Tuckaluge Creek Habitat Survey

- Chattahoochee National Forest -

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Introduction

In April 1996 we surveyed Tuckaluge Creek on the Tallulah Ranger District (TRD) , Chattahoochee National Forest (CNF) to quantify current stream habitat. Habitat in Tuckaluge Creek was classified and inventoried using Basinwide Visual Estimation Techniques (BVET [Dolloff et. al 1993]). We modified standard BVET methods to measure stream habitat parameters identified in the CNF monitoring plan for woody debris additions in Tuckaluge Creek (Mitzi Pardew, Personal Communication). The use of BVET allowed us to estimate woody debris loading, amount of pool and riffle area, substrate composition, stream depth, and the width of the riparian area. Further, we were able to map the distribution of woody debris in Tuckaluge Creek.

The purpose of this report is to describe the current stream habitat of Tuckaluge Creek in a format useful to the CNF and the TRD. The enclosed information is intended as a baseline for Forest Service managers involved in stream habitat improvement projects or land use decisions in the Tuckaluge Creek Watershed.

Methods

Two-stage visual estimation techniques were used to quantify stream habitat in a 2.7 mile section of Tuckaluge Creek beginning at the downstream forest boundary (Figure 1). During the first stage, all habitat units were classified and the surface area and depth were estimated. Sampling strata were based on naturally occurring habitat units such as pools (an area in the stream with low water velocity, streambed gradient near zero, and a smooth water surface) and riffles (an area in the stream with relatively steep gradient, shallow water, relatively high velocity, and turbulent surface).

Habitat in Tuckaluge Creek was classified and inventoried by a two-person crew. One crew member identified each habitat unit by type, estimated surface area, classified the dominant (covering the major percentage of the wetted channel) and subdominant (covering the second highest percentage of the wetted channel) substrate (Table 1), and estimated the average and maximum depth of each habitat unit. 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 0.1-ft increments. The length (0.1 ft) of each habitat unit was measured with a hip chain.

Another crew member classified and inventoried large woody debris (LWD), associated with each habitat unit (within the stream channel) and recorded the data on a field data logger. LWD was divided into four classes: 1) less than 15-ft long, less than 14-in diameter, 2) less than 15-ft long, greater than 14-in diameter, 3) greater than 15-ft long, less than 14-in diameter, and 4) greater than 15-ft long, greater than 14-in diameter. LWD less than 4-ft long and less than 4-in diameter were omitted from the survey.

The first unit of each habitat type selected for intensive sampling (accurate measurement of surface area - second stage sampling) was determined randomly. Additional units were selected systematically (one unit out of 20 for each habitat type). The width of these systematically selected habitat units was measured with a 50-ft measuring tape at intervals ranging from about 5 to 10 ft. Interval size was determined by the length and the morphology of the unit (e.g., intervals of measured widths increased with increasing unit length).

The relationship between the estimated surface area and the measured surface area typically is strongly and positively correlated when the estimates are made by experienced personnel; thus, visual estimates were corrected by multiplying all estimates by a calibration ratio (Hankin and Reeves 1988). The calibration ratio ($\hat{Q}$), the estimated true total area ($\hat{M}$) and the variance of the area estimator $\hat{V}(\hat{M})$ were calculated separately for each habitat type and each stream.

In each of the systematically selected riffles we also estimated the stream channel width (ft) at bankfull and riparian width (ft) as described by Harrelson et. al 1994. We used this information to describe the channel and flood plain associated with Tuckaluge Creek.

BVET calculations were computed using a Statistical Analysis Systems (SAS) program developed by Dr. Patricia Flebbe (100 Cheatham Hall, VA Tech, Blacksburg, VA 24061-0321). Data were summarized using a spreadsheet, graphics program, and statistical program.

The first mile (downstream) of the study area appeared to be of higher gradient, characterized by numerous waterfalls and plunge pools, than the remaining 1.7 miles. Because of possible differences from downstream to upstream we divided the study area in to three contiguous sections of similar length to test for differences in pool habitat. Section 1 began at the downstream Forest Service boundary and extended upstream about one mile, Section 2 the following mile, and Section 3 the remaining 0.7

mile. We used Kruskal-Wallis one-way ANOVA on ranks to investigate differences in average pool depth among sections.

