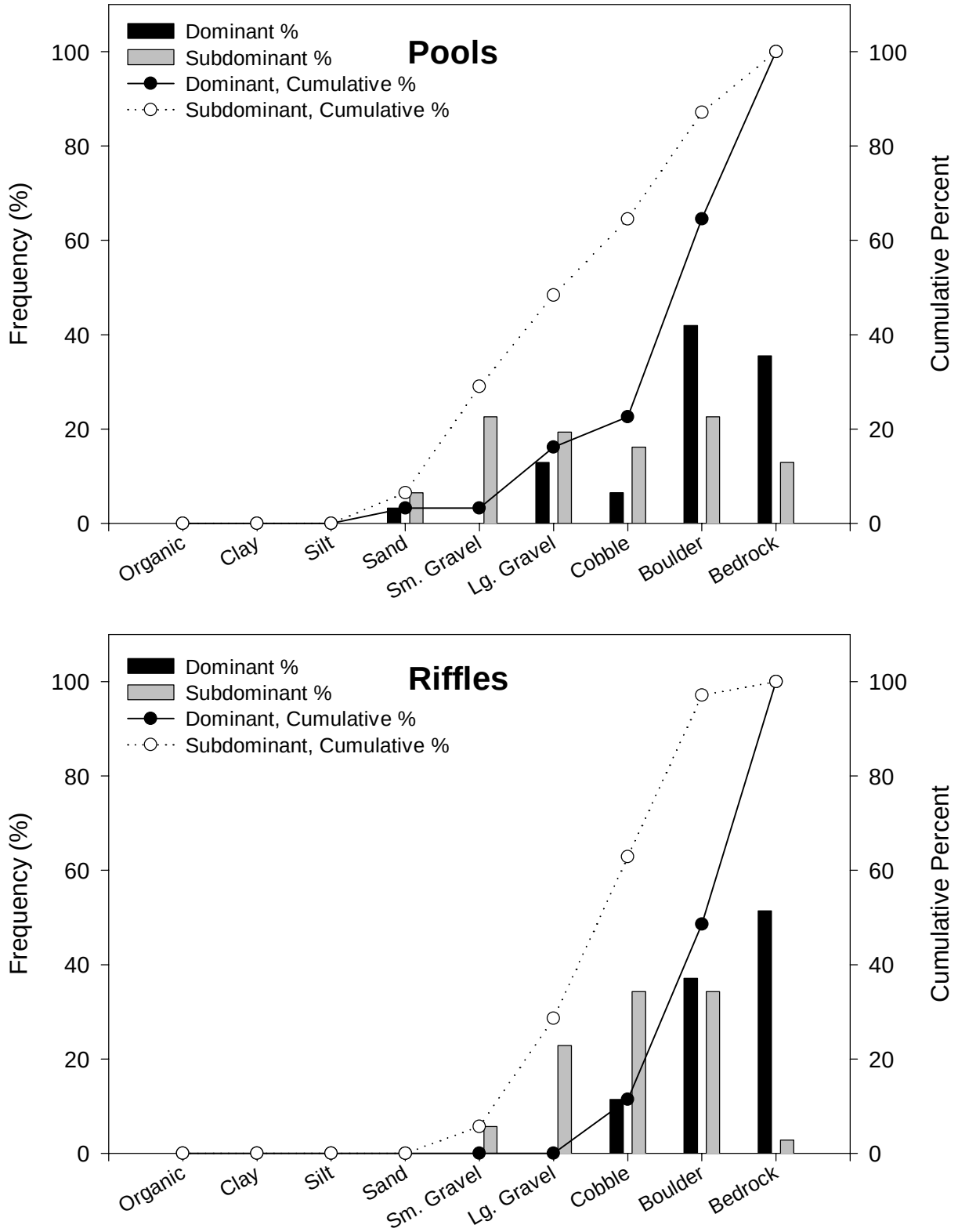

Figure A13. Frequency (percent) of dominant and subdominant substrate occurrence for pools and riffles in section 2 of the Conasauga River. Solid dots and bars represent percent and cumulative percent of dominant substrate, open dots and gray bars represent percent and cumulative percent of subdominant substrate.

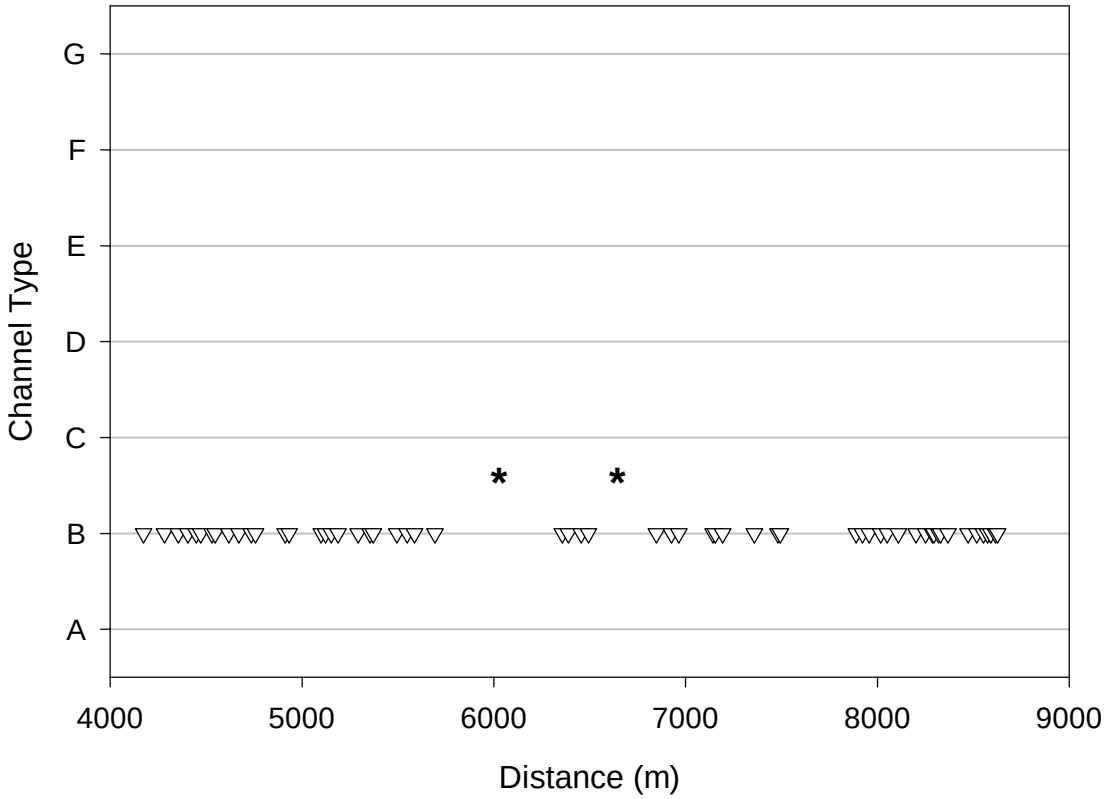

Figure A14. Rosgen's channel type distribution in section 2 of the Conasauga River. Section 2 extended from meter 4175 to meter 8626.

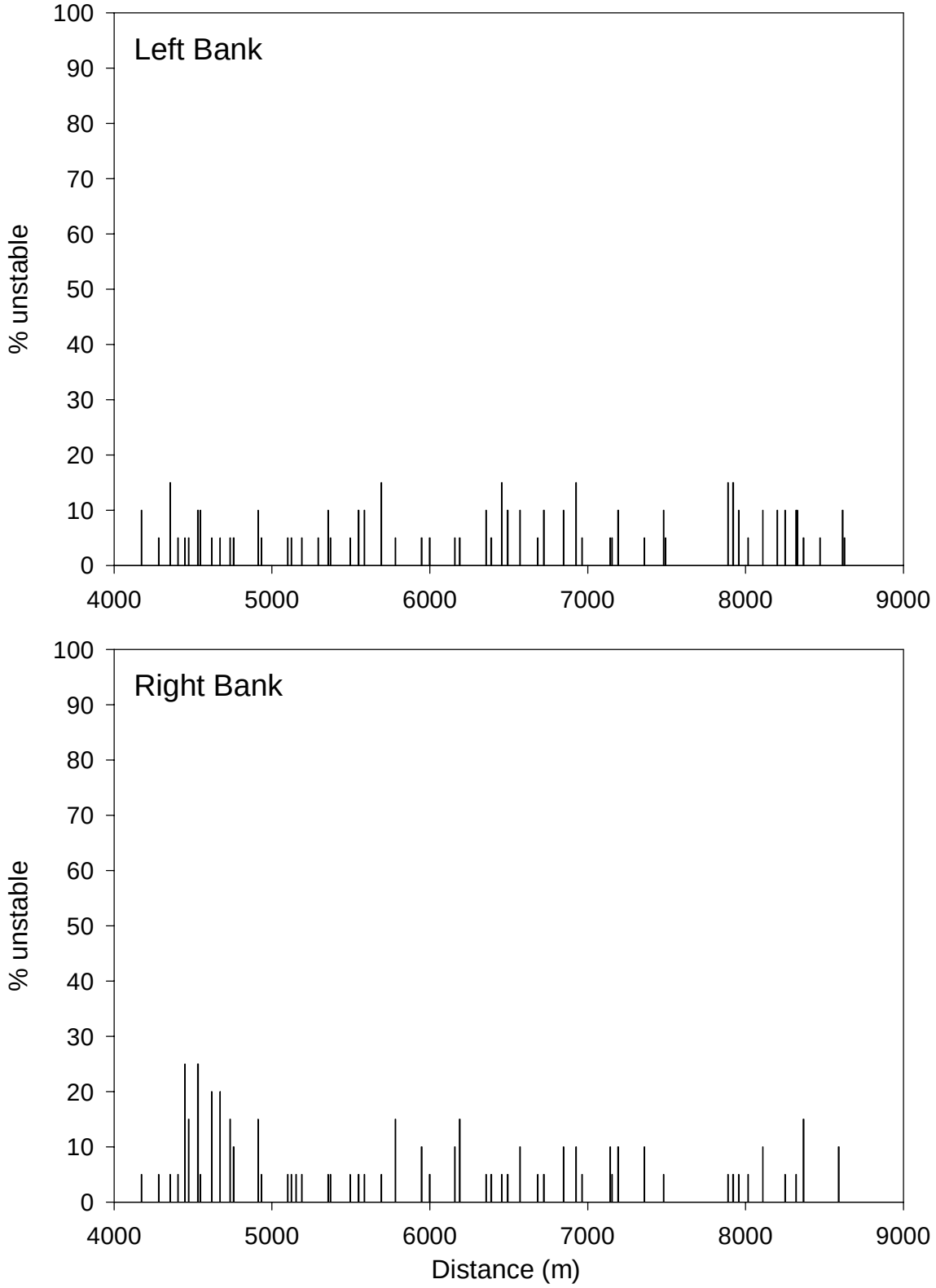

Figure A15. Percent of bank in the Conasauga River, section 2, considered to be unstable (% of bank composed of exposed erodible material from water's edge to bankfull). Estimated for every habitat unit.

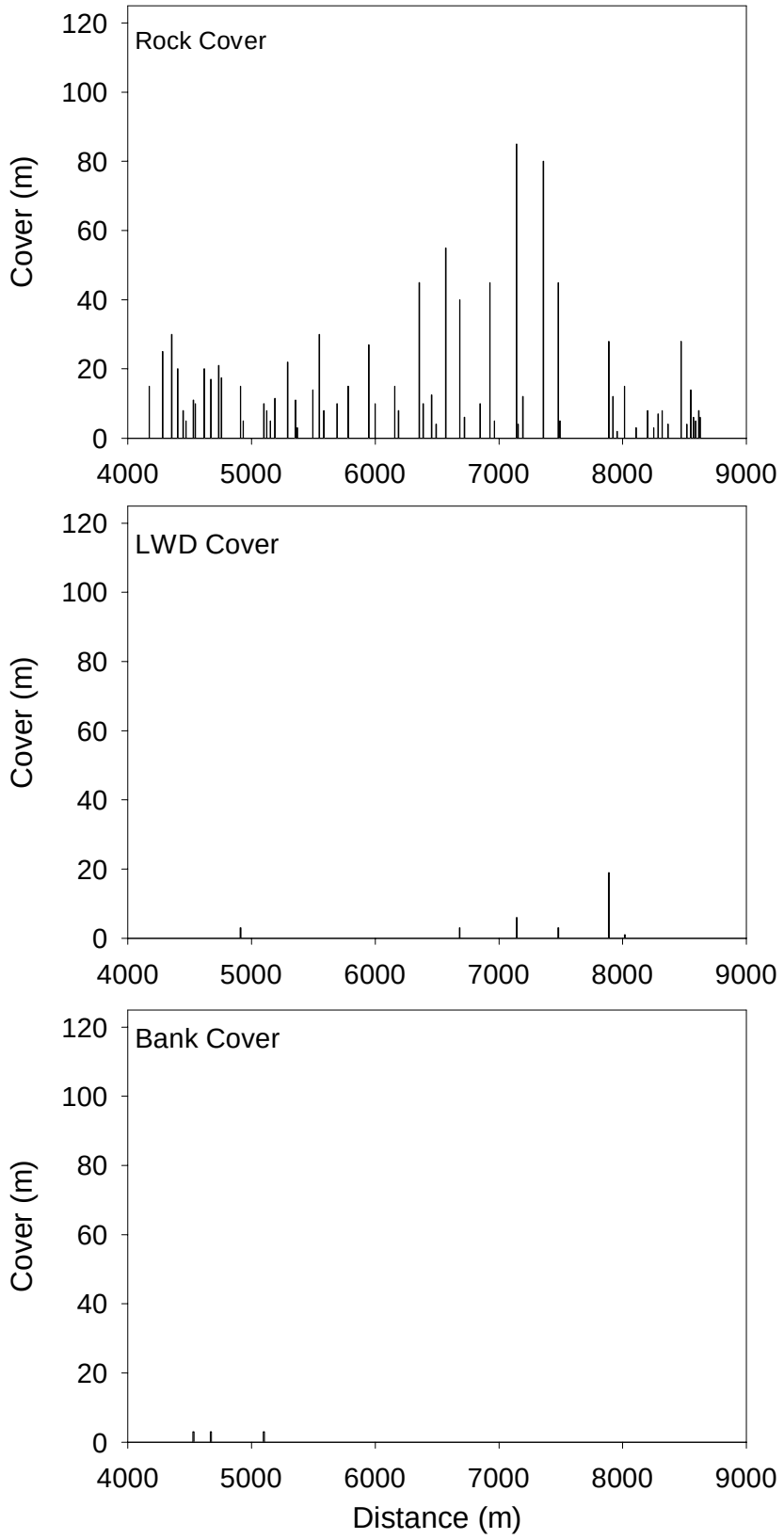

Figure A16. Estimated linear meters of overhead cover provided by rock, LWD, and undercut banks within the wetted stream channel for each habitat unit in section 2 of the Conasauga River. Cover was considered to be provided if a 15 cm object could be hidden beneath the cover type.

