

# **Assessment of side channel habitat and fish community structure, Little Southwest Miramichi River, New Brunswick.**

A progress report for the Atlantic Salmon Federation  
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## **Executive Summary**

The objectives of this research are to: 1) document the fish communities and physical habitat characteristics in side channels, 2) investigate Atlantic salmon and brook trout usage of this habitat, 3) determine the processes forming and maintaining these channels, and, 4) make management recommendations to preserve and enhance these habitats. The research was conducted on side channels within the Little Southwest Miramichi River, New Brunswick. There are three main channel types within these rivers: main channels, side channels open upstream receiving periodic flow from main channels, and side channels closed upstream with no flow from main channels. Both types of side channels are open to the main channel downstream, allowing fish migration.

To determine fish community and habitat characteristics, five side channels, two open upstream and three closed upstream, were sampled in June, August and October. Morphologically homogeneous habitat units (plots) were visually identified and substrate, velocity, depth, temperature, length, width, alga and plant bed cover, and bank cover measured or estimated. In collaboration with Department of Fisheries and Oceans, each plot was electrofished for approximately five minutes and the fish speciated. Over three seasons 5125 fish were counted and a total of 4.07 hours of electrofishing was conducted.

In total, 17 species were found in both side channel types. Closed side channels had higher species richness than open channels in June and August, but were equal in October. Atlantic salmon and Brook trout were found in both open and closed side channels. In open or closed channels, for each of the three seasons, up to 33 percent of the plots contained Salmon, and up to 29 percent of the plots contained trout. Analysis of habitat variables found differences between channel types and between seasons. An interesting result found that side channel temperatures are up to 2.5°C cooler than the main channel in summer. Analysis of habitat and community data will continue as will the investigation into the processes forming and maintaining these habitats.

## Introduction

Side channels are common in the large gravel rivers in the Maritimes, but their habitat characteristics, fish community structure and formation is not fully documented. Biologists have found, through radio tracking, that side channels are used by kelt, adult Atlantic salmon (*Salmo Salar*) overwintering in rivers (Cunjak, University of New Brunswick, pers. com., 1998). Side channels may also be important habitat for sea run brook trout (*Salvelinus fontinalis*), a species with increasing interest in co-management with Atlantic salmon. In west coast rain forests, side channels are important overwintering habitat for juvenile salmonids (Hartman and Brown 1987, Peterson 1982). The objectives of this research are to: 1) document the fish community and physical habitat characteristics of side channels, 2) investigate Atlantic salmon and brook trout usage of this habitat, 3) determine the processes forming and maintaining side channels, and 4) make management recommendations to preserve and enhance these habitats.

This research was conducted on the Little Southwest Miramichi River New Brunswick because there are distinct reaches with side channels, a large Atlantic salmon run, natural channels with no dams and little river engineering, and local and international interest. There are three main channel types within these rivers: main channels, side channels open upstream receiving periodic flow from main channels, and side channels closed upstream with no flow from main channels. Both types are open to the main channel downstream, allowing fish migration. The average width of open and closed side channels ranged between 9.7-18.1 m (table 1). Side channel lengths varied from 180 to 620 m. Open channel lengths were measured from their entrance at the main channel to their return to the main channel. Lengths of closed side channels were measured to an obstruction, usually a beaver dam, or a change of character.

Table 1. Average width, length and area of sampled side channels.

Side channel code	Channel Width (m)	Length (m)	Area (m <sup>2</sup> )
Ob1	15.3	335	5132
Ob2	10.6	620	6562
Cb1	18.1	475	8590
Cb2	9.7	180	1740
Cb3	11.0	180	1980

(Ob represents open side channel, Cb represents closed side channel)

### **Methods**

To determine fish community and habitat characteristics, five side channels, two open upstream and three closed upstream on the Little Southwest Miramichi River, were sampled in the late-spring, (growing season), late-summer (end of growing season), and fall (winter habitat usage). Morphologically homogeneous habitat units were visually identified and average substrate, algae and plant cover, velocity, depth, temperature, length, width, and bank cover measured or estimated. Temperature data loggers were placed in one open side channel and one closed. Then, in collaboration with Department of Fisheries and Oceans, each habitat unit was electrofished for approximately five minutes and the fish speciated.