Results and Discussion

We identified 174 pools and 136 riffles in the 2.7 mile study section. Visual estimates of stream width were paired with measured stream width for 16 pools and 14 riffles. Paired observation were highly correlated for pools ($r = 0.98$, $p < 0.0001$) and riffles ($r = 0.93$, $p < 0.0001$). Total area was estimated for each habitat type using correction factors ($\hat{Q}$) that ranged from 1.03 for pools to 1.06 for riffles.

We estimated that the Tuckaluge Creek study area contained 111,493 ft^2 (95% confidence interval $\pm$ 7,274 ft^2) of pool area and 149,003 ft^2 (95% confidence interval $\pm$ 5,391 ft^2) of riffle area. Forty-three percent of the total habitat area is in pool habitat; however, the pool:riffle ratio varies from downstream to upstream. Pool habitat makes up about 45% and 49% of the total habitat area in sections 1 and 2, respectively, but less than 28% in Section 3.

Tuckaluge Creek substrata was diverse but varied with habitat type. Sand was the dominant and subdominant substrata in pools (Figure 2). The dominant and subdominant substrata in riffles was more coarse; characterized by cobble, boulder, and bedrock (Figure 2).

The maximum and average depth of pools and riffles was deepest in Section 1 (Table 2). Average pool depth in Section 1 was significantly different from pool depths in sections 2 and 3 (ANOVA on Ranks, df = 2, $p < 0.0001$; Figure 3). Pools with greater depth provide benefits to salmonids not provided by shallower pools. One such benefit, which is pertinent to the Tuckaluge Creek LWD project, is the ability of deep pools to allow more conspecifics to coexist (Frazer 1969; Allee 1982).

Total riparian width in the Tuckaluge study area ranged 31.5 to 100.4 ft ($\bar{x}$ = 54.1 ft, n = 13; Figure 4): right-bank (facing upstream) riparian width ranged from 0.3 to 46.6 ft ($\bar{x}$ = 15.7 ft, n = 13), and left-bank riparian width ranged from 3.9 to 34.4 ft ($\bar{x}$ = 12.8 ft, n = 13). The mean channel width was 25.6 ft (range = 17.7 - 40.3 ft).

LWD is relatively abundant and widely distributed in the study area (Figure 5 and 6). Pieces in the largest size class (> 15' in length and > 14"in diameter) are probably more stable than smaller pieces and are more likely to influence instream habitat. The largest LWD size class was also common and widely distributed in the study area: sections 1 and 3 had the highest loading of this size class (96 and 90 pieces per mile) and Section 2 the lowest (68 pieces per mile).

LWD debris forms pools and provides complex cover for fish and macroinvertebrates (Dolloff 1994). The size and placement of LWD as well as the stream channel size, constriction, and gradient influence the size, shape, depth, and complexity of the pools they form (Sullivan et al. 1987). For example, all three sections of Tuckaluge Creek had a relatively high number of large pieces of wood relative to numerous other streams in the southern Appalachians (Dolloff et al. 1994; Flebbe and Dolloff 1995) . The pools in Section 1, however, are significantly deeper than pools in sections 2 and 3 and the percentage of pool habitat in Section 3 is notably less than in the other two sections.

Flow generally increases from upstream to downstream and as the channel gradient increases (Sullivan et al. 1987). Section 1 was located in the downstream section of the study and was notably steeper in gradient than the other two sections. The energy of the water would be greater in this section of stream and therefore the influence of LWD on the channel morphology would also be greater. Our data suggest that the quantity and placement of LWD may be more critical in the upstream sections of Tuckaluge Creek for optimal pool formation.

Conclusions

Habitat for salmonids, based on the variables collected in this study, appears to be the most suitable in the lower portion of the Tuckaluge Creek study area (Section 1). Pool frequency in Section 3 and pool depth in sections 2 and 3 could be improved by strategic placement of large pieces of wood in the stream. We suggest that habitat improvement by the addition of LWD proposed by the CNF be concentrated to the upper 1.7 miles of the study area. Managers can use the distribution of LWD in Tuckaluge Creek (Figure 6) as a guide to identify locations where LWD is limited.

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Table 1. Criteria for substrate classifications.

CLASS	Diameter	CLASS	Diameter
organic debris		large gravel	1-10cm
clay		cobble	11-30cm
silt		boulder	30cm
sand	silt- 2mm	bedrock	
small gravel	2-10mm		

Table 2. Maximum and average depths (ft) of pools and riffles by stream section in Tuckaluge Creek.