Habitat Summary, Conasauga River, Section 3

District:	Ocoee (TN), Cohutta (GA)
Quadrangle:	Tennga (GA)
Survey Date:	07/15/00
Downstream Starting Point:	Confluence with Graham Branch
Total Distance Surveyed (km):	2.9
Percent of Total Area Pools:	67
Number of Pools:	28
Number of Pools per km:	10
Total Pool Area (m^2):	31279±4666
Mean Pool Area (m^2):	1117
Correction Factor:	0.97
Mean Maximum Depth (cm):	91
Mean Average Depth (cm):	45
Mean Residual Pool Depth (cm):	18
Percent of Total Area Riffles:	33
Number of Riffles:	28
Number of Riffles per km:	10
Total Riffle Area (m^2):	15560±2922
Mean Riffle Area (m^2):	556
Correction Factor:	0.87
Mean Maximum Depth (cm):	38
Mean Average Depth (cm):	24
Number of LWD pieces per km:	18
LWD < 5 m, 5-10 cm:	1
LWD < 5 m, 10-50 cm:	4
LWD < 5 m, > 50 cm:	0
LWD > 5 m, 5-10 cm:	1
LWD > 5 m, 10-50 cm:	9
LWD > 5 m, > 50 cm:	2
Rootwads:	1
Mean Bankfull Channel Width (m):	21
Rosgen's Channel Type Frequency:	
% Type A:	0
% Type B:	20
% Type C:	80
% Type D:	0
% Type E:	0
% Type F:	0
% Type G:	0
Percent of Pool Habitat Surveyed as Glides:	18
Percent Pools with > 35% Embeddedness:	64
Average Channel Gradient (%):	2

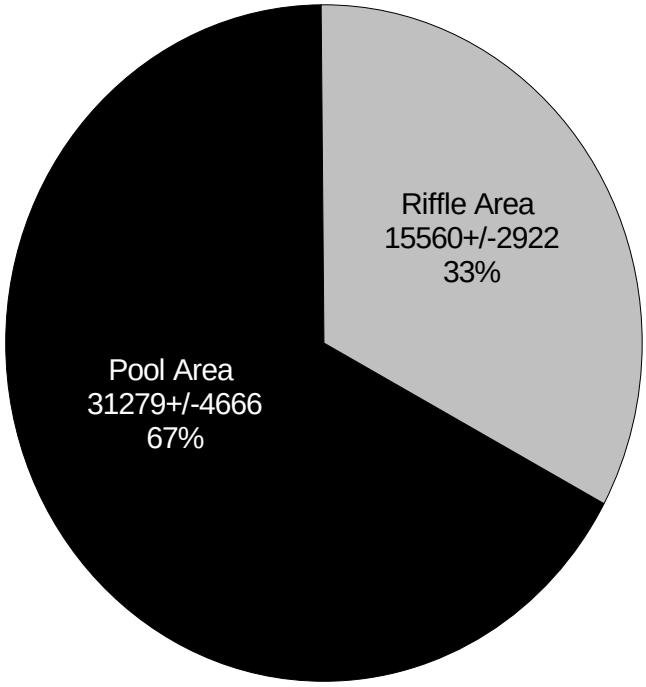

Figure A17. Percent pool and riffle surface area in section 3 of the Conasauga River.

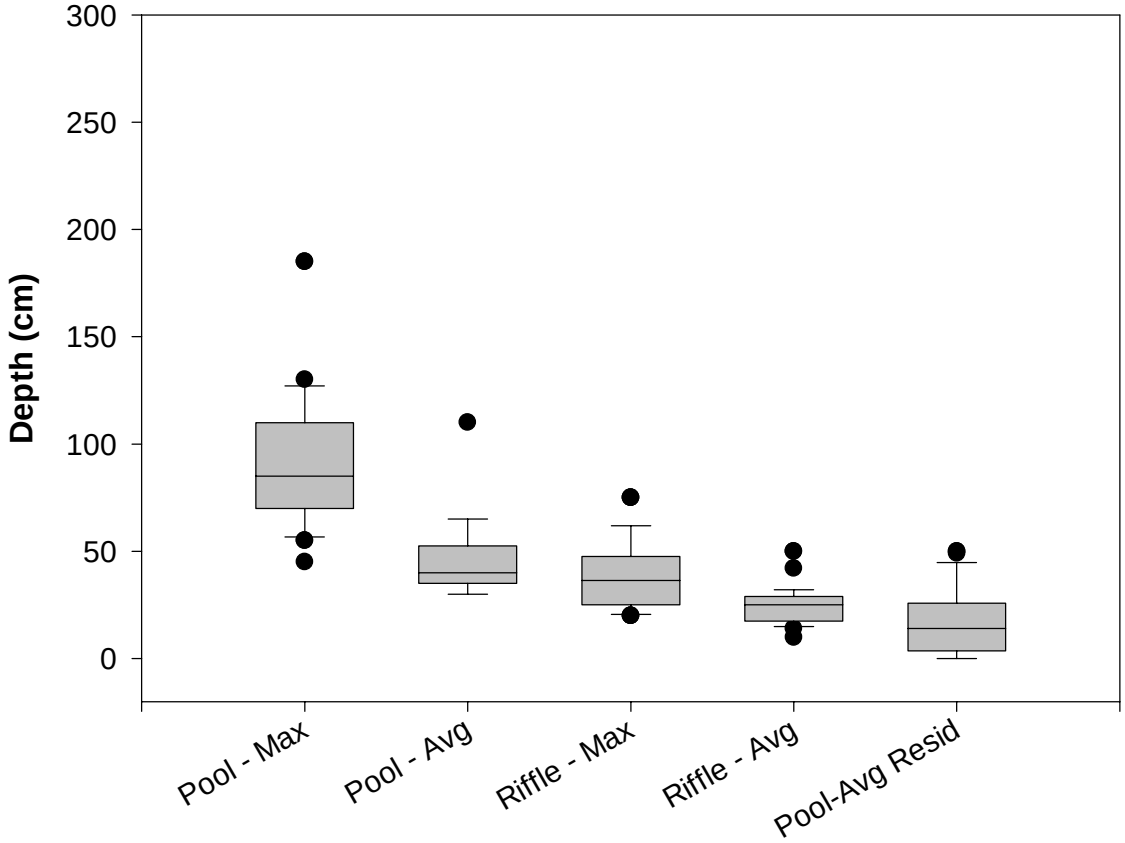

Figure A18. Maximum and average depths for pools and riffles, and average residual pool depths for Conasauga River section 3. The boxes enclose the middle 50% of the observations, the bar in the center of the boxes represent the median, and the capped lines extending above and below the boxes represent the 90% and 10% quantiles. Clsoed circles represent entire range of data.

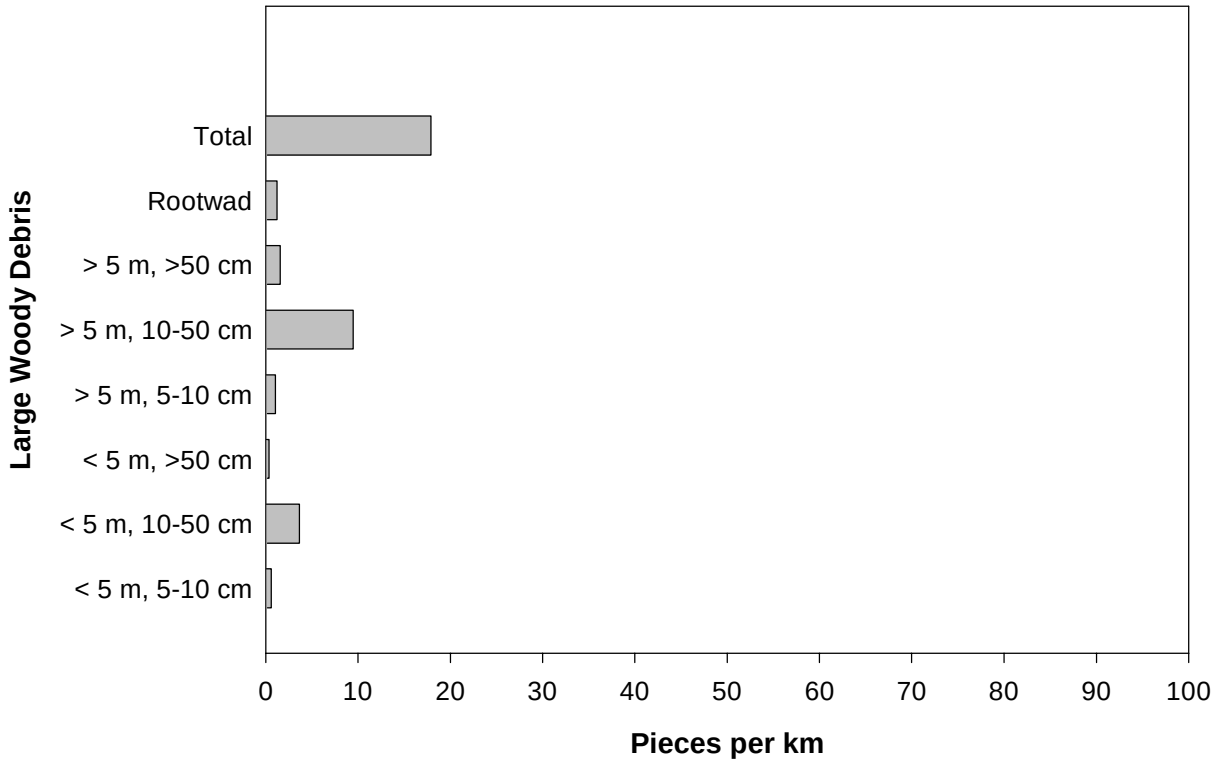

Figure A19. Pieces of large woody debris (LWD) per kilometer in section 3 of the Conasauga River.

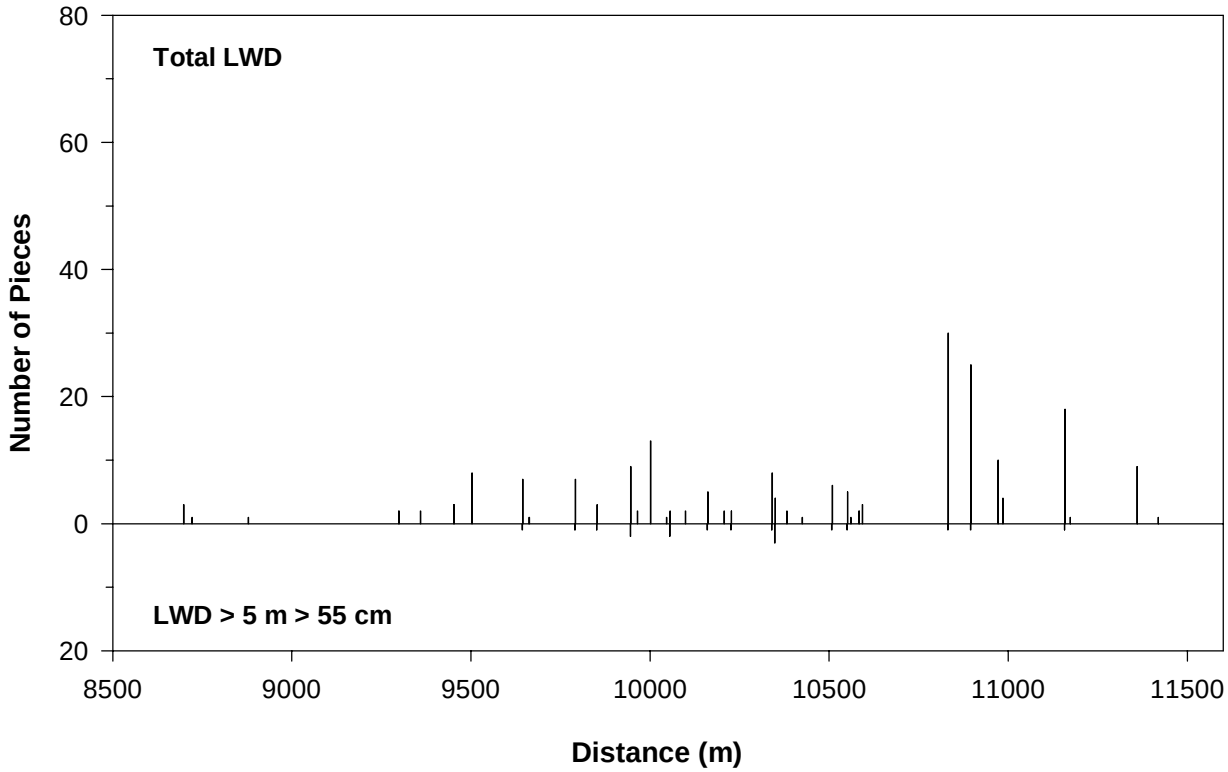

Figure A20. Distribution and abundance of LWD in section 3, of the Conasauga River. Section 3 extended from meter 8626 to meter 11510.

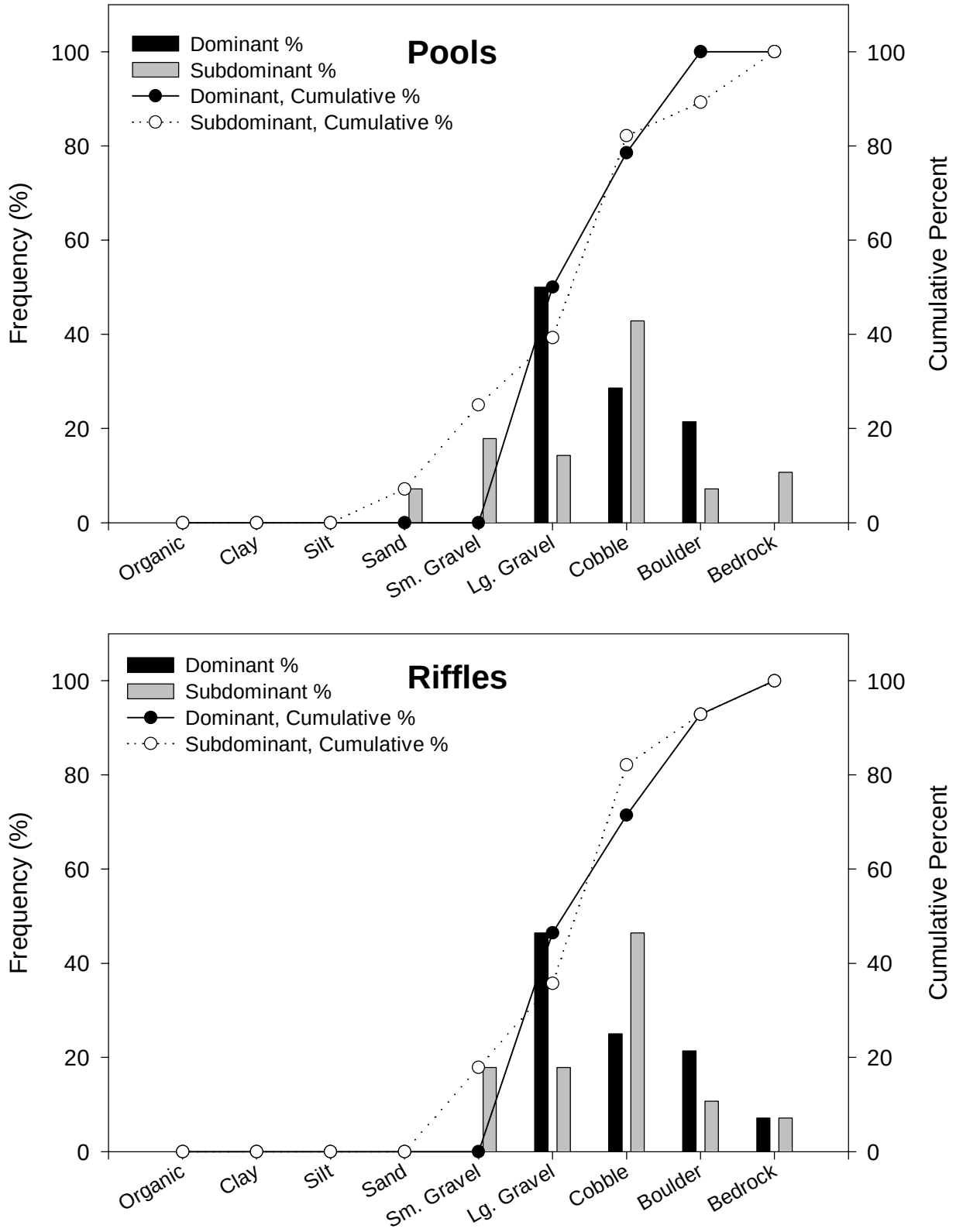

Figure A21. Frequency (percent) of dominant and subdominant substrate occurrence for pools and riffles in section 3 of the Conasauga River. Solid dots and bars represent percent and cumulative percent of dominant substrate, open dots and gray bars represent percent and cumulative percent of subdominant substrate.