Over the three seasons 5125 fish were counted, with the greatest number of fish in August, and the least in June. A total of 4.07 hours of electrofishing was conducted with an average of 305 seconds (5.08 minutes) per plot. Plot size ranged from 8.5 to 103 m<sup>2</sup> with an average of 60 m<sup>2</sup> and a standard deviation of 14 m<sup>2</sup>. Ideally plot size would have been consistently 60 m<sup>2</sup> but some plots were smaller because they dried out or, plot width was decreased during high water levels when fished from the bank, and larger plots were used at sites with no morphological break within the site.

### **Results: Fish Community, Atlantic salmon and Brook trout**

#### *Community*

Species richness (number of species) is a common measure of biodiversity. In total 17 species were identified in the open and closed side channels sampled (table 2, figure 1). Closed side channels had higher species richness than open channels in June

and August, and the same in October. Species richness increased in one open channel through the seasons (from 8 to 11) and decreased in one closed channel (14 to 11).

Table 2. List of species found in open and closed side channels.

Sea Lamprey	Creek Chub	Gaspereau
Atlantic Salmon	White Sucker	Three spine Stickleback
Brook Trout	Banded killifish	Golden Shiner
Northern Redbelly Dace	Brook Stickleback	Common Shiner
Finescale Dace	Nine Spine Stickleback	Black Nose Dace
Lake Chub	Slimy Sculpin	

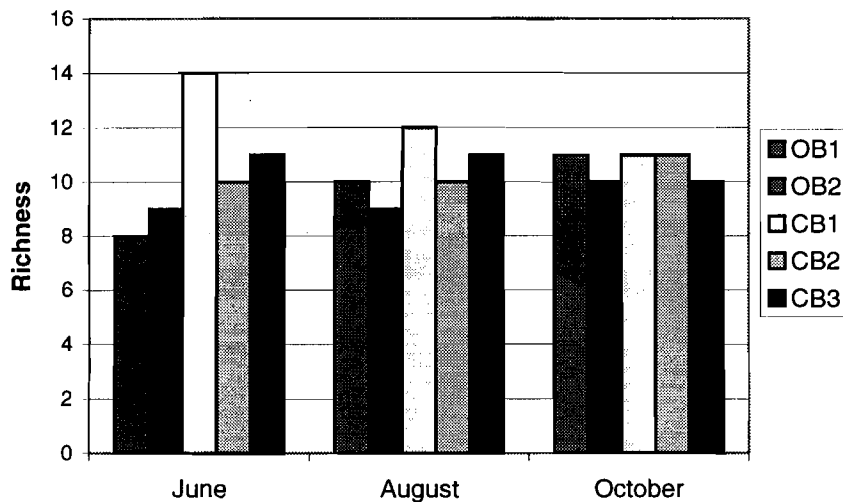


Figure 1. Species richness for open and closed side channels in three seasons. (Ob represents open side channel, Cb represents closed side channel)

### *Atlantic salmon and brook trout*

Atlantic salmon and Brook trout are of particular interest to this study and Atlantic salmon and brook trout fry and parr were found in both open and closed channels. There are two ways to analyze this data, the percentage of plots where a species was found (frequency) and the density, or in this case timed density of each species.

#### *Atlantic salmon*

In all cases, except for parr in October, open channels had a higher percentage of plots with salmon (frequency) than closed (Fig 2. A). In open side channels, the frequency of plots where young of the year (YOY) salmon occurred increased from June (8%) to August (25%) to October (33%), while, the frequency of parr decreased from June (29%) to August (21%) to October (5%). In closed channels, the percentage of plots where YOY salmon occurred was the same through June and August (4%) and increased in October (13%), while the frequency of parr decreased from June (17%) to August (13%) and then leveled through October.

A timed effort technique was used to determine relative abundance within plots and although these values may not easily be compared to data from other studies, comparisons within this study are useful. Timed densities for each season and channel type were calculated using the number of individuals in that channel type divided by the area of the plots in that channel type, divided by the number of seconds electrofished in that channel type.

Timed densities for salmon were always higher in open than closed in all cases except parr in October (Fig 2. B). Timed densities for YOY salmon in open and closed channels increased from June to August, then fell in October for open channels and were equal in August and October for closed. Values for parr in open and closed channels increased greatly from June to August and then decreased in October.