		Maximum Depth	Average Depth
Section	**N**	**Mean (Range)**	**Mean (Range)**
		Pools	
1	65	3.0 (1.3-6.5)	1.8 (0.7-3.9)
2	69	2.4 (1.3-4.6)	1.4 (0.8-2.3)
3	41	2.2 (1.3-3.6)	1.5 (0.8-3.3)
		Riffles	
1	50	1.5 (0.7-2.9)	0.9 (0.3-1.5)
2	53	1.2 (0.5-2.6)	0.7 (0.3-1.0)
3	33	1.1 (0.7-1.8)	0.6 (0.3-1.0)

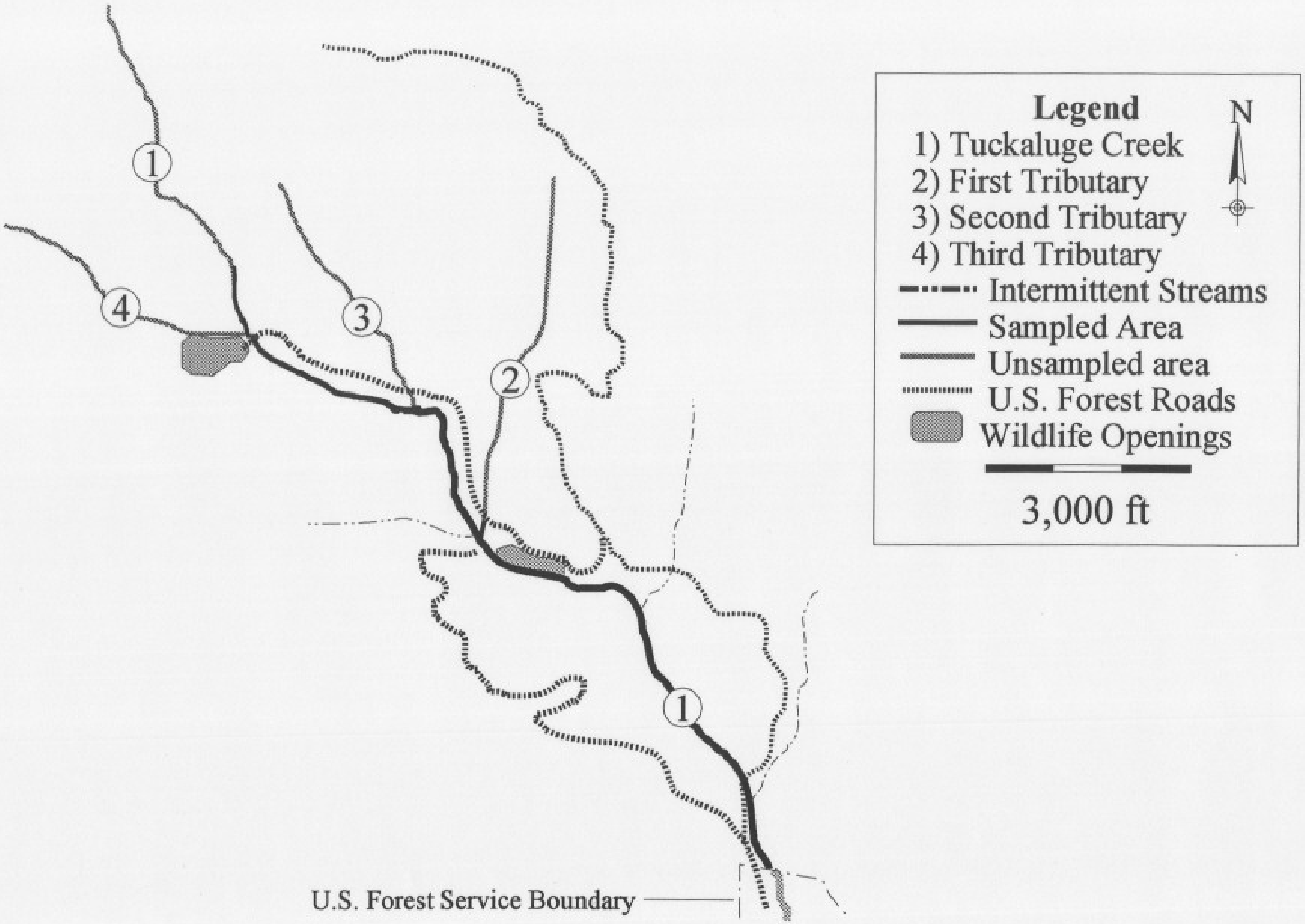

Figure 1. Tuckaluge Creek on the Chattahoochee National Forest, Georgia.