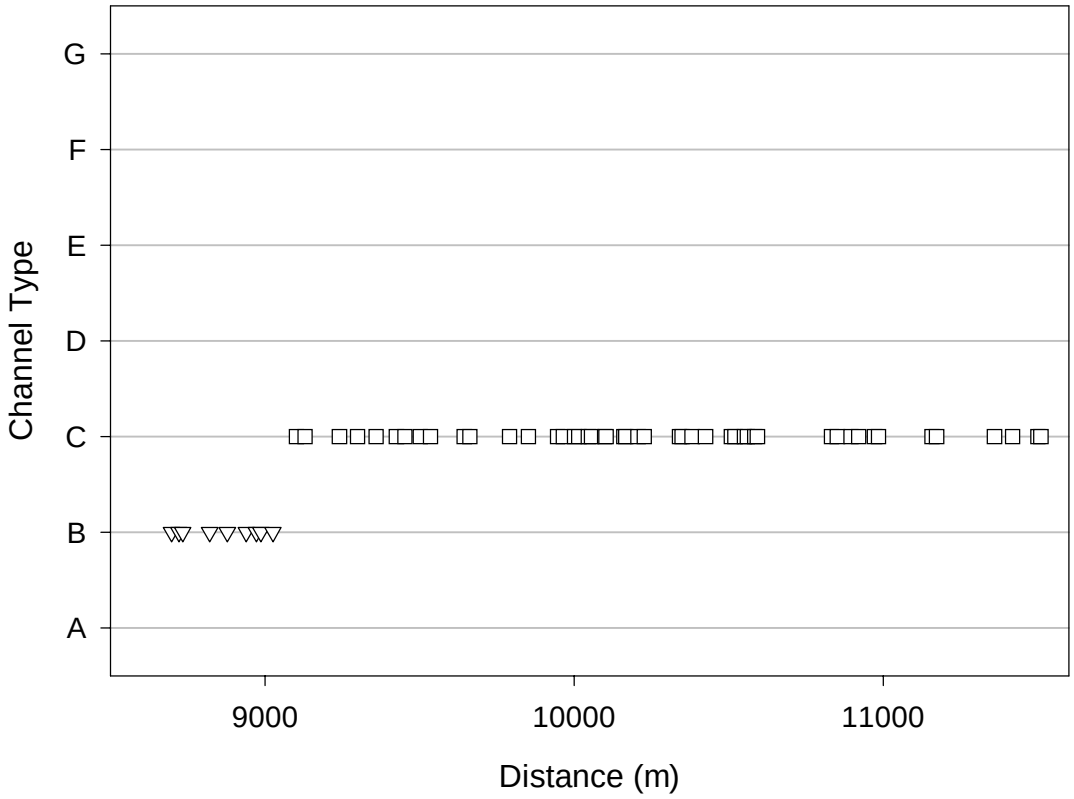

Figure A22. Rosgen's channel type distribution in section 3 of the Conasauga River. Section 3 extended from meter 8626 to meter 11510.

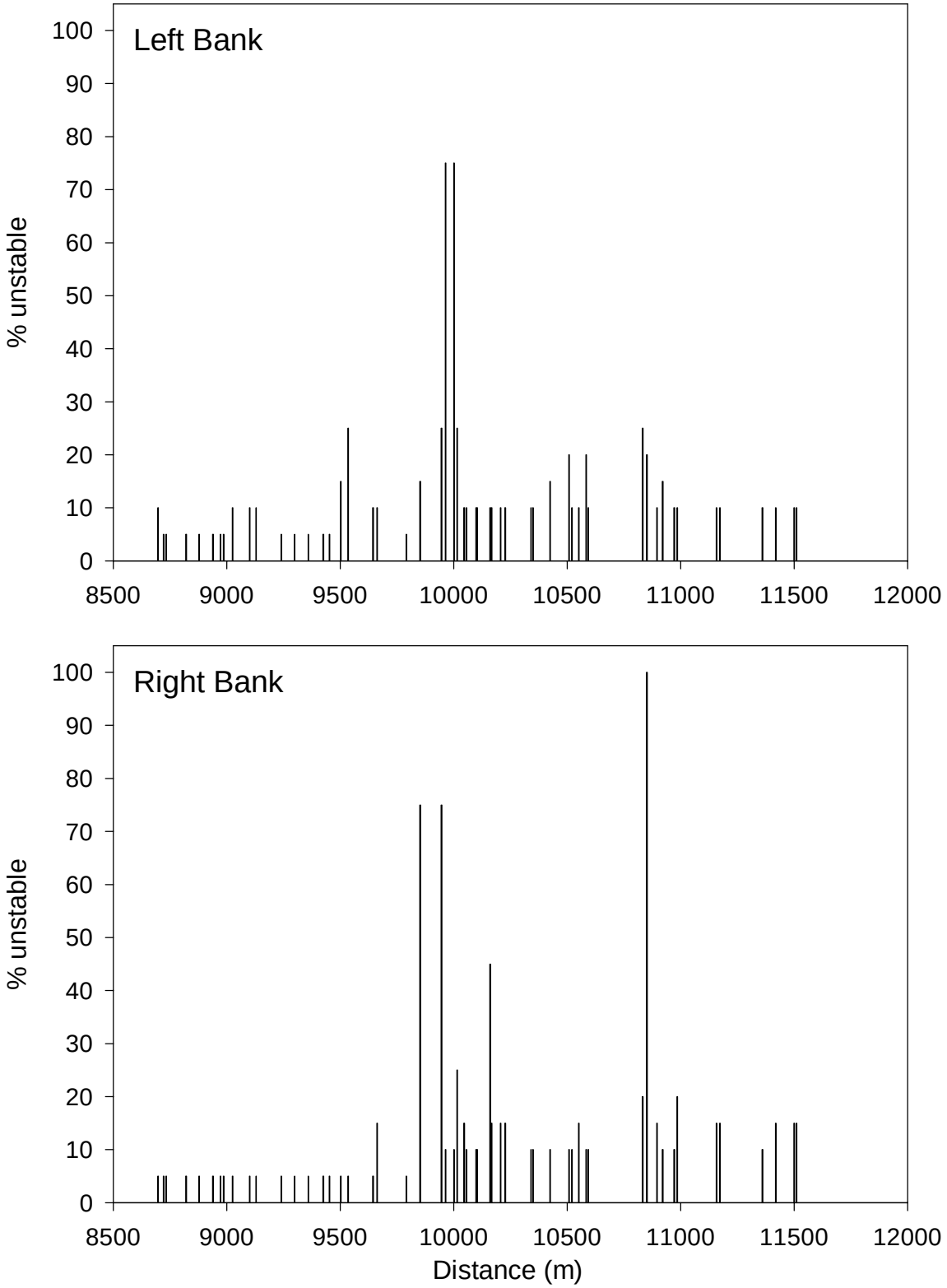

Figure A23. Percent of bank in the Conasauga River, section 3, considered to be unstable (% of bank composed of exposed erodible material from water's edge to bankfull). Estimated for every habitat unit.

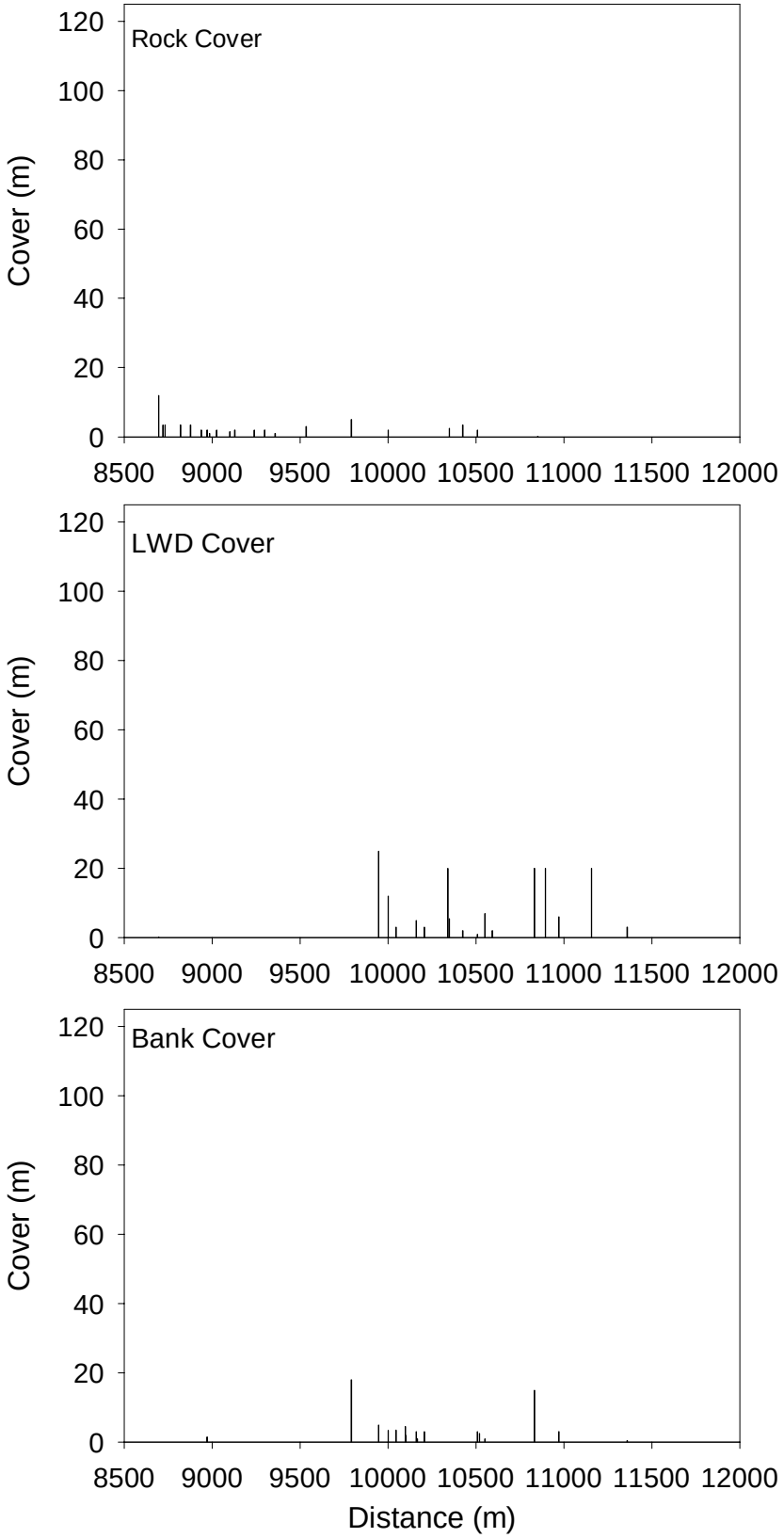

Figure A24. Estimated linear meters of overhead cover provided by rock, LWD, and undercut banks within the wetted stream channel for each habitat unit in section 3 of the Conasauga River. Cover was considered to be provided if a 15 cm object could be hidden beneath the cover type.

Habitat Summary, Conasauga River, Section 4

District:	Cohutta (GA)
Quadrangle:	Tennga (GA)
Survey Date:	07/15/00
Downstream Starting Point:	Forest boundary below Route 103
Total Distance Surveyed (km):	5.3
Percent of Total Area Pools:	72
Number of Pools:	94
Number of Pools per km:	18
Total Pool Area (m^2):	45363±304
Mean Pool Area (m^2):	483
Correction Factor:	0.85
Mean Maximum Depth (cm):	79
Mean Average Depth (cm):	45
Mean Residual Pool Depth (cm):	30
Percent of Total Area Riffles:	28
Number of Riffles:	71
Number of Riffles per km:	13
Total Riffle Area (m^2):	17439±4056
Mean Riffle Area (m^2):	246
Correction Factor:	1.04
Mean Maximum Depth (cm):	40
Mean Average Depth (cm):	22
Number of LWD pieces per km:	7
LWD < 5 m, 5-10 cm:	1
LWD < 5 m, 10-50 cm:	2
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
Rootwads:	0
Mean Bankfull Channel Width (m):	20
Rosgen's Channel Type Frequency:	
% Type A:	37
% Type B:	6
% Type C:	57
% Type D:	0
% Type E:	0
% Type F:	0
% Type G:	0
Percent of Pool Habitat Surveyed as Glides:	37
Percent Pools with > 35% Embeddedness:	14
Average Channel Gradient (%):	7

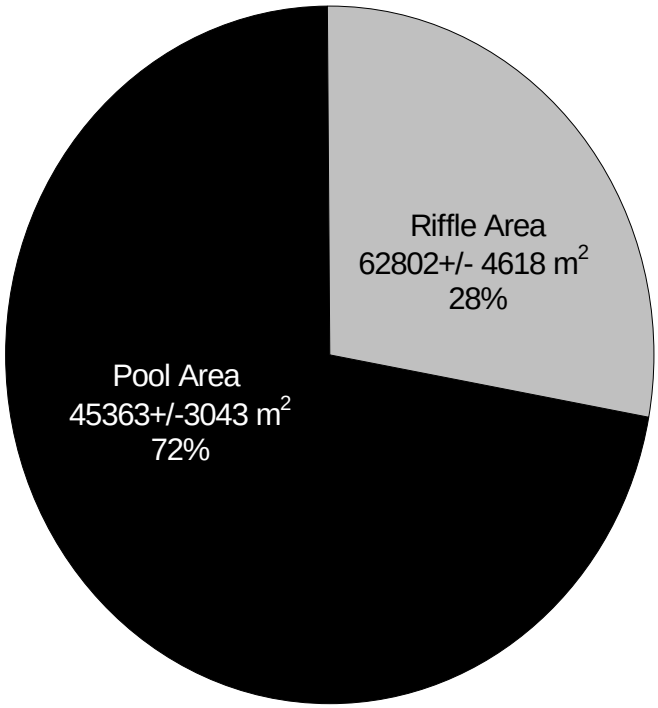

Figure A25. Percent pool and riffle surface area in section 4 of the Conasauga River.

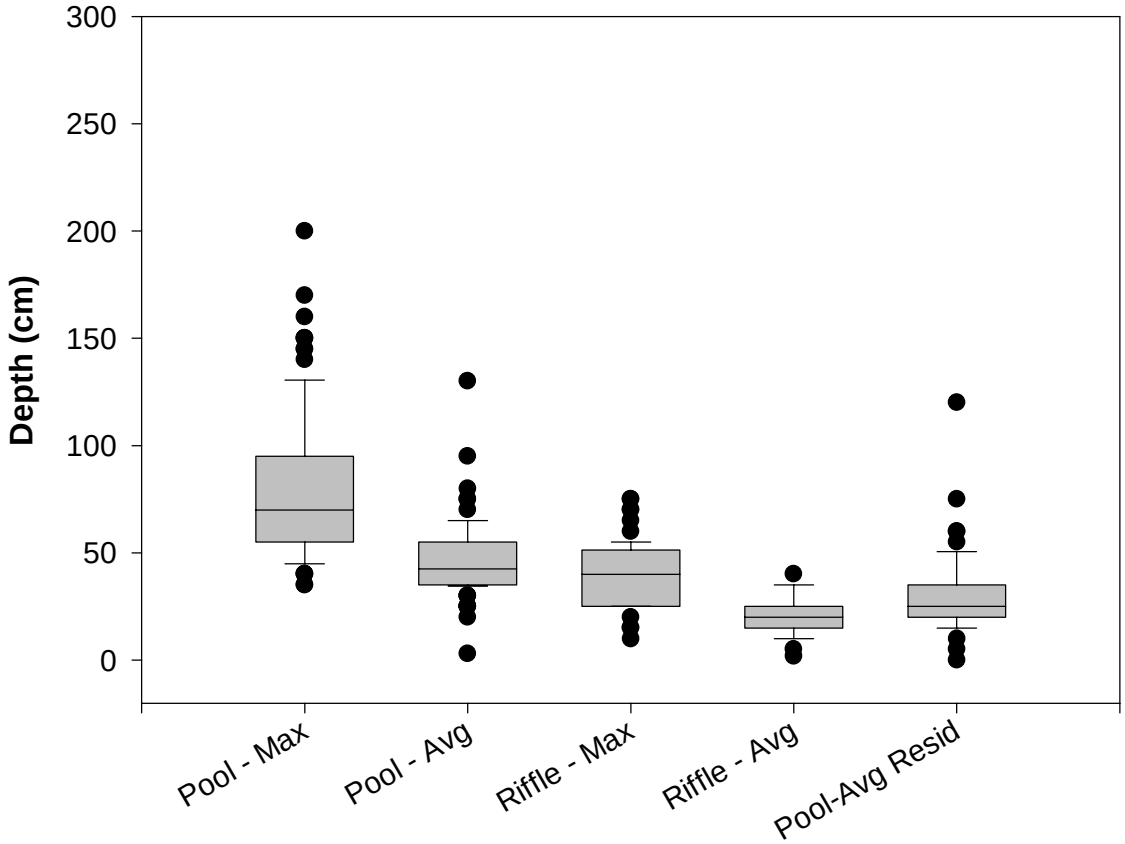

Figure A26. Maximum and average depths for pools and riffles, and average residual pool depths for Conasauga River section 4. The boxes enclose the middle 50% of the observations, the bar in the center of the boxes represent the median, and the capped lines extending above and below the boxes represent the 90% and 10% quantiles. Closed circles represent entire range of data.

