Riparian Function and Management of Small Streams 2005 Update

The Prince George Small Stream Project, whose members are comprised of Ministry of Forests Regional Research, P. Beaudry and Associates Ltd.; Department of Fisheries and Oceans, Science Branch and Canadian Forest Products Ltd., are working on describing and quantifying natural stream functions in small streams in the Prince George Forest District and the effects of forest management on these functions. Small streams are important because they make up a major portion (70-80%) of every watershed[1]. The project was initiated in the 2001 field season to determine if harvesting to the minimums specified in the Prince George District Manager's Policy for "Maintaining the Biological and Physical Attributes of S4, Small Fish-bearing Streams" ("D.M. Policy") maintains the necessary ecological attributes for healthy fish habitat. You may be familiar with this project having attended one of the field tours or the Natural Function of Small Streams course. This update provides some interim results for consideration when managing small streams in the SBS biogeoclimatic zone.

The experimental design for the project is based on a *Before-after-control-impact paired design (BACI-P)* described by Schwarz (1998[2]). This type of design has at least two types of sampling (before and after impact) in areas (treatment and a control) with biological and environmental variables being measured in combinations of time and space. In 2001 plots were established in 3 locations for intensive aquatic and riparian ecosystem monitoring:

1) Bowron - SBSvk, spruce-subalpine fir stand
2) Chuchinka - SBSwk1, white spruce-subalpine fir stand and
3) Tagai - SBSdw2, lodgepole pine stand.

The streams in this study are small (80 to 160cm bankfull width) and low gradient (3-6%). The sites were monitored for 2 years pre-harvest and monitoring has continued post-harvest. The sites were harvested to the minimum standards specified in the "D.M. Policy". The Bowron site was harvested in winter 2002/03, the Chuchinka in summer 2003 and the Tagai sites in spring and summer 2004.

The pre-harvest data have been compiled to describe natural stream functions in small streams in the SBS biogeoclimatic zone. A summary of some of the key findings documented to date are provided below:

There is a large range of woody debris found in these small streams. Every stream had an abundance of small woody debris pieces (5-15 cm diameter), and every stream had large woody debris, i.e. > 30 cm diameter. Small streams require a range of woody debris for channel and streambank stability and ecological diversity, for retention of organic matter, as a food source for invertebrates, a refuge for fish and a substrate for microbes and algae. On average, 60 to 80% of the woody debris was recruited from a distance of 10 m from the edge of the stream, while only 40-50% of the woody debris was recruited from within 5 m of the stream. Thus we suggest that trees retained for future woody debris contribution should be located within 10m of the stream. Source distance was related to stand height with taller stands having longer woody debris source distances. Blowdown of trees into small streams is a natural process.

[1] Gomi, T., R.C. Sidle, and J.S. Richardson, 2002. Understanding Processes and Downstream Linkages of Headwater Systems. BioScience, Vol. 52, No. 10.

[2] Schwarz C.J. 1998. Studies of Uncontrolled Events. *In:* Statistical Methods for Adaptive Management Studies. Res. Br, B.C. Min. For., Res. Br., Victoria, BC, Land Manage. Handb. No 42.

An average of 3 sediment sources (mostly old root wads) were identified for every 100m along undisturbed small streams. There were more natural sediment sources found on streams in lacustrine parent material.

These small streams are relatively cool in the summer months ranging from 6.7-10.6^{o}C with small daily fluctuations of 1 or 2 degrees Celsius. The low temperatures are attributed to stream shading and input of cooler groundwater along the length of these streams.

Rainbow trout were caught only intermittently in these small streams indicating that fish are a poor indicator of fish-bearing status in headwater streams. This is attributed to transient stream use dependent on annual stream flow conditions and variable recruitment of spawners from downstream populations.

Very low nutrient levels (nitrogen and phosphorous) and low levels of benthic invertebrates (i.e. insects that live on the bottom of the stream) were found in these streams when compared to data from coastal BC, suggesting that theses streams naturally have lower productivity than coastal streams of the same size.

Preliminary post harvest data have been collected at all treatment sites. We found that the D.M. Policy requirements for protection around small streams can be operationally achieved. The retention did not increase the number of sediment sources except on one site where there were very high levels of blowdown. Blowdown levels declined substantially the second year after harvesting. Not all blowdown contributed to woody debris in the stream. Some increase in turbidity (in-stream sediment) was noted, which was attributed to roads and skidtrails.

At two years post-harvest there have been no significant changes in stream width or depth, which is not surprising as there has been no time for wood or root decay and the streambanks were well protected with an effective 5 m machine free zone. The retained trees will contribute woody debris in the future and minimize changes to stream width and depth.

In the 2 years post-harvest the average, maximum and minimum stream temperature changed less than 3^{o}C, on average. The highest temperatures occurred in late July, early August corresponding to the warmer air temperatures at this time of year. This temperature change may have been larger in the absence of the retained buffer and riparian understory.

The low nutrient levels and low levels of benthic invertebrates have not changed during the first 2 years post-harvest despite the harvesting disturbances. There has been a reduction in downstream invertebrate drift. The post-harvest increased light levels, recorded at the stream surface, have not increased the abundance of periphyton, which is the matrix of algae and other microbes that grows on the stream bottom substrate. Their growth appears to be limited by the low stream nutrient levels. A reduction in the canopy biomass has resulted in a significant decrease in litterfall inputs; which are important for the productivity of these small streams.

The project researchers are continuing to monitor these sites to determine the changes that occur over time. To obtain more information on the Prince George Small Stream Project contact the researchers directly, attend the next Natural Function of Small Streams course (UNBC continuing studies), read published articles in Streamline (spring 2003), Trout Unlimited: Forest Land - Fish II Conference (2004), American Water Resources Assoc. Riparian Ecosystems and Buffers (conference 2004); or look for a new MOF website on fish-forestry projects (due on the Ministry of Forests website by December 2005).

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