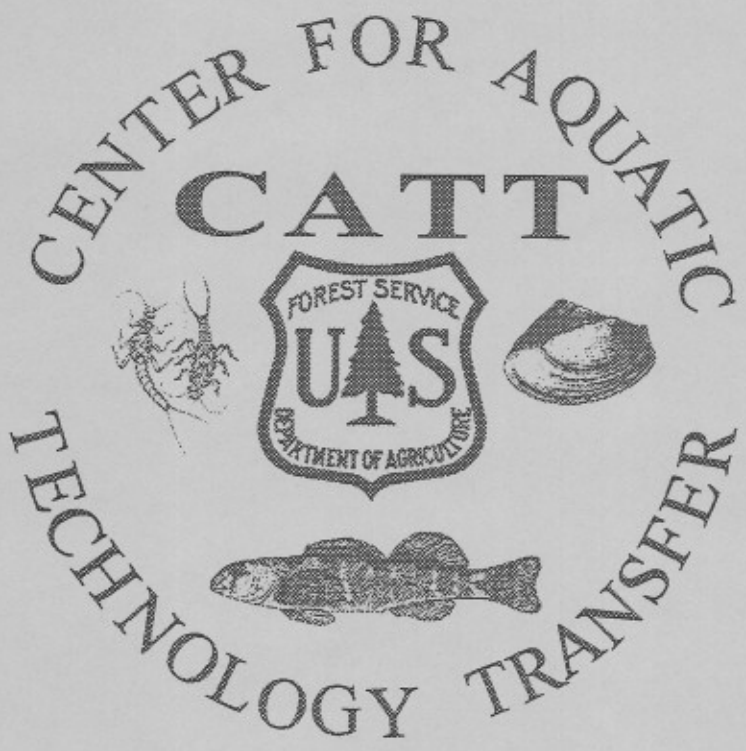
Stream Habitat Inventory of the Turtletown Creek Watershed: Cherokee National Forest



United States Department of Agriculture Forest Service
Center for Aquatic Technology Transfer
Department of Fisheries and Wildlife Sciences
Virginia Tech, Blacksburg, VA 24061-0321

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Introduction

In Summer 1997 we used basinwide visual estimation techniques (BVET)(Hankin and Reeves 1988; Dolloff et al. 1993) to quantify current stream conditions on the Cherokee National Forest (CNF). The use of BVET allowed us to estimate total habitat area, percentage of pool and riffle area, channel width, water depth, and classify the stream substratum particle size distribution and substratum embeddedness. We also inventoried and mapped the distribution of woody debris. In this report we describe the current baseline conditions of habitat in Turtletown Creek and three of its major tributaries; Negro Creek, Rocky Ford Creek, and Hall Creek.

Study Streams

We began our survey of Turtletown Creek at its confluence with the Hiwassee River and ended 11.6 miles upstream at the confluence of Rocky Ford Creek and Hall Creek. We divided Turtletown Creek into three sections: the break between the lower and middle sections occurred 3.3 miles upstream of the Turtletown Creek-Hiwassee River confluence and the break between the middle and upper section occurred 7.7 miles upstream of the Turtletown Creek-Hiwassee River confluence (Figure 1). We surveyed 1.4 miles of Negro Creek, 0.8 miles of Rocky Ford Creek, and 1.3 miles of Hall Creek (all tributary surveys began at their confluence with Turtletown Creek; Figure 1).

Methods

We used two-stage visual estimation techniques to quantify habitat in the study streams. During the first stage, one crew member identified each habitat unit by type (pool or riffle), estimated wetted stream width, estimated stream channel width in riffles, classified the dominant

and subdominant substrata particle size (Table 1), and assessed substrata embeddedness (siltation). Substrata embeddedness was assessed by visually estimating the proportion of the substrata and interstitial spaces covered with fine silt particles (Table 2). The remaining crew members classified and inventoried large woody debris (LWD) associated with each habitat unit (within the stream channel), estimated the maximum, average, and pool-riffle crest depth of each habitat unit, and recorded the data on a Husky Hunter field data logger. LWD greater than 4-ft long and greater than 4-in diameter 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. 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. Pool-riffle crest depth was measured at the deepest point, within the thalweg, at the pool-riffle interface. The length of each habitat unit was measured with a hip chain.

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 (about one unit out of 7 for each habitat type). The wetted width and stream channel width (at bankfull as described by Harrelson et. al 1994) of these systematically selected habitat units was measured with a 50-ft measuring tape.

BVET calculations were computed using a Statistical Analysis Systems (SAS) program developed by Dr. Patricia Flebbe (100 Cheatham Hall, VA Tech, Blacksburg, VA 24060). Data were summarized using a Quattro Pro spreadsheet, SigmaPlot graphics software, and SigmaStat statistical software. Field notes are given in Appendix A.

Results

Turtletown Creek

Lower section - We identified 52 pools and 43 riffles in the lower Turtletown Creek study section. Visual estimates of habitat areas were paired with measured habitat area for 8 (15%) pools and 7 (16%) riffles. We estimated that the lower study section of Turtletown Creek contained 28.1% pool habitat (4.5 $\pm$ 0.5 acres) of and 71.9% riffle habitat (11.5 $\pm$ 0.9 acres). Total area was estimated for each habitat type using correction factors ($\hat{Q}$) that ranged from 0.94 to 0.98.

We estimated the average stream channel width in the lower Turtletown Creek section to be 46.9 ft. The width of the stream channel, however, was highly variable (Figure 2).

The mean pool-riffle crest depth in the lower Turtletown Creek study section was 1.9 ft (Figure 3). Mean maximum depth was 3.7 ft and the mean average depth was 2.2 ft. Both maximum and average depth were variable within and among habitat types (Figures 4 and 5).

We identified bedrock and sand as the most common (modal) dominant and subdominant substratum, respectively, in the lower Turtletown Creek study section. The dominant and subdominant substrata, however, varied between habitat types (Figures 6 and 7). In general, the substrate embeddedness in the lower Turtletown Creek study section was low; silt covered less than 25% of the substrata in most cases (Figure 8).

Lower Turtletown Creek contained about 427 pieces of LWD per mile (Figures 9 and 10). This section contained about than 292 pieces per mile of the larger size classes which are the most stable and most capable of forming instream habitat and providing cover for fishes (Figure 9).

Middle section - We identified 41 pools and 29 riffles in the middle Turtletown Creek study section. Visual estimates of habitat areas were paired with measured habitat area for 13 (32%) pools and 18 (62%) riffles. We estimated that the middle study section of Turtletown Creek contained 85.8 % pool habitat (12.7 $\pm$ 1.0 acres) of and 14.2 % riffle habitat (2.0 $\pm$ 0.1 acres). Total area was estimated for each habitat type using correction factors ($\dot{Q}$) that ranged from 0.99 to 1.00.

We estimated the average stream channel width in the middle Turtletown Creek section to be 33.3 ft. The width of the stream channel, however, was variable (Figure 2).

The mean pool-riffle crest depth in the middle Turtletown Creek study section was 1.5 ft (Figure 3). Mean maximum depth was 4.1 ft and the mean average depth was 2.7 ft. Both maximum and average depth were variable within and among habitat types (Figures 11 and 12).

We identified sand and bedrock as the most common (modal) dominant and subdominant substratum, respectively, in the middle Turtletown Creek study section but varied between habitat types (Figures 13 and 14). The substrate embeddedness in the middle Turtletown Creek study section ranged from low to high; silt covered as much as 100% of the substrata in some cases (Figure 15).

Middle Turtletown Creek contained about 286 pieces of LWD per mile (Figures 16 and 17). This section contained about 140 pieces per mile of the larger size classes (Figure 16).

Upper section - We identified 41 pools and 32 riffles in the upper Turtletown Creek study section. Visual estimates of habitat areas were paired with measured habitat area for 6 (15%) pools and 5 (16%) riffles. We estimated that the upper study section of Turtletown Creek contained 85.0 % pool habitat (7.9 $\pm$ 2.3 acres) of and 15.0 % riffle habitat (1.4 $\pm$ 0.4 acres). Total area was

estimated for each habitat type using correction factors ($\hat{Q}$) that ranged from 1.05 to 1.20.

We estimated the average stream channel width in the upper Turtletown Creek section to be 28.1 ft. The width of the stream channel, however, was variable (Figure 2).

The mean pool-riffle crest depth in the upper Turtletown Creek study section was 1.8 ft (Figure 3). Mean maximum depth was 2.9 ft and the mean average depth was 2.0 ft. Both maximum and average depth were variable within and among habitat types (Figures 18 and 19).

We identified clay as the most common (modal) for both the dominant and subdominant substratum in the upper Turtletown Creek study section. The dominant and subdominant substrata, however, varied between habitat types (Figures 20 and 21). The substrate embeddedness in the upper Turtletown Creek study section ranged from low to high; however, silt primarily covered less than 25% of the substrata in most cases (Figure 22).

Upper Turtletown Creek contained about 225 pieces of LWD per mile (Figures 23 and 24). This section contained about 137 pieces per mile of the larger size classes (Figure 23).

Negro Creek

We identified 35 pools and 19 riffles in the Negro Creek study section. Visual estimates of habitat areas were paired with measured habitat area for 6 (17%) pools and 5 (26%) riffles. We estimated that the study section of Negro Creek contained 90.7 % pool habitat (2.6 ± 0.5 acres) of and 9.3 % riffle habitat (0.3 ± 0.03 acres). Total area was estimated for each habitat type using correction factors ($\hat{Q}$) that ranged from 1.01 to 1.05.

We estimated the average stream channel width in the Negro Creek section to be 19.3 ft. The width of the stream channel, however, was variable (Figure 2).

The mean pool-riffle crest depth in the Negro Creek study section was 1.4 ft (Figure 3).

Mean maximum depth was 2.7 ft and the mean average depth was 1.8 ft. Both maximum and average depth were variable within and among habitat types (Figures 25 and 26).

We identified sand and small gravel as the most common (modal) dominant and subdominant substratum, respectively, in the Negro Creek study section but varied between habitat types (Figures 27 and 28). The substrate embeddedness in the Negro Creek study section ranged from low to high; however, silt primarily covered between 5 and 50% of the substrata in most cases (Figure 29).

The Negro Creek study section contained about 381 pieces of LWD per mile (Figures 30 and 31). This section contained about 243 pieces per mile of the larger size classes (Figure 30).

Rocky Ford Creek

We identified 18 pools and 17 riffles in the Rocky Ford Creek study section. Visual estimates of habitat areas were paired with measured habitat area for 3 (16%) pools and 4 (24%) riffles. We estimated that the study section of Rocky Ford Creek contained 58.9 % pool habitat (0.8 ± 0.2 acres) of and 41.1 % riffle habitat (0.6 ± 0.1 acres). Total area was estimated for each habitat type using correction factors ($\hat{Q}$) that ranged from 1.02 to 1.14.

We estimated the average stream channel width in the Rocky Ford Creek section to be 16.6 ft. The width of the stream channel, however, was variable (Figure 2).

The mean pool-riffle crest depth in the Rocky Ford Creek study section was 1.6 ft (Figure 3). Mean maximum depth was 2.3 ft and the mean average depth was 1.5 ft. Both maximum and average depth were variable within and among habitat types (Figures 32 and 33).

We identified sand and small gravel as the most common (modal) dominant and subdominant substratum, respectively, in the Rocky Ford Creek study section. The dominant and

subdominant substrata, however, varied between habitat types (Figures 34 and 35). The substrate embeddedness in the Rocky Ford Creek study section was relatively low; silt covered less than 25% of the substrata in most cases (Figure 36).

The Rocky Ford Creek study section contained about 35 pieces of LWD per mile (Figures 37 and 38). This section contained only about 17 pieces per mile of the larger size classes (Figure 37).

Hall Creek

We identified 19 pools and 16 riffles in the Hall Creek study section. Visual estimates of habitat areas were paired with measured habitat area for 6 (32%) pools and 7 (44%) riffles. We estimated that the study section of Hall Creek contained 90.0 % pool habitat (1.7 $\pm$ 0.1 acres) of and 10.0 % riffle habitat (0.2 $\pm$ 0.01 acres). Total area was estimated for each habitat type using correction factors ($\hat{Q}$) that ranged from 0.91 to 0.98.

We estimated the average stream channel width in the Hall Creek section to be 16.9 ft. The width of the stream channel, however, was variable (Figure 2).

The mean pool-riffle crest depth in the Hall Creek study section was 1.3 ft (Figure 3). Mean maximum depth was 2.1 ft and the mean average depth was 1.4 ft. Both maximum and average depth were variable within and among habitat types (Figures 39 and 40).

We identified sand and small gravel as the most common (modal) dominant and subdominant substratum, respectively, in the Hall Creek study section but varied between habitat types (Figures 41 and 42). The substrate embeddedness in the Hall Creek study section ranged from low to high; however, silt primarily covered between 5 and 75% of the substrata in most cases (Figure 43).

The Hall Creek study section contained about 282 pieces of LWD per mile (Figures 44 and 45). This section contained about 161 pieces per mile of the larger size classes (Figure 44).

Literature Cited

Dolloff, C. A., D. G. Hankin, and G. H. Reeves. 1993. Basinwide estimation of habitat and fish populations in streams. General Technical Report SE-83. Asheville, North Carolina: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experimental Station. 25 pp.

Hankin, D. G. and G. H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Canadian Journal of Fisheries and Aquatic Sciences. 45: 834-844.

Harrelson, Cheryl C., Rawlins, C. L., Potyondy, John P. 1994. Stream channel reference sites: an illustrated guide to field technique. Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61p.

Table 1. Substrate classification criteria.

SUBSTRATE CLASSES		
Rank	**Size (inches)**	**Common name**
1		organic debris
2		clay
3		silt
4	silt- 0.08	sand
5	0.08 - 0.4	small gravel
6	0.4 - 4.0	large gravel
7	0.4 - 12.0	cobble
8	> 12.0	boulder
9		bedrock

Table 2. Substrata embeddedness: percentage of the substrata and interstitial spaces covered with fine silt and clay particles.