#### *Brook trout*

Frequency of YOY Brook trout was always highest in open channels except in October (Fig 3. A). In open channels, frequency of YOY trout decreased from June

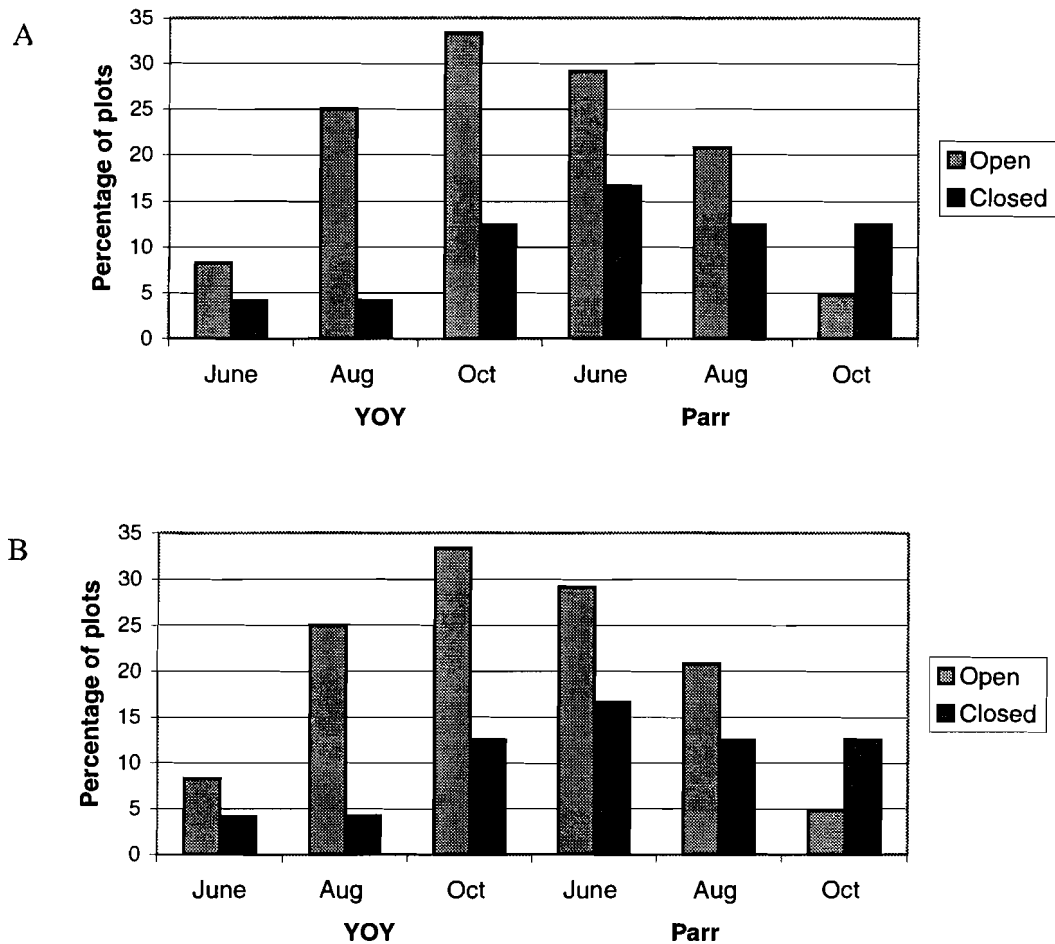


Figure 2. (A) Percentage of plots in which Atlantic Salmon occurred, by season and side channel type. (B) Atlantic salmon (young of the year and parr) timed density, by month and side channel type

(29%) to August (17%) to October (0%). While in closed channels, frequency of YOY trout increased from June (8%) to August (13%) then decreased in October (4%). For juvenile or adult trout, closed channels always had higher frequency than open. Open channels showed the same frequency of juvenile trout from June to August (13%) then decreased to zero in October. In closed channels, the frequency of juvenile or adult trout increased greatly from June (21) to August (38) then greatly declined in October (4%).

