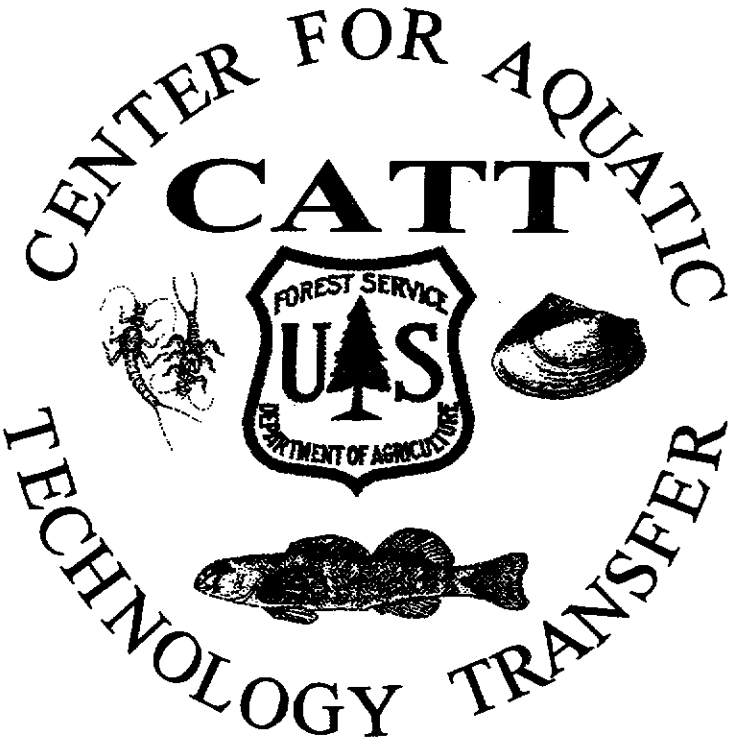
# An Inventory of Stream Habitat and Tennessee Dace *Phoxinus tennesseensis* in Lynn Camp Creek, Punch & Judy Creek, and Laurel Creek, George Washington - Jefferson National Forest, Virginia




United States Department of Agriculture Forest Service
**Center for Aquatic Technology Transfer**
Department of Fisheries and Wildlife Sciences
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# An Inventory of Stream Habitat and Tennessee Dace *Phoxinus tennesseensis* in Lynn Camp Creek, Punch & Judy Creek, and Lick Creek, George Washington - Jefferson National Forest, Virginia

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## Introduction

The basinwide visual estimation technique (BVET) (Hankin and Reeves 1988; Dolloff et al. 1993) was used to inventory habitat and fish in three North Fork Holston River tributaries, Virginia. This study, in part, is a continuation of a 1998 study of the distribution and abundance of the Tennessee dace *Phoxinus tennesseensis* (a state threatened species) in Lynn Camp Creek. The Lynn Camp Creek study section is located within the Hungry Mother State Park boundary downstream and adjacent to the previous study section located on US Forest Service property.

Punch & Judy Creek and Laurel Creek were surveyed to expand the knowledge of distribution and abundance of Tennessee dace *P. tennesseensis* in other areas of this watershed. The two study sections on these streams are entirely within US Forest Service boundaries in the Wythe-Blacksburg Ranger District of the George Washington-Jefferson National Forest (GW-JNF).

## Study Streams

The study section of Lynn Camp Creek started at the confluence with Lick Creek and continued to the US Forest Service boundary approximately 1.7 kilometers upstream (Figure 1). The Punch & Judy Creek study section started at the confluence with Laurel Creek and ended 3.5 kilometers upstream at a location were the stream was deemed marginal to support fish (Figure 2). The Laurel Creek study section started at an old US Forest Service boundary and ended 1.7 kilometers upstream at the confluence with Punch & Judy Creek (Figure 2).

## Methods

### Habitat

Standard BVET methods were modified to measure stream habitat parameters identified in the GW-JNF plan. Included in the plan is an outline of the desired-future-condition (DFC) for all streams within the forest based on physical habitat. The

pertinent DFC's for the GW-JNF include woody debris loading of 78 to 186 pieces per kilometer and 30 to 70 percent of the total stream habitat area in pools.

Habitat in all streams was stratified into similar groups based on naturally occurring habitat units including pools (areas in the stream with low water velocity, streambed gradient near zero, and a smooth water surface), and riffles (areas in the stream with relatively steep gradient, shallow water, relatively high velocity, and turbulent surface).

Two-stage visual estimation techniques were used to quantify habitat and DFC's in the study stream. Habitat was classified and inventoried by a two-person crew. One crew member identified each habitat unit by type, estimated the maximum and average depths of each habitat unit, measured depth at riffle crest for each riffle, estimated wetted stream width, and classified the dominant and subdominant substrata particle size (Modified Wentworth scale). The remaining crewmember classified and inventoried LWD within the active stream channel and recorded the data on a Husky Hunter field computer. LWD greater than 1 meter long and greater than 10 centimeters in diameter was divided into four classes: 1) less than 5 m long, less than 55 cm in diameter, 2) less than 5 m long, greater than 55 cm in diameter, 3) greater than 5 m long, less than 55 cm in diameter, and 4) greater than 5 m long, greater than 55 cm 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 5 cm increments. The length (0.1 m) 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 and calibration) was determined randomly. Additional units were selected systematically (about one unit out of 10 for each habitat type).

BVET calculations were computed using an Excel spreadsheet. Data were summarized using an Excel spreadsheet, Power Point presentations, and SigmaPlot graphics software.

## Fish

Underwater observation was used to estimate the distribution and relative abundance of Tennessee dace in each of the habitat units selected for intensive sampling in the Lynn Camp Creek and Punch & Judy Creek study section. When a sample unit was encountered, a diver entered at the downstream end and proceeded slowly upstream to the head of the unit while searching for and counting all fish. When a fish was sighted, it was directed out of the line of travel by the diver's hand to prevent double counting. About 25% of the total number of pools and 13% of the total number of riffles were snorkeled in the Lynn Camp Creek study section for multiple-pass removal census (Kwak, 1992), using a 700V AC backpack electrofisher, to verify species identification and diver counts (Figure 24). Eleven % of the total number of pools and 8% of the total number of riffles were snorkeled in the Punch & Judy study section (Figure 25).

Due to time constraints, only electrofishing was used to sample fish in the Laurel Creek study section. The catch from a single pass was used in pools and riffles to examine relative abundance and species presence.

In the three study sections, all fish were counted and identified before being returned to their approximate location of capture. Tennessee dace were measured for fork length (FL; mm) and total length (TL; mm), and weighed (0.1 g). All fish captured were released immediately after handling.

# Results

## Habitat

*Lynn Camp Creek* – Ninety-six pools and 70 riffles were identified in the 1.7-kilometer-long study section of Lynn Camp Creek. Visual estimates of habitat areas were paired with measured habitat area for 20 (21%) pools, and 10 (14%) riffles. The study section of Lynn Camp Creek was estimated to contained 65.0% pool habitat (3981.2 $\pm$ 322.5 $m^2$) and 35% riffle habitat (2139.2 $\pm$ 120.3 $m^2$) (Figure 3). Total area was estimated for

each habitat type using correction factors (Q) that ranged from 1.05 for pools to 1.10 for riffles.

Maximum depth in the Lynn Camp Creek study section ranged from a mean of 11.3 cm in riffles to 40.7 cm in pools (Figure 4). Likewise, average depth ranged from a mean of 5.2 cm in riffles to 19.3 cm in pools (Figure 4). The mean average residual depth was 40.1 cm (Figure 4).

Large gravel was identified as the most common (modal) dominant substratum and cobble the most common subdominant substratum for pools in the Lynn Camp Creek study section. The remainder of pool stream bottom also contained a large percentage of small gravel (Figure 5). In riffles, the most common (modal) dominant and subdominant substrata were cobble and large gravel, respectively (Figure 6).

The total of 86 pieces of LWD per kilometer in the Lynn Camp Creek study section just meets the DFC for stream habitat on the GW-JNF (Figure 7). This section contained over 24 pieces of the smallest size class, which is preferred by Tennessee dace and other *Phoxinus* species (Etnier and Starnes 1993; Jenkins and Burkhead 1994)(Figure 7).

*Punch & Judy Creek-* A total of 198 pools and 157 riffles were identified in the 3.5 - kilometer- long study section of Punch & Judy Creek. Visual estimates of habitat areas were paired with measured habitat area for 20 (10%) pools, and 11 (7%) riffles. The study section of Punch & Judy Creek contained 56.7% pool habitat (5207.5 $\pm$ 203.3 $m^2$) and 43.3% riffle habitat (3981.0 $\pm$ 423.7 $m^2$) (Figure 9). Total area was estimated for each habitat type using correction factors (Q) that ranged from 1.08 for pools to 1.16 for riffles.

Maximum depth in the Punch & Judy Creek study section ranged from a mean of 11.9 cm in riffles to 35.7 cm in pools (Figure 10). Average depth ranged from a mean of 5.0 cm in riffles to 18.6 cm in pools (Figure 10). The mean average residual depth was 36.1 cm (Figure 10).

Large gravel was identified as the most common (modal) dominant and subdominant substratum for pools in the Punch & Judy Creek study section (Figure 11).

In riffles, the most common (modal) dominant and subdominant substrata were large gravel and small gravel, respectively (Figure 12).

The Punch & Judy Creek study section contained about 194 pieces of LWD per kilometer (Figure 13). This section, however, only contained about 11 pieces per kilometer of the larger size classes, which are the most stable and most capable of forming instream habitat and providing cover for fishes (Figure 14).

*Laurel Creek*- Seventy-two pools and 54 riffles were identified in the 1.7 kilometer- long study section of Laurel Creek. Visual estimates of habitat areas were paired with measured habitat area for 7 (10%) pools, and 4 (7%) riffles. We estimated the study section of Laurel Creek contained 75.1% pool habitat (4731.4 $\pm$ 599.2 m sq.) and 24.9% riffle habitat (1571.5 $\pm$ 268.3 m sq.) (Figure 15). Total area was estimated for each habitat type using correction factors (Q) that ranged from 1.08 for pools to 1.07 for riffles.

Maximum depth in the Laurel Creek study section ranged from a mean of 12.2 cm in riffles to 46.8 cm in pools (Figure 16). Average depth ranged from a mean of 5.2 cm in riffles to 23.0 cm in pools (Figure 16). The mean average residual depth was 38.4 cm (Figure 16).

Large gravel was identified as the most common (modal) dominant and subdominant substratum for pools in the Laurel Creek study section (Figure 17). In riffles the most common (modal) dominant and subdominant substrata were large gravel and cobble, respectively (Figure 18).

The Laurel Creek study section contained 204 pieces of LWD per kilometer (figure19). 147 pieces per kilometer in this section are of the smallest size class and 11 pieces per kilometer are of the largest size class (figure 19).

**Fish**

*Lynn Camp Creek* - Fourteen species of fish were captured while sampling 10 pools

and 5 riffles during the electrofishing survey of the Lynn Camp Creek study section (Table 1). Tennessee shiner *Notropis leuciodus* and blacknose dace *Rhinichthys atratulus* were the most abundant species. Tennessee dace made up 6.0 % of the relative abundance (Figure 21). A population estimate of 480 (± 243) and a density of 12 fish per 100 $m^2$ were calculated for Tennessee dace in the Lynn Camp Creek study section for pools only. Tennessee dace were not found in riffles during both the underwater observation and the electrofishing surveys.

*Punch & Judy Creek*- Nine species of fish were captured while sampling 10 pools and 10 riffles during the electrofishing survey of the Punch & Judy study section (Table 2). Creek chub *Semotilus atromaculatus* and blacknose dace *R. atratulus* were the most abundant species. Tennessee dace made up 12.7 % of the relative abundance (Figure 22). A population estimate of 935 (± 1874) and a density of 18 fish per 100 $m^2$ were calculated for Tennessee dace in Punch & Judy Creek pools in the entire stream. Tennessee dace were not found in riffles during both the underwater observation and the electrofishing surveys.

*Laurel Creek*- Fifteen species of fish were captured while sampling 6 pools and 4 riffles during the electrofishing survey of the Laurel Creek study section (Table 3). Creek chub *S. atromaculatus* was the most abundant species (Figure 23). Tennessee dace was the second most abundant species and made 21.9 % of the relative abundance (Figure 23). Unlike the other two streams, Tennessee dace were captured in 2 riffles in the study section (Figure 26).