Embeddedness Rating	
Rank	**Percent coverage**
1	0 - 5
2	5 -25
3	25 - 50
4	50 -75
5	75 - 100

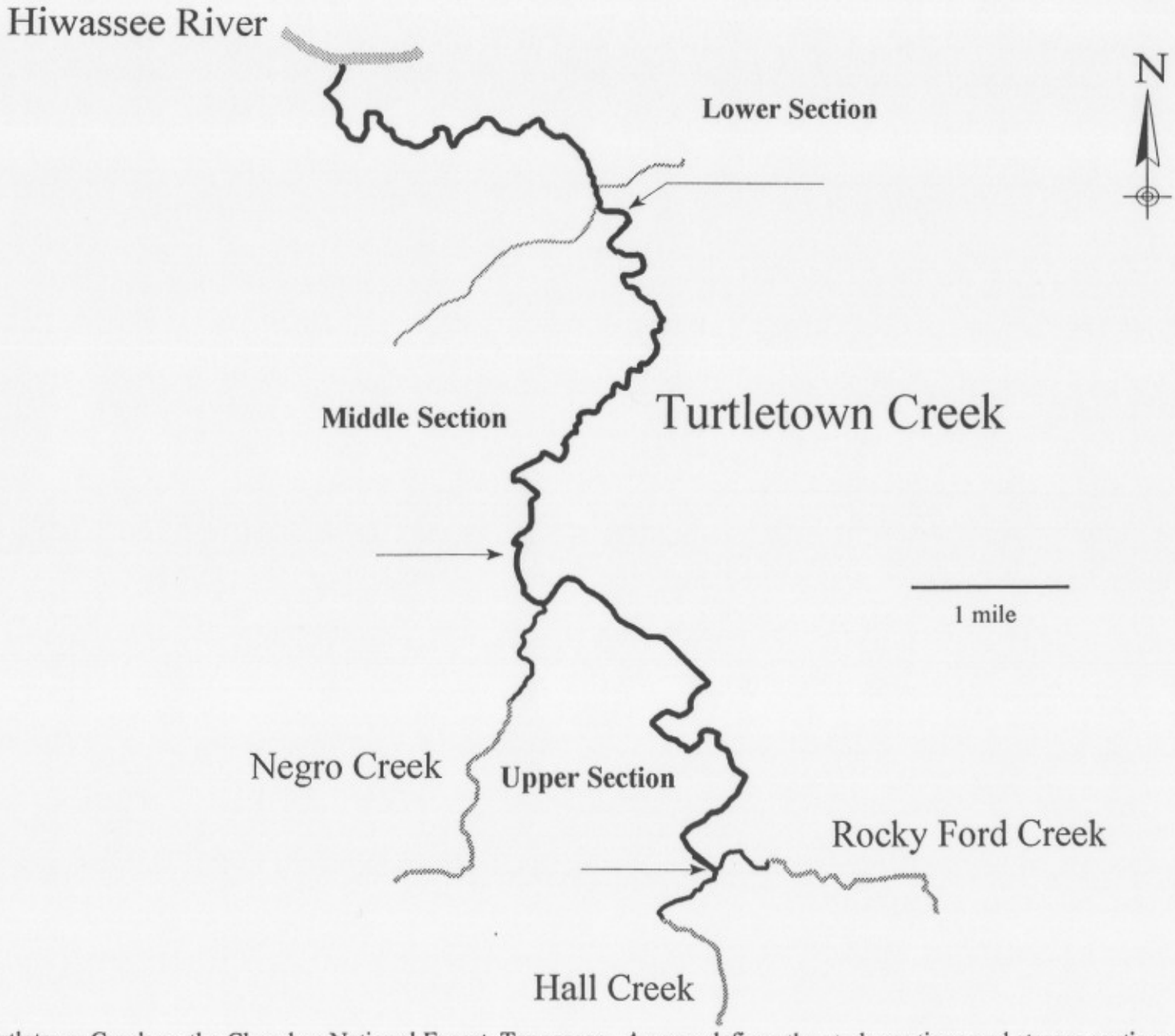

Figure 1. Turtletown Creek on the Cherokee National Forest, Tennessee. Arrows defines the study sections and stream sections highlighted in gray were not included in this study.

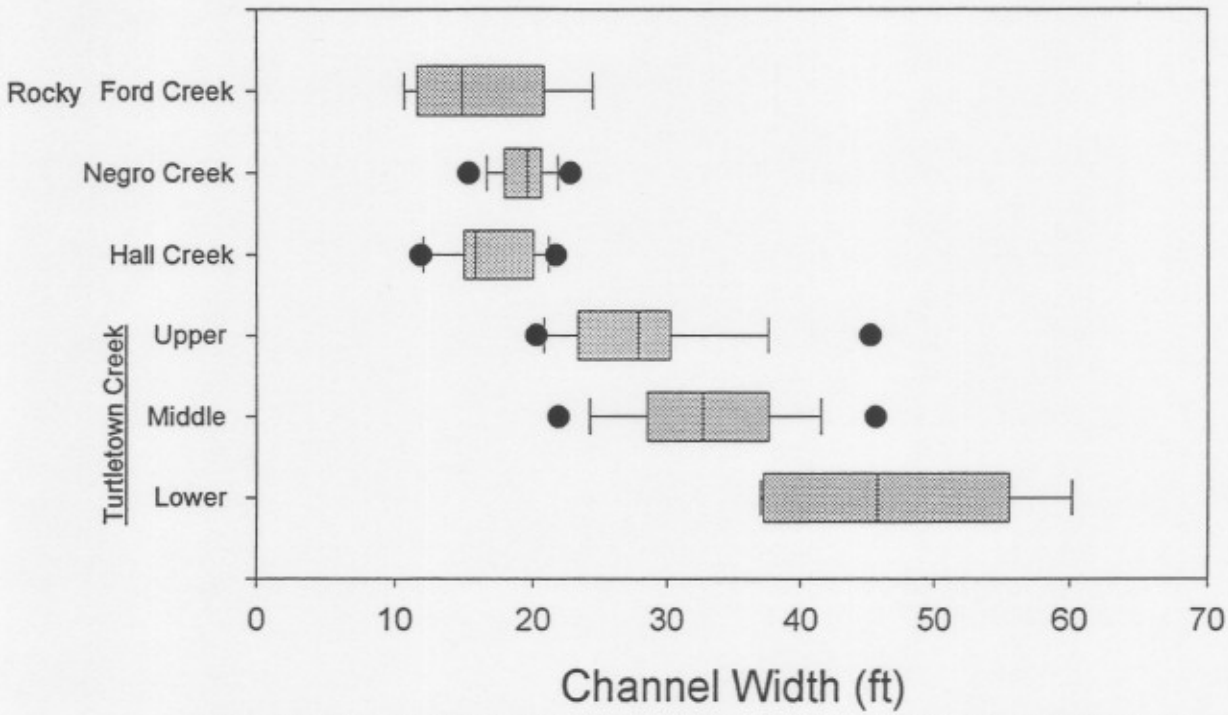

Figure 2. Box plots for stream channel width in habitat-units of by stream and stream section. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

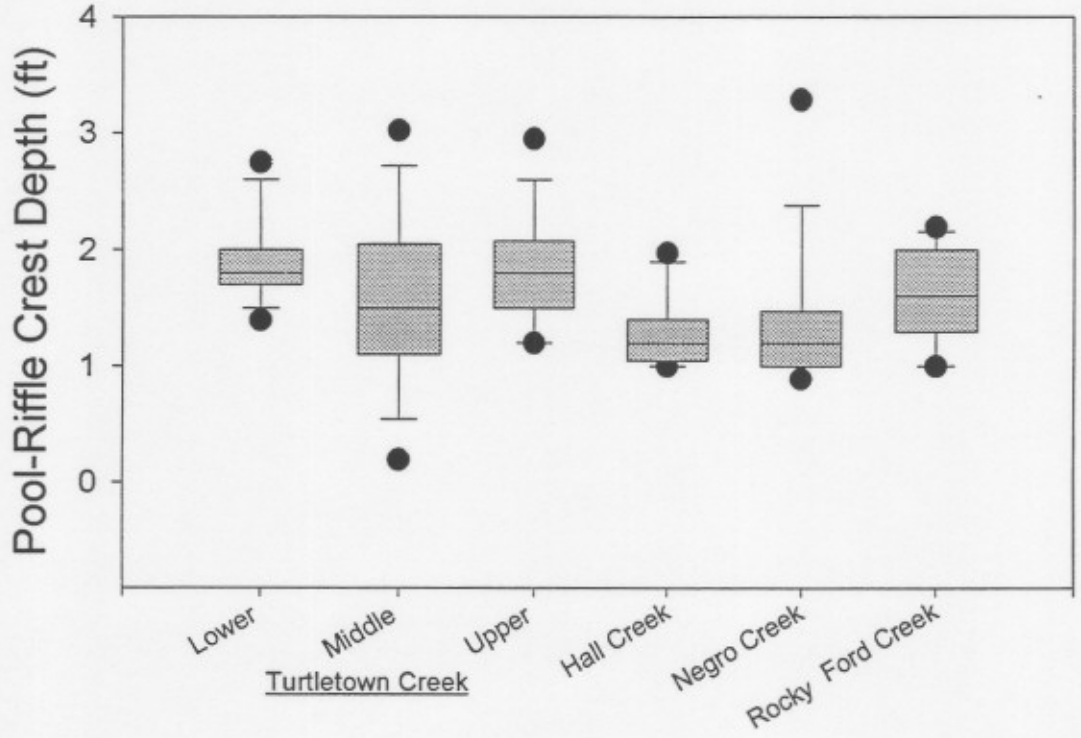

Figure 3. Box plots for pool-riffle crest depth in habitat-units by stream and stream section. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

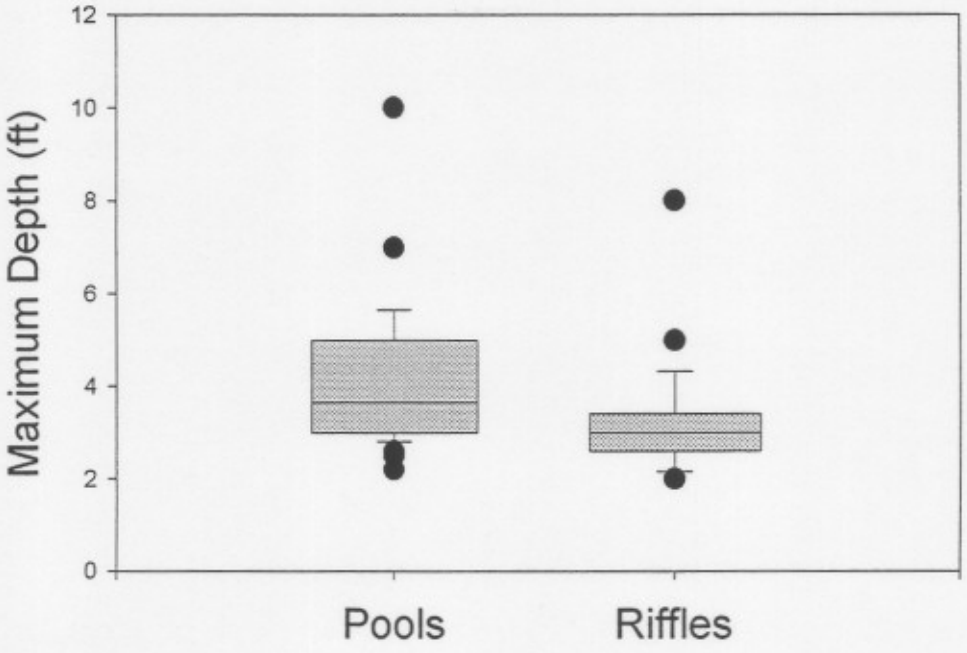

Figure 4. Box plots for habitat-unit and section maximum depth in lower Turtletown Creek. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

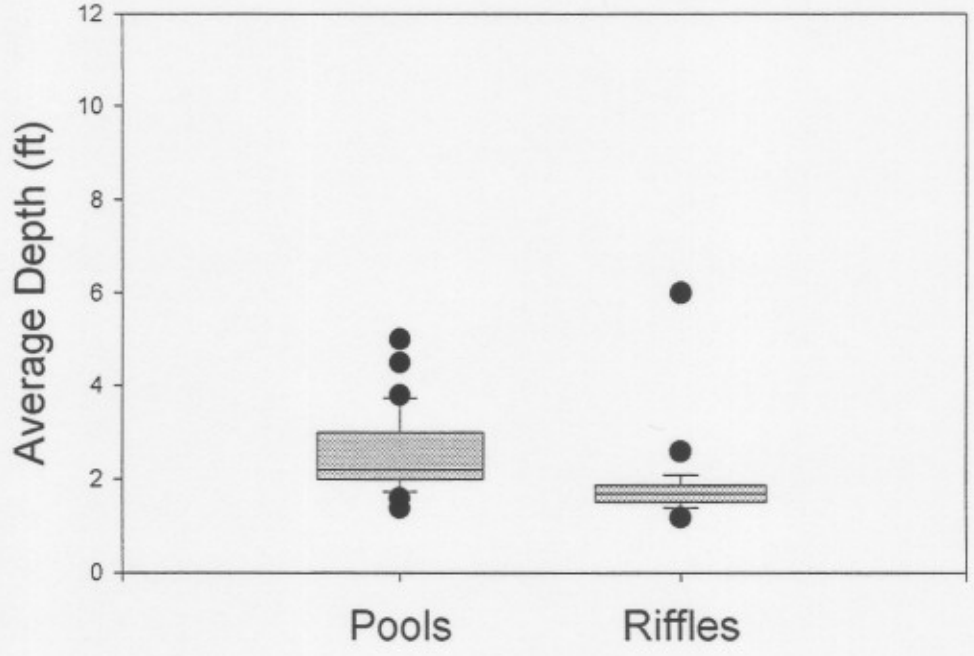

Figure 5. Box plots for habitat-unit and section average depth in lower Turtletown Creek. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

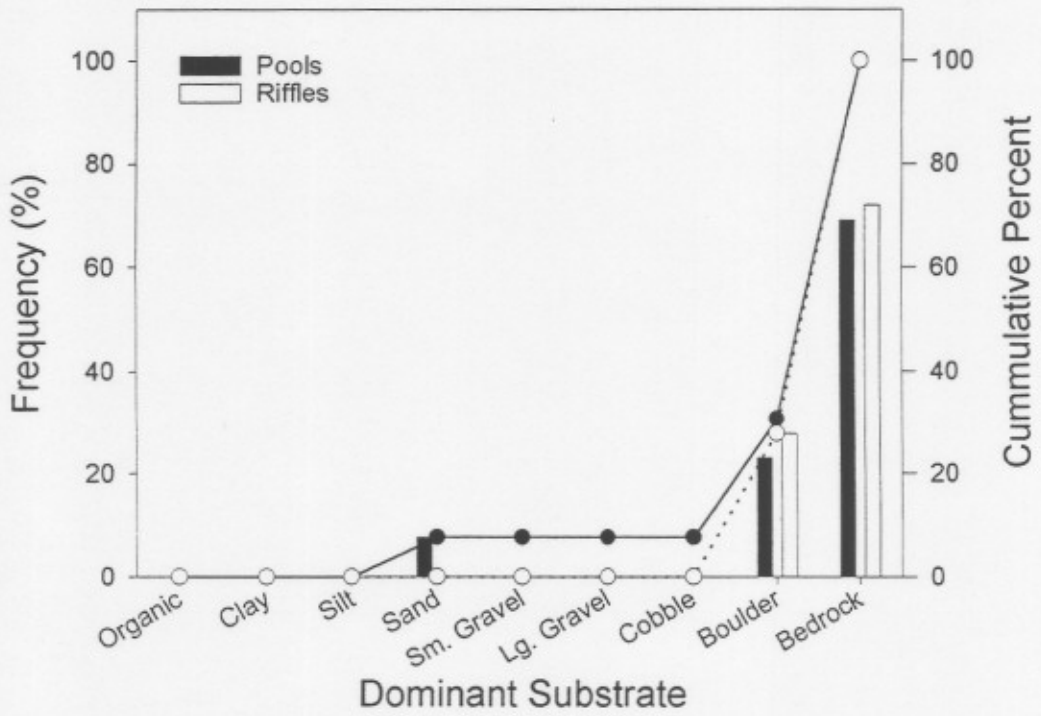

Figure 6. Frequency (percent) of dominant substrate occurrence by habitat type in lower Turtletown Creek. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