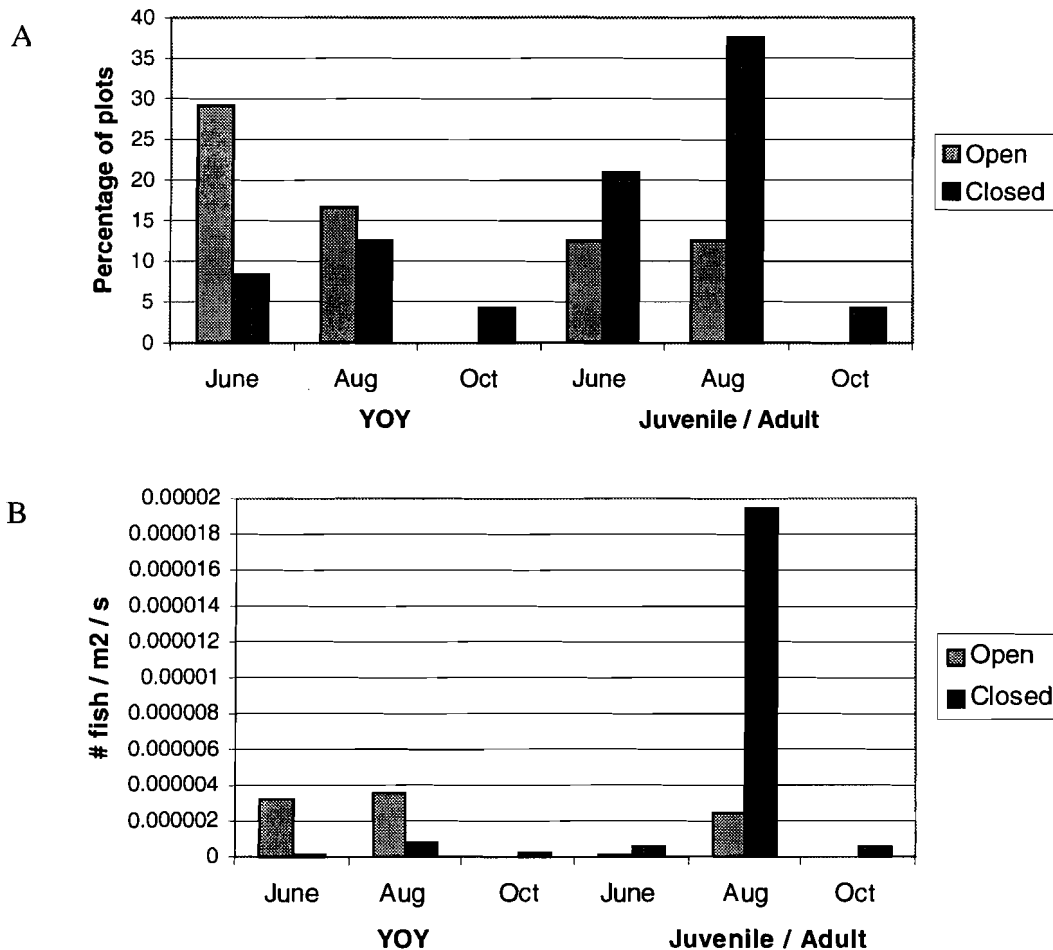


Figure 3. (A) Percentage of plots in which Brook trout occurred, by season and side channel type. (B) Brook trout (young of the year and juvenile or adult) timed density, by season and side channel type.

Timed densities of YOY trout were higher in open than closed channels for June and August but reversed in October (Fig 3. B). In both open and closed channels, YOY trout timed densities increased from June to August, then decreased in October. Timed densities of juvenile or adult trout were always higher in closed than open channels. Timed density of juvenile or adult trout, increased in both open and closed channels between June and August and decrease in October. Density in closed channels are 8 times greater than open in August.

## **Results: Habitat**

There were six physical variables measured to characterize side channel habitat: temperature, water depth, velocity, algae and plants bed cover, bank cover composition, and substrate size.

Temperatures were highest in August and lowest in October (Fig 4. A). The greatest average difference between temperatures taken in the main channel and in side channels was in June. Side channel plots were on average between 2.2 and 2.5<sup>0</sup> C colder than the main channel in June, between 1.8 and 2.1<sup>0</sup> C colder than the main channel in August, and between 0.4 and 1.0<sup>0</sup> C warmer in October. Open channels were always slightly cooler than closed side channels when compared to the main channel.