## Discussion and Recommendations

Tennessee dace were more abundant in the lower section of Lynn Camp compared to the section located upstream on US Forest Service property. A relative

abundance of 3.4 % and a density of 4.3 fish per 100 m sq of pool surface area were calculated for the upper section compared to 6.0 % relative abundance and 12.0 fish per 100 m sq of pool surface area for the lower section (Underwood, 1999). This may be due to better habitat conditions within the lower section (i.e. larger, deeper pools) compared with the upper section. The population in the lower section probably supports the upstream population on US Forest Service property. This suggests continued cooperation between USFS and state resource personnel will be essential in managing and monitoring the Lynn Camp Creek population of Tennessee dace.

Sampling in Punch & Judy Creek was made difficult by low water visibility after the first pass of electrofishing. Low stream flow prevented the pools from flushing clear and made locating and capturing fish difficult during 2nd and 3rd passes. This may have affected the population estimate and relative abundance calculations for Punch & Judy Creek. A survey during regular stream flows may provide a more accurate estimate of the Tennessee dace population.

The Laurel Creek study section was mistakenly started at an old US Forest Service boundary and due to time constraints was not completely surveyed. It is recommended that a complete survey of the entire stream on US Forest Service property be completed. Laurel Creek has the highest relative abundance of Tennessee dace of the three study sections and apparently supports a healthy population. The stocking of the three trout species in Laurel Creek does not seem to be limiting the Tennessee dace population. A study focusing on the relationship of stocked trout and Tennessee dace would help managers make a decision on future stockings.

More studies of Tennessee dace in the North Fork Holston and other drainages may extend the known range of the Tennessee dace and improve its status within Virginia. Further studies may also help determine preferred habitat conditions for Tennessee dace.

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Table 1. Fish species composition of Lynn Camp Creek, North Fork Holston River.

| Scientific name | Common name |
|---|---|
| *Notropis leuciodus* | Tennessee shiner |
| *Campostoma anomalum* | central stoneroller |
| *Phoxinus tennesseensis* | Tennessee dace |
| *Semotilus atromaculatus* | creek chub |
| *Cottus spp.* | sculpin |
| *Etheostoma flabellare* | fantail darter |
| *Rhinichthys atratulus* | blacknose dace |
| *Luxilus coccogenis* | warpaint shiner |
| *Nocomis micropogon* | river chub |
| *Notropis telescopis* | telescope shiner |
| *Catostomus commersoni* | white sucker |
| *Clinostomus funduloides* | rosyside dace |
| *Micropterus dolomieu* | smallmouth bass |
| *Etheostoma flabellare* | snubnose darter |

Table 2. Fish species composition of Punch & Judy Creek, North Fork Holston River.

| Scientific name | Common name |
|---|---|
| *Phoxinus tennesseensis* | Tennessee dace |
| *Rhinichthys atratulus* | blacknose dace |
| *Clinostomus funduloides* | rosyside dace |
| *Semotilus atromaculatus* | creek chub |
| *Campostoma anomalum* | central stoneroller |
| *Catostomus commersoni* | white sucker |
| *Notropis leuciodus* | Tennessee shiner |
| *Etheostoma flabellare* | fantail darter |
| *Cottus spp.* | sculpin |

Table 3. Fish species composition of Laurel Creek, North Fork Holston River.

| Scientific name | Common name |
|---|---|
| *Oncorhynchus mykiss* | rainbow trout |
| *Salmo trutta* | brown trout |
| *Salvelinus fontinalis* | brook trout |
| *Phoxinus tennesseensis* | Tennessee dace |
| *Rhinichthys atratulus* | blacknose dace |
| *Clinostomus funduloides* | rosyside dace |
| *Semotilus atromaculatus* | creek chub |
| *Catostomus commersoni* | white sucker |
| *Campostoma anomalum* | central stoneroller |
| *Notropis leuciodus* | Tennessee shiner |
| *Etheostoma flabellare* | fantail darter |
| *Etheostoma simoterum* | snubnose darter |
| *Ambloplites rupestris* | rock bass |
| *Ichthyomyzon spp.* | lamprey ammocoetes |
| *Cottus spp.* | sculpin |

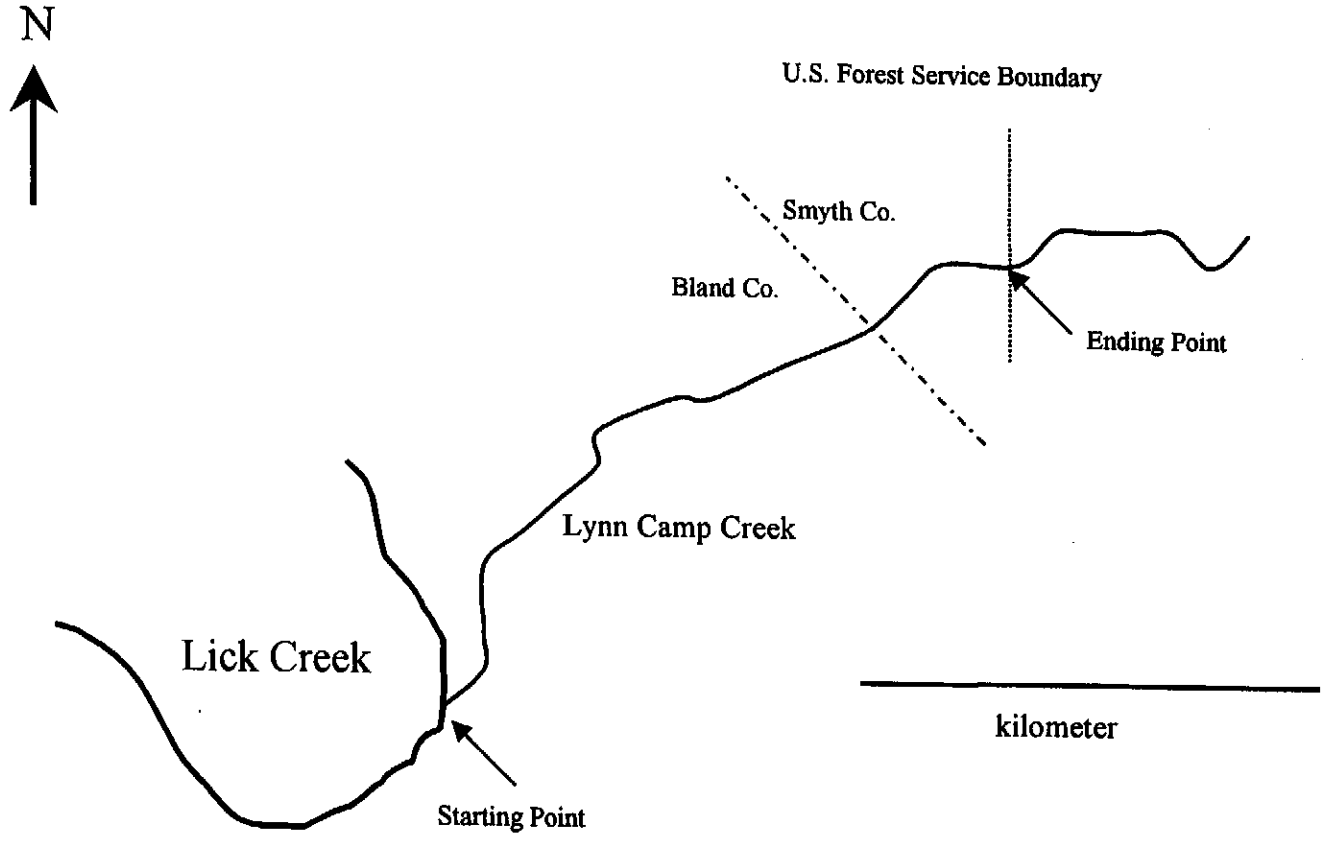


Figure 1. Map showing the lower Lynn Camp Creek study section. The arrows indicate starting and ending points.

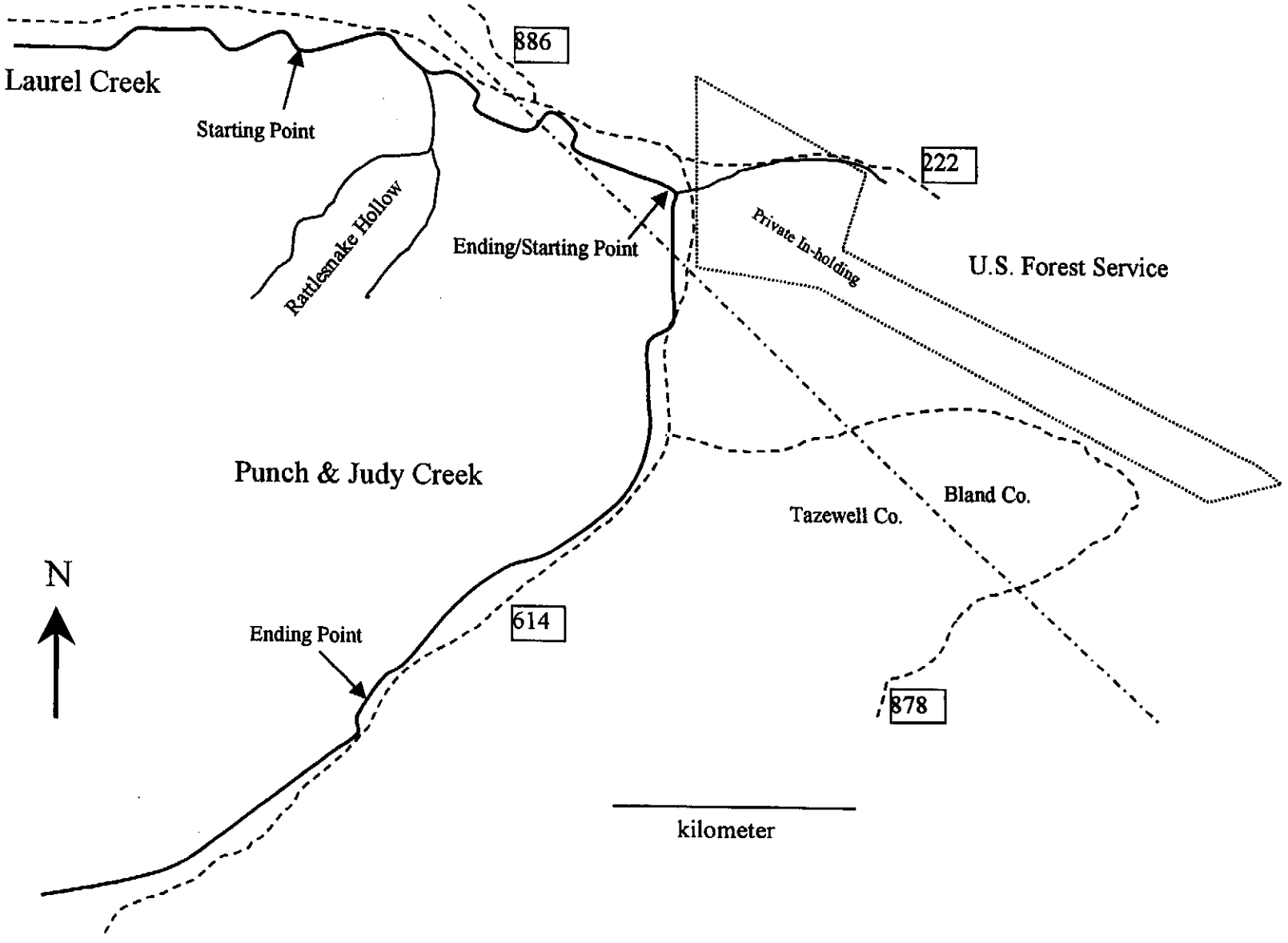


Figure 2. Map showing the Laurel Creek and Punch & Judy Creek study sections. The arrows indicate starting and ending points.