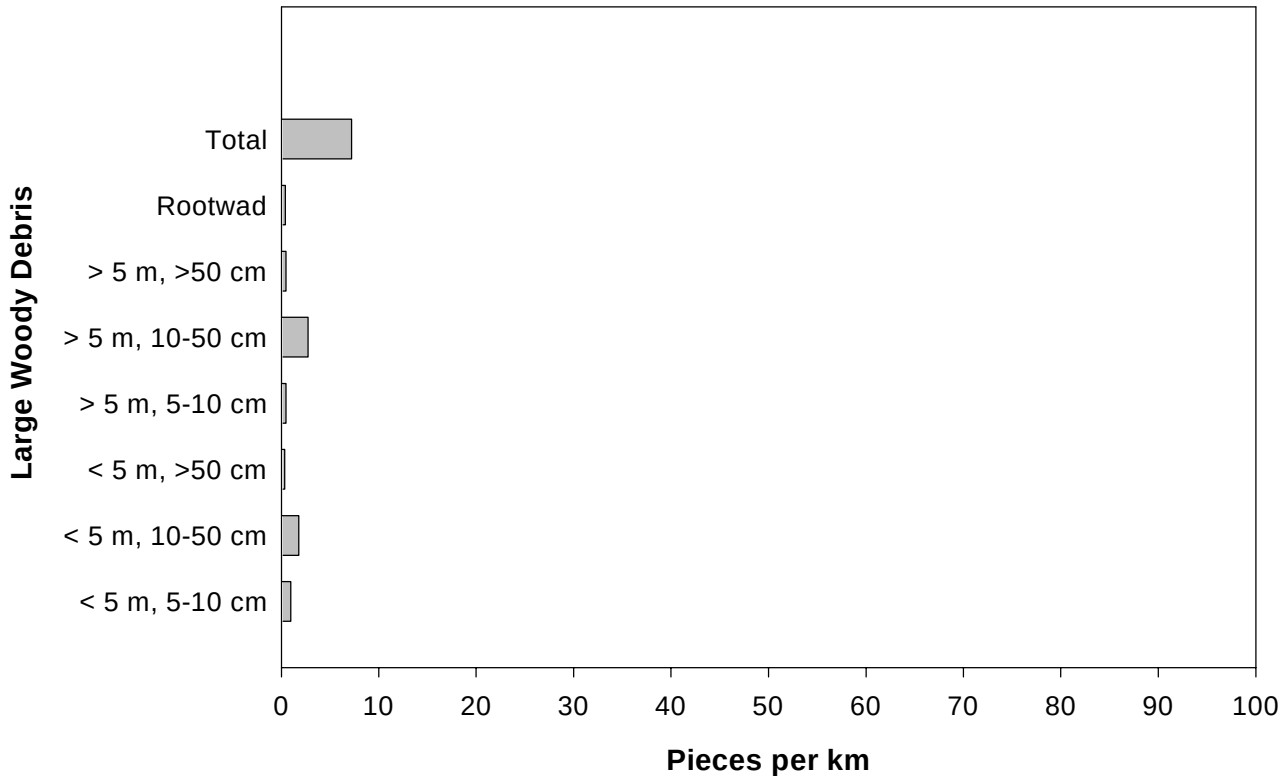

Figure A27. Pieces of large woody debris (LWD) per kilometer in section 4 of the Conasauga River.

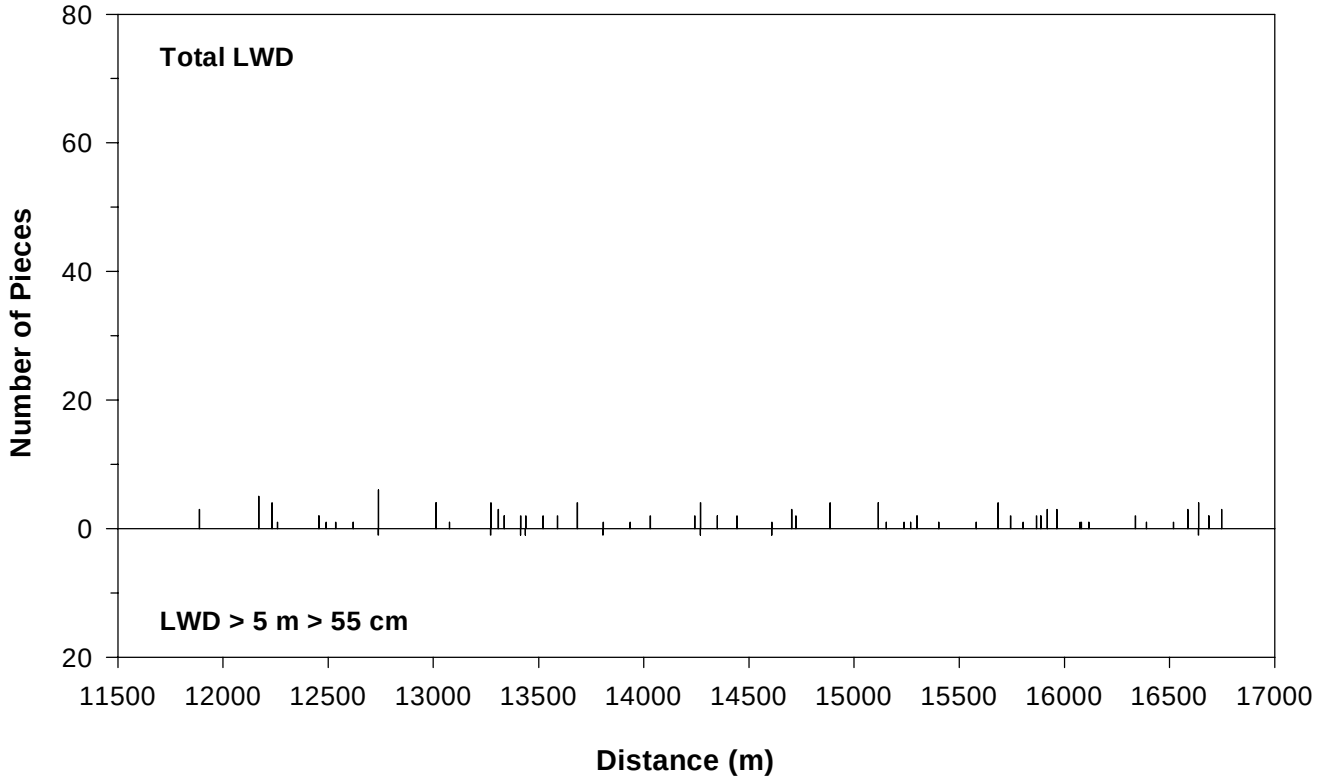

Figure A28. Distribution and abundance of LWD in section 4 of the Conasauga River. Section 4 extended from meter 11510 to meter 16761.

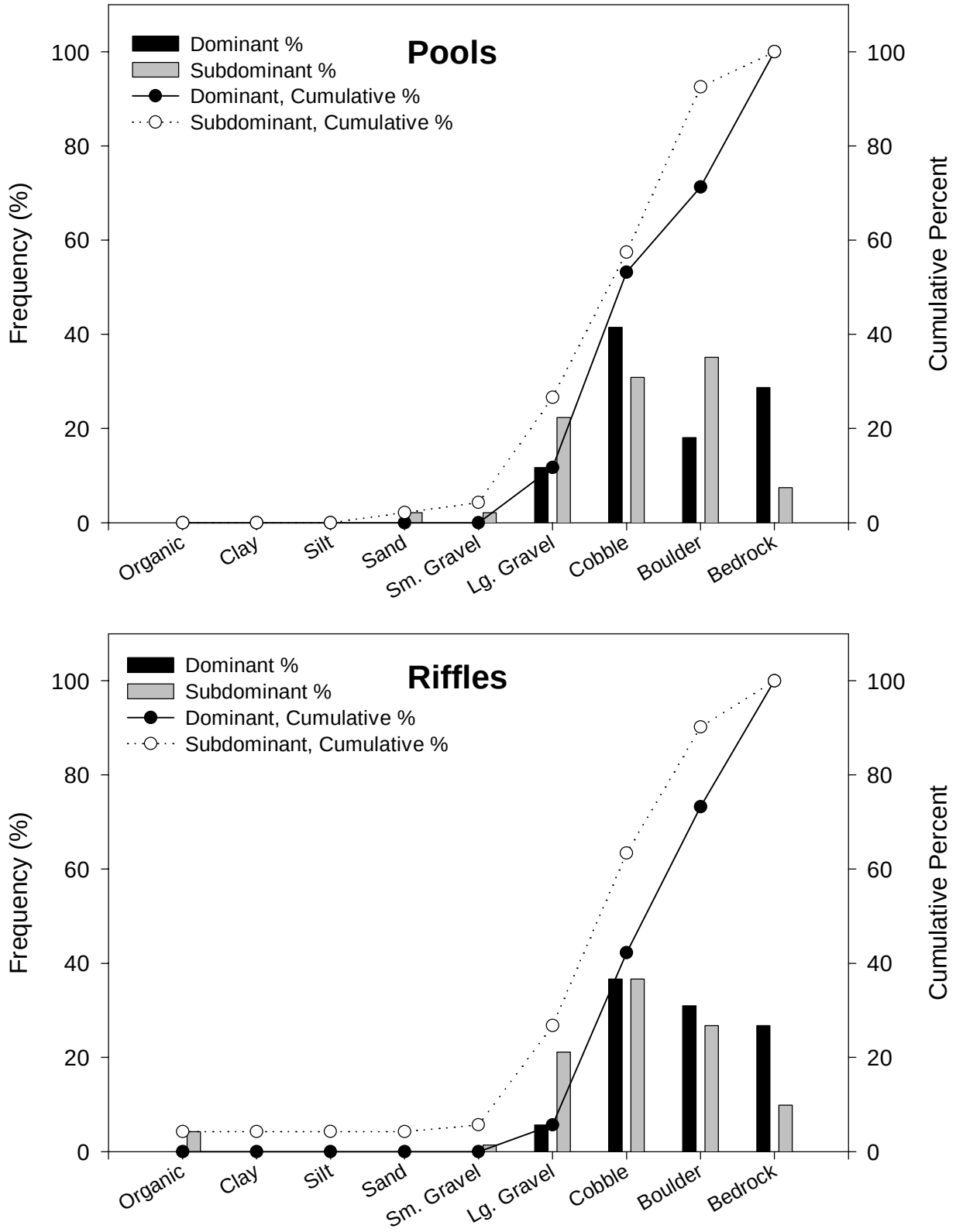

Figure A29. Frequency (percent) of dominant and subdominant substrate occurrence for pools and riffles in section 4 of the Conasauga River. Solid dots and bars represent percent and cumulative percent of dominant substrate, open dots and gray bars represent percent and cumulative percent of subdominant substrate.

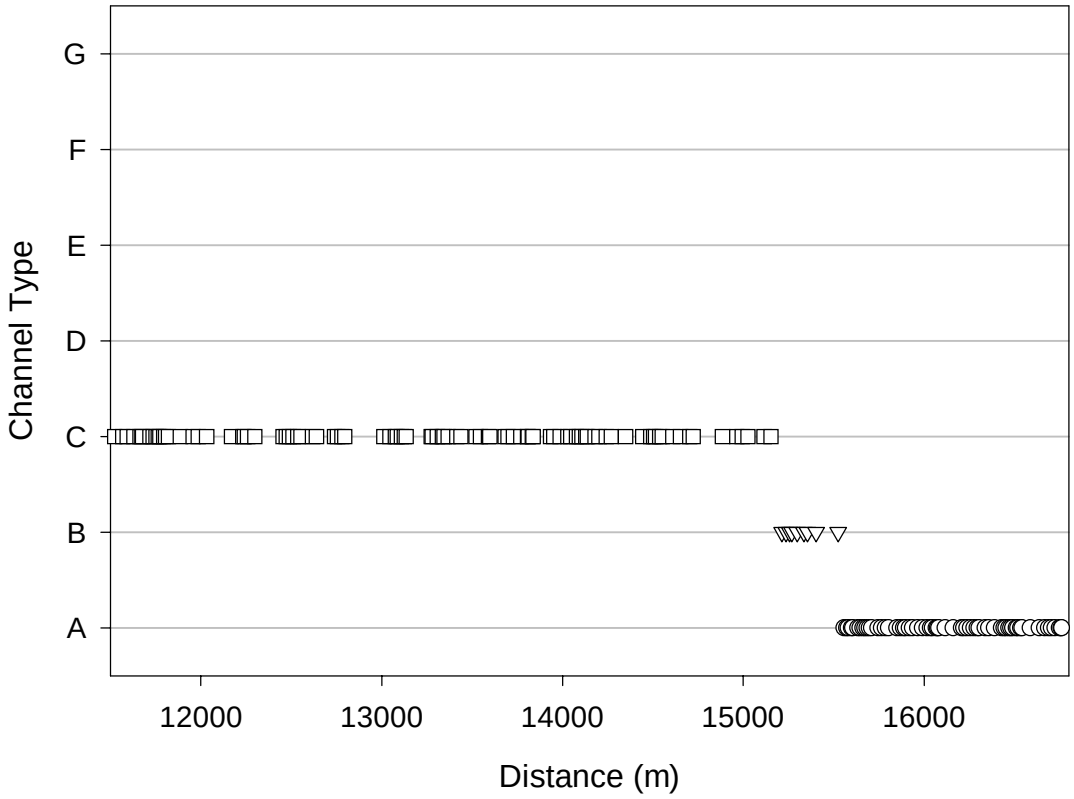

Figure A30. Rosgen's channel type distribution in section 4 of the Conasauga River. Section 4 extended from meter 11510 to meter 16761.

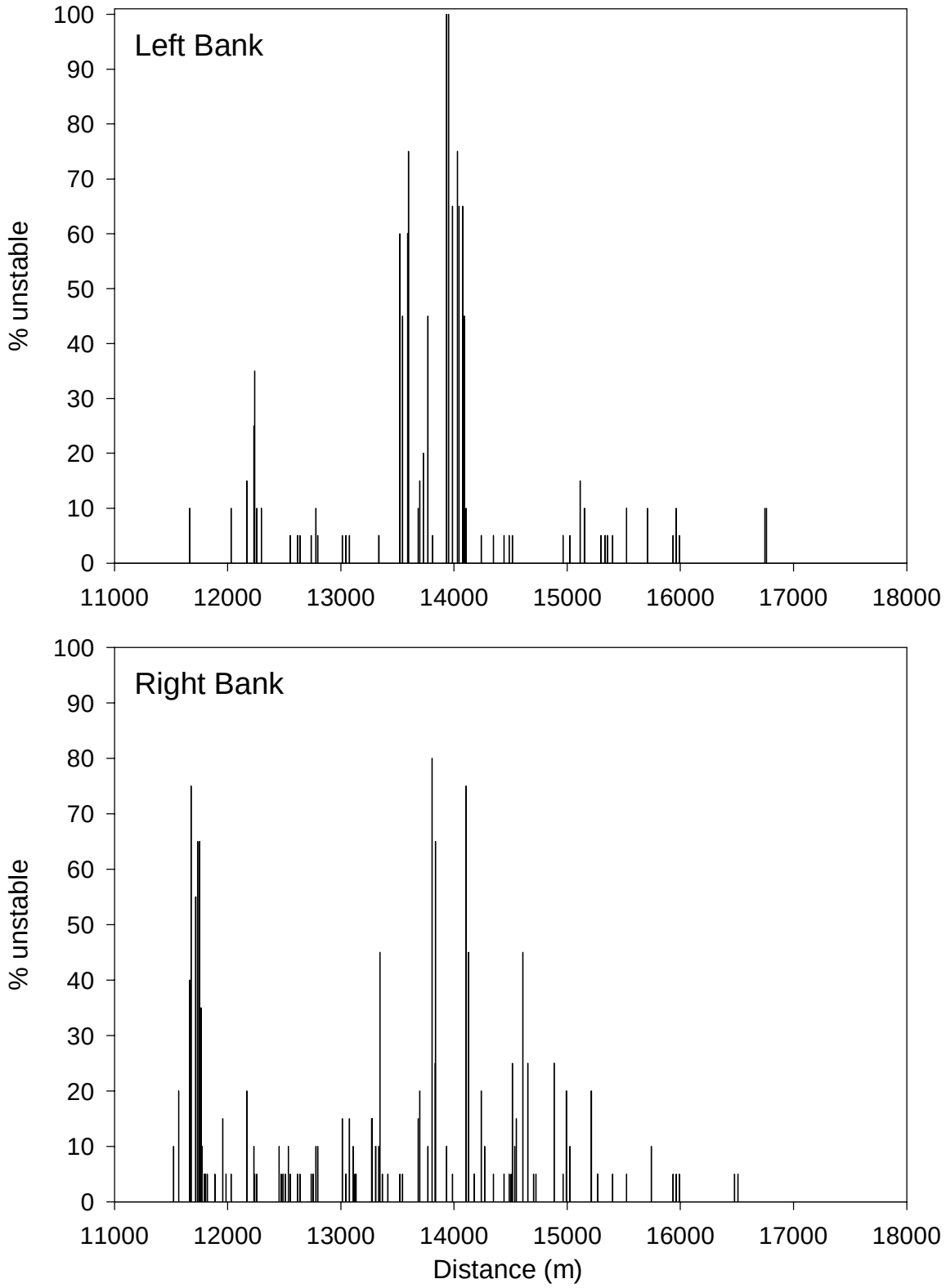

Figure A31. Percent of bank in the Conasauga River, section 4, considered to be unstable (% of bank composed of exposed erodible material from water's edge to bankfull). Estimated for every habitat unit.