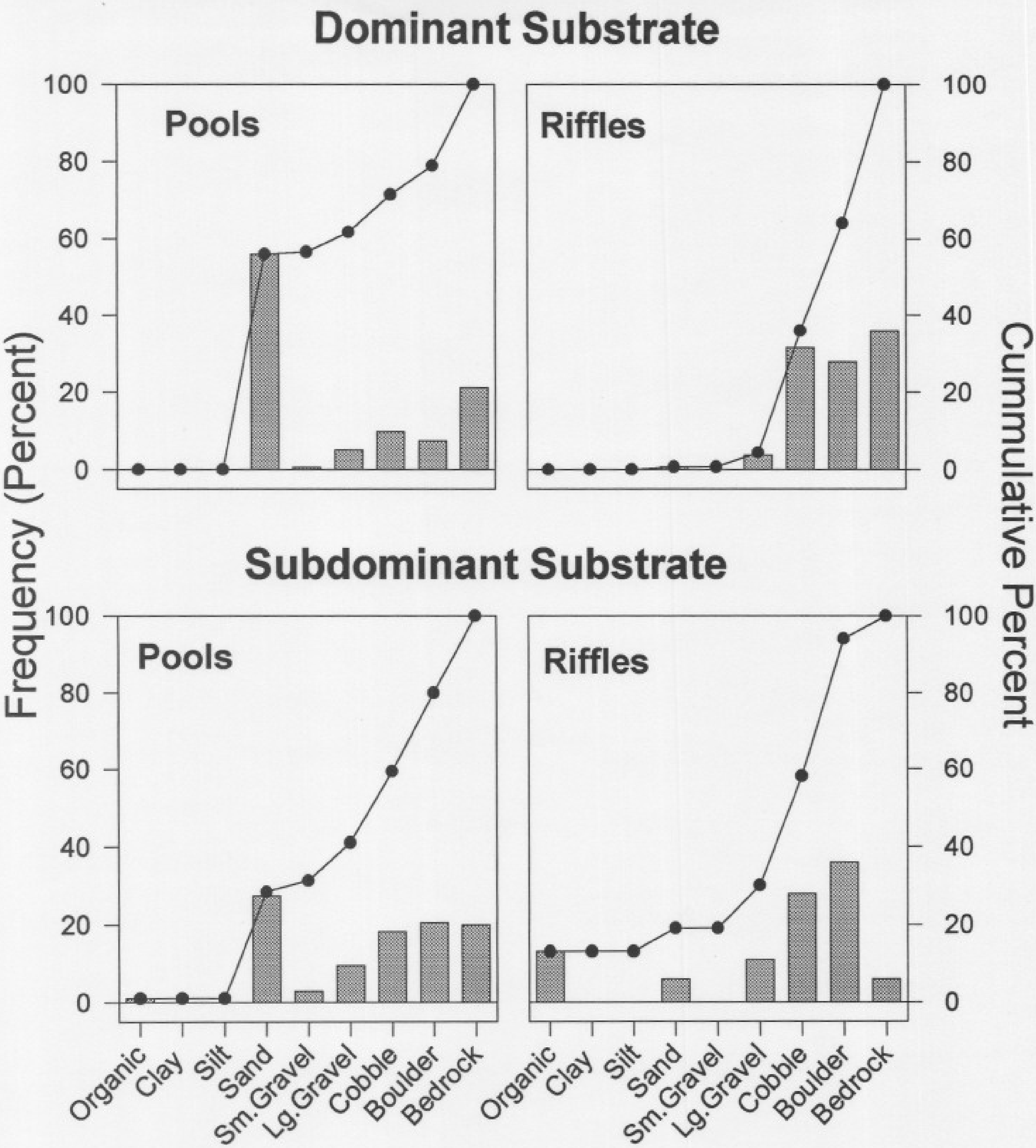

Figure 2. Dominant and subdominant substrate composition by habitat type in Tuckaluge Creek. Bars represent frequency and dots represent cumulative percent.