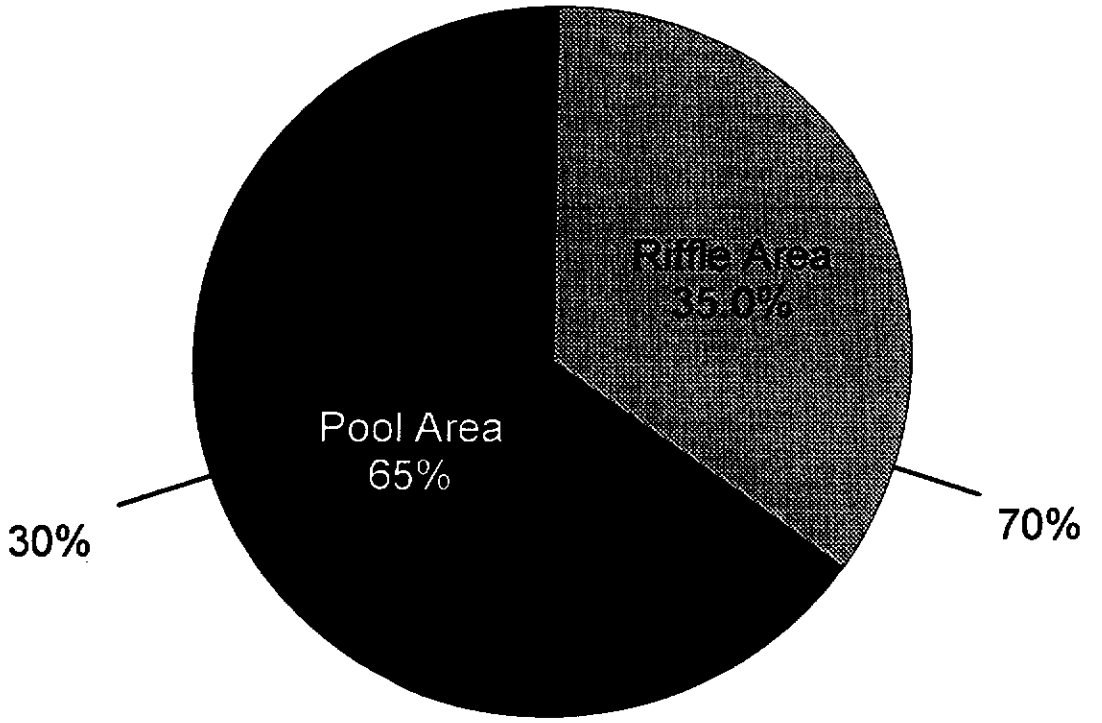


Figure 3. Percent pool and riffle surface area in the study section of Lynn Camp Creek. The GW-JNF DFC of 30 to 70 % pool area is indicated on graph.

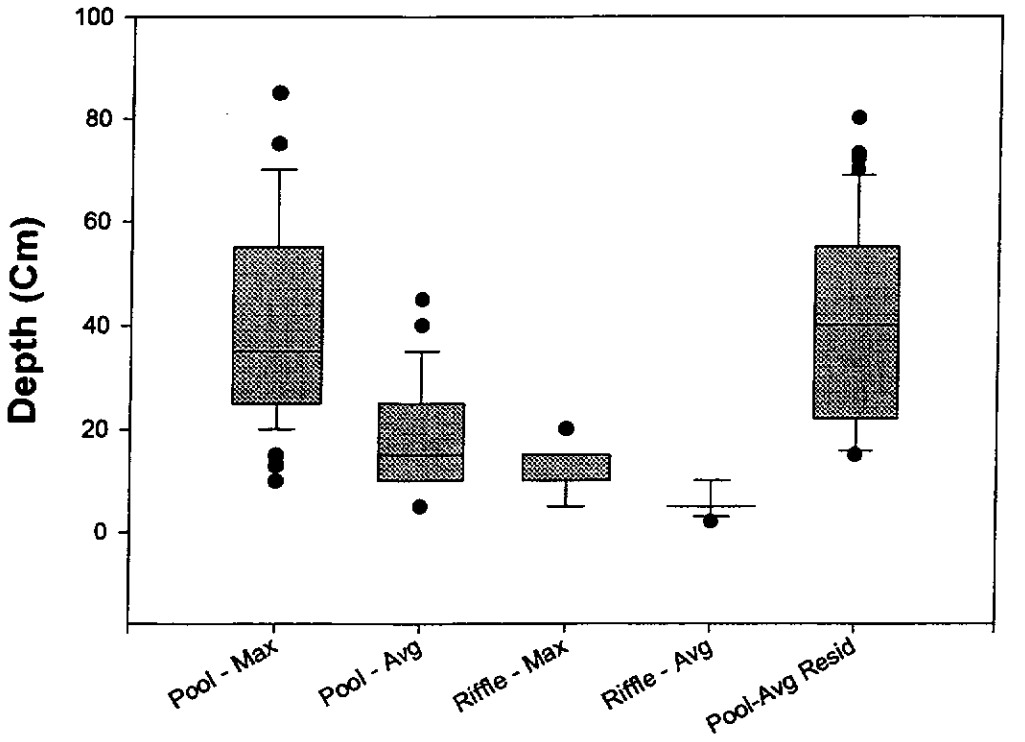


Figure 4. Box plots representing maximum and average depths for pools and riffles, and average residual pool depths in the study section of Lynn Camp Creek. The boxes enclose the middle 50% of the observations, the bar in the center of the boxes represent the median, and the capped lines extending above and below the boxes represent the 90% and 10% quantiles.

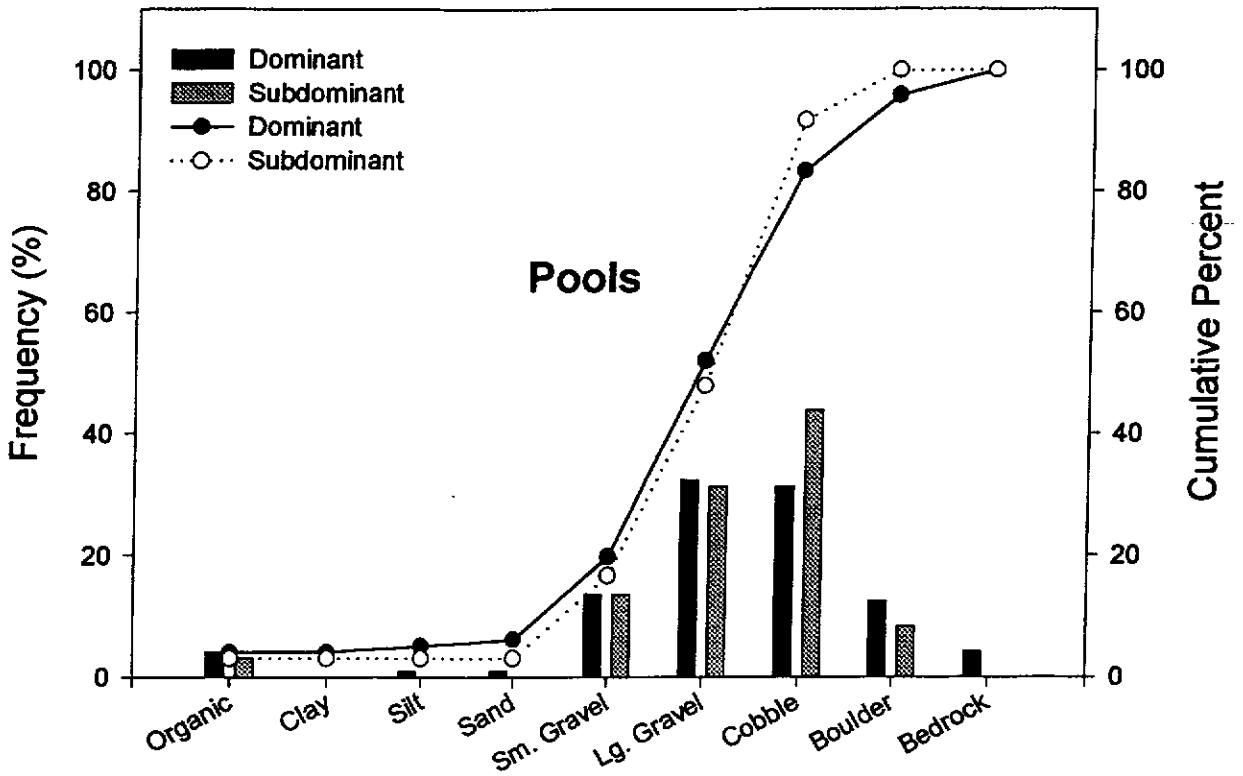


Figure 5. Frequency (percent) of dominant and subdominant substrate occurrence for pool type habitat in the study section of Lynn Camp Creek. Solid dots represent cumulative percent of dominant substrate and open dots represent cumulative percent of subdominant substrate.

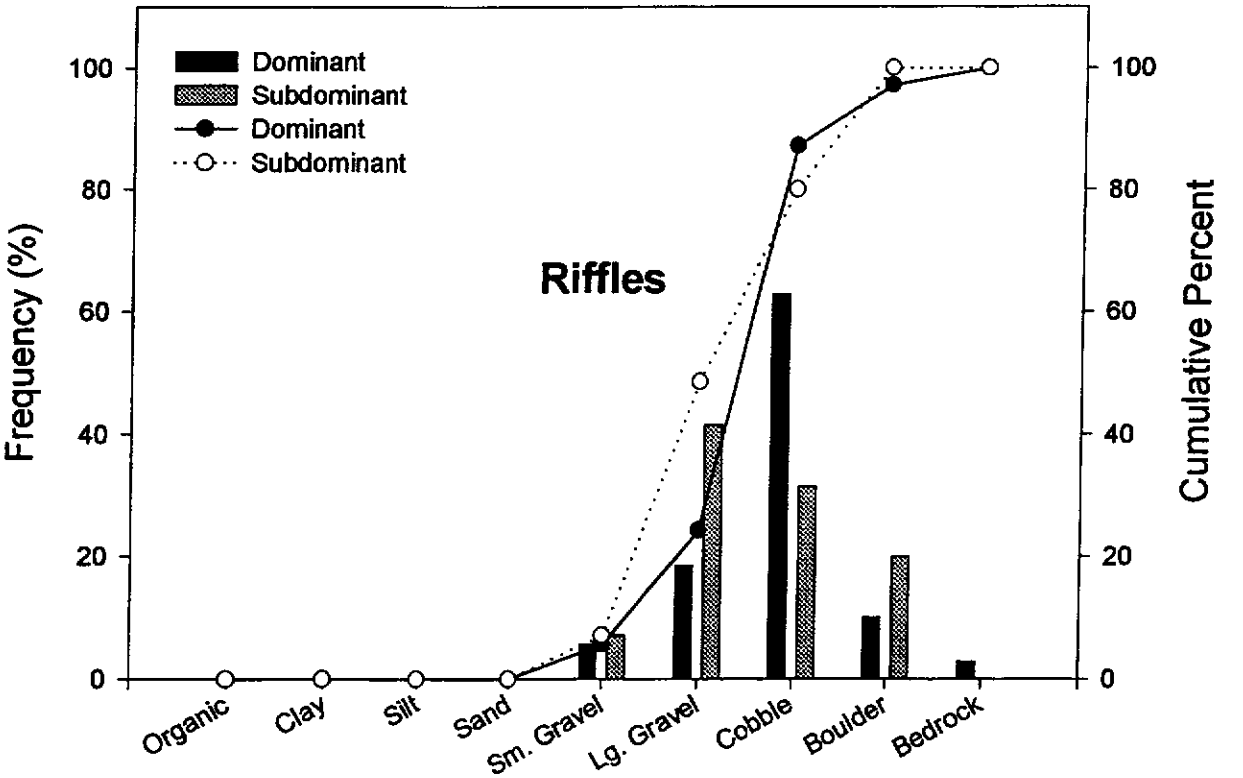


Figure 6. Frequency (percent) of dominant and subdominant substrate occurrence for riffle type habitat in the study section of Lynn Camp Creek. Solid dots represent cumulative percent of dominant substrate and open dots represent cumulative percent of subdominant substrate.