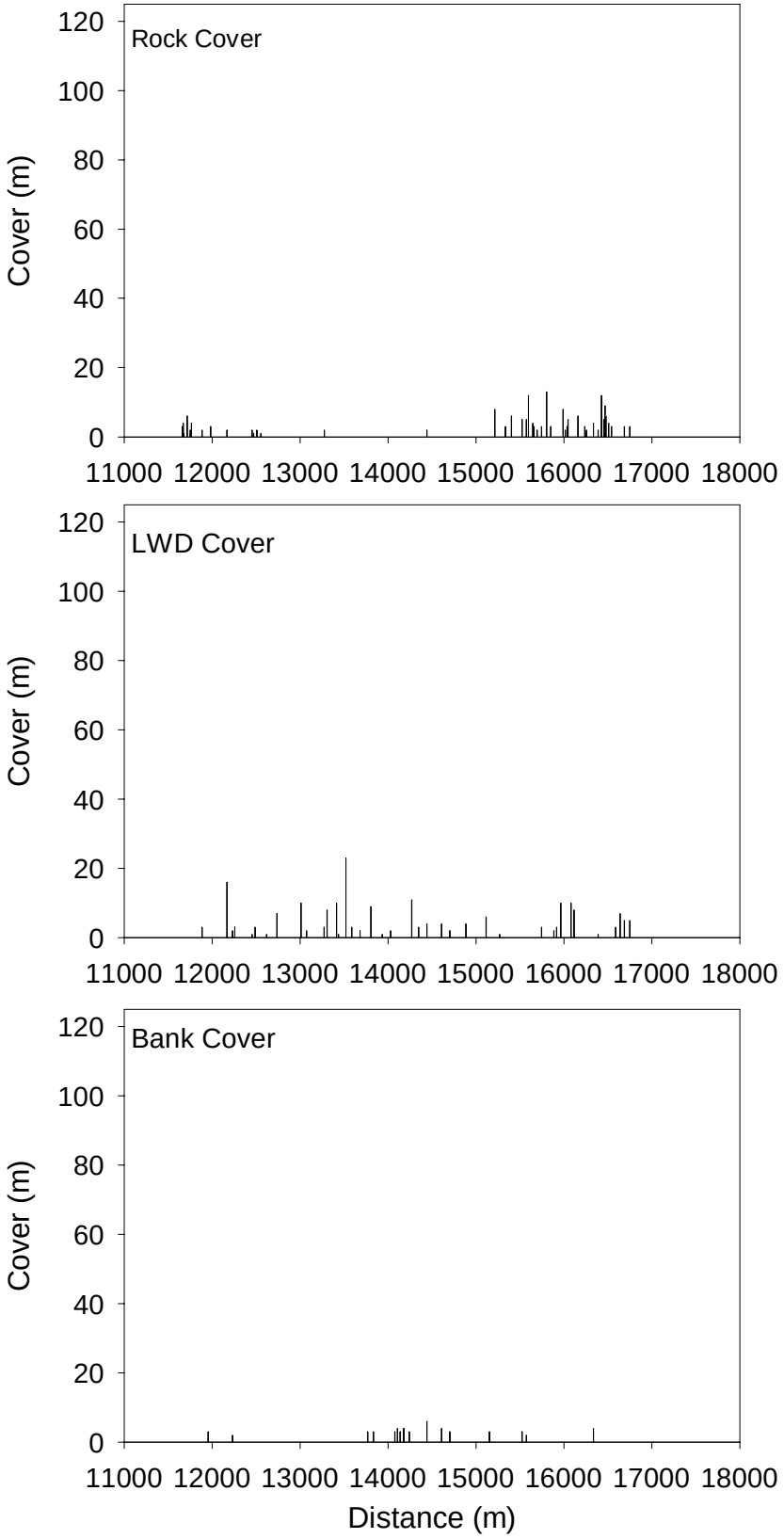

Figure A32. Estimated linear measure of overhead cover provided by rock, LWD, and undercut banks within the wetted stream channel for each habitat unit in section 4 of the Conasauga River. Cover was considered to be provided if a 15 cm object could be hidden beneath the cover type.

Habitat Summary, Conasauga River, Total Stream

District:	Ocoee (TN), Cohutta (GA)
Quadrangle:	Parksville (TN), Tennga (GA)
Survey Date:	07/15/01
Downstream Starting Point:	Forest boundary, Cherokee NF, southwest of Forest Rd. 221
Total Distance Surveyed (km):	16.8
Percent of Total Area Pools:	67
Number of Pools:	197
Number of Pools per km:	12
Total Pool Area (m^2):	194783±11029
Mean Pool Area (m^2):	989
Correction Factor:	0.96
Mean Maximum Depth (cm):	106
Mean Average Depth (cm):	62
Mean Residual Pool Depth (cm):	38
Percent of Total Area Riffles:	33
Number of Riffles:	164
Number of Riffles per km:	10
Total Riffle Area (m^2):	96341±15107
Mean Riffle Area (m^2):	587
Correction Factor:	1.02
Mean Maximum Depth (cm):	52
Mean Average Depth (cm):	28
Number of LWD pieces per km:	65
LWD < 5 m, 5-10 cm:	21
LWD < 5 m, 10-50 cm:	11
LWD < 5 m, > 50 cm:	1
LWD > 5 m, 5-10 cm:	7
LWD > 5 m, 10-50 cm:	20
LWD > 5 m, > 50 cm:	3
Rootwads:	1
Mean Bankfull Channel Width (m):	24
Rosgen's Channel Type Frequency:	
% Type A:	19
% Type B:	55
% Type C:	26
% Type D:	0
% Type E:	0
% Type F:	0
% Type G:	0
Percent of Pool Habitat Surveyed as Glides:	30
Percent Pools with > 35% Embeddedness:	20
Average Channel Gradient (%):	6

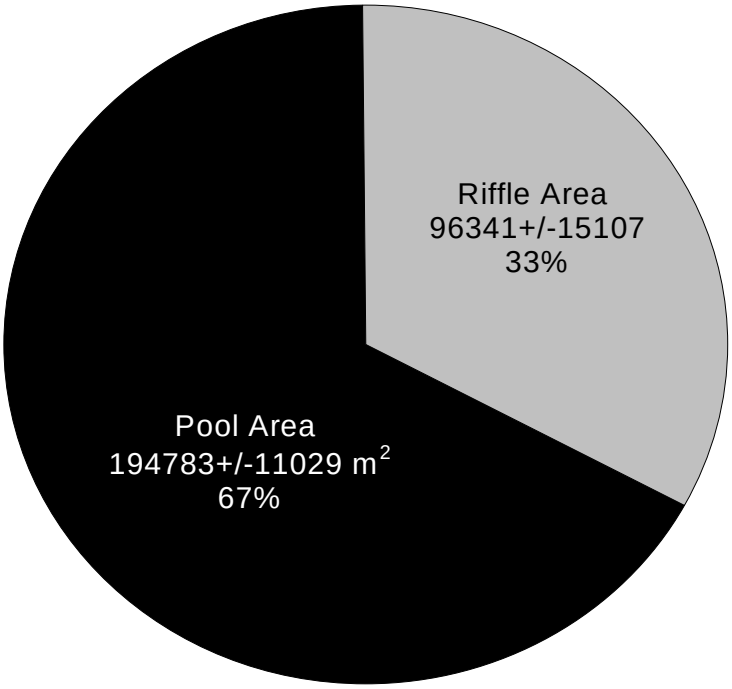

Figure A33. Percent pool and riffle surface area in the Conasauga River, total.

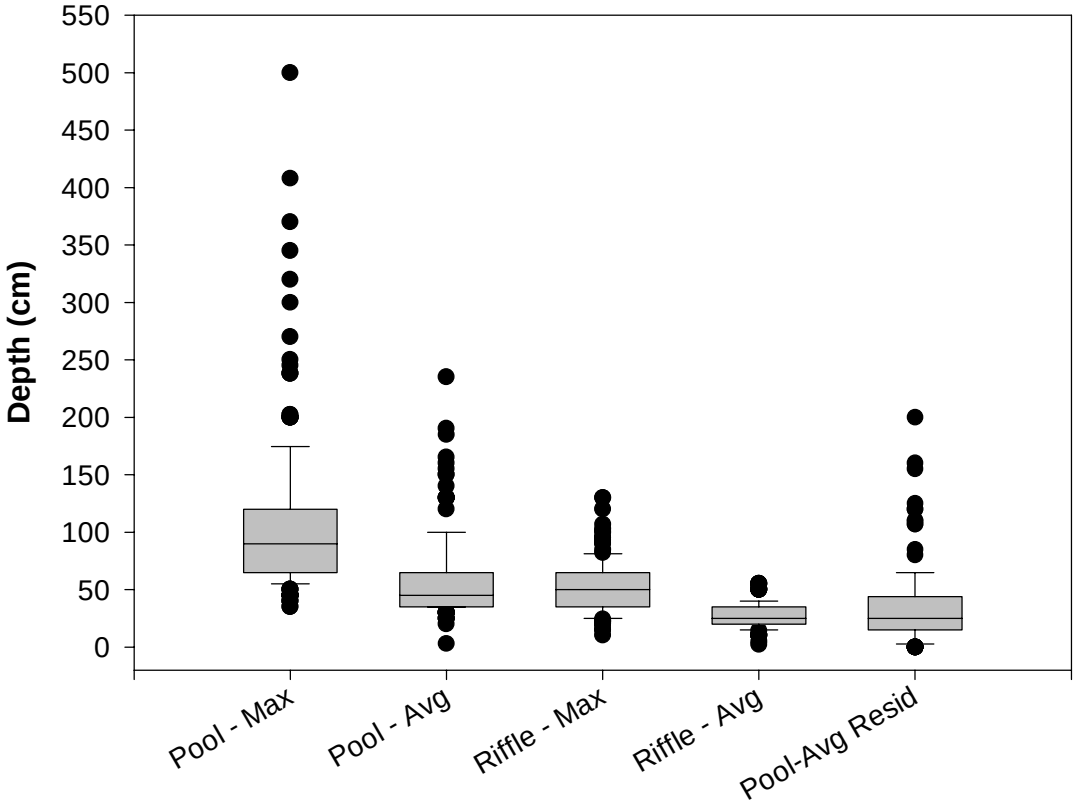

Figure A34. Maximum and average depths for pools and riffles, and average residual pool depths for Conasauga River, total. The boxes enclose the middle 50% of the observations, the bar in the center of the boxes represent the median, and the capped lines extending above and below the boxes represent the 90% and 10% quantiles. Closed circles represent entire range of data

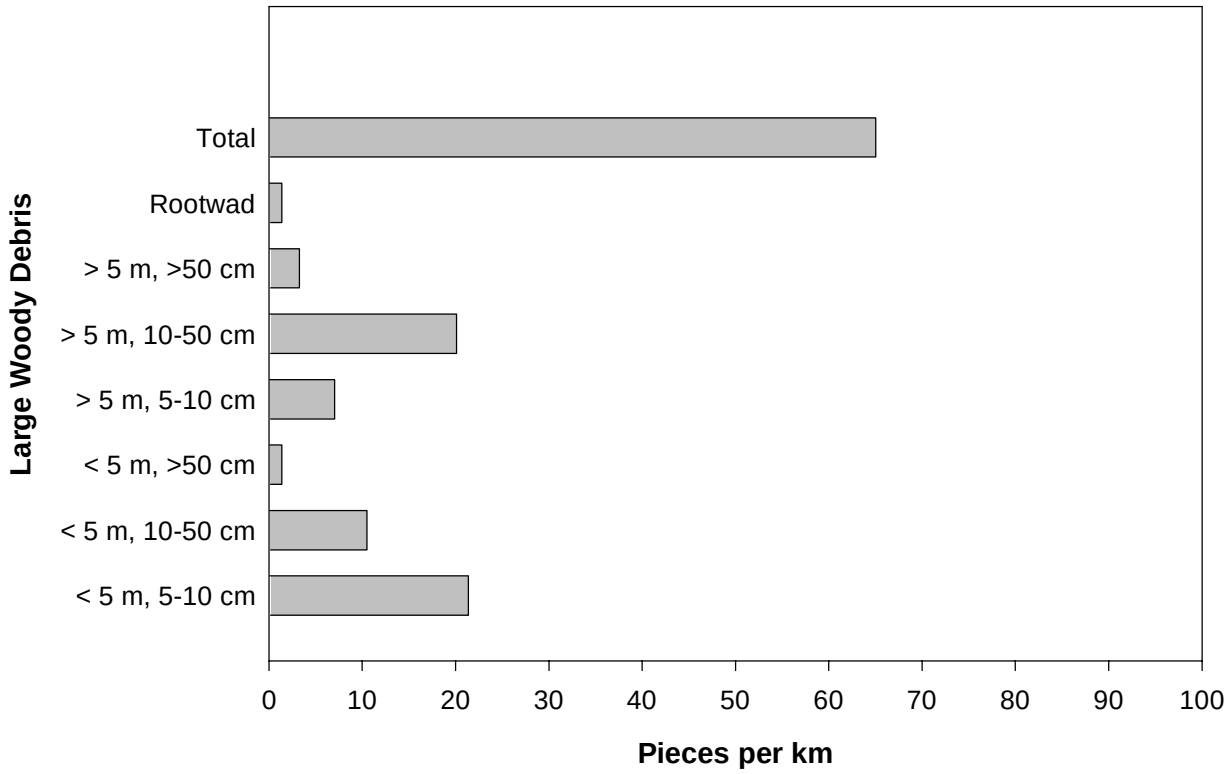

Figure A35. Pieces of large woody debris (LWD) per kilometer in the Conasauga River, total.

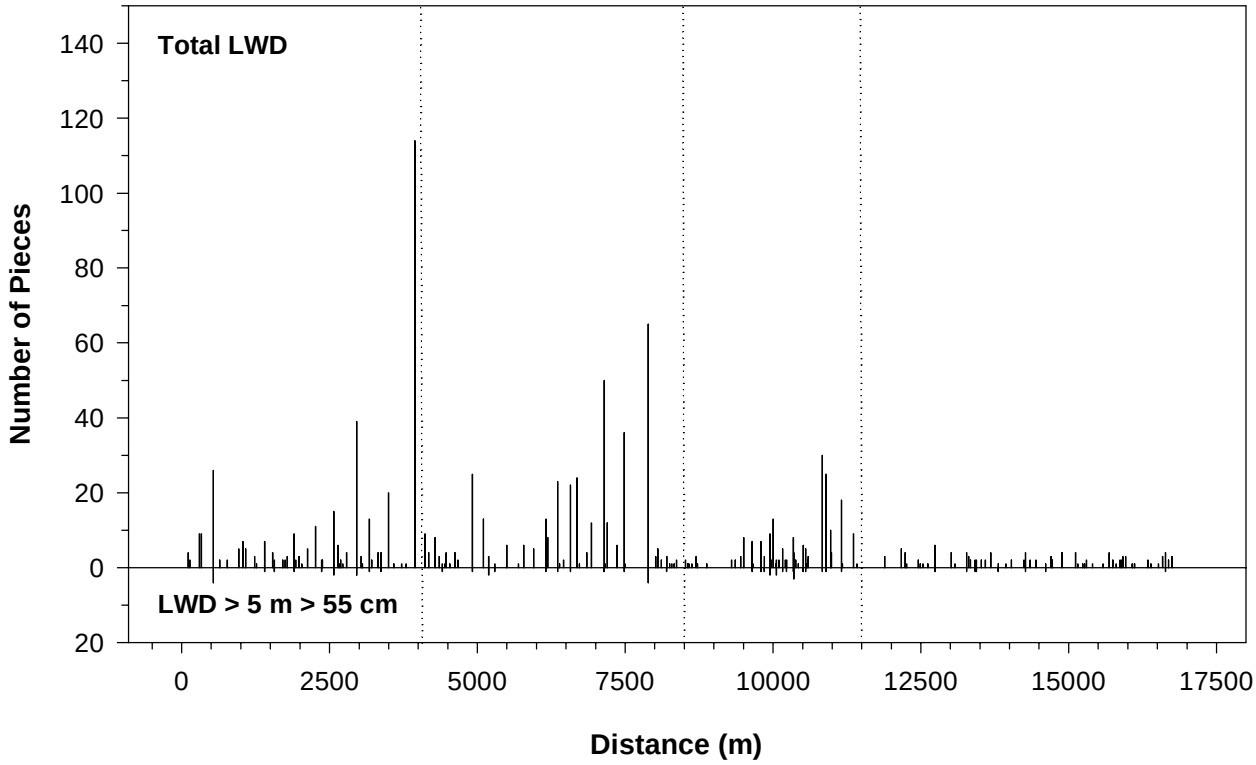

Figure A36. Distribution and abundance of LWD in the Conasauga River, total. Vertical dashed lines represent section breaks.