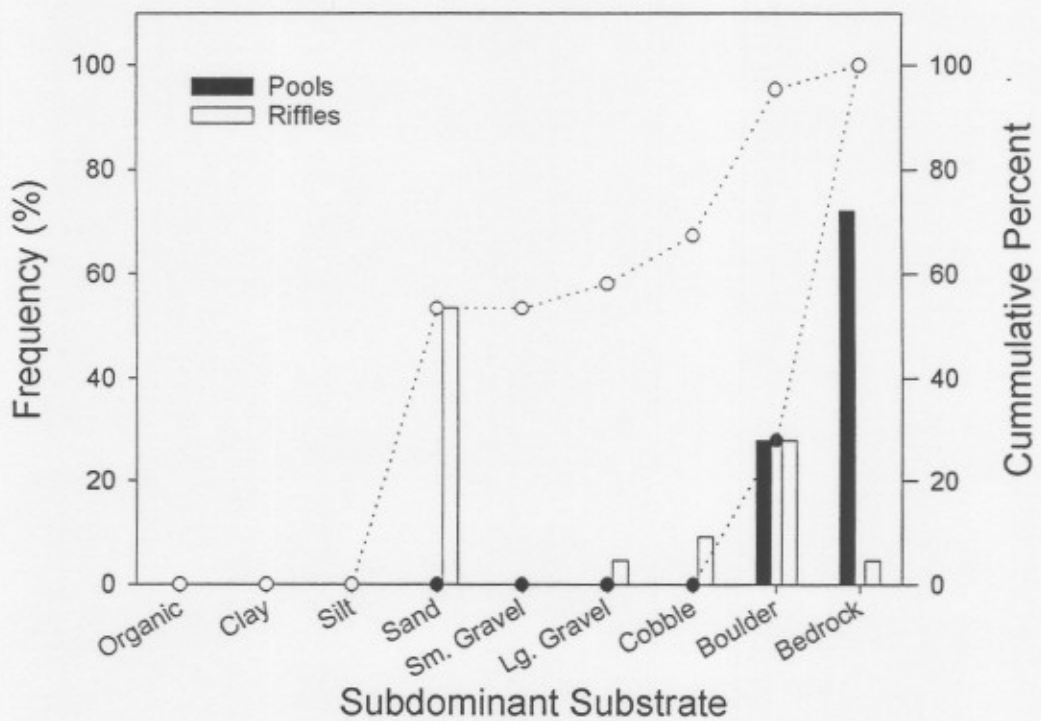

Figure 7. Frequency (percent) of subdominant substrate occurrence by habitat type in lower Turtletown Creek. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

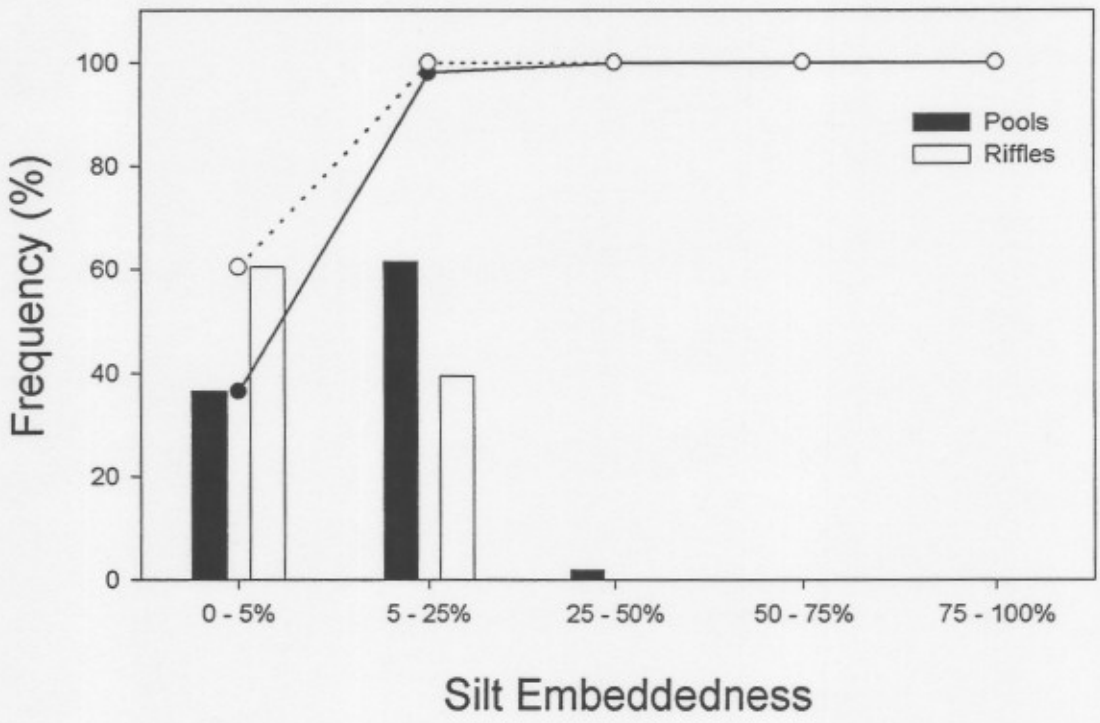

Figure 8. Frequency (percent) of pools and riffles in lower Turtletown Creek best described by one of five classes of embeddedness. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

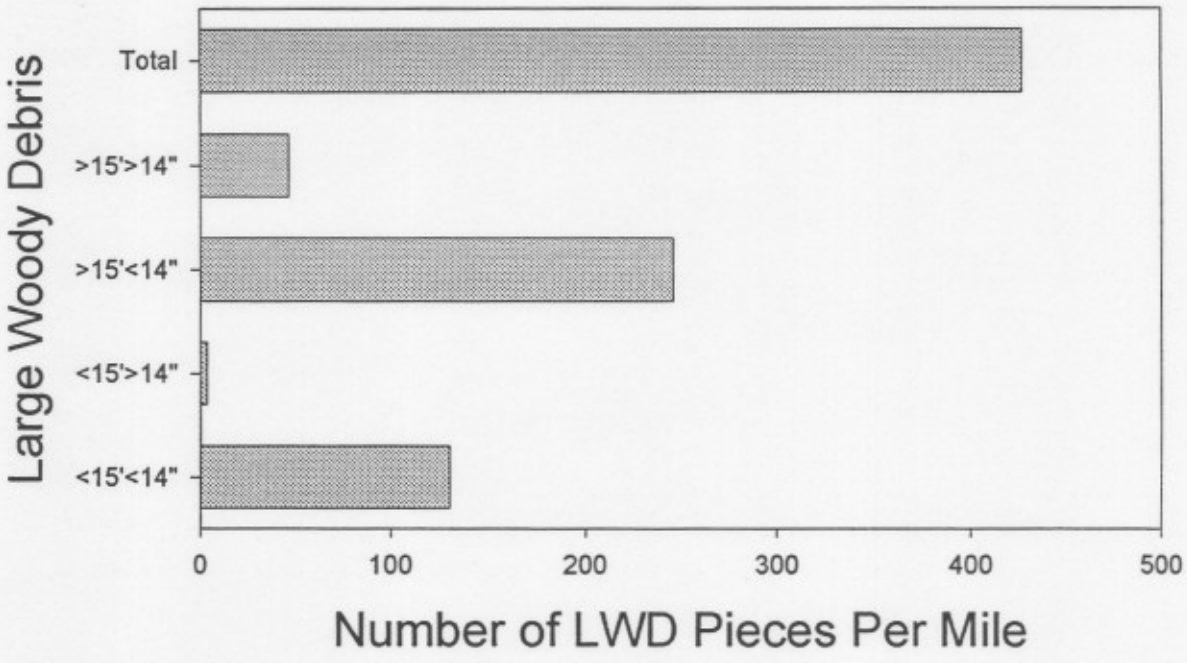

Figure 9. Pieces of large woody debris per mile in lower Turtletown Creek.

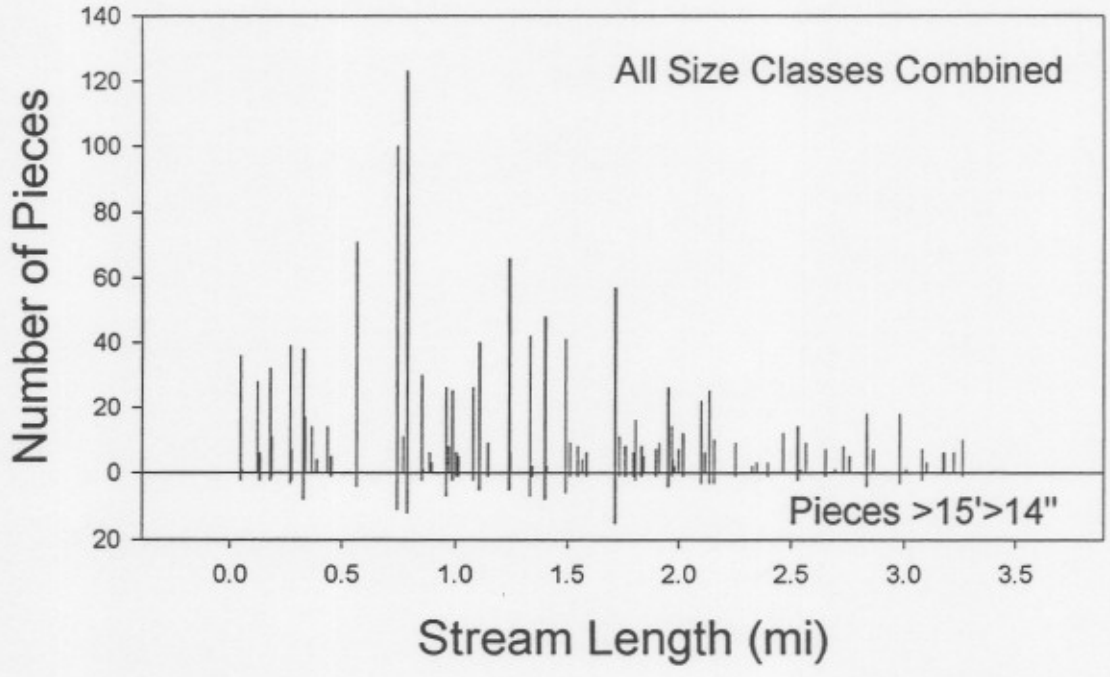

Figure 10. Distribution and total abundance of large woody debris in lower Turtletown Creek.

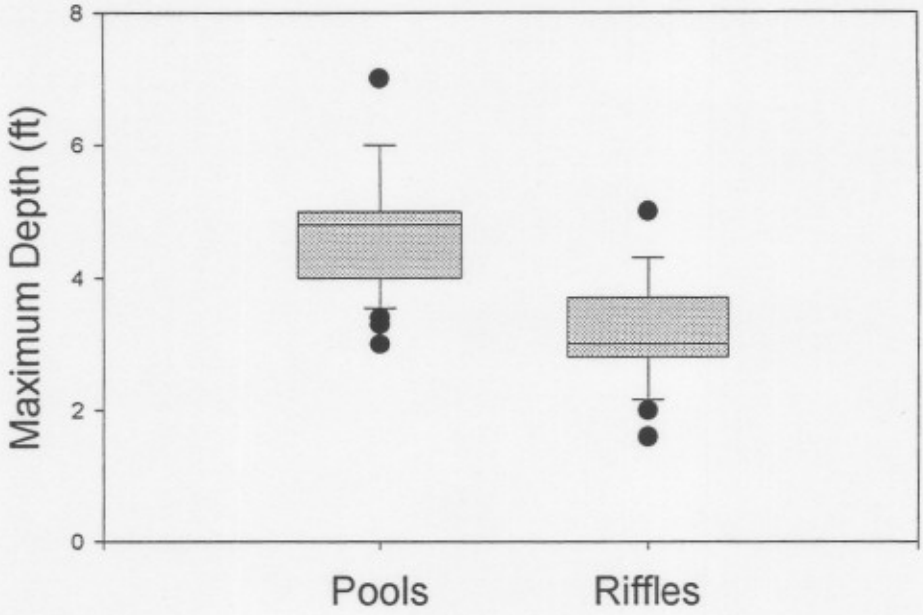

Figure 11. Box plots for habitat-unit and section maximum depth in middle Turtletown Creek. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

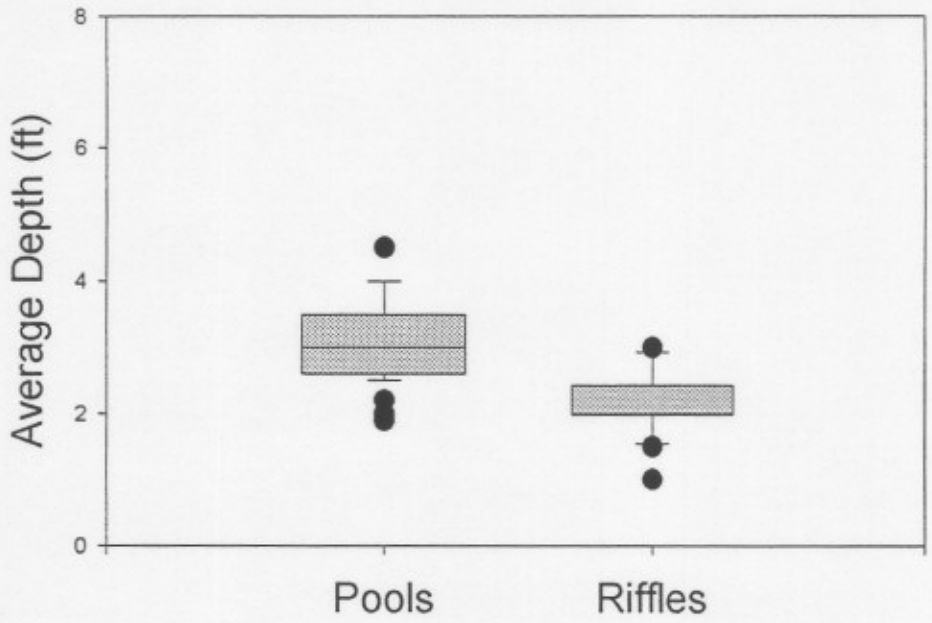

Figure 12. Box plots for habitat-unit and section average depth in middle Turtletown Creek. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

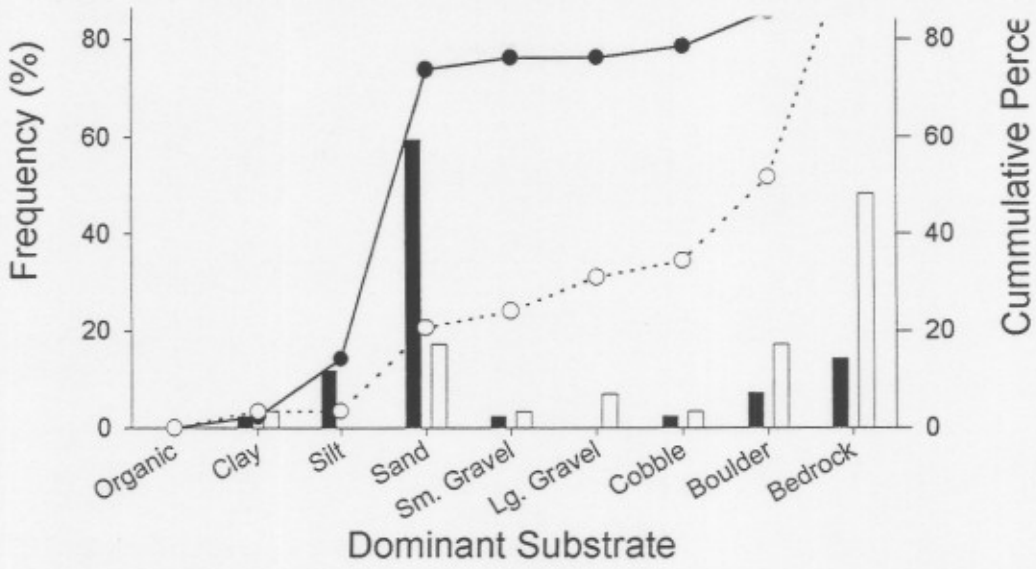

Figure 13. Frequency (percent) of dominant substrate occurrence by habitat type in middle Turtletown Creek. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