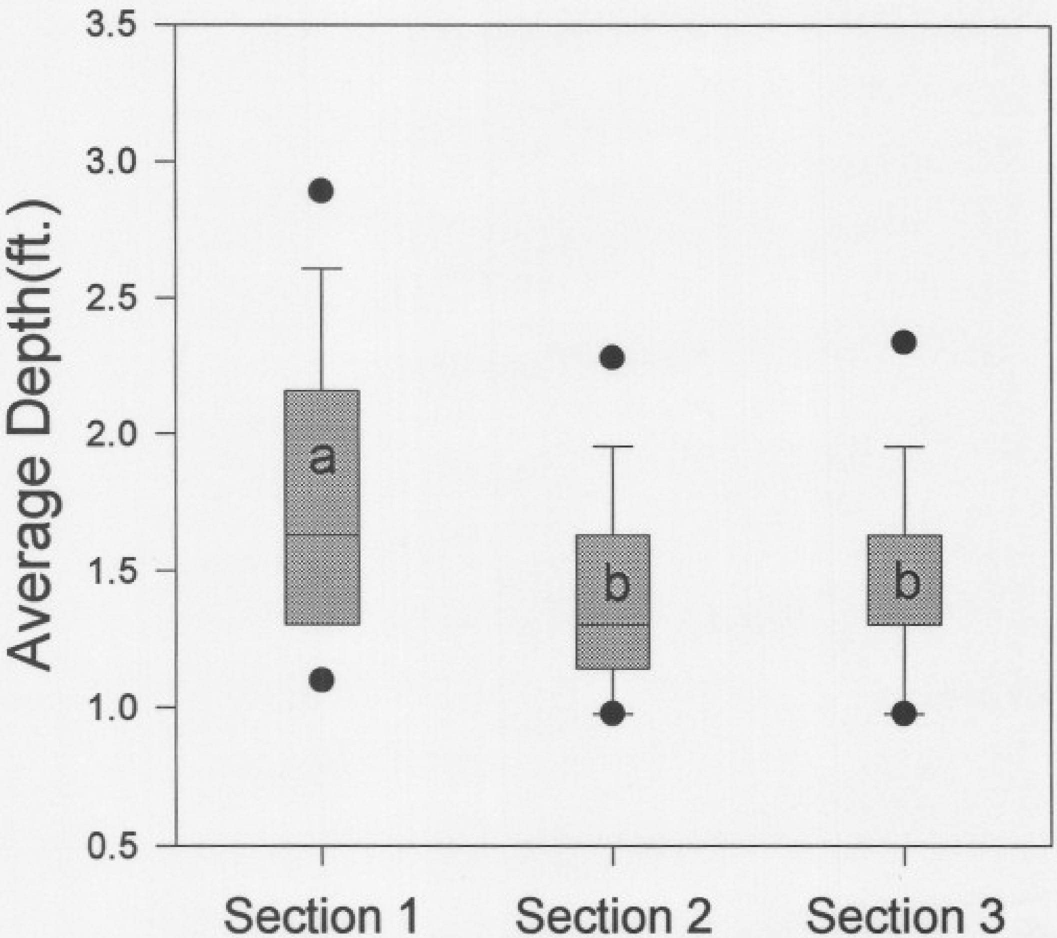

Figure 3. Box plots of pool depth. The box encloses the middle 50% of the observations, the bar in the center of the box represents the median, and the capped lines extending above and below the box represents the 90% and the 10% quantiles. Box plots with the same letters are not significantly different (ANOVA, $p < 0.0001$).