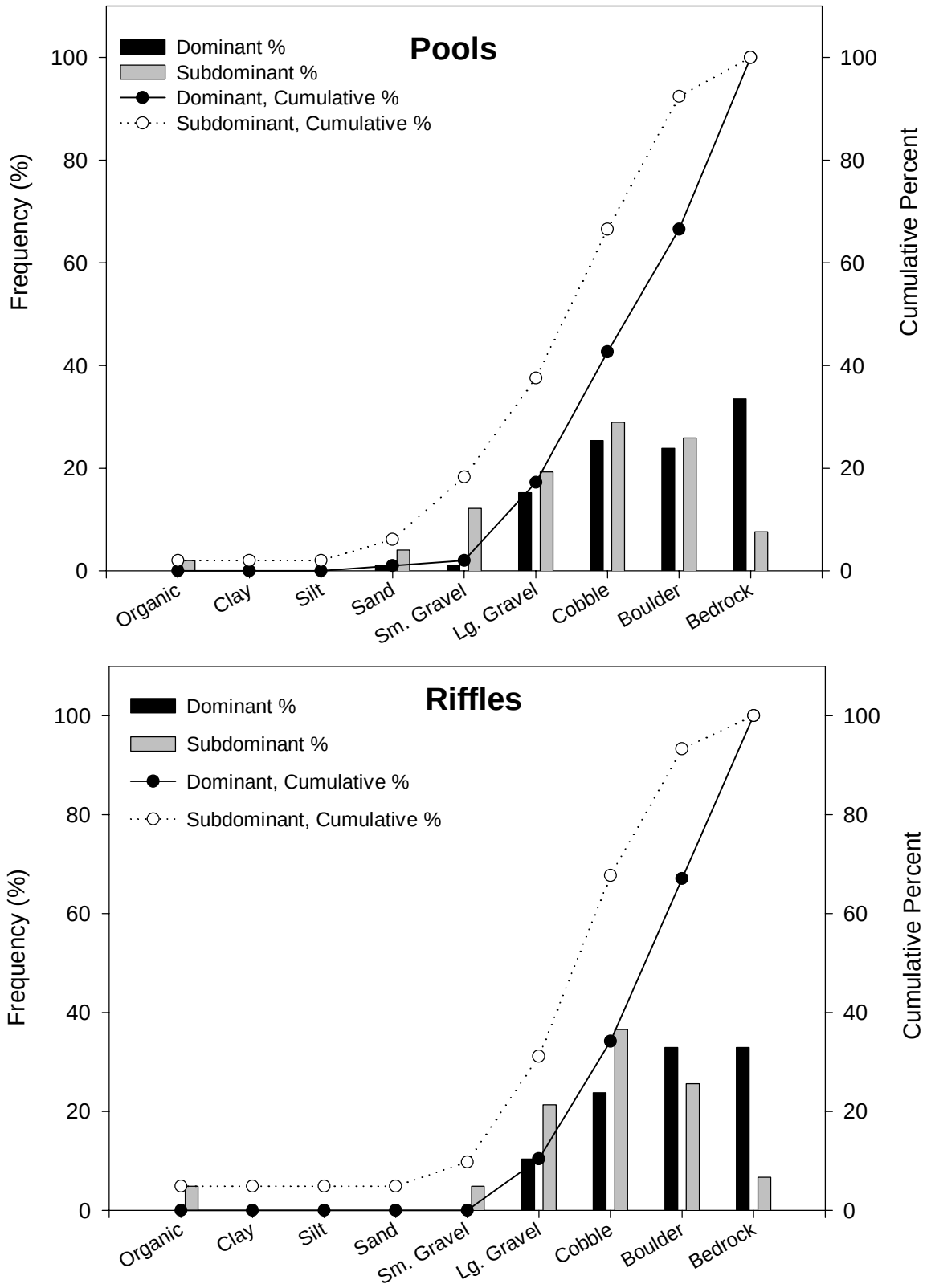

Figure A37. Frequency (percent) of dominant and subdominant substrate occurrence for pools and riffles in the Conasauga River, total. Solid dots and bars represent percent and cumulative percent of dominant substrate, open dots and gray bars represent percent and cumulative percent of subdominant substrate.

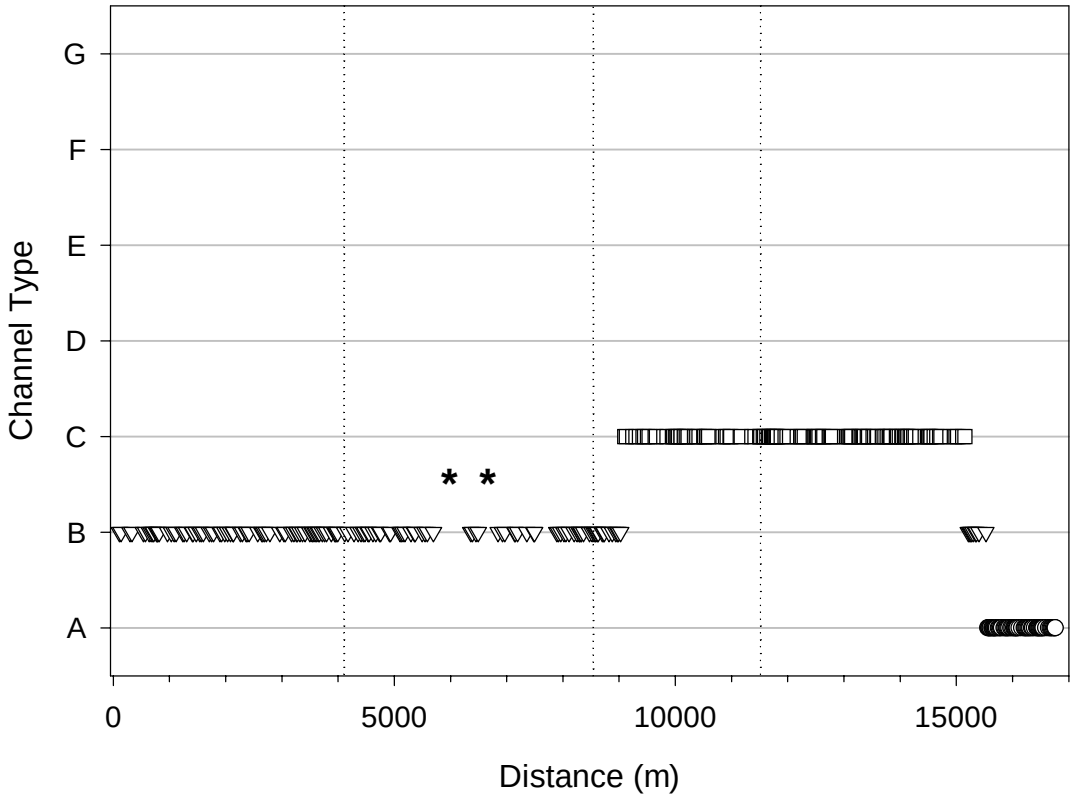

Figure A38. Rosgen's channel type distribution in the Conasauga River, total. Vertical dashed lines represent section breaks.

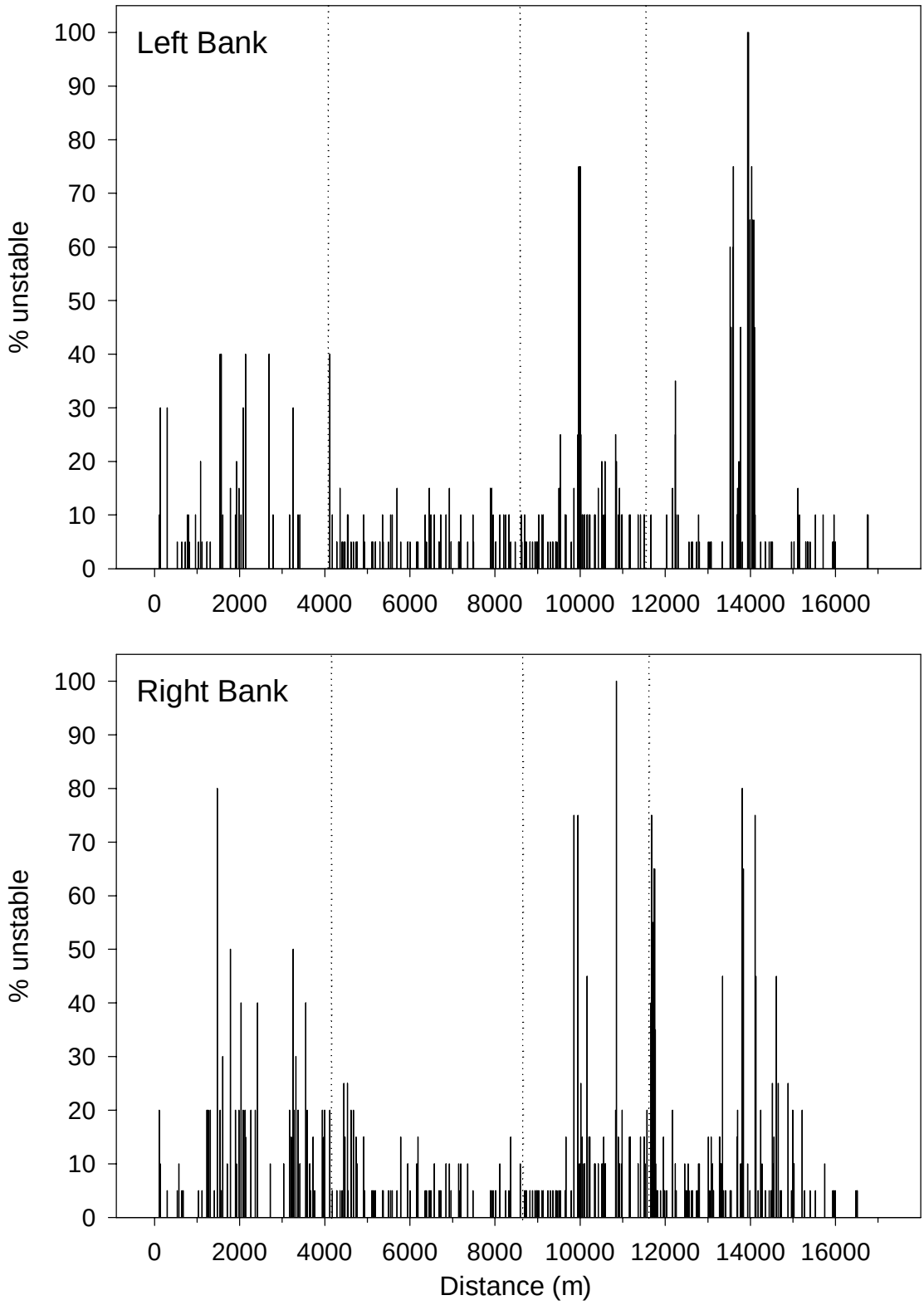

Figure A39. Percent of bank in the Conasauga River, total, considered to be unstable (% of bank composed of exposed erodible material from water's edge to bankfull). Estimated for every habitat unit. Vertical dashed lines represent section breaks.

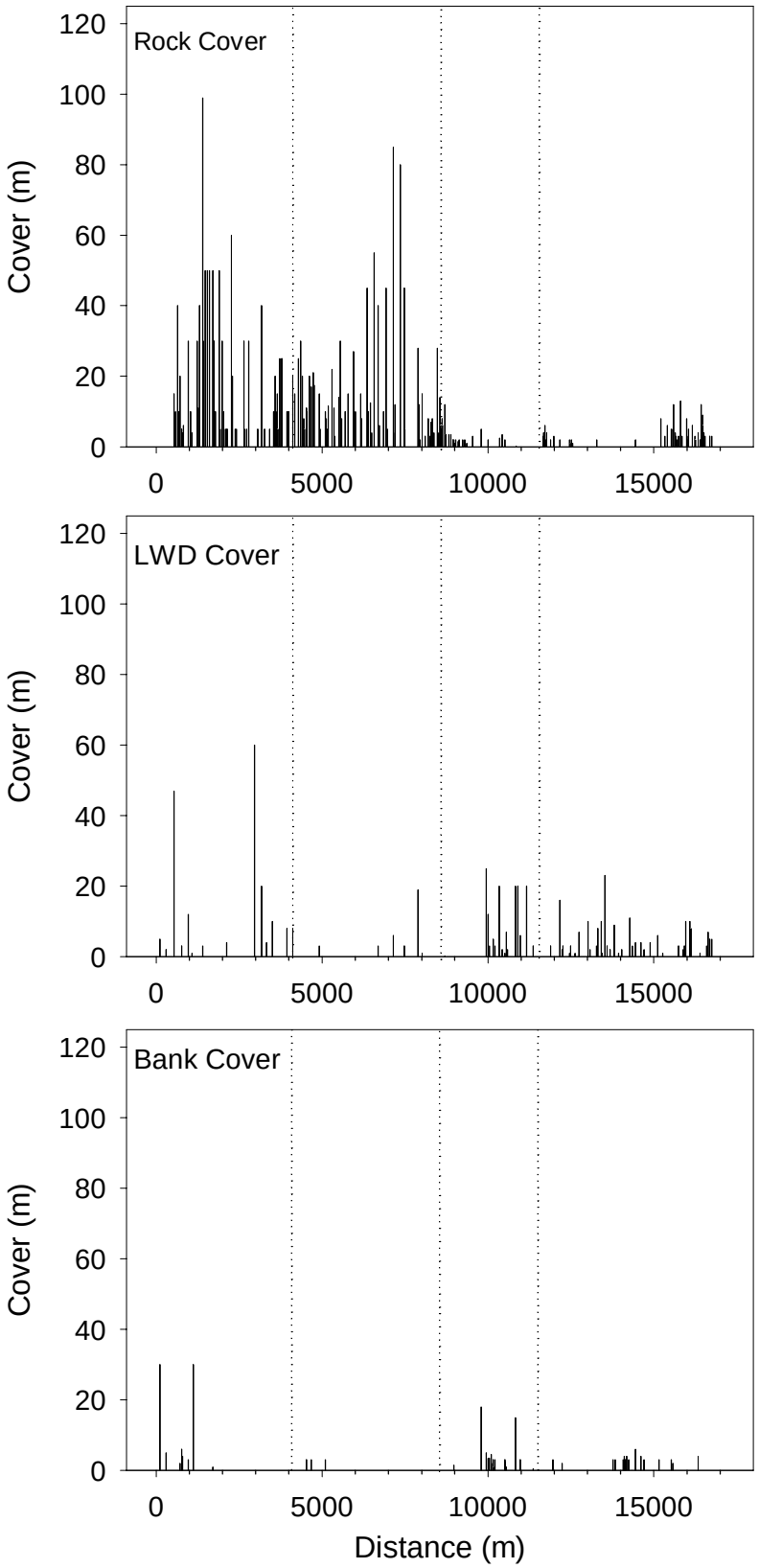

Figure A40. Estimated linear measuremeters of overhead cover provided by rock, LWD, and undercut banks within the wetted stream channel for each habitat unit in the Conasauga River, total. Cover was considered to be provided if a 15 cm object could be hidden beneath the cover type. Vertical dashed lines represent section breaks.

Appendix B: Macroinvertebrate Report

FINAL REPORT

Submitted: 28 February 2001

Macroinvertebrate Sample Analysis:
USDA Forest Service
Southern Research Station (RWU4202)
Chattooga and Conasauga Watersheds

Dr. J. Reese Voshell Jr., Stephen W. Hiner, and Michael D. Moeykens
Department of Entomology
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

In fulfillment of Research Cost Reimbursable Agreement No. SRS 00-CR-11330139-179, USDA Forest Service, Southern Research Station (RWU4202)

Sixty-six samples of benthic macroinvertebrates that were collected in 2000 by the USDA Forest Service from the Chattooga and Conasauga watersheds 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. Kendell/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 66 samples has been stored in an individual vial. All samples will be returned to USDA Forest Service personnel.