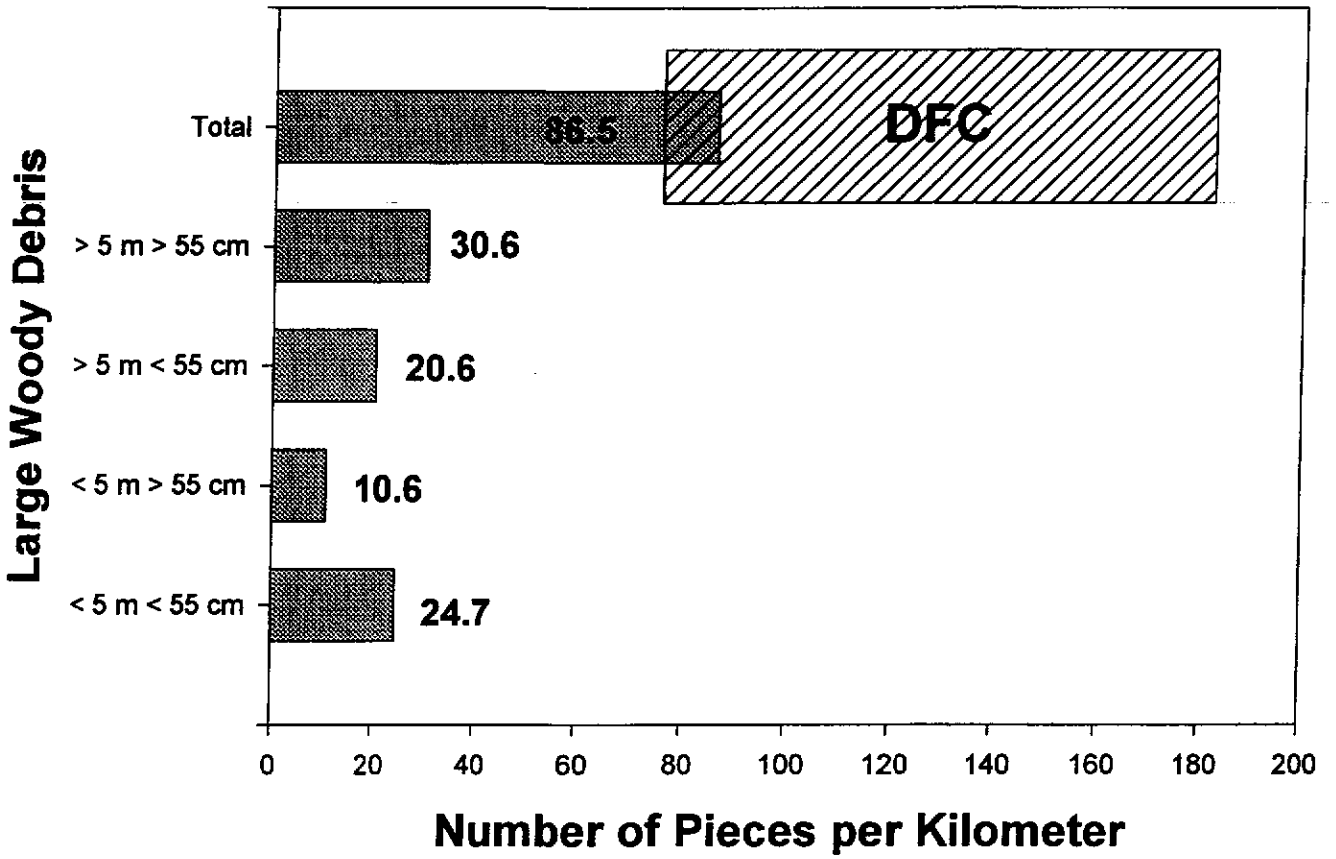


Figure 7. Pieces of large woody debris per kilometer in the study section of Lynn Camp Creek. The GW-JNF DFC of 78 to 186 pieces per kilometer is indicated on graph.

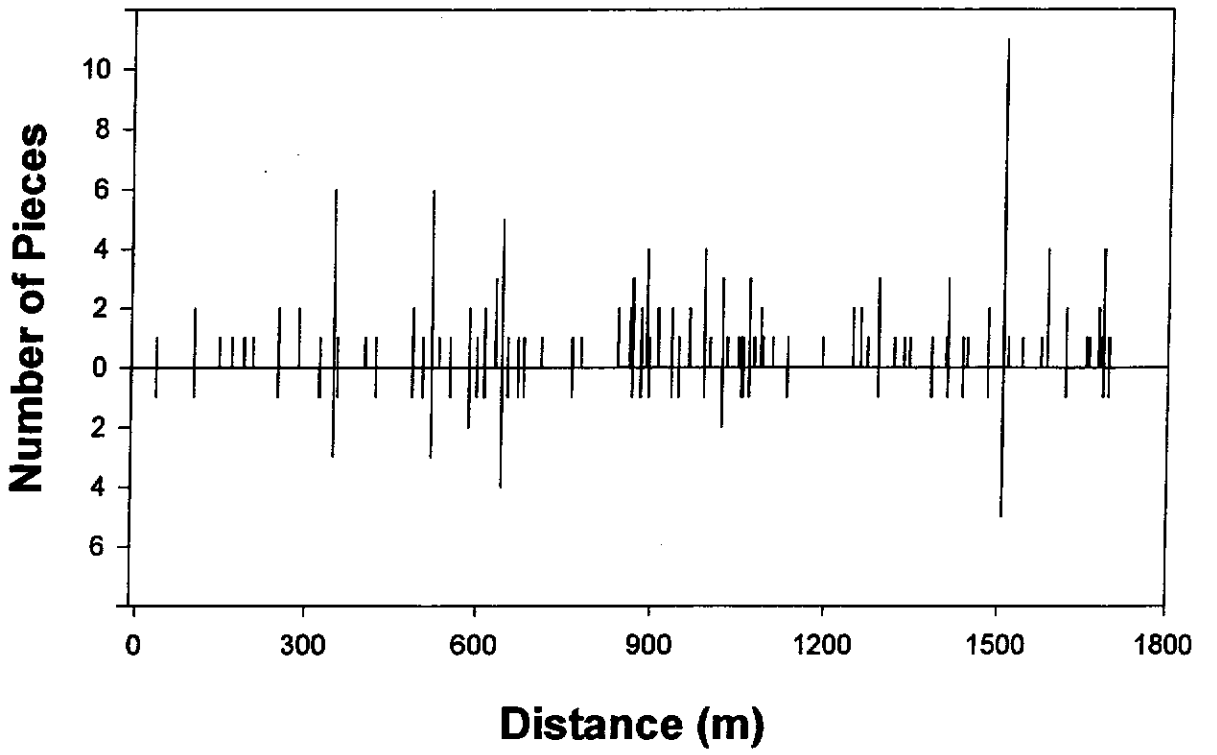


Figure 8. Distribution and total abundance of large woody debris in the study section of Lynn Camp Creek.

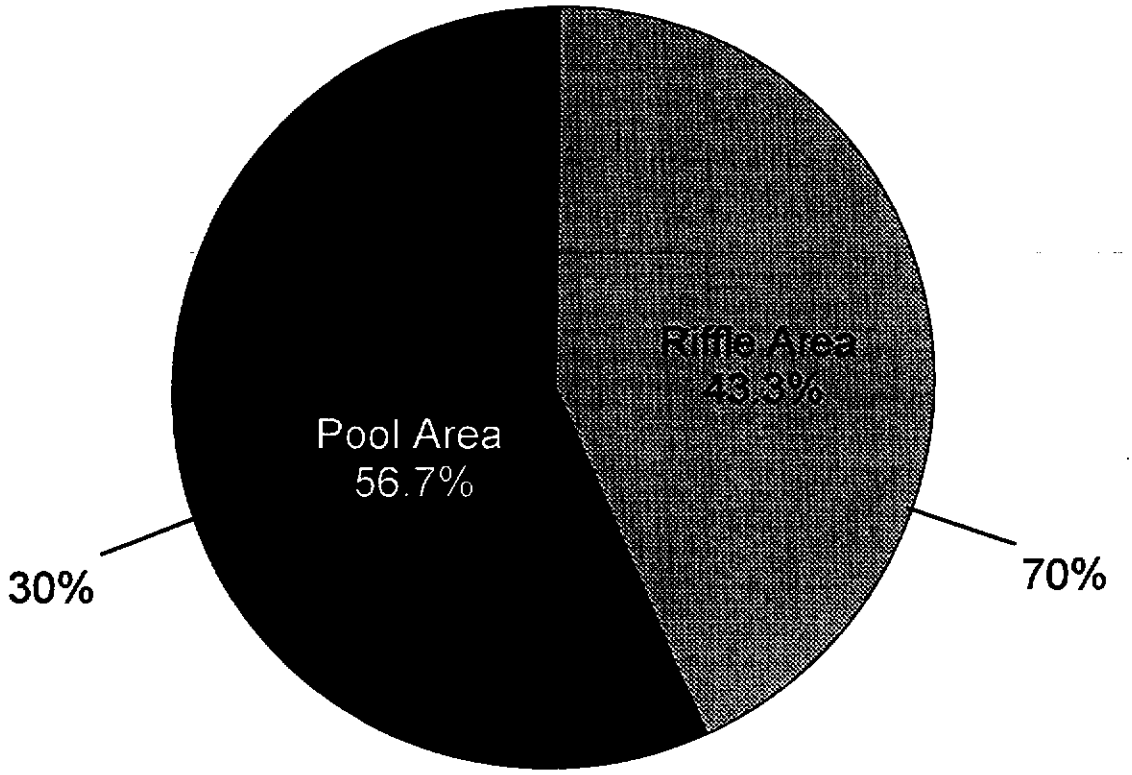


Figure 9. Percent pool and riffle surface area in the study section of Punch and Judy Creek. The GW_JNF DFC of 30 to 70 % pool area is indicated on graph.

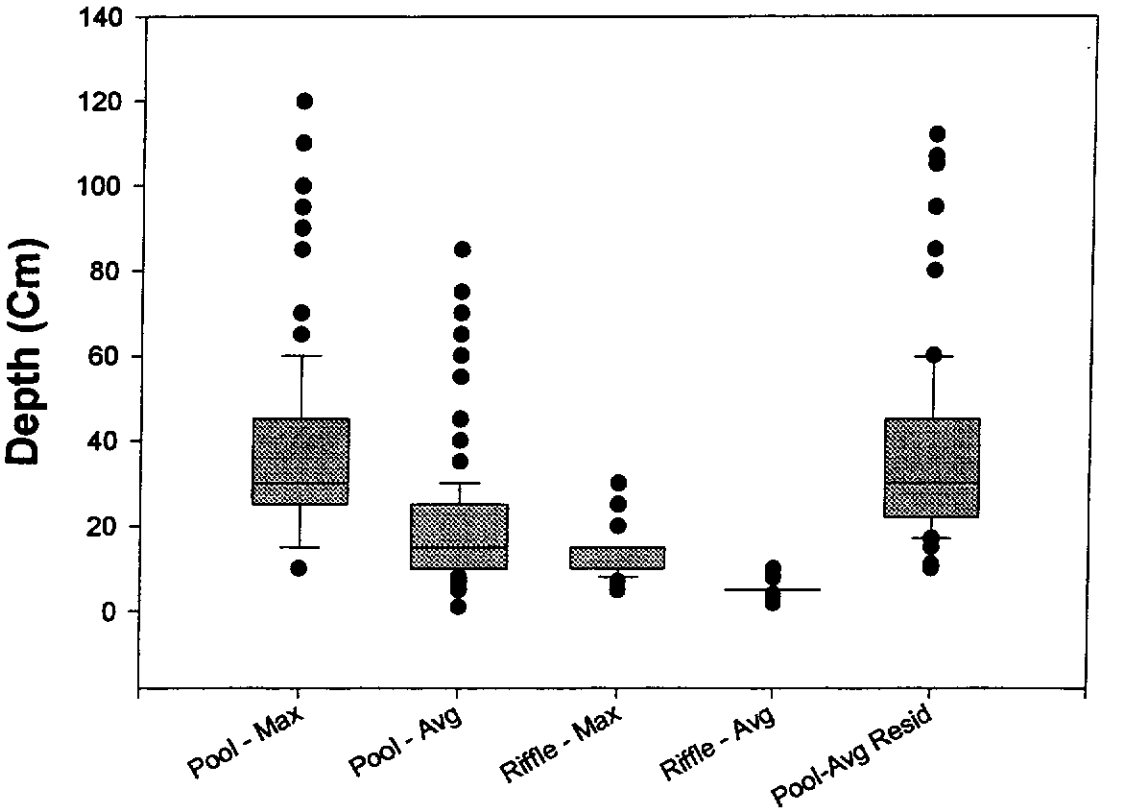


Figure 10. Box plots representing maximum and average depths for pools and riffles, and average residual pool depths in the study section of Punch & Judy Creek. The boxes enclose the middle 50% of the observations, the bar in the center of the boxes represent the median, and the capped lines extending above and below the boxes represent the 90% and 10% quantiles.