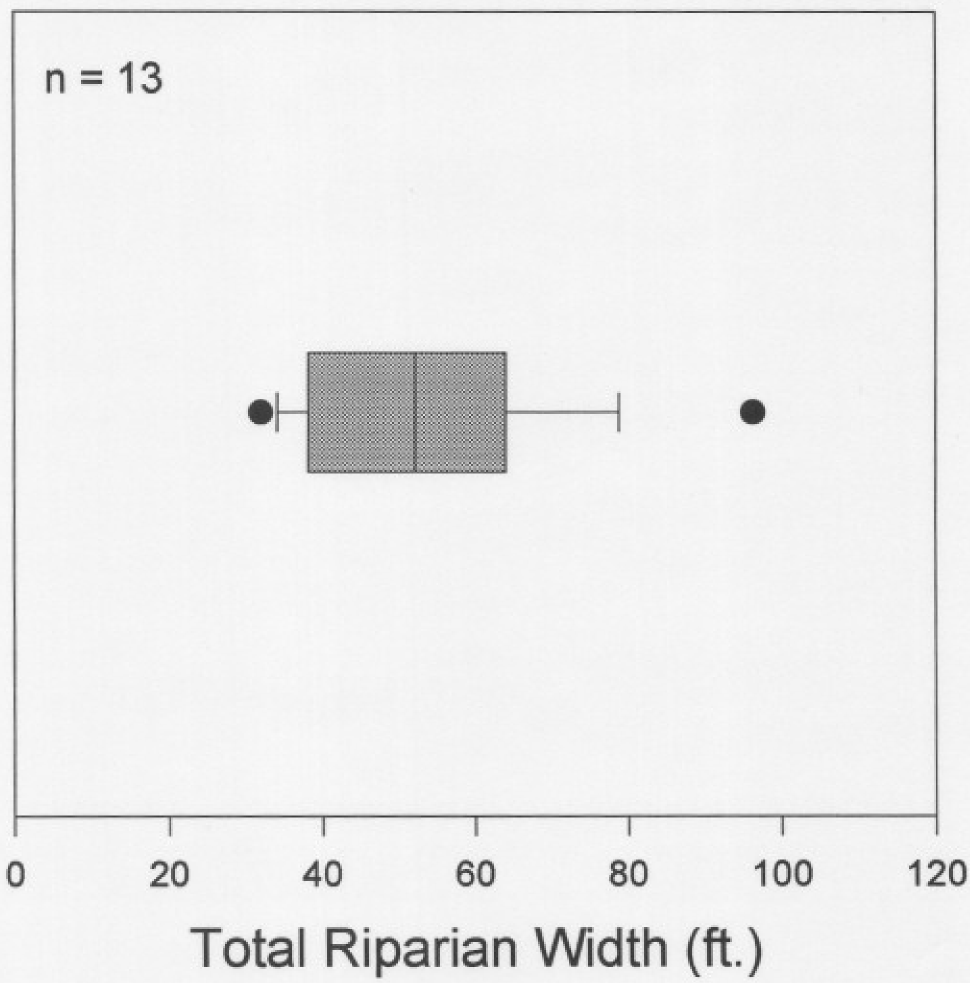

Figure 4. Box plot of total riparian width. The box encloses the middle 50% of the observations, the bar in the center of the box represents the median, and the capped lines extending above and below the box represent the 90% and 10% quantiles.