USDA Forest Service Project

Macroinvertebrate Data 2000

Conasauga Watershed

Metrics	JACK101	JACK102	JACK201	JACK202	CON304	CON304.5	CON303	CON302	CON305	CON1T02
Total Number of Individuals (N)	233	221	194	164	211	203	196	201	233	188
Number of Taxa	30	25	33	25	28	23	29	27	25	18
Number of EPT Taxa (EPT Taxa)	20	16	19	16	9	8	12	14	12	7
Number of Clinger Taxa (Clinger Taxa)	9	10	11	7	16	10	14	15	15	10
Percent Clingers	25.32	38.46	13.40	10.37	64.93	28.57	58.67	64.18	27.90	8.51
Percent 1 Dominant Taxon	24.03	22.62	51.55	31.71	22.75	55.67	26.53	20.40	52.79	86.17
Percent 2 Dominant Taxa	42.49	41.63	57.73	44.51	36.49	64.53	45.92	40.30	63.52	88.83
Percent Tolerant Organisms	22.32	19.91	61.34	49.39	35.55	60.59	32.65	39.80	62.66	87.77
Intolerant Taxa	27	23	25	19	21	19	23	22	19	15
Percent Diptera	25.32	20.81	55.15	39.02	28.44	62.07	29.59	21.89	55.79	86.17
Percent Chironomidae	18.45	19.00	51.55	31.71	22.75	55.67	26.53	19.90	52.79	86.17
Percent EPT (%EPT)	67.38	68.33	37.63	41.46	29.38	14.29	29.08	44.78	19.74	4.26
North Carolina Biotic Index (NCBI)	2.49	2.78	4.40	4.06	4.21	5.06	4.21	4.35	5.14	5.74
Percent Collectors	24.46	27.15	57.73	39.63	24.17	57.14	30.61	33.83	54.94	87.23
Percent Filterers	18.03	21.27	7.22	20.12	17.54	3.45	8.16	20.90	13.73	1.60
Percent Scrapers	7.30	17.65	5.15	6.10	47.39	25.62	47.45	38.31	7.30	5.85
Percent Shredders	35.62	25.34	18.56	17.07	0.00	1.48	1.53	1.99	0.86	1.06
Percent Predators	13.30	8.60	10.31	17.07	10.90	12.32	12.24	4.98	23.18	4.26

USDA Forest Service Project

Macroinvertebrate Data 2000

Conasauga Watershed

Metrics	CON1T01	CON201	CON202	CON203	CON204	CON301	CON103	CON102	CON104	CON101
Total Number of Individuals (N)	224	203	245	219	180	202	201	201	189	229
Number of Taxa	34	23	23	29	29	33	22	29	27	30
Number of EPT Taxa (EPT Taxa)	13	10	11	12	14	15	9	12	13	15
Number of Clinger Taxa (Clinger Taxa)	13	16	16	15	17	19	11	15	15	14
Percent Clingers	22.32	63.55	73.06	60.73	46.11	46.04	46.77	76.12	65.08	73.36
Percent 1 Dominant Taxon	62.95	27.09	22.04	25.11	40.00	41.58	37.31	32.84	26.46	17.90
Percent 2 Dominant Taxa	68.30	50.25	38.37	44.75	55.00	53.96	60.70	43.78	46.56	33.62
Percent Tolerant Organisms	69.20	40.39	34.69	35.62	49.44	50.99	51.24	29.35	36.51	28.38
Intolerant Taxa	27	18	20	23	21	24	16	22	23	22
Percent Diptera	66.07	32.51	22.04	24.66	42.78	42.08	38.81	13.93	22.75	14.41
Percent Chironomidae	62.95	27.09	16.33	19.63	40.00	41.58	37.31	10.45	20.11	12.66
Percent EPT (%EPT)	11.61	23.65	39.59	37.90	32.22	29.70	26.37	38.81	39.68	37.12
North Carolina Biotic Index (NCBI)	5.42	4.10	3.91	4.09	4.74	4.54	4.69	3.90	4.34	3.76
Percent Collectors	66.96	28.57	26.53	24.66	46.67	49.01	40.80	13.43	22.75	18.34
Percent Filterers	4.46	20.20	22.86	22.83	11.67	8.91	16.92	28.86	21.16	21.40
Percent Scrapers	15.63	41.38	42.45	35.62	28.89	30.20	29.85	47.76	41.27	51.09
Percent Shredders	1.79	2.46	3.67	1.83	1.67	3.96	0.00	1.00	3.17	1.31
Percent Predators	10.27	7.39	4.49	15.07	11.11	6.44	12.44	8.96	11.64	7.86

USDA Forest Service Project
Macroinvertebrate Data 2000
Conasauga Watershed

Taxa	JACK 1-01	JACK 1-02	JACK 2-01	JACK 2-02	CON 3-04	CON 3-04.5	CON 3-03	CON 3-02	CON 3-05	CON 1-T02	CON 1-T01	CON 2-01	CON 2-02	CON 2-03	CON 2-04	CON 3-01	CON 1-03	CON 1-02	CON 1-04	CON 1-01
Oligochaeta			5		1	2	1	2	2		4	2		3	1		6	2	1	4
Hirudinea															1	1				
Cambaridae	3		2								2									
Pteronarcys	5		2			1	2				1									
Tallaperla	10		12				1		2					1						
Paragnetina			3						1											
Agnetina				2																
Acroneuria	1		4	3	6		4	3	11		1	6	2	19	8	6	10	4	5	6
Perlesta placida group	4	2			1	1	4	1	1								3		1	2
Beloneuria		2																		
Perlodidae											1									
Yugus	1																			
Isoperla	3																			
Leuctra	56	50	10	17		2				1	1			1				1		
Ephemera			1													1				
Litobrancha recurvata	8			9																
Neoephemera				3				1												
Caenis			1																	
Serratella								8					10			2		2	3	3
Drunella	2	10						2					4					3		1
Ephemerella	4	7	1		2				1					3						
Eurylophella		2																		
Paraleptophlebia			3								1									1
Baetis (complex)	1	9					4	8	1	1	1	1	14	5	5	6		1		2
Stenonema	4	11	4	5	22	15	20	14	2	1	6	2	10	5	12	10	2	8	16	18
Epeorus			1	1					1						2	3				
Leucrocuta						2							2	3	4	4	3	3	2	
Tricorythodes						1				1					2	2	1			
Isonychia	3	5			10	6	6	4	5	1	4	6	9	7	2	4	6	2	2	11
Cordulegaster		1		3																
Gomphidae						1														
Stylogomphus albistylus											2									
Gomphus			1	1						1	2				2		1			1
Hagenius										1	1									
Lanthus	2	6	1	4			3				3						1	2		1
Macromia					1						5				1	1				3
Boyeria					1	2	2	1		1	1							2	1	1
Neurocordulia														2					1	
Argia					1											1				
Gerris	2	2														1				
Sialis														1		1		1		
Corydalus cornutus					3	5	1	3	25	4	1	5	4	5	3		6	6	8	3
Nigronia serricornis					4	4	2		1	1	1			1	2	1	1			
Neohermes									14				2			1				
Hydropsyche			8	1	4			16	11	2	2	14	35	3	6	5	7	13	1	6
Cheumatopsyche					8		8	20	3		4	3		23	5	6	13	18	29	21
Diplectrona modesta	35	39		5																
Parapsyche	4	3																		
Rhyacophila	2	2	5	4																
Chimarra					6				7			10	2	12	6	2	8	22	8	8
Dolophilodes			1																	
Leptoceridae								8												
Triaenodes															3				3	

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Taxa	JACK 1-01	JACK 1-02	JACK 2-01	JACK 2-02	CON 3-04	CON 3-04.5	CON 3-03	CON 3-02	CON 3-05	CON 1-T02	CON 1-T01	CON 2-01	CON 2-02	CON 2-03	CON 2-04	CON 3-01	CON 1-03	CON 1-02	CON 1-04	CON 1-01
Setodes																1				2
Oecetis					3		2													
Nectopsyche											2									
Psilotreta		1									1				1					
Micrasema								2		1		2	6			4			2	1
Brachycentrus			3	1			1								1					1
Lepidostoma	11	2	2	6				2				3	3	1		4		1	1	2
Glossosoma	1	2		1			4													
Pycnopsyche	1	4	10	4																
Goera						1														
Neophylax			1																	
Phylocentropus				5																
Polycentropus	1		1				1	1			1	1			1				2	
Molanna				1																
Peltodytes																3				
Gyrinidae							1													
Psephenus herricki			1		4		6		2	1	5	1	1	2		3	2		2	1
Ectopria		3																		
Helichus					1									1		1				
Stenelmis					29	18	38	41	6	5	8	47	54	55	27	25	47	66	50	41
Macronychus					3	1	1	1				1	1	1		1		2	1	
Ancyronyx					4															1
Microcylloepus					2				1					6				1		
Optioservus	6	10	1	3	5	2	4	5	1	1	2	11	6	4		1		8	1	
Dubiraphia					4	4	4	2	1	2	12	1			4	2	1			
Promoresia	4	2	3		20	1		10		1	1	18	24	1	1	3	3	3	3	19
Protoplasa fitchii																				1
Tipula				1										1						
Antocha							2	1			3		1		2			1	1	
Dicranota	7	1	1	2																
Hexatoma	1	3	1	9	3	5	4	1			1	2		1	1		2	1	3	1
Dixa	1																			
Simulium			2		9	1		2	6			8	10	5	1	1		3		2
Chironomidae	43	42	100	52	48	113	52	40	123	162	141	55	40	43	72	84	75	21	38	29
Ceratopogonidae	7		1			7					1						1	1		
Tabanidae											1									
Atherix			1								1	1	3	4				1	1	
Hemerodromia									1						1					
Chelifera			1																	
Planorbidae							1													
Pleuroceridae					6	8	16	2	4			3	2		3	11	2	2	3	36
Sphaeriidae				21			1													

Appendix C: Pebble Count Distribution Figures

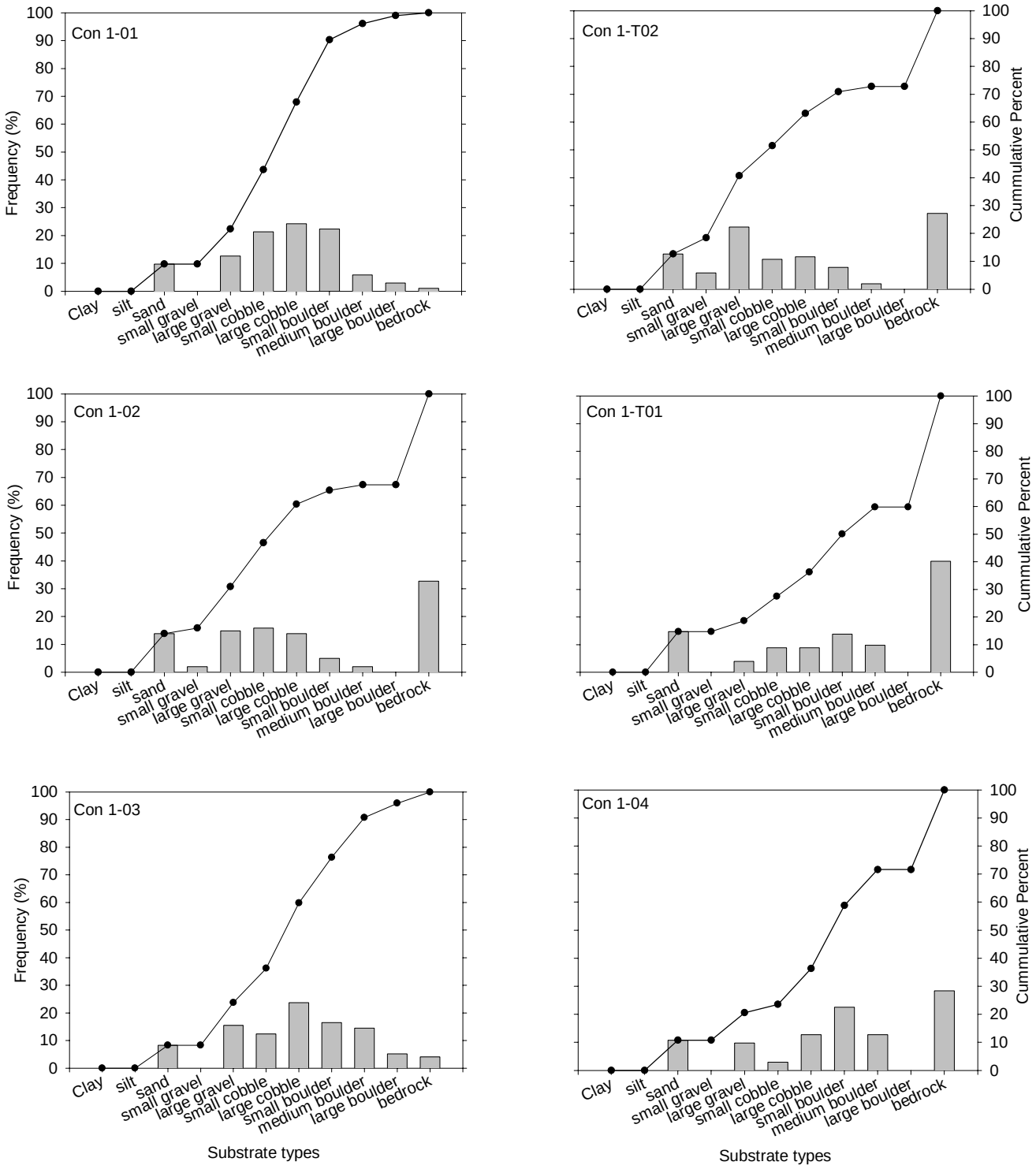

Figure C1. Percent (bars) and cummulative percent (lines) of substrate classes (Table 4) for sites in section 1 of the Conasauga River created using pebble count data.

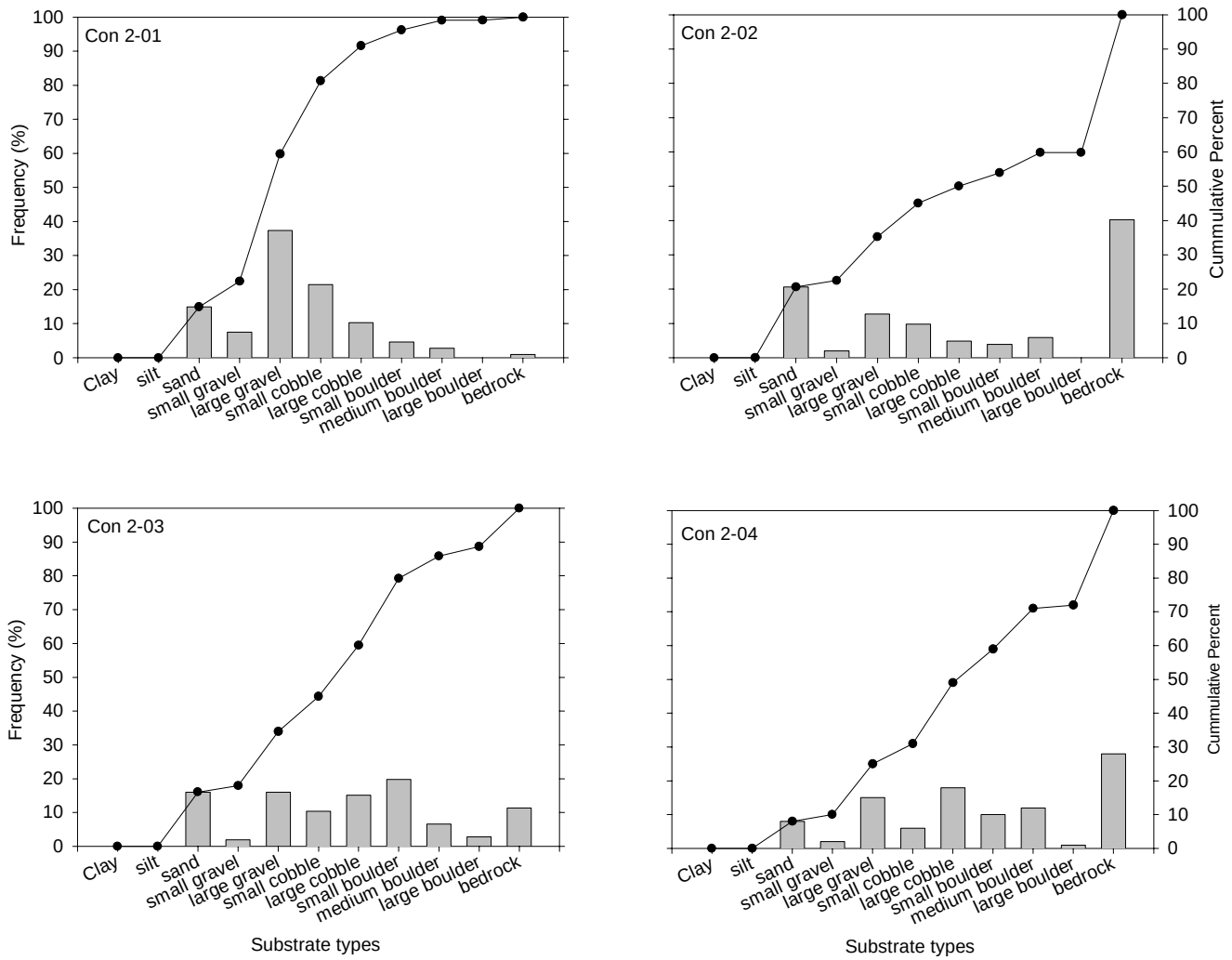

Figure C2. Percent (bars) and cummulative percent (lines) of substrate classes (Table 4) for sites in section 2 of the Conasauga River created using pebble count data.