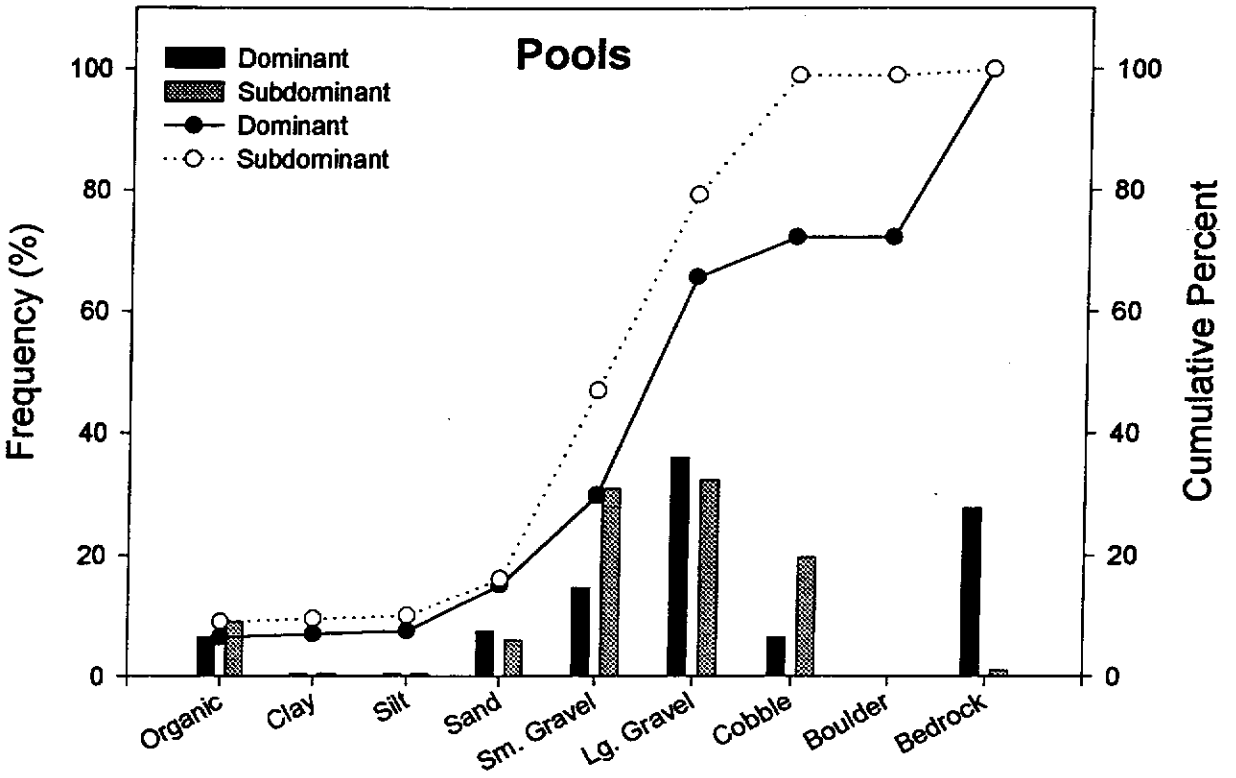


Figure 11. Frequency (percent) of dominant and subdominant substrate occurrencefor pool type habitat in the study section of Punch and Judy Creek. Solid dots represent cumulative percent of dominant substrate and open dots represent cumulative percent of subdominant substrate.

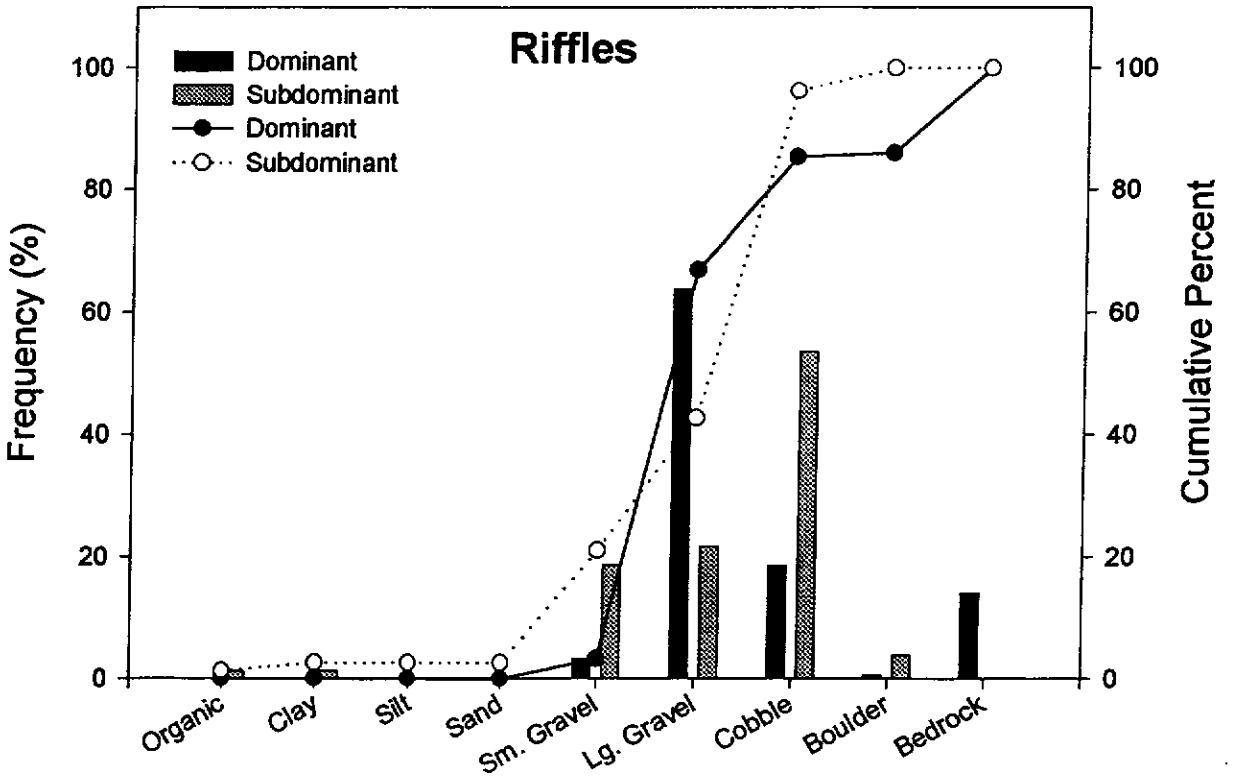


Figure 12. Frequency (percent) of dominant and subdominant substrate occurrence for riffle type habitat in the study section of Punch and Judy Creek. Solid dots represent cumulative percent of dominant substrate and open dots represent cumulative percent of subdominant substrate.

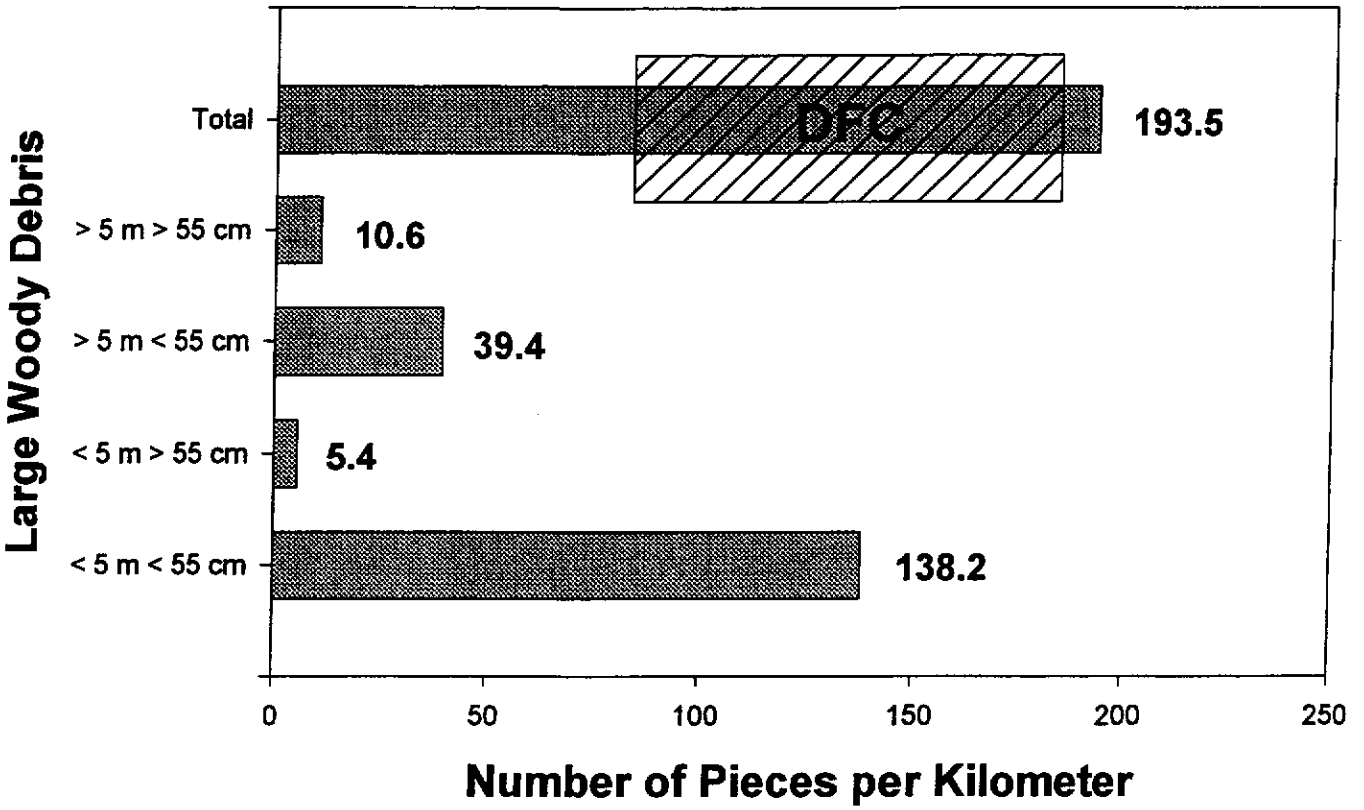


Figure 13. Pieces of large woody debris per kilometer in the study section of Punch and Judy Creek. The GW-JNF DFC of 78 to 186 pieces of wood per kilometer is indicated on graph.

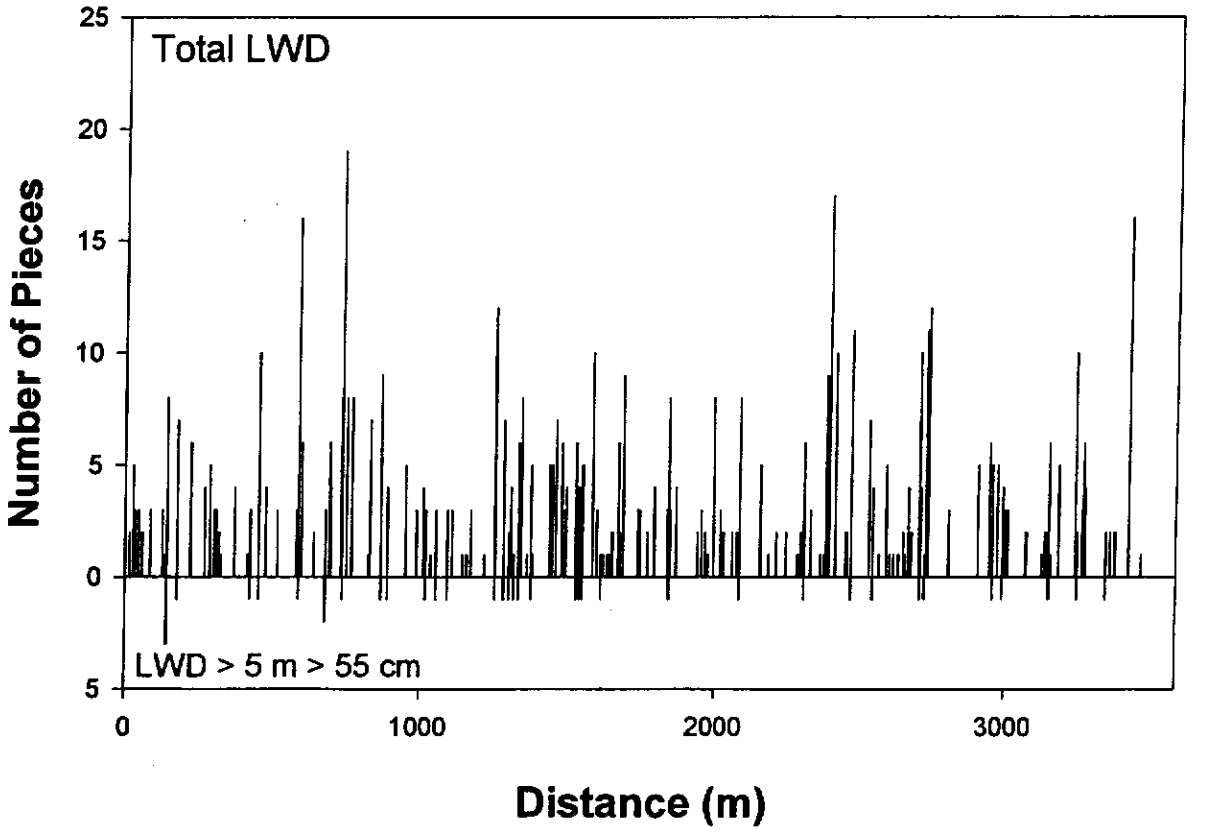


Figure 14. Distribution and total abundance of large woody debris in the study section of Punch and Judy Creek.