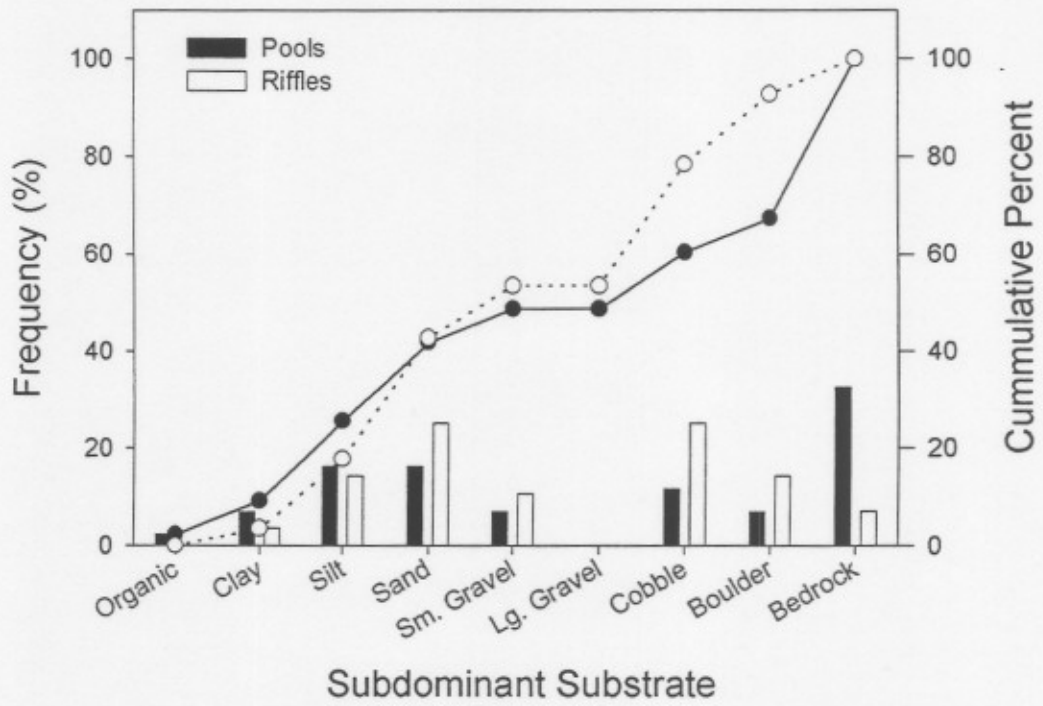

Figure 14. Frequency (percent) of subdominant substrate occurrence by habitat type in middle Turtletown Creek. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

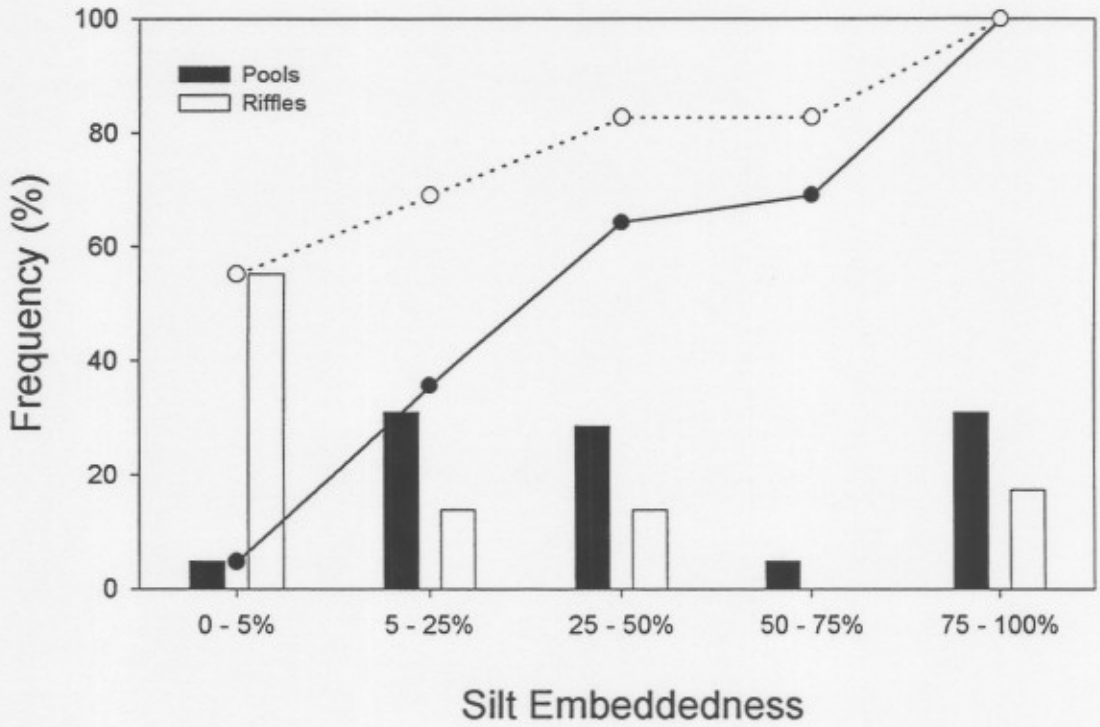

Figure 15. Frequency (percent) of pools and riffles in middle Turtletown Creek best described by one of five classes of embeddedness. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

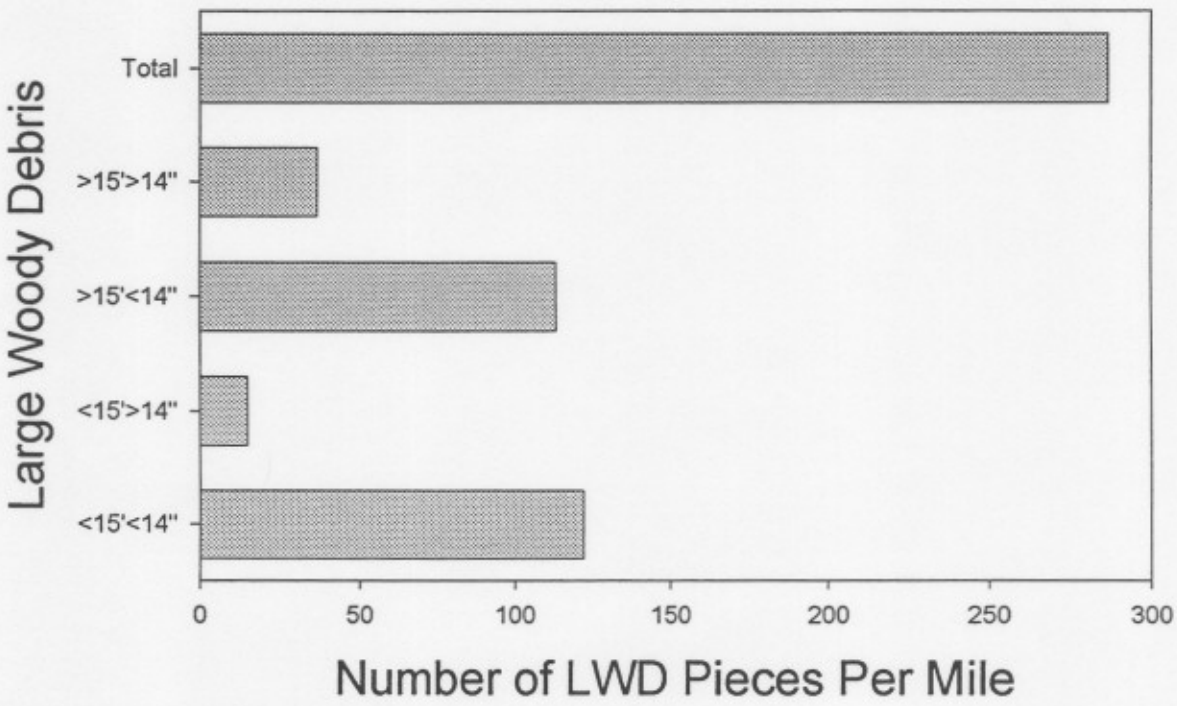

Figure 16. Pieces of large woody debris per mile in middle Turtletown Creek.

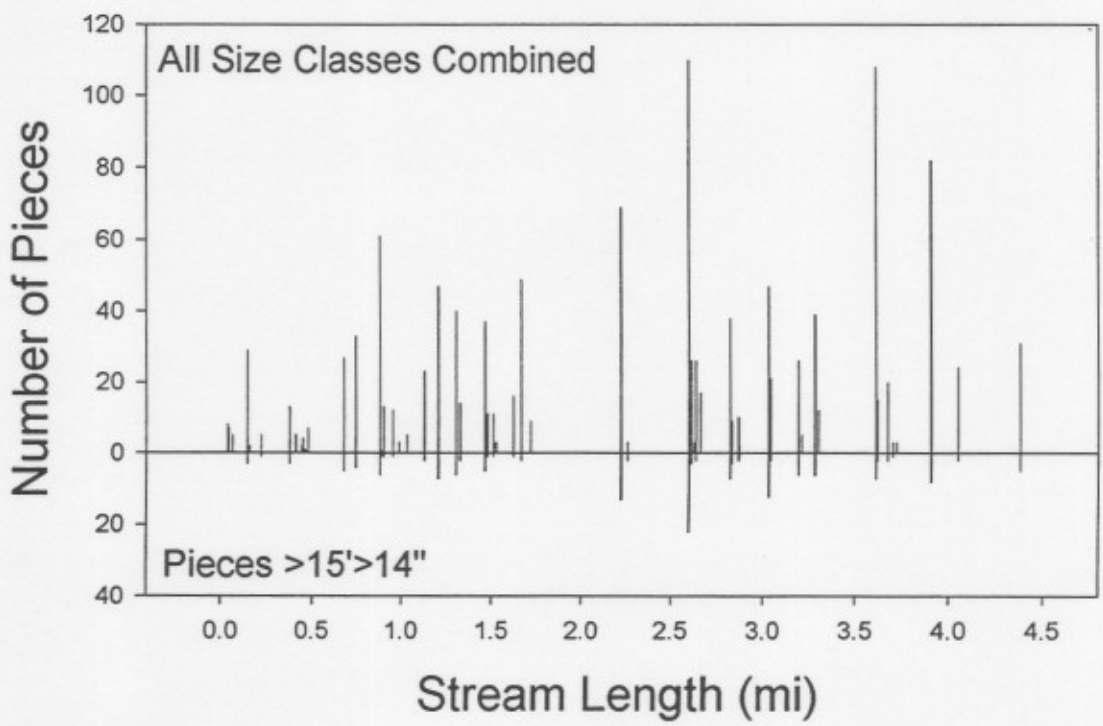

Figure 17. Distribution and total abundance of large woody debris in middle Turtletown Creek.

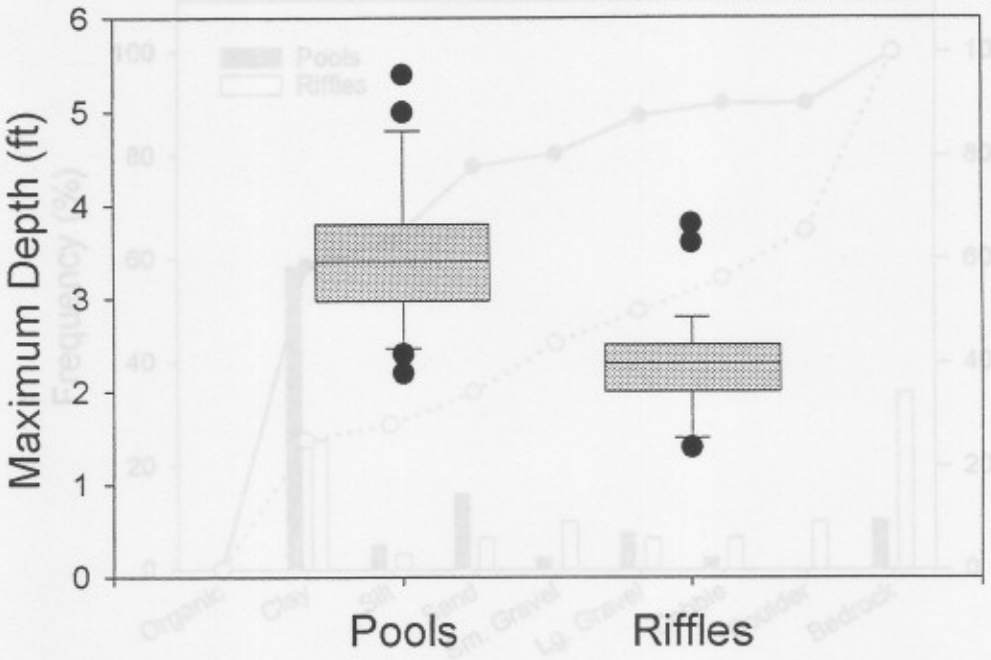

Figure 18. Box plots for habitat-unit and section maximum depth in upper Turtletown Creek. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

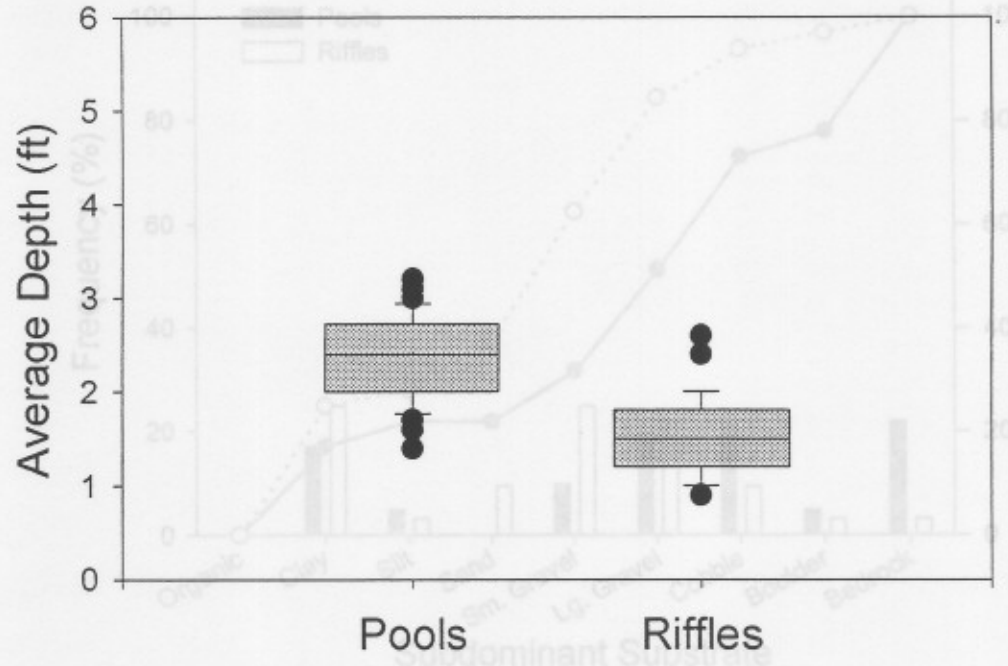

Figure 19. Box plots for habitat-unit and section average depth in upper Turtletown Creek. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