Velocities were measured using a current meter at 50% of the depth or determining the surface velocity by timing a float which was multiplied by 80% to estimate the velocity at 50% of the depth. The average plot velocities were higher in closed channels than open channels in June and August because open channels were cut off from the main channel at these times (Fig 4. B). In October, velocities increased with water levels in open side channels and increased only slightly in closed. A high flow occurred between sampling the two open channels, increasing the velocities in one channel and biasing the result.

On average, plots in closed side channels were deeper than open (Fig 4. C). Seasonally, depths were lowest in August, highest in October, with June levels in between. The high flow that occurred between the sampling of the two open channels deepened one of the open channels, biasing that result.

Substrate diameter in millimeters was visually estimated in each plot for three size classes: 84 percent finer than (D84), 50 percent finer than (D50), and 16 percent finer than (D16). This gives the range of substrate diameters present within a plot. The three estimates (June, August, and October) were averaged for each plot because estimation errors decrease with replication and substrate composition did not change over the sampling period. On average, the D84 and D50 of closed side channel plots are coarser than open, while the D16 values are similar (Fig 5. A).

Algae and plant cover was visually estimated as percent of the bed surface covered. On average, plots in closed channels had a higher percent of both plants and

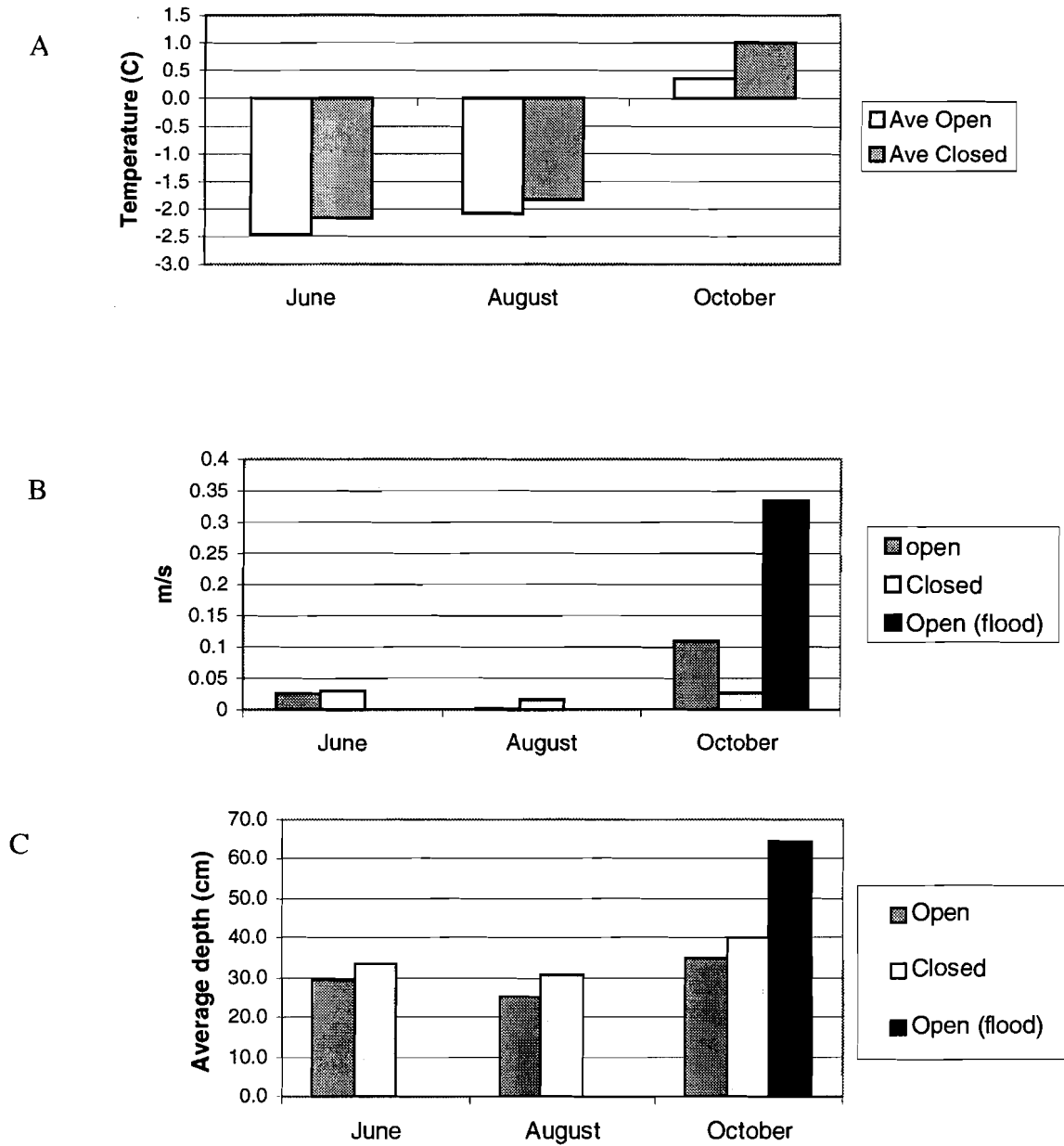


Figure 4. (A) Average temperature difference between the main channel and side channels in three seasons. (B) Average velocity in open and closed side channels for three seasons. (C) Average depth of open and closed side channels for three seasons. In B and C, note the higher depth and velocity in October for open channel plots sampled after a flood.