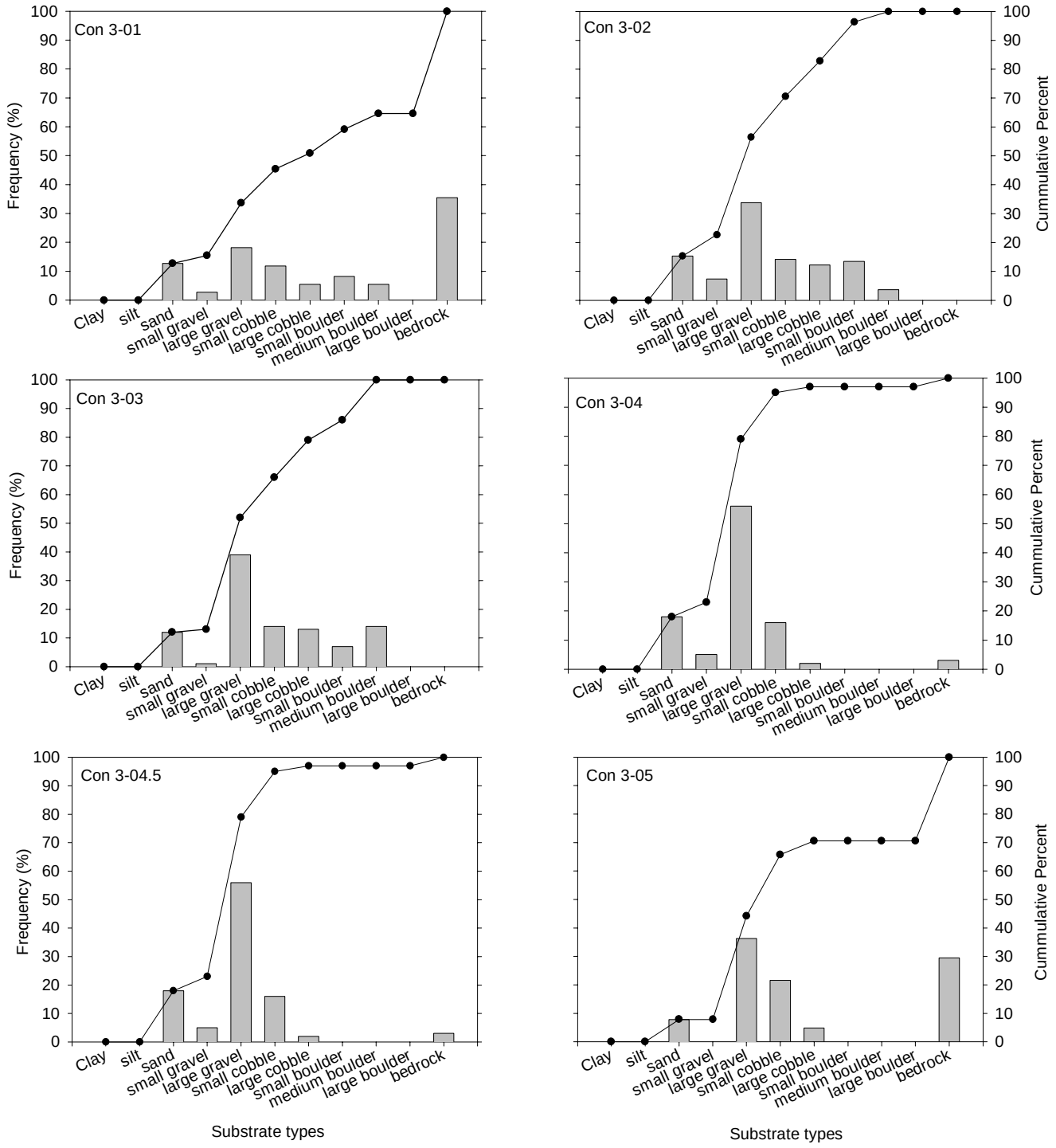

Figure C3. Percent (bars) and cummulative percent (lines) of substrate classes (Table 4) for sites in section 3 of the Conasauga River created using pebble count data.

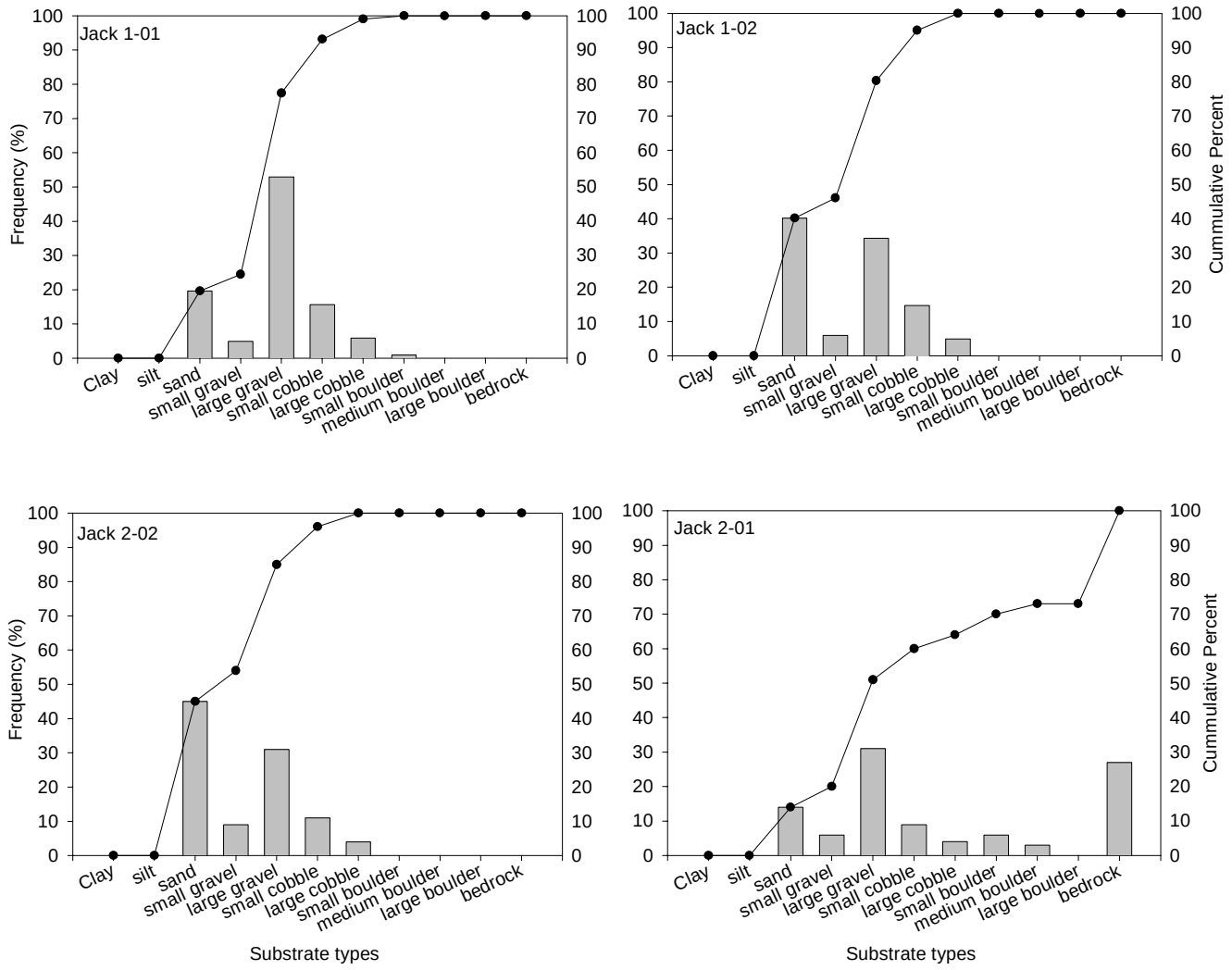

Figure C4. Percent (bars) and cummulative percent (lines) of substrate classes (Table 4) for sites area 1 and area 2 in the Jacks River created using pebble count data.

Appendix D: Pfankuch & EPA channel stability forms

PFANKUCH CHANNEL STABILITY RATING FORM										
			Excellent		Good		Fair		Poor	
Upper Banks	Landform Slope	1	Bank slope gradient <30%.	(2)	Bank slope gradient 30%-40%.	(4)	Bank slope gradient 40% - 60%.	(6)	Bank slope gradient 60%+	(8)
	Mass Wasting or failure (existing or potential)	2	No evidence of past or any potential for future mass wasting into channel.	(3)	Infrequent and/or very small. Mostly healed over. Low future potential.	(6)	Moderate frequency & size, with some raw spots eroded by water during high flows.	(9)	Frequent or large, causing sediment nearly year long or imminent danger of same	(12)
	Debris Jam potential (floatable objects)	3	Essentially absent from immediate channel area.	(2)	Present, but mostly small twigs and limbs.	(4)	Present volume and size are both increasing.	(6)	Moderate to heavy amounts, predominantly larger sizes.	(8)
	Vegatative Bank Protection	4	90% plant density. Vigor and variety suggests a deep, dense soil binding, root mass.	(3)	70% - 90% density. Fewer plant species or lower vigor suggests a less dense or deep root mass.	(6)	50% - 70% density. Lower vigor and fewer species form a shallower, discontinuous root mass.	(9)	< 50% density and fewer species & lower vigor indicate poor, discontiuous, shallow root mass.	(12)
Lower Banks	Channel Capacity	5	Ample for present plus some increases. Peak flows contained W/D ratio <7.	(1)	Adequate. Overbank flows rare. Width to depth (W/D) ratio 8 to 15.	(2)	Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25.	(3)	Inadequate. Overbank flows common. W/D ratio >25.	(4)
	Bank Rock Content	6	65%+ with large, angular boulders 12"+ numerous.	(2)	40% - 65%, mostly small boulders to cobbles 6" - 12".	(4)	20% - 40% with most in the 3" to 6" class.	(6)	< 20% rock fragments of gravel sizes, 1" to 3" or less.	(8)
	Obstructions, Flow Deflectors, Sediment Traps	7	Rocks and old logs firmly embedded. Flow pattern without cutting or deposition. Pools and riffles stable.	(2)	Some present, causing erosive cross currents and minor pool filling. Obstructions and deflectors newer and less firm.	(2)	Moderately frequent, moderately unstable obstructions & deflectors move with high water causing bank cutting and filling of pools.	(8)	Frequent obstructions and deflectors cause bank erosion yearlong. Sediment traps full, channel migration occurring.	(8)
	Cutting	8	Little or none evident. Infrequent raw banks less than 6" high generally.	(4)	Some, intermittently at outcurves and constrictions. Raw banks may be up to 12".	(8)	Significant. Cuts 12" - 24" high. Root mat overhangs and sloughing evident.	(12)	Almost continuous cuts some over 24" high. Failure of overhangs frequent.	(16)
	Deposition	9	Little or no enlargement of channel or point bars.	(4)	Some new increases in bar formation, mostly from coarse gravels.	(8)	Moderate deposition of new gravel & coarse sand on old and some new bars.	(12)	Extensive deposits of predominantly fine particles. Accelerated bar development.	(16)
Bottom	Rock Angularity	10	Sharp edges and corners, plane surfaces roughened.	(1)	Rounded corners and edges, surfaces smooth and flat.	(2)	Corners and edges well rounded in two dimensions.	(3)	Well rounded in all dimensions, surface smooth.	(4)
	Brightness	11	Surfaces dull, darkened, or stained, Generally not "bright".	(1)	Mostly dull, but may have up to 35% brigh surfaces.	(2)	Mixture, 50/50% dull and bright range 35% - 65%.	(3)	Predominantly bright, 65%+ exposed or scoured surfaces.	(40)
	Consolidation or particle packing	12	Assorted sizes tightly packed and/or overlapping.	(2)	Moderatly packed with some overlapping.	(4)	Mostly a loose assortment with no apparent overlap.	(6)	No packing evident. Loose assortment, easily moved.	(8)
	Bottom Size Distribution and Percent Stable Materials	13	No change in size evident. Stable materials 80% - 100%.	(4)	Distribution shift slight. Stable materials 50% - 80%.	(8)	Moderate change in sizes. Stable materials 20% - 50%.	(12)	Marked distribution change. Stable materials 0% - 20%.	(16)
	Scouring and Deposition	14	Less than 5% of the bottom affected by scouring and deposition.	(6)	5% - 30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.	(12)	30% - 50% affected. Deposits & scour at obstructions, constrictions, and bends. Some filling of pools.	(18)	More than 50% of the bottom in a state of flux or change year long.	(24)
	Clinging Aquatic Vegetation (moss and algae)	15	Abundant. Growth largely mosslike, dark green, perennial. In swift water, too.	(1)	Common. Algal Forms in low velocity & pool areas. Moss here too and in swifter waters.	(2)	Present but spotty, mostly in backwater areas. Seasonal blooms make rocks slick.	(3)	Perennial types scarce or absent. Yellow-green, short term bloom may be present.	(4)
			Excellent Column Total:		Good Column Total:		Fair Column Total:		Poor Column Total:	
Add values in each column and record the total here:										

Habitat Assessment Field Data Sheet-High Gradient Streams (Front)

Stream Name		Location
Station#_____ RiverMile___		Stream Class
LAT_____ LONG_____		River Basin
STORET_____		Agency
Investigators		
Form Completed By	Date Time AM PM	Reason for Survey

	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
Parameters to be evaluated in sampling reach	1. Epifaunal Substrate/ Available Cover	Greater than 70% of Substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40 – 70% mix of stable habiat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the for of newfall, but not yet prepared for colonization (may rate at high end of scale).	20 – 40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Embeddedness	Gravel, cobble, and boulder particles are 0 – 25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, Cobble, and boulder particles are 25 to 50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50 – 75% surrounded by fine sediment.	Gravel, cobble, and boulder particle are more than 75% surrounded by fine sediment.
	Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is <0.3 m/s, deep is >0.5 m).	Only 3 of the 4 regimes present (if fast shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
	Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand, or fine sediment; 5 – 30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand, or fine sediment on old and new bars; 30 – 50% of the bottom affected; sediment deposits at obstructions, constrictions.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25 – 75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition – Form 2

Habitat Assessment Field Data Sheet-High Gradient Streams (Back)

	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
Parameters to be evaluated broader than sampling reach	6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal patern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e. dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
	Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	7. Frequency of Riffles (or bends)	Occurrence if riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstructions is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
	Score	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	8. Bank Stability (score each bank) **Note: determine left and right side by facing upstream.**	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5 – 30% of bank in reach has areas of erosion.	Moderately unstable; 30 – 60% of bank in reach has area of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60 – 100% of bank has erosional scars.
	Score (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Score (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
	9. Vegetative Protection (score each bank)	More than 90% of the streambank surface and immediate riparian zone covered by native vegatation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or mot evident; almost all plants allowed to grow naturally.	70 – 90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50 – 70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 cetimeters or less in average stubble height.
	Score (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Score (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
	10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clearcuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12 – 18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6 – 12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activites.
	Score (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Score (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score _____

Habitat Assessment and Physicochemical Characterization Field Data Sheets – Form 2