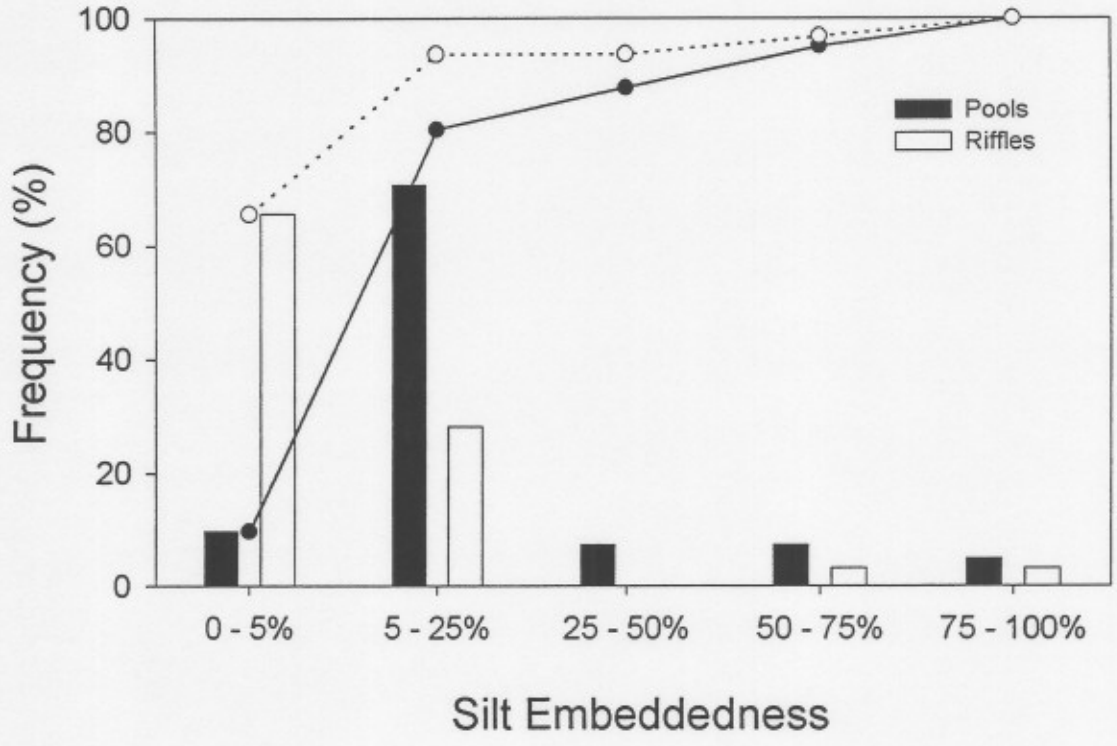

Figure 22. Frequency (percent) of pools and riffles in upper Turtletown Creek best described by one of five classes of embeddedness. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

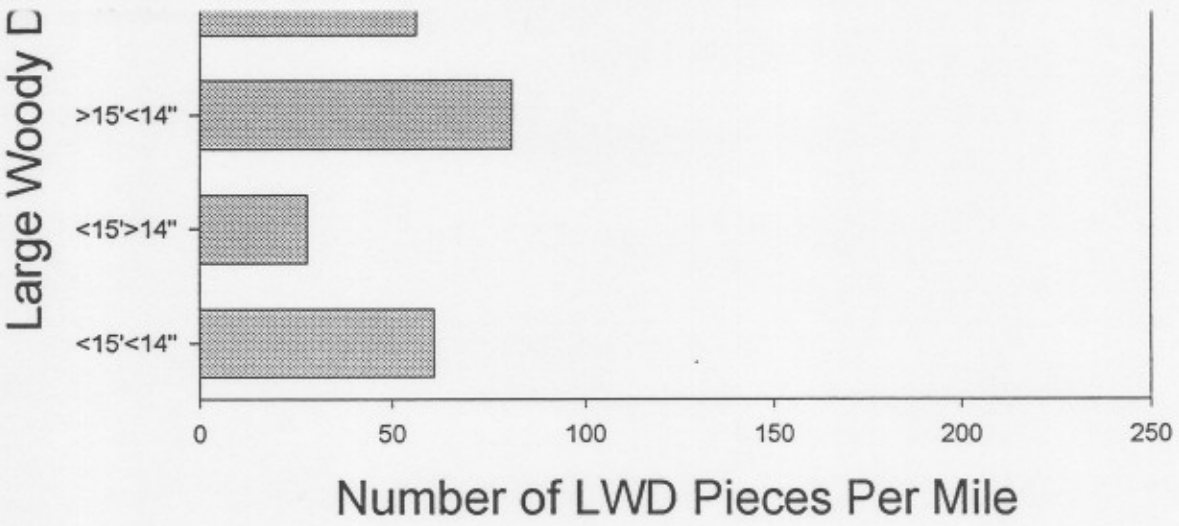

Figure 23. Pieces of large woody debris per mile in upper Turtletown Creek.

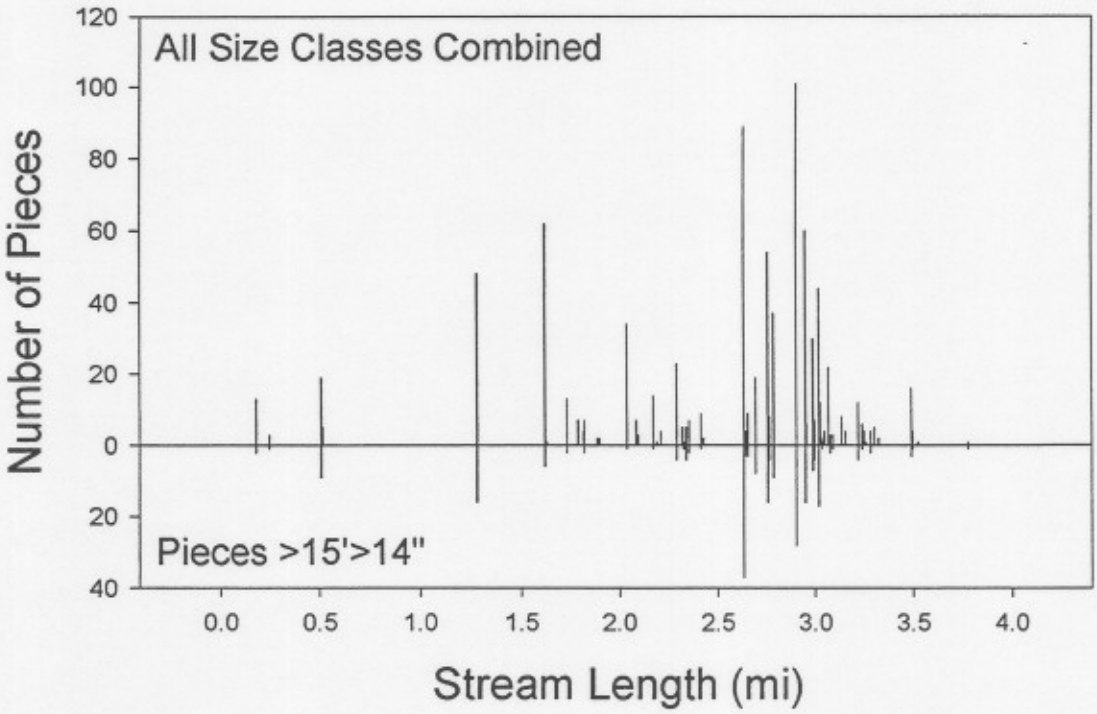

Figure 24. Distribution and total abundance of large woody debris in upper Turtletown Creek.

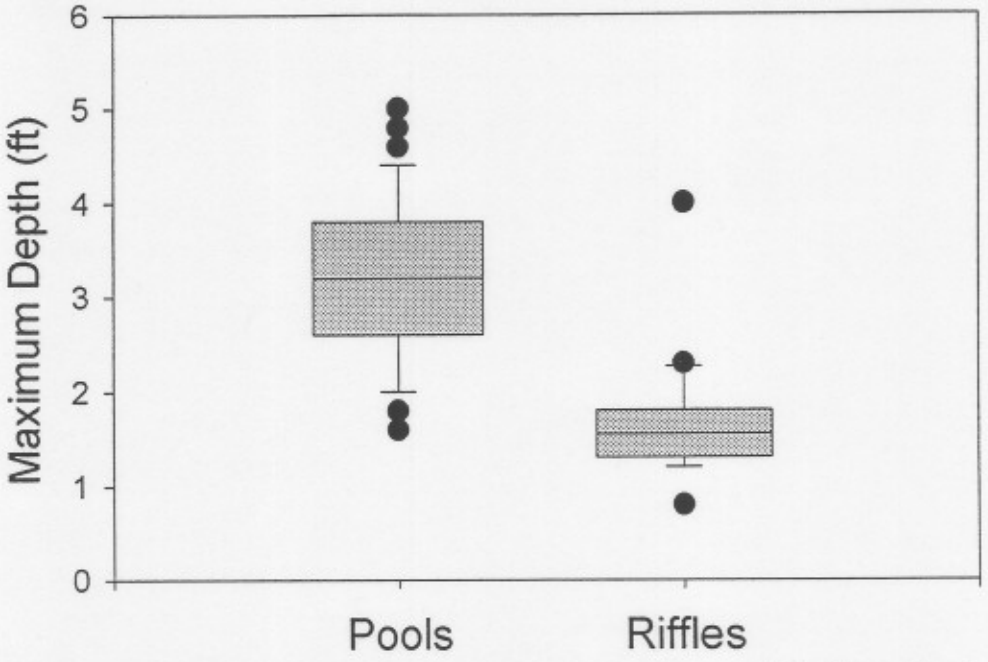

Figure 25. Box plots for habitat-unit and section maximum depth in Negro Creek. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

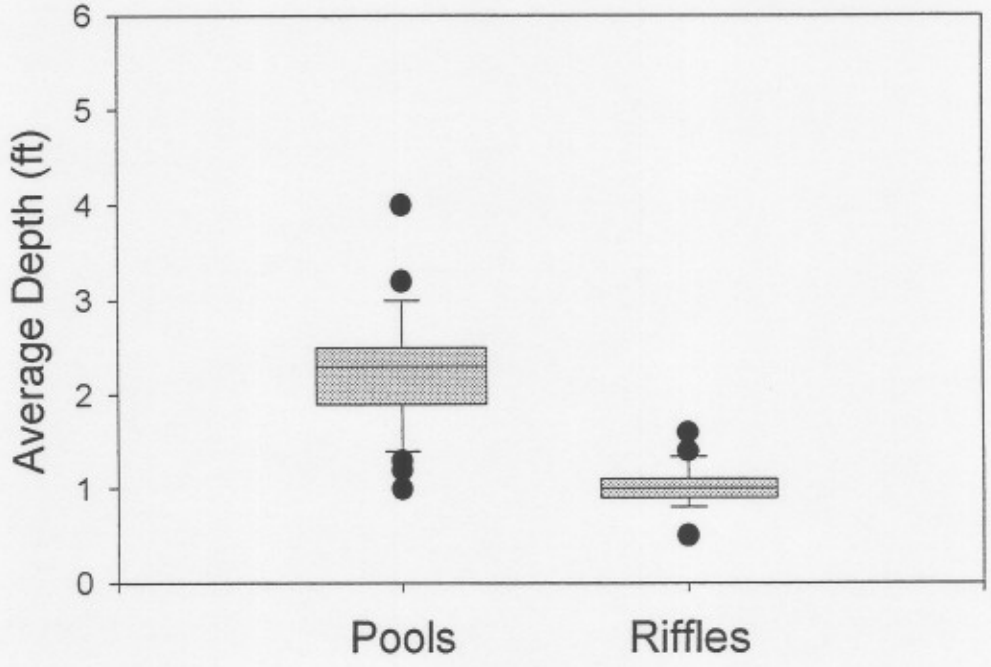

Figure 26. Box plots for habitat-unit and section average depth in Negro Creek. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

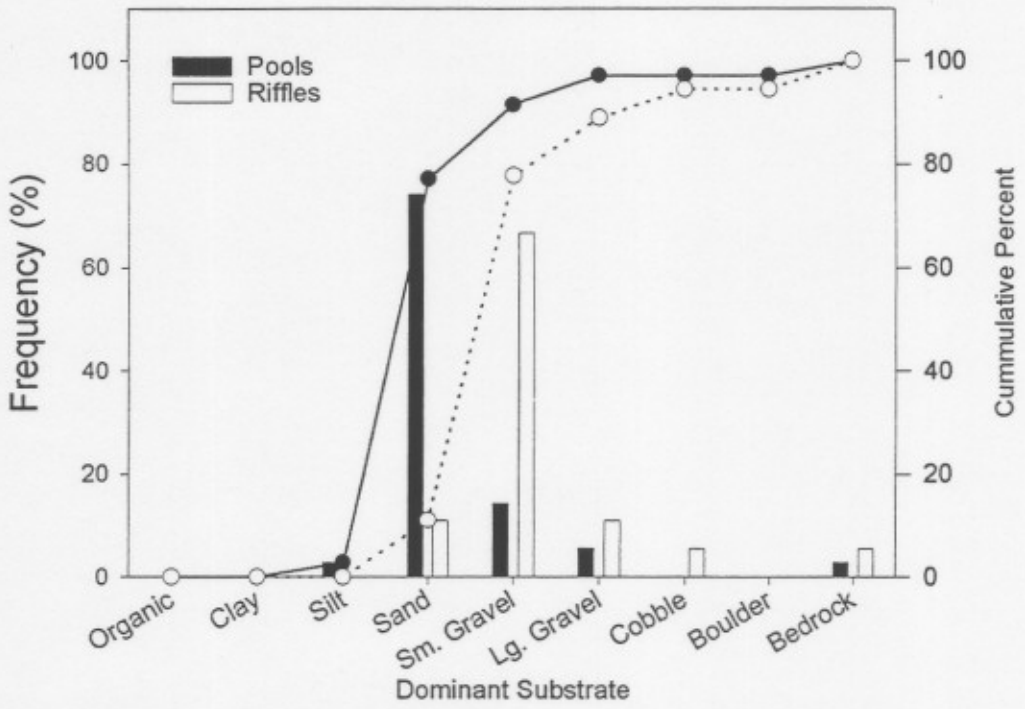

Figure 27. Frequency (percent) of dominant substrate occurrence by habitat type in Negro Creek. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

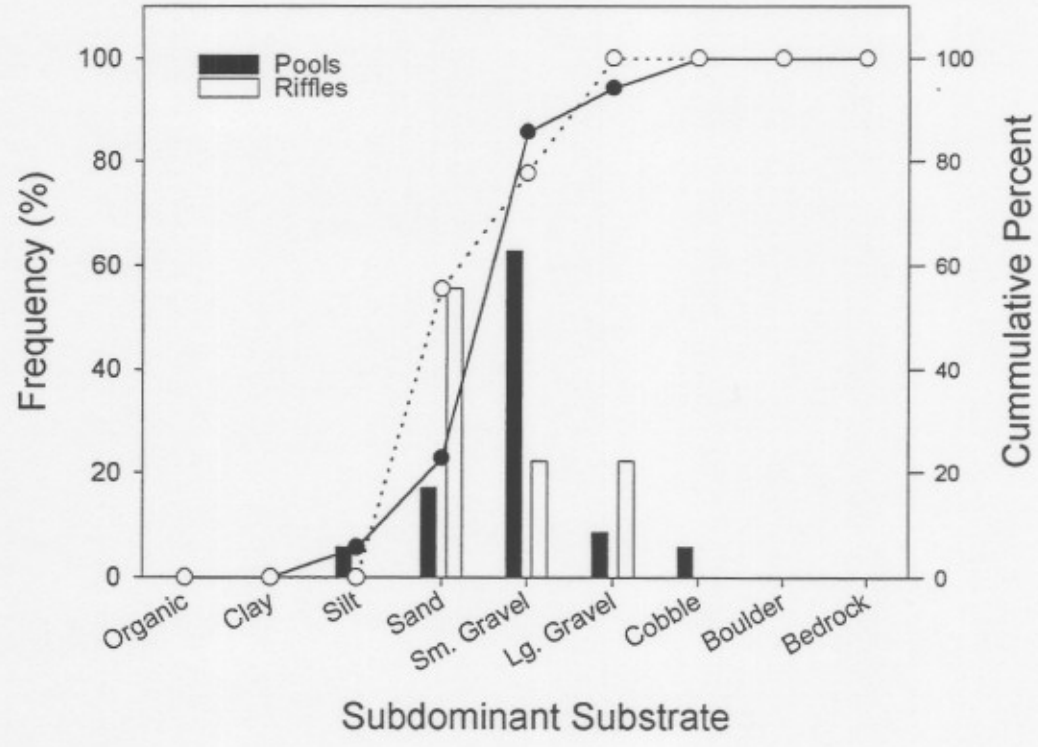

Figure 28. Frequency (percent) of subdominant substrate occurrence by habitat type in Negro Creek. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