algae in all seasons except August when the percent of plant cover was approximately the same (Fig 5. B). The amount of plant cover in closed side channels was the same from June to August then increased in October. The alga cover in closed channels increased from June to August then leveled in October. In open channels, plant and alga cover increase from June to August then decreased in October. In all cases alga cover was higher than plant cover.

Bank cover was visually estimated as percent of the bank that was composed of grass, shrub, tree or root (large woody debris included with root, Fig 5. C). Bank composition was counted only if it could be “seen or felt” from the water. If the water level had decreased so that the water was no longer touching the bank, but instead was on gravel or sand, bank cover would not be counted. Trees were counted only if they were overhanging the plot. Roots were counted only when they could be seen. This underestimated the amount of roots because they may have been hidden behind leaves, and shrubs or been underwater. Bank composition changed through the seasons and open and closed channels showed differences. The total average bank cover of open and closed channels were the same in June, lower in open than closed in August, and greater in open than closed in October. Tree cover decreased in October due to the fall of leaves. Root cover was higher in open than closed channels for all months but August when it was the same. Tree cover was higher in open channels than closed, but grass cover was higher in closed than open. Shrub cover was higher in open than closed for all but August.

### **Preliminary conclusions**

River systems with side channels offer valuable habitat diversity because fish utilize various habitats at different life stages and through the seasons. Biodiversity is enhanced by habitat diversity because many species use these various habitats. More information is needed on fish communities, micro habitats, and formation of side channels so that these habitats can be managed most effectively. Side channels have been obstructed in the past by agriculture, and road and bridge building, but the effect of these activities on side channel habitats remains unknown.