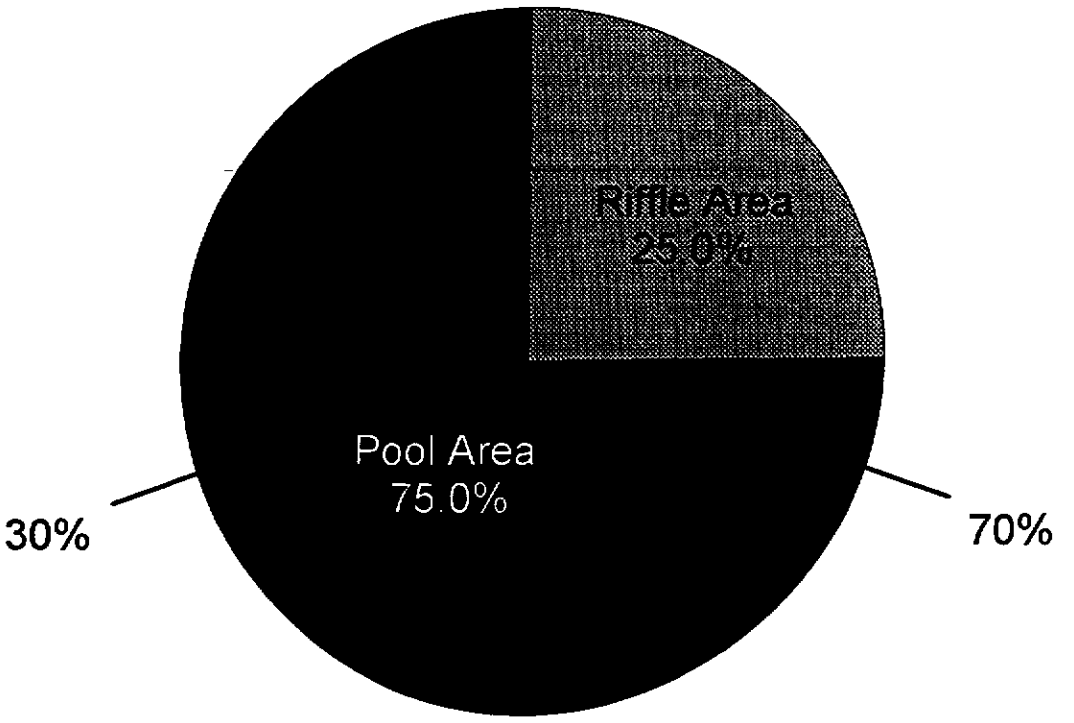


Figure 15. Percent pool and riffle surface area in the study section of Laurel Creek. The GW-JNF DFC of 30 to 70 % pool area is indicated on graph.

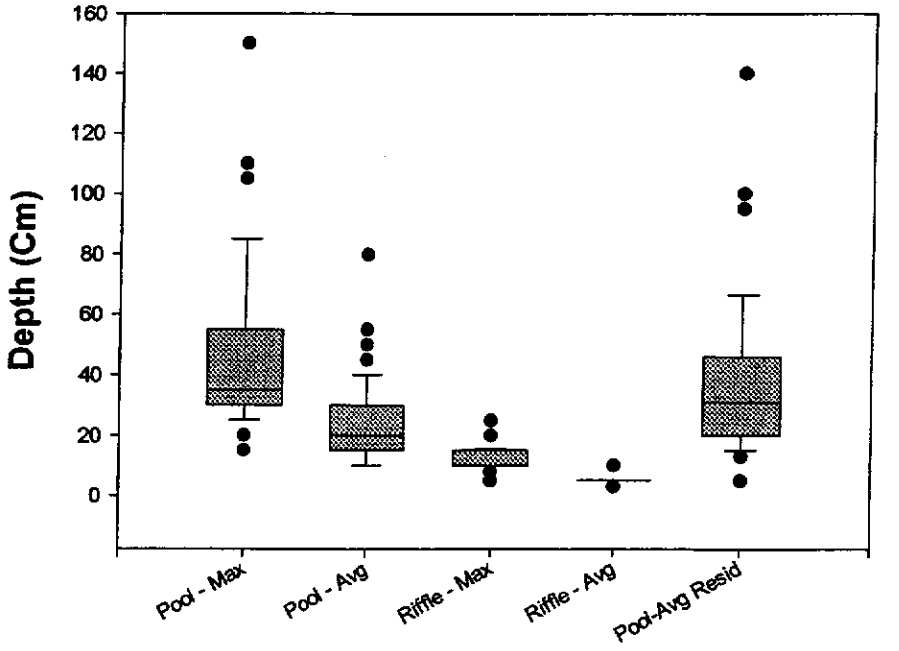


Figure 16. Box plots representing maximum and average depths for pools and riffles, and average residual pool depths for Laurel Creek. The boxes enclose the middle 50% of the observations, the bar in the center of the boxes represent the median, and the capped lines extending above and below the boxes represent the 90% and 10% quantiles.

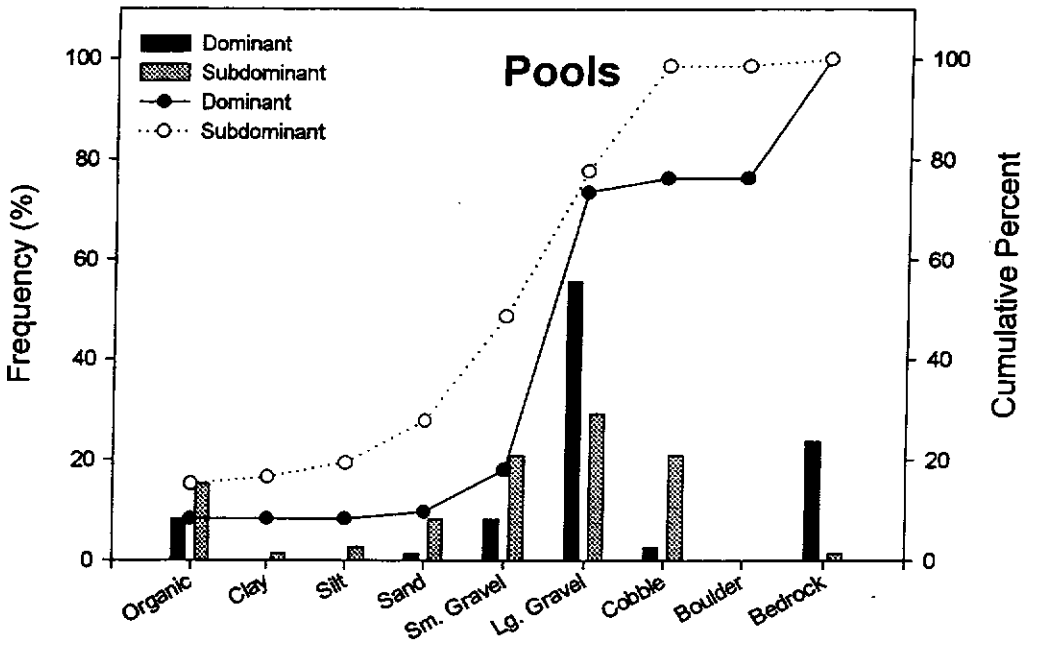


Figure 17. Frequency (percent) of dominant and subdominant substrate occurrence for pool type habitat in the study section of Laurel Creek. Solid lines represent cumulative percent of dominant substrate and open dots represent cumulative percent of subdominant substrate.

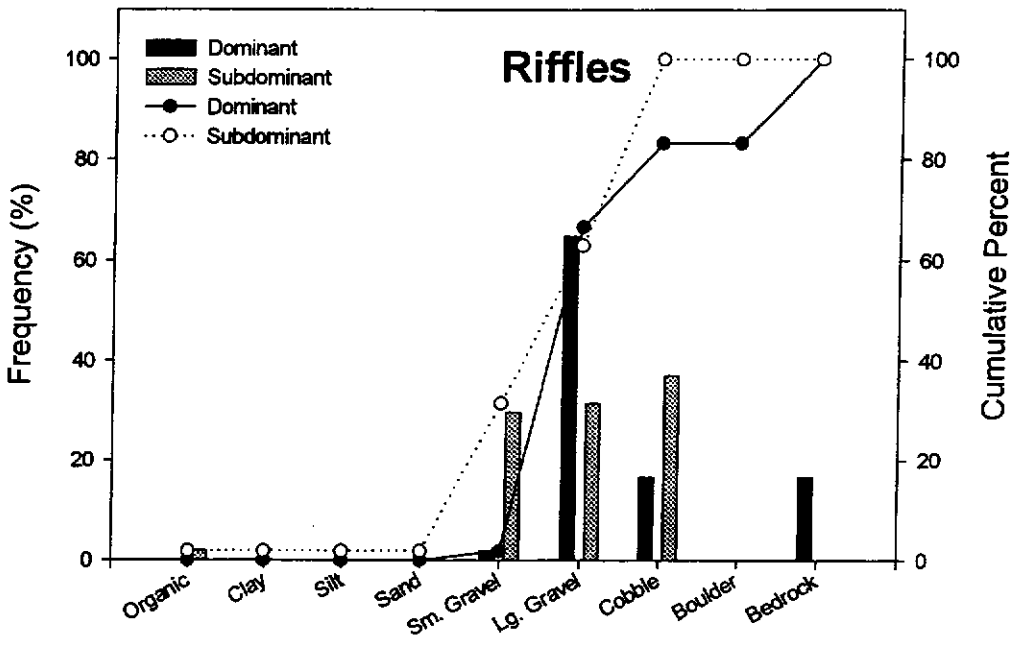


Figure 18. Frequency (percent) of dominant and subdominant substrate occurrence for riffle type habitat in the study section of Laurel Creek. Solid dots represent cumulative percent of dominant substrate and open dots represent cumulative percent of subdominant substrate.

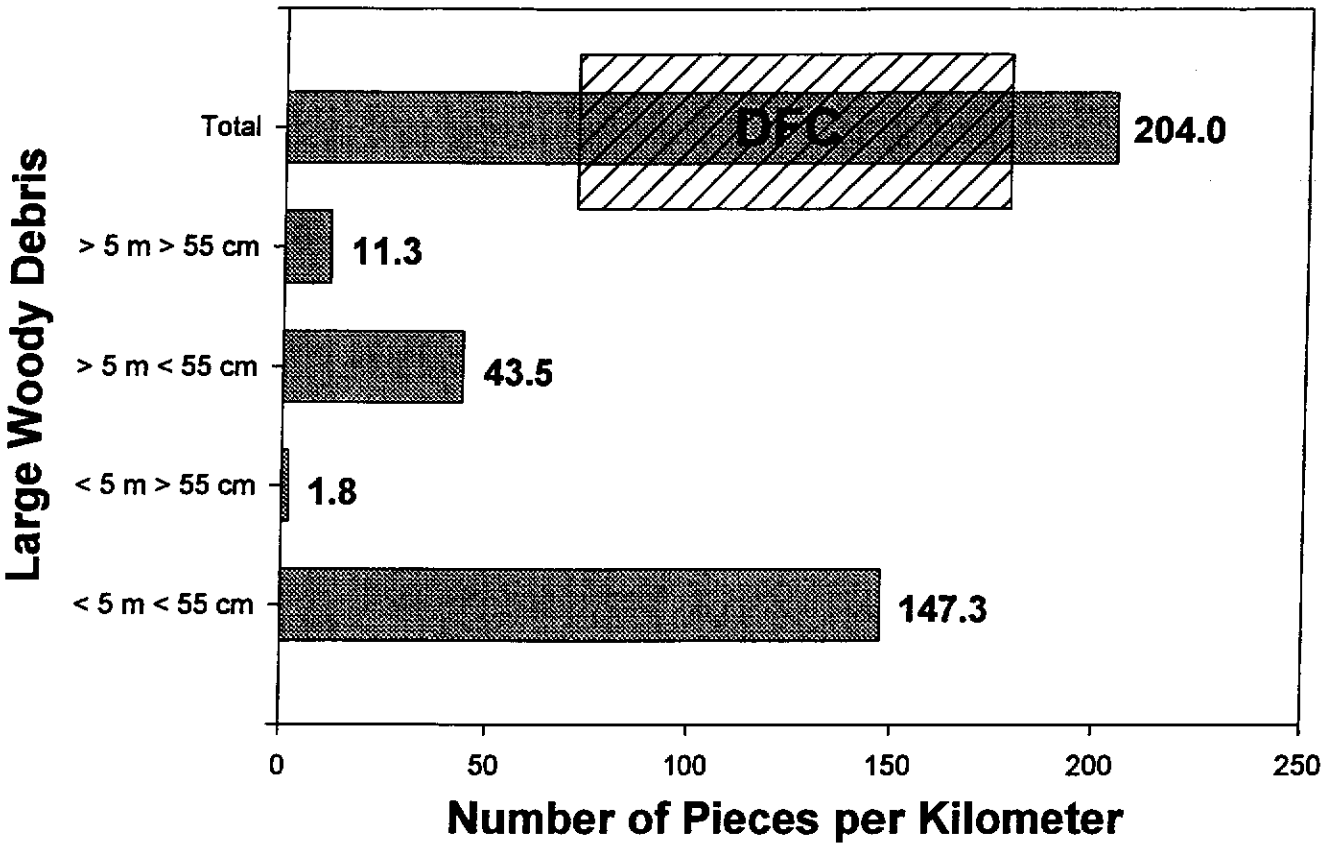


Figure 19. Pieces of large woody debris per kilometer in the study section of Laurel Creek. The GW-JNF DFC of 78 to 186 pieces per kilometer is indicated on graph.