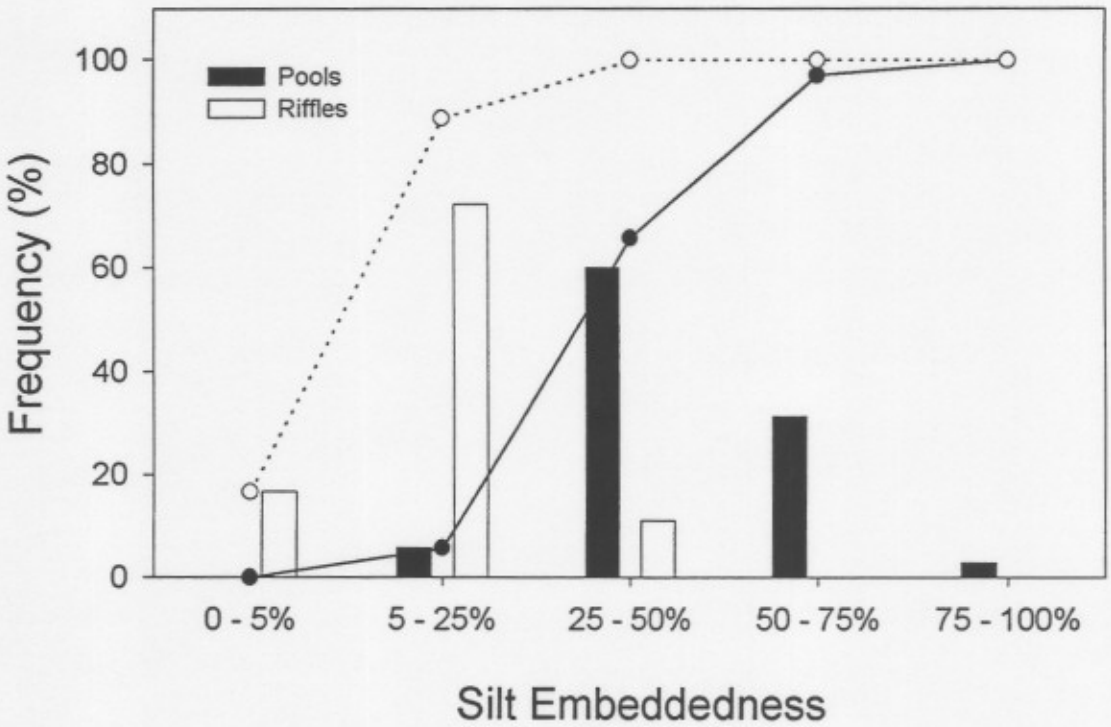

Figure 29. Frequency (percent) of pools and riffles in Negro Creek best described by one of five classes of embeddedness. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

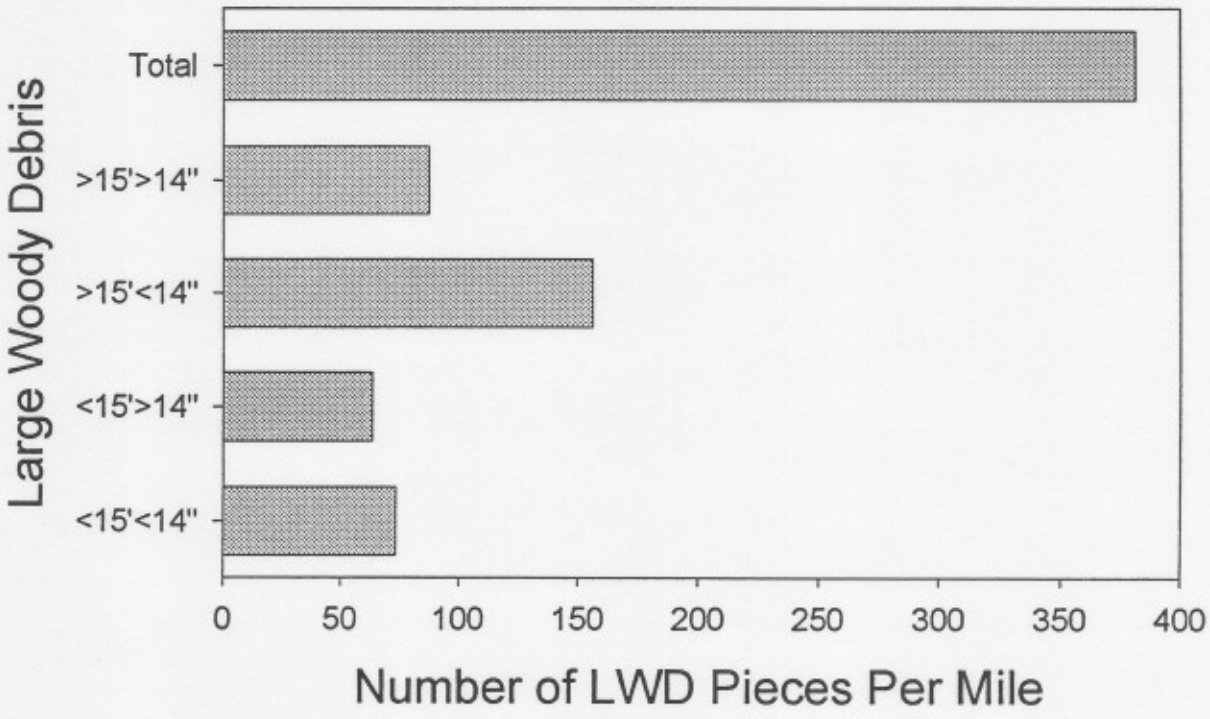

Figure 30. Pieces of large woody debris per mile in Negro Creek.

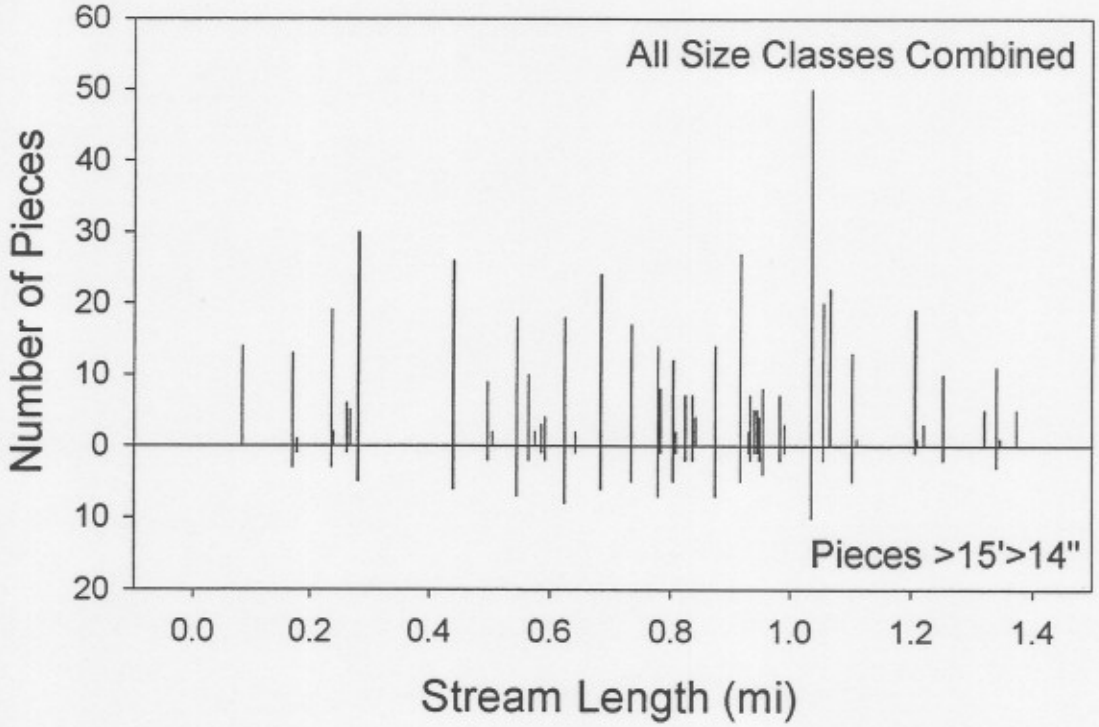

Figure 31. Distribution and total abundance of large woody debris in Negro Creek.

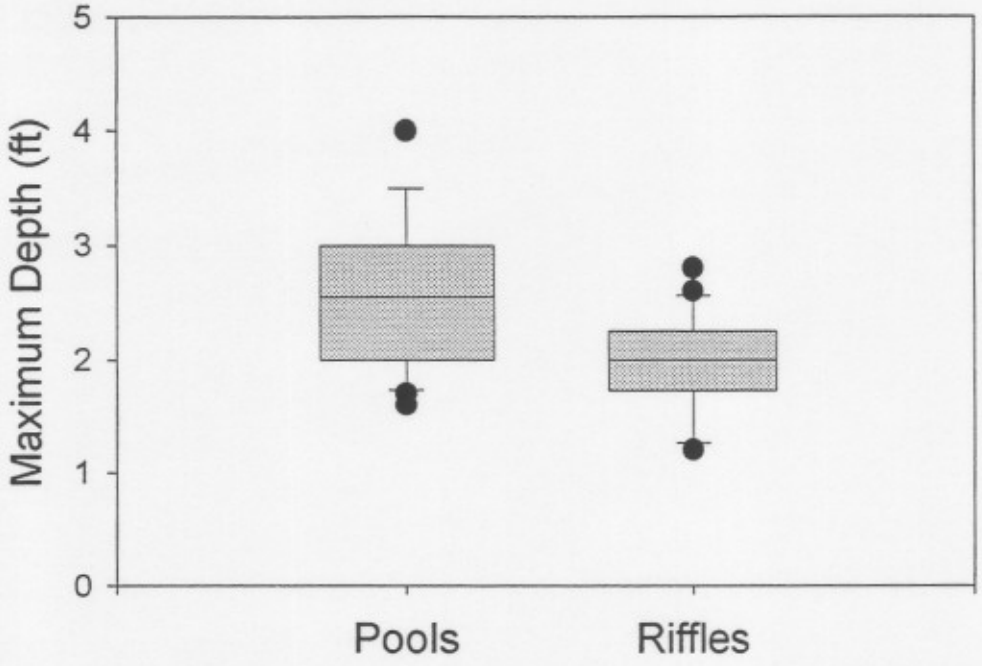

Figure 32. Box plots for habitat-unit and section maximum depth in Rocky Ford Creek. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

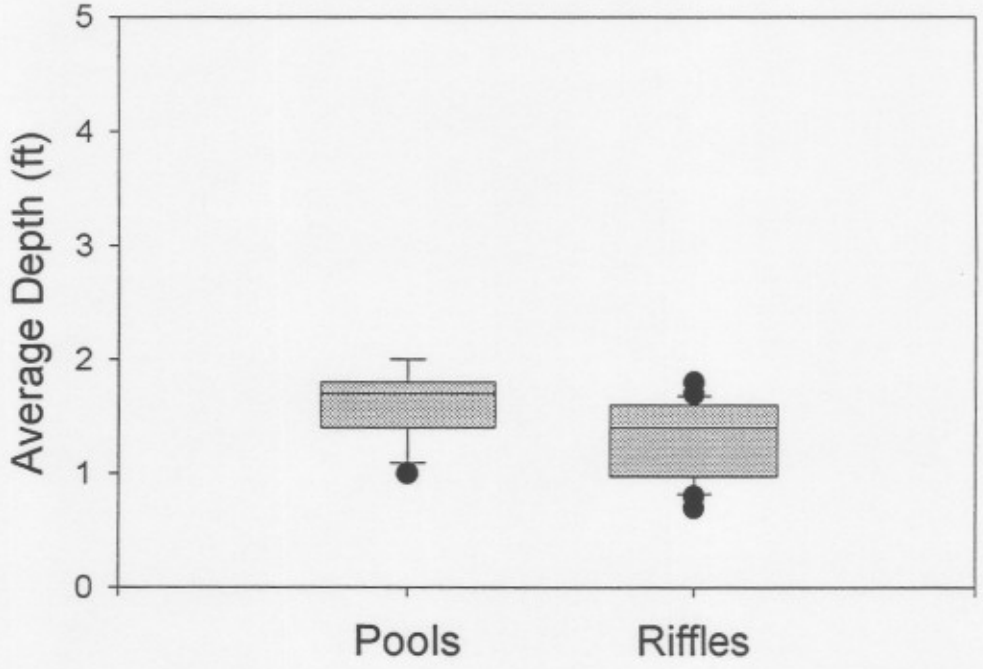

Figure 33. Box plots for habitat-unit and section average depth in Rocky Ford Creek. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

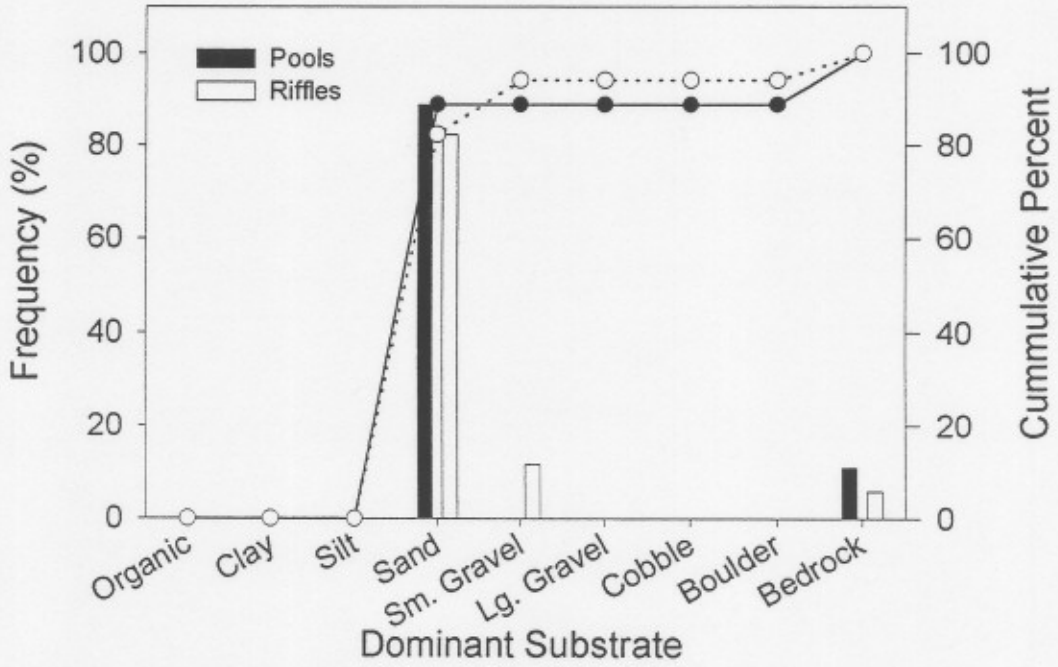

Figure 34. Frequency (percent) of dominant substrate occurrence by habitat type in Rocky Ford Creek. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