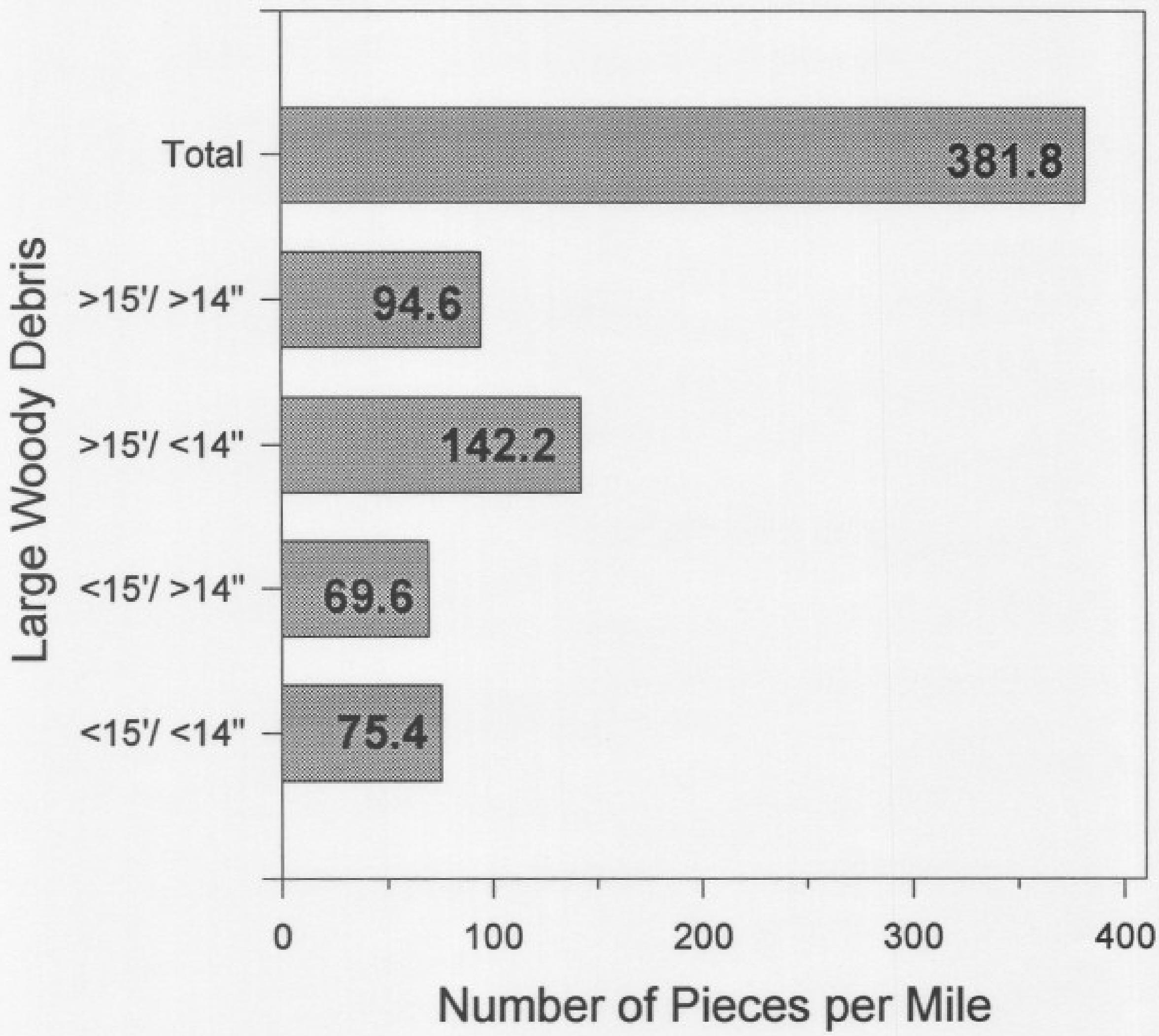

Figure 5. Pieces of large woody debris by size class in Tuckaluge Creek.