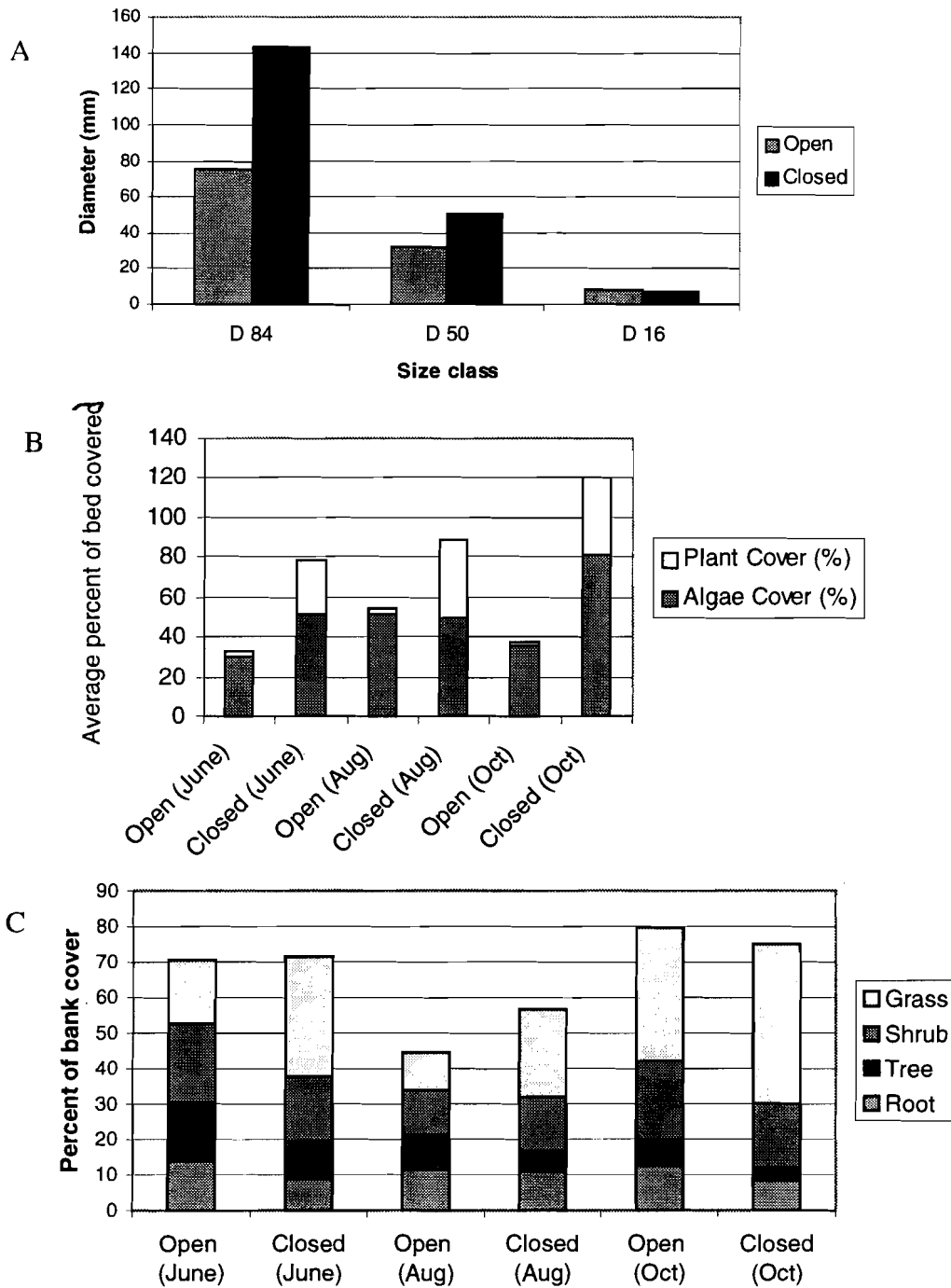


Figure 5. (A) Substrate size in open and closed side channels (average of three observations). (B) Average algae and plant cover of the bed in percent by season and side channel type. (C) Average composition of bank cover in percent of bank, by season and side channel type.

## **Future research**

Analysis of this data will continue. Detailed temperature data collected from one open and one closed channel using data loggers has yet to be analyzed. Also, water samples taken for conductivity measurements to determine ground water inputs will be analyzed. The data collection methods allow for the use of ordination techniques. Correspondence analysis and Canonical correspondence analysis will be applied to investigate the community structure and the habitat controls on community within these side channels.

The observations of side channel community and habitat were made over three seasons (spring-fall). Two conditions were not investigated in this study: winter conditions with ice cover and spring high flow because the techniques used for the open water portion of this study are not appropriate. Winter field observations will be made while the side channels are frozen to determine selected habitat characteristics. River ice will be cored and the thickness of the ice, water depth and velocity determined to investigate conditions under the ice. This will not determine if fish are present in side channels in the winter but if there are hydraulic conditions that may allow them to survive in these sites.

Finally, the processes that control the formation and maintenance of side channels will be determined. Maps and airphotos will be analyzed to determine the location and stability of side channels. Field data collection, including surveying and gravel sampling, will continue in the summer of 2000. Channel long profiles and cross-sections will be determined using standard surveying techniques and gravel composition measured by bulk sampling. The maximum water level attained from winter to spring will be determined using maximum stage recorders placed within reaches with side channels. Ice jams are thought to play a role in side channel formation but direct measurement of ice jam processes is difficult and dangerous. Field evidence of ice jams, fresh scars on trees and the floodplain will give insight into the roll of ice jams in side channel formation. Also, ice jams may be detected with maximum stage recorders because water levels behind jams can locally be much higher than bankfull stage.

## References

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