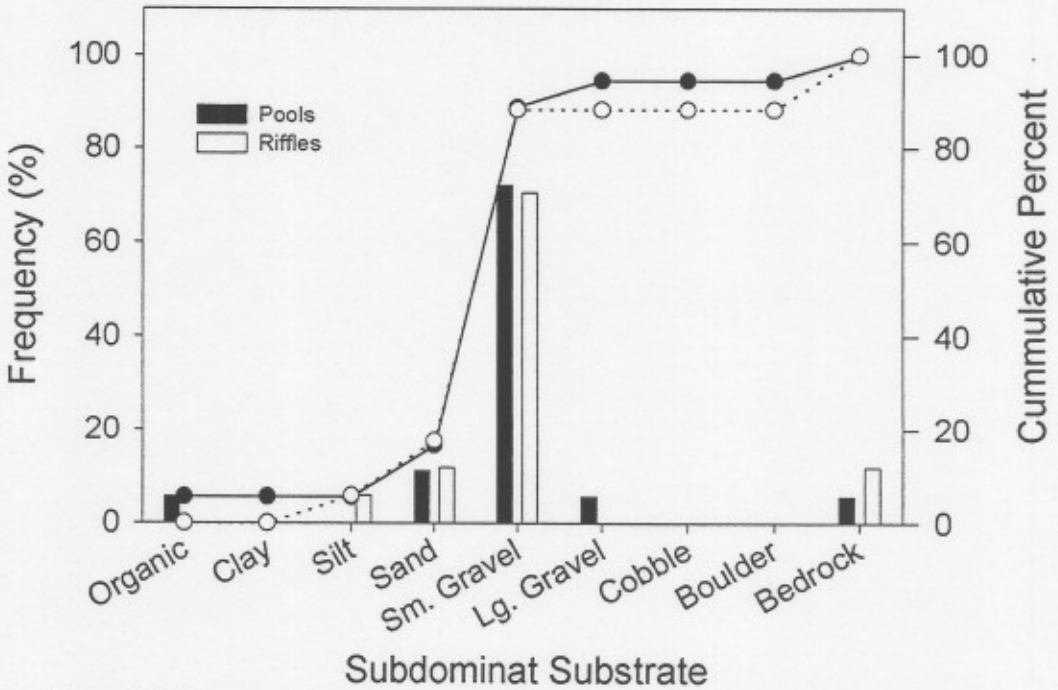

Figure 35. Frequency (percent) of subdominant substrate occurrence by habitat type in Rocky Ford Creek. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

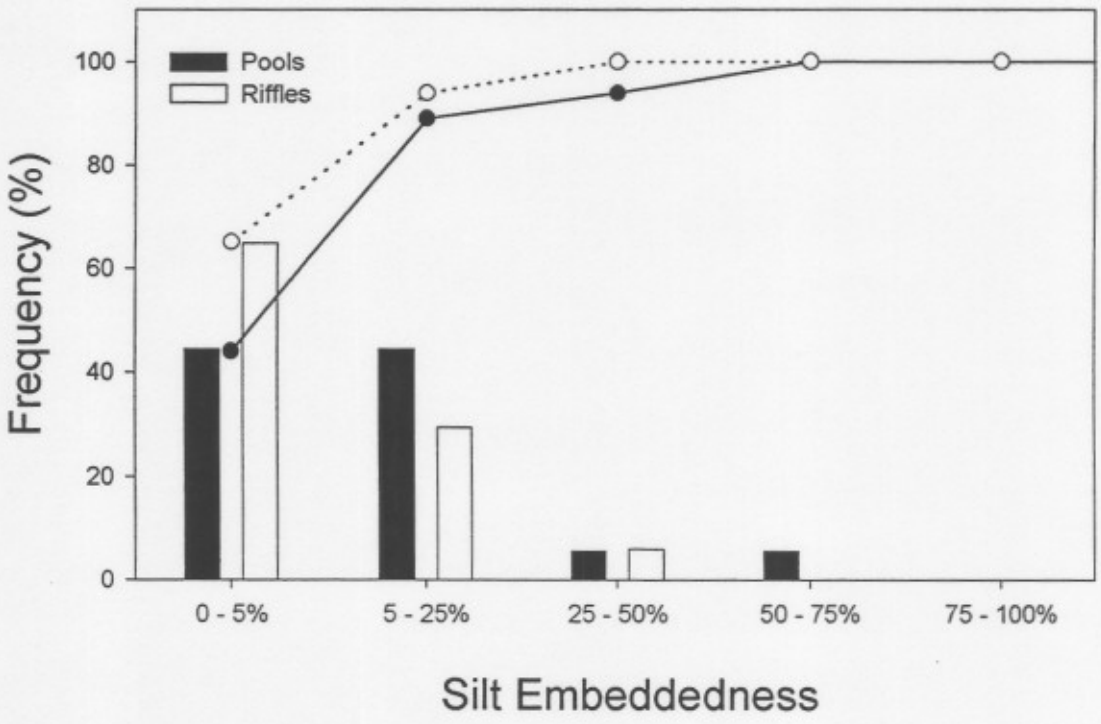

Figure 36. Frequency (percent) of pools and riffles in Rocky Ford Creek best described by one of five classes of embeddedness. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

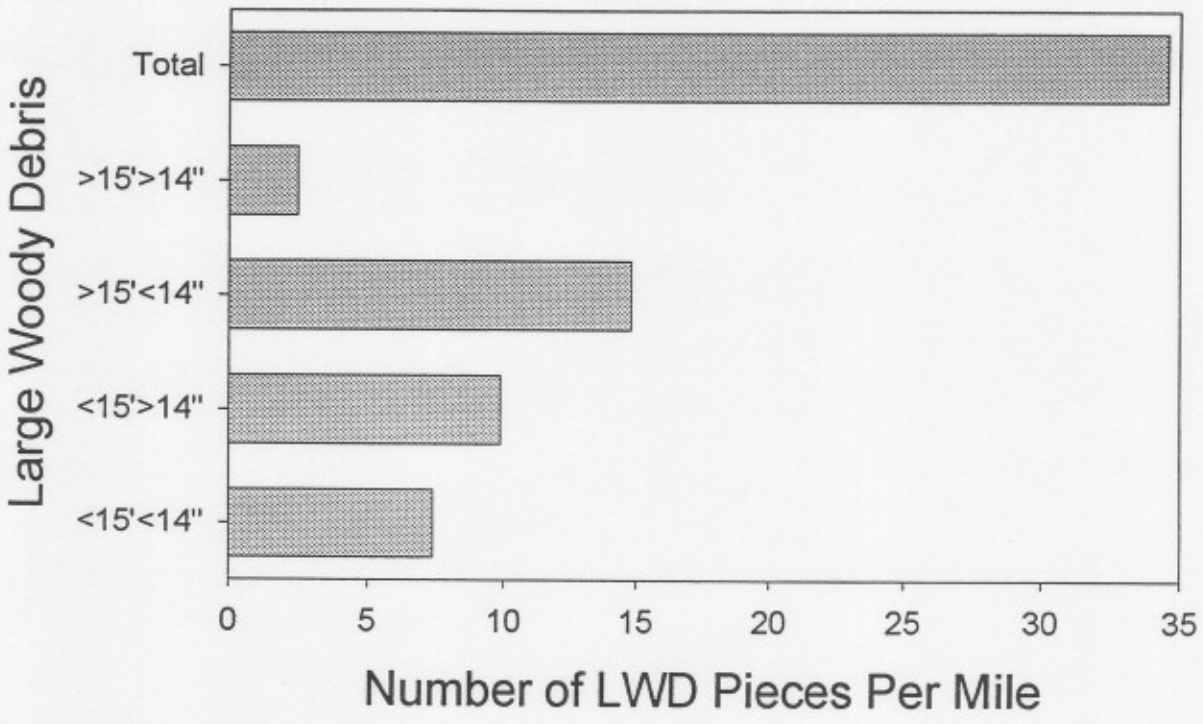

Figure 37. Pieces of large woody debris per mile in Rocky Ford Creek.

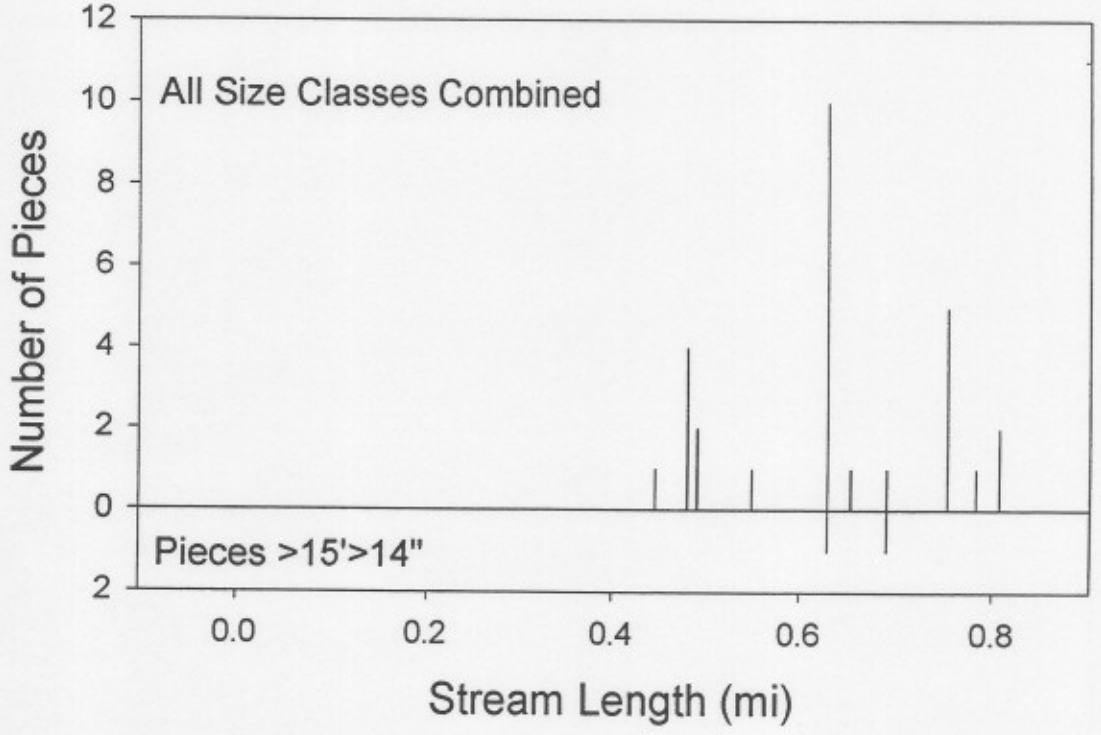

Figure 38. Distribution and total abundance of large woody debris in Rocky Ford Creek.

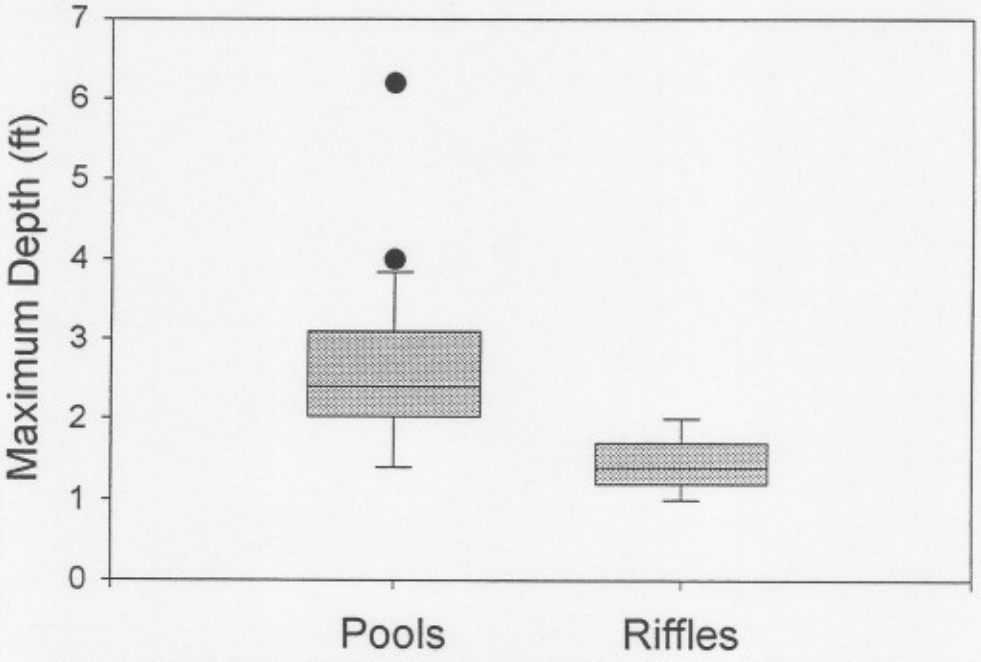

Figure 39. Box plots for habitat-unit and section maximum depth in Hall Creek. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

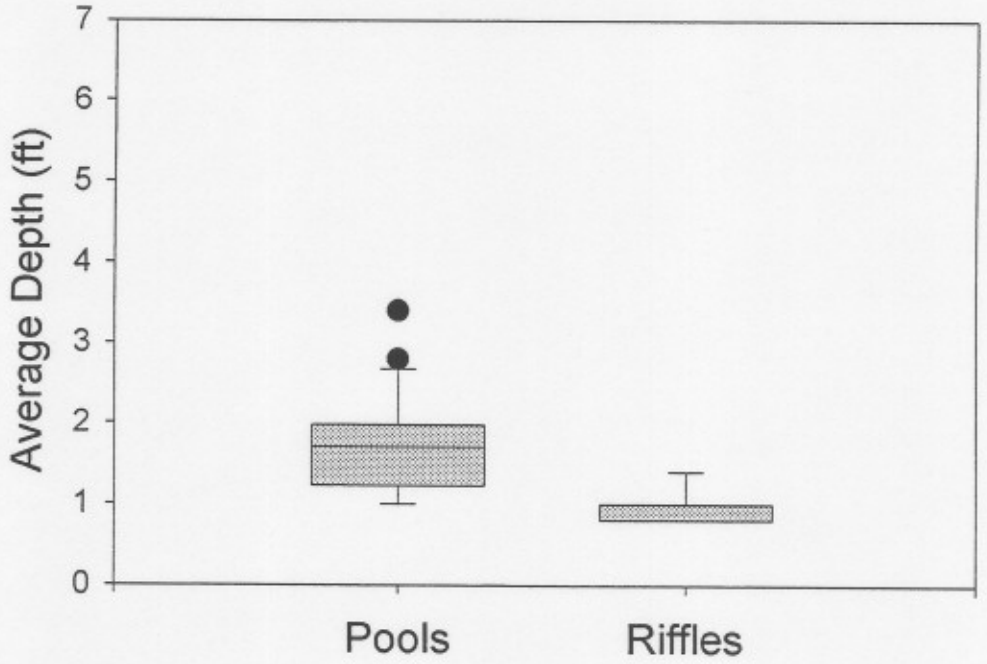

Figure 40. Box plots for habitat-unit and section average depth in Hall Creek. The box encloses the middle 50% of the observations, the capped lines below and above the box represent the 10% and 90% quantiles, respectively, dots represent outliers and the solid line in the box represents the median.