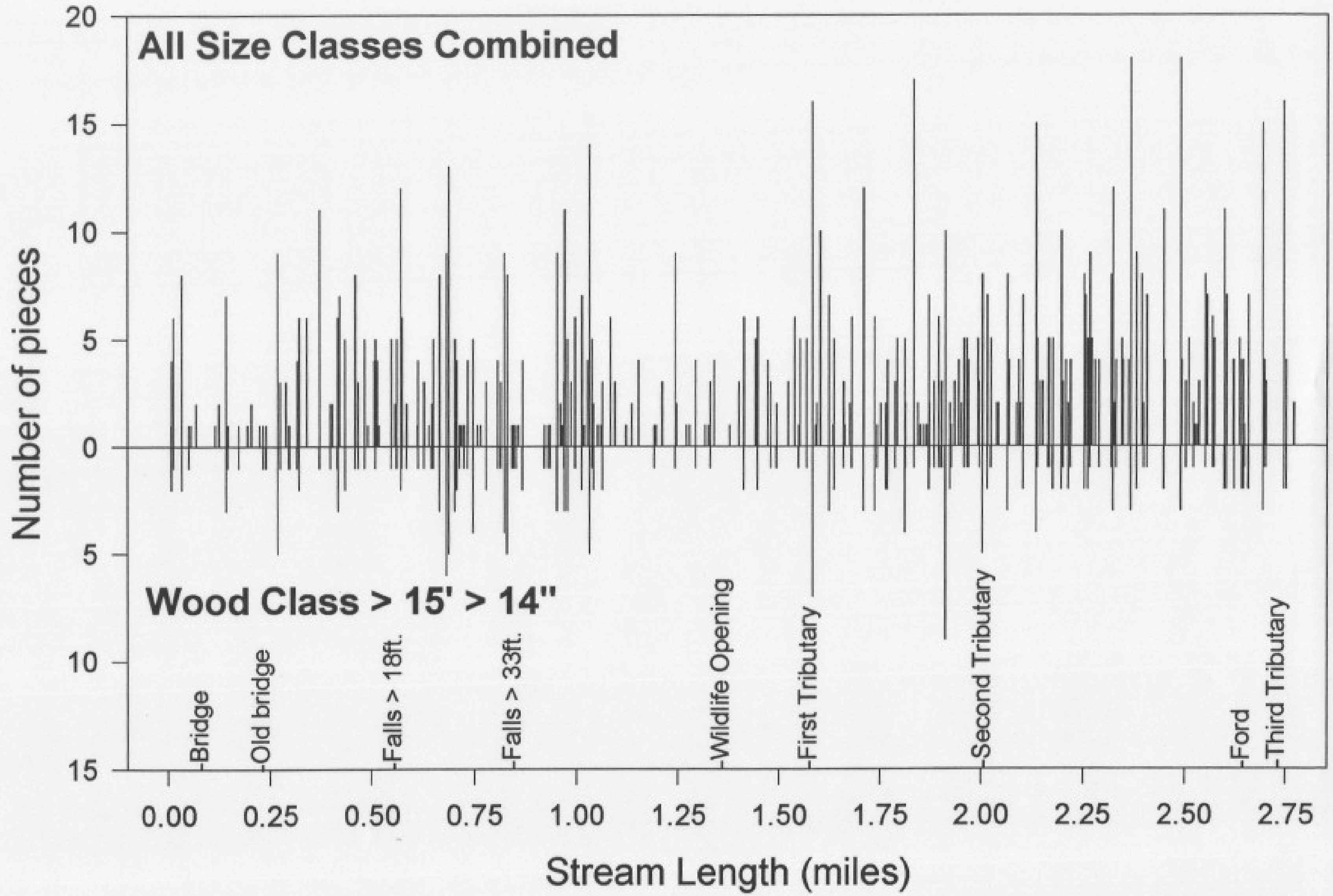

Figure 6. Distribution of large woody debris in Tuckaluge Creek.

Appendix A. Habitat data from the second tributary (Figure 1) on Tuckaluge Creek.

Habitat Type	no.	Distance (ft)	Estimated Area (ft2)	Dominant Substrate	Subdominant Substrate	Maximum Depth (ft)	Average Depth (ft)	Large Woody Debris			
								<15'<14"	<15'>14"	>15'<14"	>15'>14"
Riffle	1	37.4	245.3	4	6	1.1	0.7				
Pool	1	57.1	129.1	4	9	1.0	0.7			1	
Riffle	2	69.2	47.8	8	6	1.0	0.5				
Pool	2	79.7	68.9	4	8	1.0	0.7			2	
Pool	3	101.4	85.2	4	6	0.8	0.7	1		2	
Riffle	3	138.1	241.0	4	7	0.5	0.3	1	1		1
Pool	4	151.9	67.8	4	9	1.3	1.0			1	
Riffle	4	170.2	150.6	7	4	0.5	0.3	1	1		
Pool	5	177.1	27.1	4	7	1.0	0.8	1			
Pool	6	207.3	247.4	4	6	1.0	0.8	2		1	1
Riffle	5	243.4	177.5	4	7	0.8	0.5	1		4	
Pool	7	262.4	137.3	7	4	0.8	0.7				
Riffle	6	299.5	243.1	9	7	0.8	0.7				1
Pool	8	311.6	67.7	8	4	1.3	1.0	2			
Riffle	7	442.1	1284.6	7	4	0.8	0.3	5		4	3
Pool	9	464.1	216.2	4	8	1.0	0.8	1		2	
Riffle	8	482.2	147.9	7	6	0.8	0.7	2			
Pool	10	515.6	164.6	4	6	1.3	1.0	3	1	2	1
Riffle	9	697.7	1671.9	7	6	0.8	0.5	10	3	1	
Pool	11	708.2	137.7	8	4	0.8	0.7	3	1		
Pool	12	734.7	305.0	4	6	1.0	0.7	1			
Riffle	10	766.2	351.2	8	4	0.7	0.5	1	1		
Trib		754.4									
Pool	13	793.1	264.7	7	6	4.3	1.0	1	1		
Riffle	11	806.9	90.4	9	8	2.2	0.3	1	1	2	3
Pool	14	820.0	86.1	9	8	4.3	0.8				
Culvert		846.2									