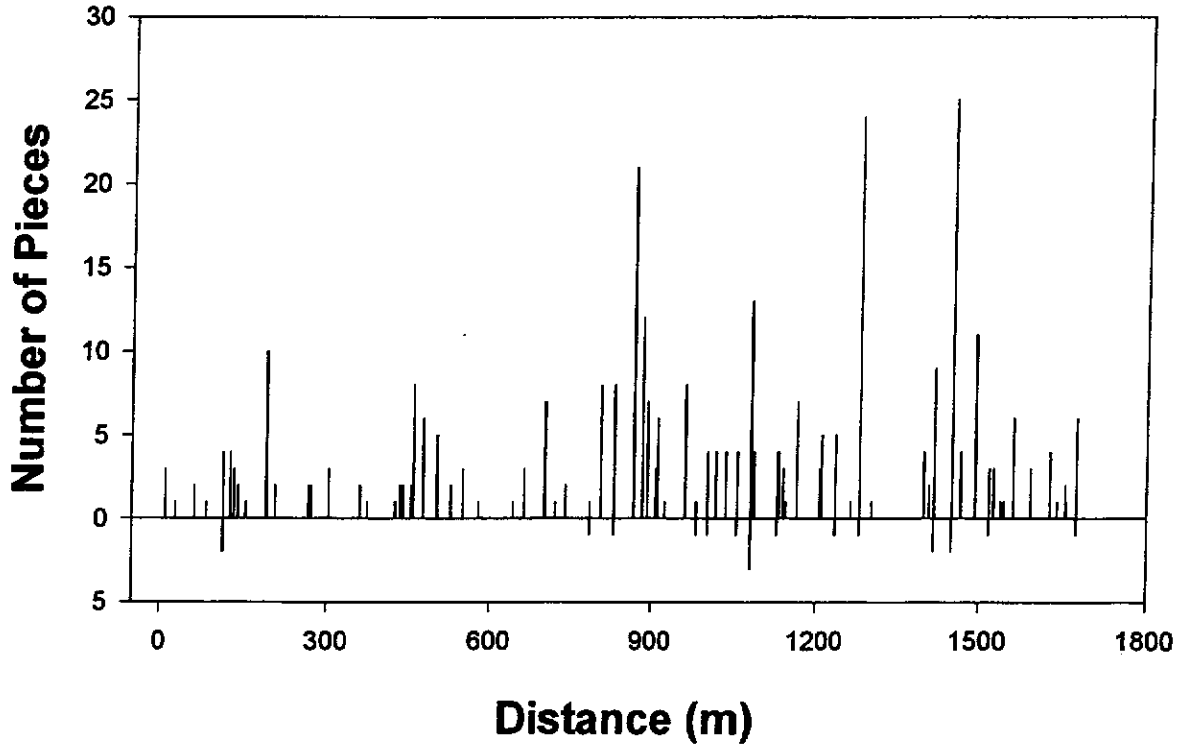


Figure 20. Distribution and total abundance of large woody debris in the study section of Laurel Creek.

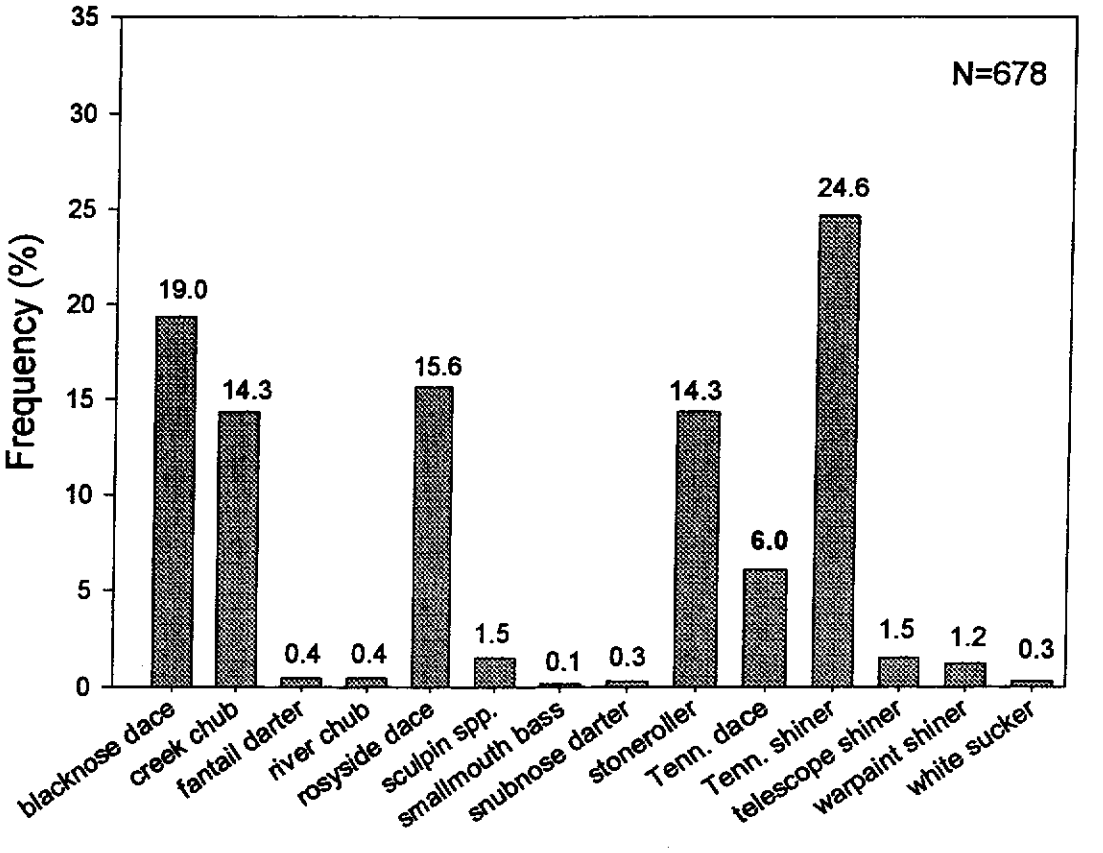


Figure 21. Vertical bar chart showing the relative abundance of each species captured in the Lynn Camp Creek study section, based on the total catch (N=678).

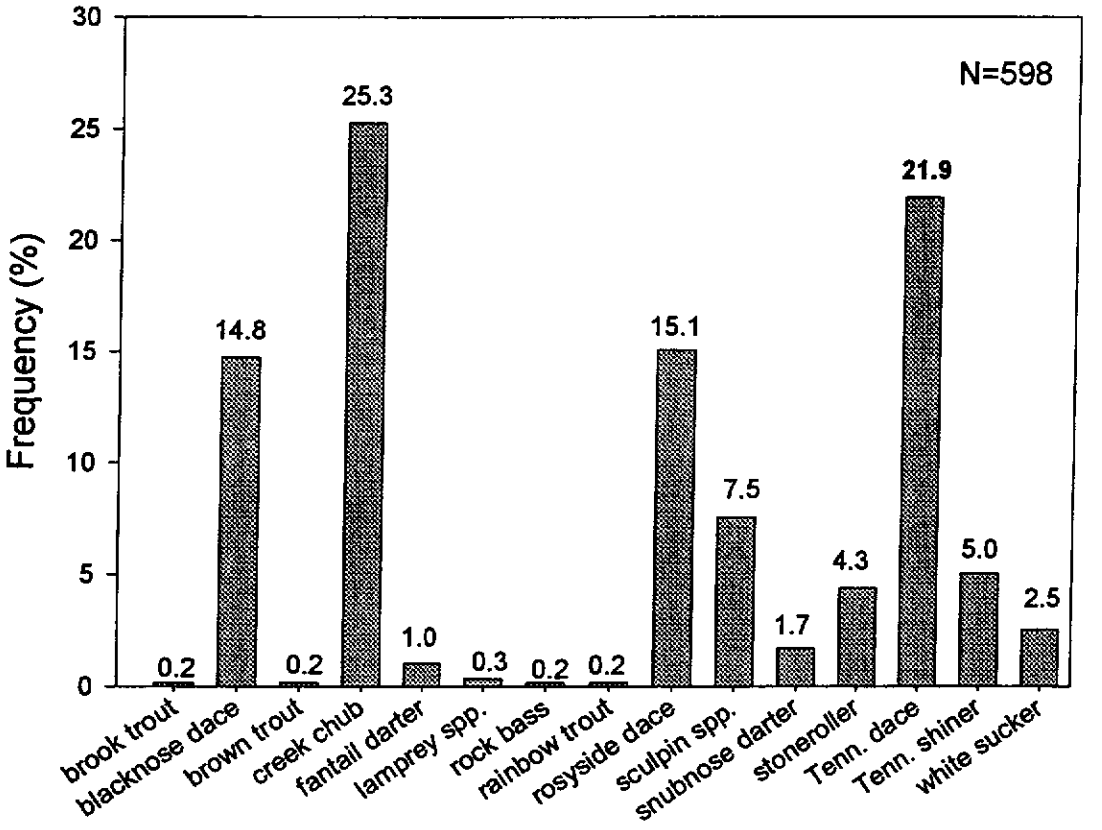


Figure 23. Vertical bar chart showing the relative abundance of each species captured in the Laurel Creek study section, based on the total catch (N=598).

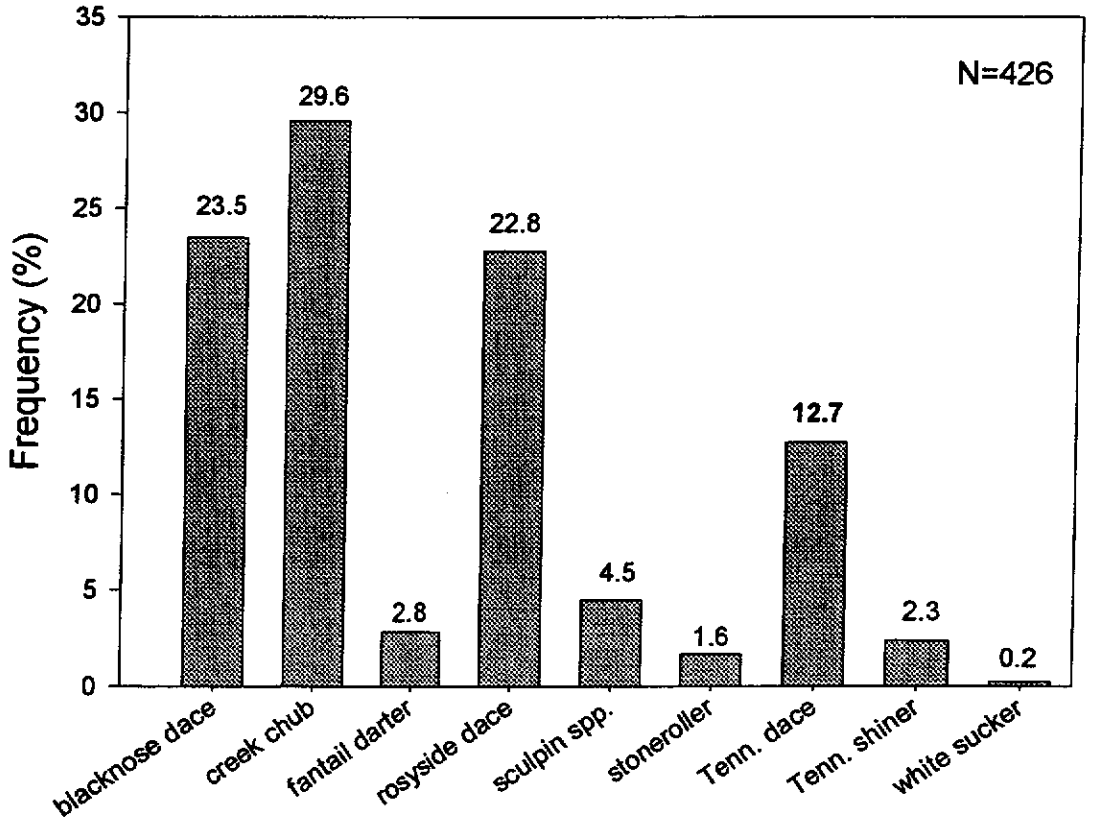


Figure 22. Vertical bar chart showing the relative abundance of each species captured in the Punch & Judy Creek study section, based on the total catch (N=426).