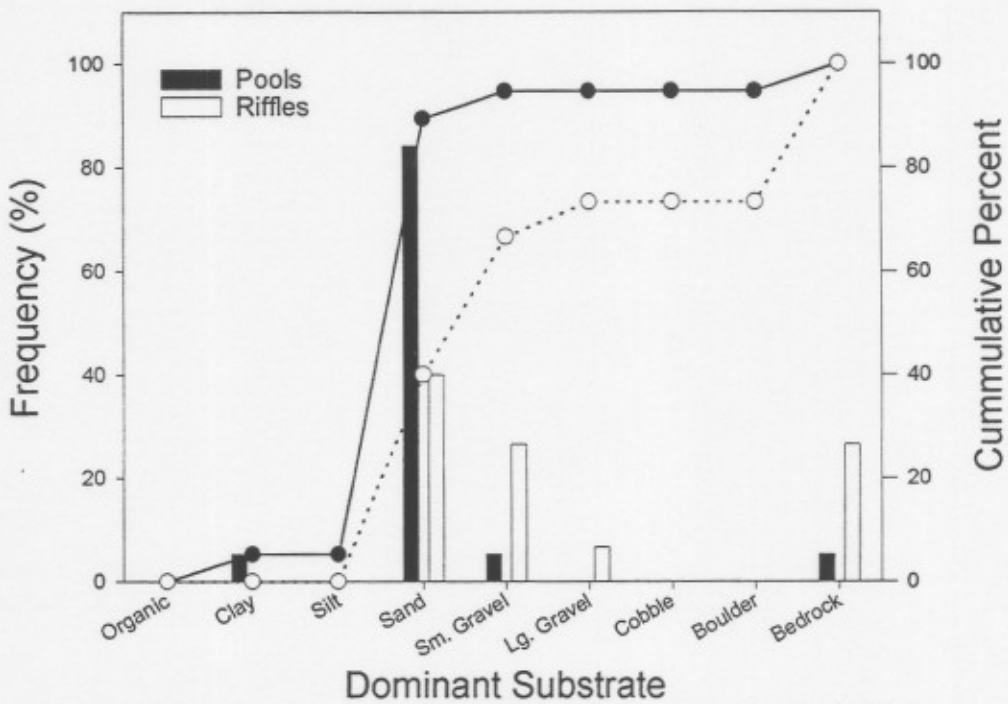

Figure 41. Frequency (percent) of dominant substrate occurrence by habitat type in Hall Creek. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

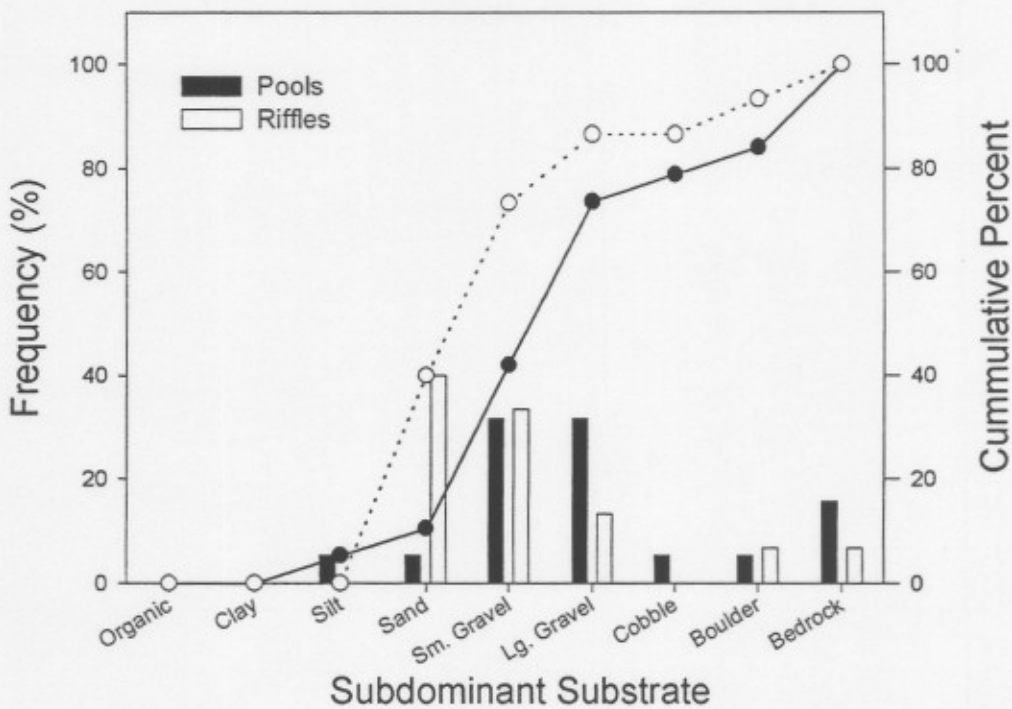

Figure 42. Frequency (percent) of subdominant substrate occurrence by habitat type in Hall Creek. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

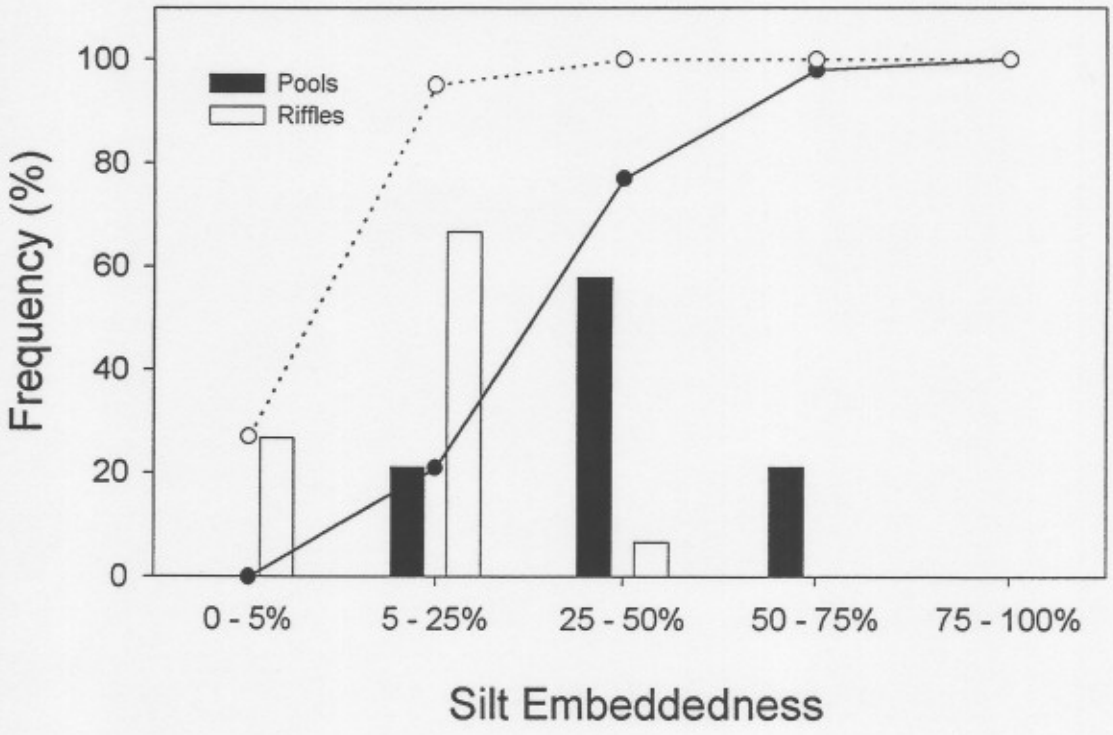

Figure 43. Frequency (percent) of pools and riffles in Hall Creek best described by one of five classes of embeddedness. Solid dots represent cumulative percent of pools and open dots represent cumulative percent of riffles.

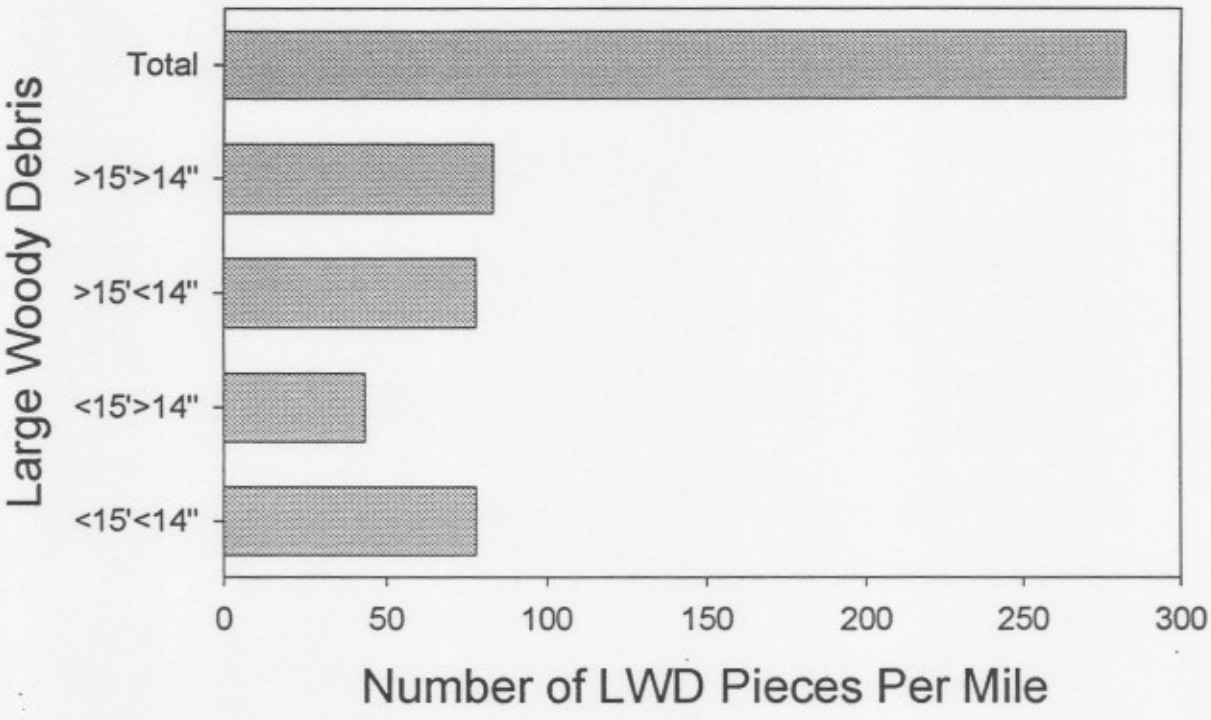

Figure 44. Pieces of large woody debris per mile in Hall Creek.

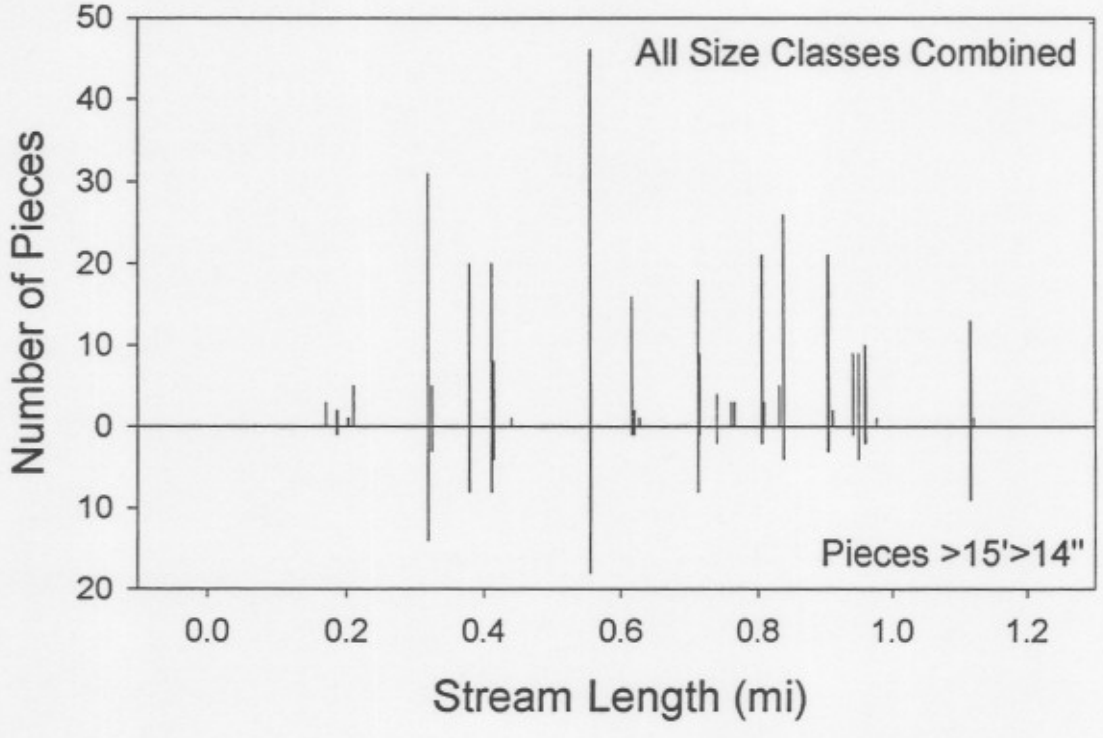

Figure 45. Distribution and total abundance of large woody debris in Hall Creek.

Appendix A. Notes taken during the Turtletown Creek watershed survey with corresponding stream distance (ft). Starting point for each distance is at the respective stream confluence (see Figure 1).

Stream	Distance (ft)	Comments
Lower Turtletown Creek	2050	steep gradient
	2296	even higher gradient
	4511	water fall- possible fish barrier
	4495	banded sculpins in water fall
	5305	cascade
	5690	cascade
	5988	20ft waterfall
	6042	7ft water fall
	9293	turbid
	10308	many down trees
	10393	30 ft waterfall
Middle Turtletown Creek		
	17404	waterfall
	21963	clearcut top of hill on left side
	27186	start of field with cows
	27186	cows in stream
	28937	water muddy
	29397	railroad bridge
	35409	railroad bridge & snapping turtle
	38128	farm field; dead sheep in stream
	40276	waterfall & a house overlooking it
	40363	old bridge
Upper Turtletown Creek		
	45032	field on left
	46406	cows next to stream
	47326	field on right
	50493	drainage ditch
	53172	silt disappearing
	59309	logging up to channel
	61050	heavy siltload
	63732	drainpipe left
Negro Creek		
	442	not turbid
	899	cow crossing
	1124	bog drain on l.
	1248	water full of trash; swampy\boggy

Appendix A. Continued.

Stream	Distance (ft)	Comments
Negro Creek (continued)	3419	railroad bridge
	3882	erosional banks
	4931	trashy banks
	5465	clearcut
	5628	clearcutting on edge left still
	6371	silty banks
		sediment trap
	7075	field on left after culvert
	7246	low turbidity
Rocky Ford Creek		
	415	bridge
	1300	irrigation pump outlet
	2353	big pieces of land in creek
		bridge
		field ends
	2534	erosion on right
	2809	bridge
	2964	silt is 21/2 feet deep!!!!!
Hall Creek		
	895	irrigation pipe right
	983	channelized
	1185	field left; heavy silt
	1375	silty banks; end field left
	3250	siltrun right
	4252	silt on banks
	4388	silt on banks
	5890	drainpipe in stream
	5939	sediment trap