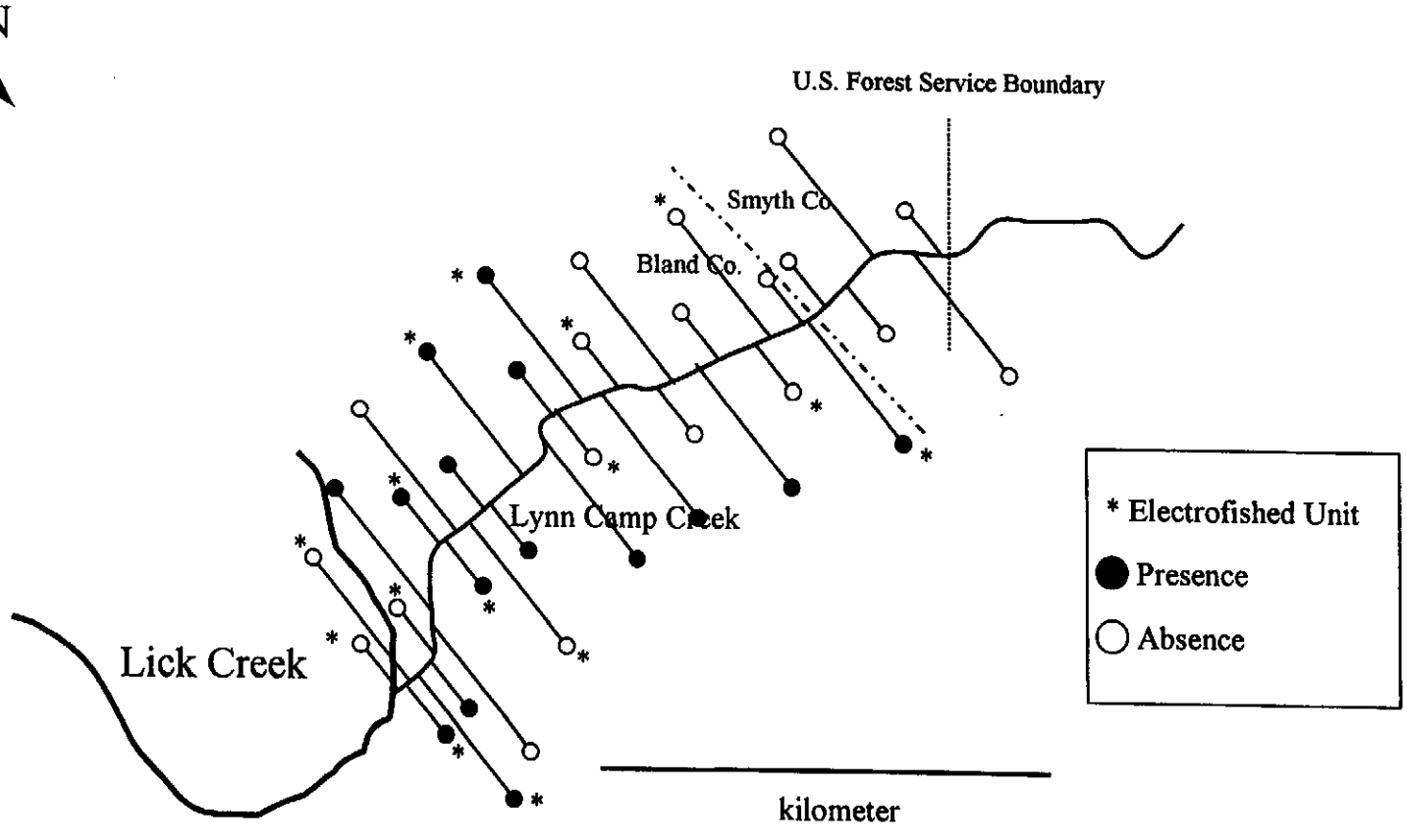


Figure 24. Distribution of Tennessee dace in the Lynn Camp Creek study section. Circles indicate sample sites. Solid circles represent sites where Tennessee dace were present. Asterisks represent units sampled with three-pass depletion electrofishing.

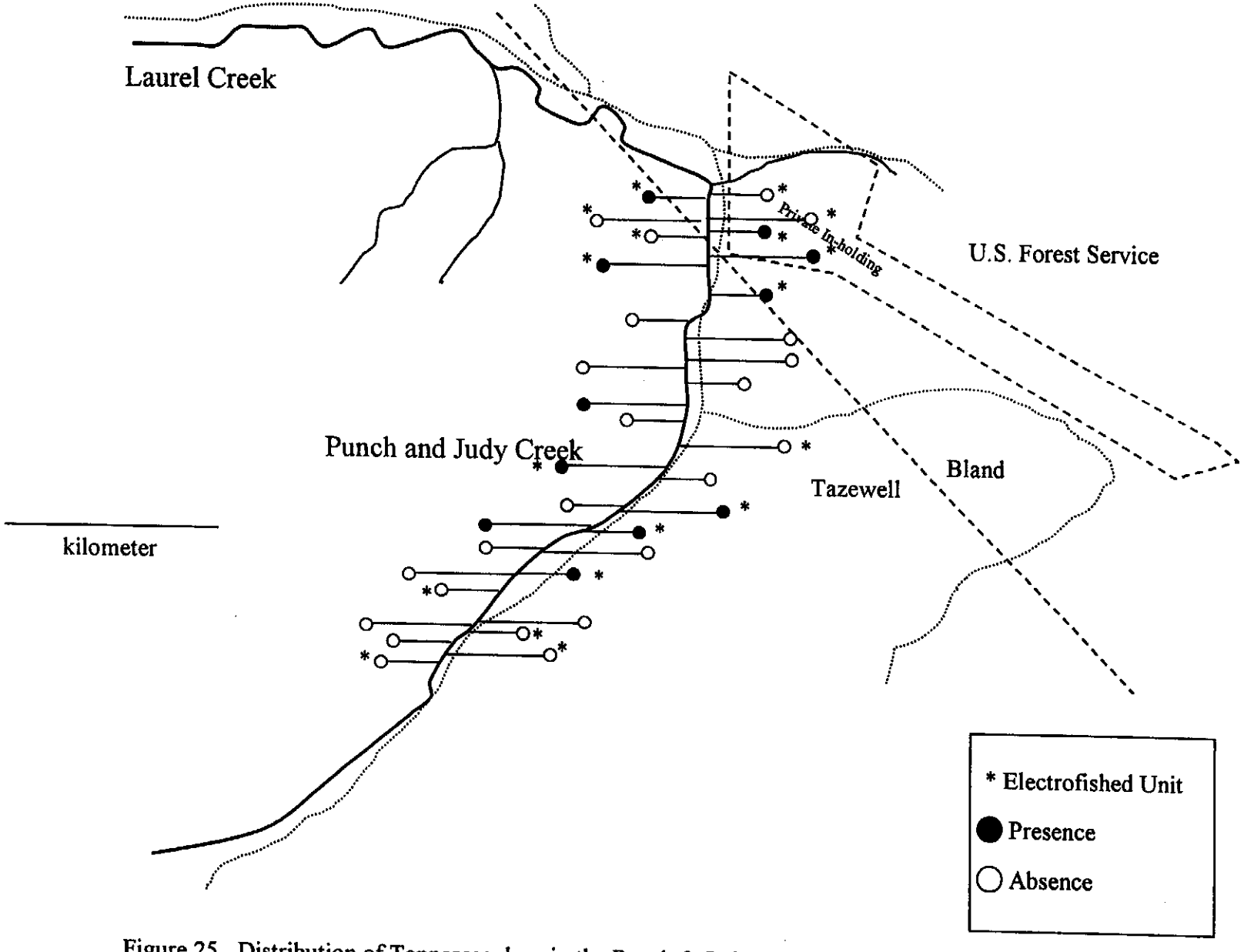


Figure 25. Distribution of Tennessee dace in the Punch & Judy Creek study section. Circles indicate sample sites. Solid circles represent sites where Tennessee dace were present. Asterisks represent units sampled with three-pass depletion electrofishing.

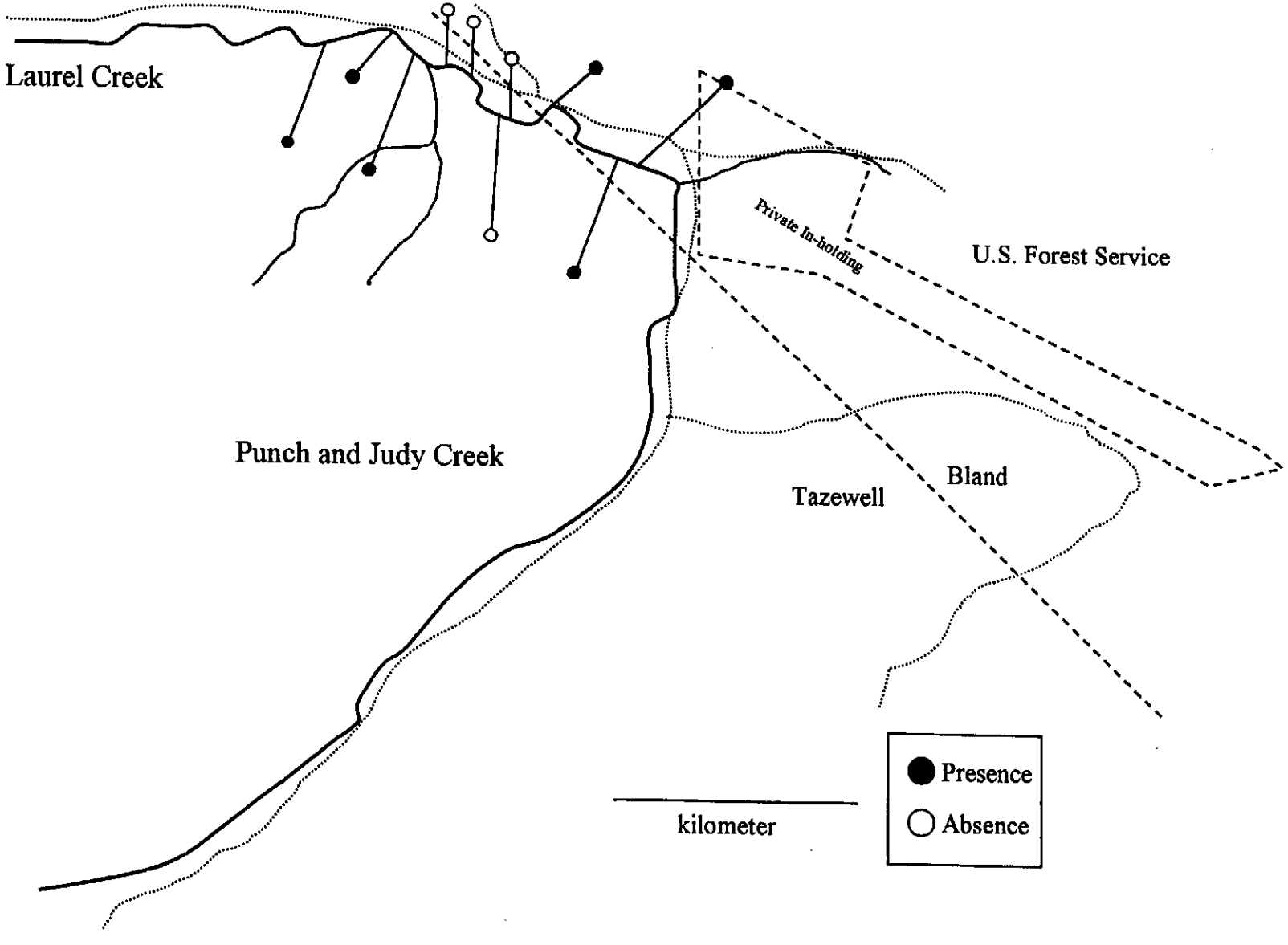


Figure 26. Distribution of Tennessee dace in the Laurel Creek study section. Circles indicate sample sites. Solid circles represent sites where Tennessee dace were present.