

# Elk River 2005 Channel Stabilization Project

## Part II: Monitoring Results

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Over much of the 20th century, the Elk River (a tributary to Upper Campbell Lake on northern Vancouver Island) changed from a stable, single-thread channel to an unstable multi-thread channel. Changes in stream morphology resulted in the unvegetated channel width increasing by four to seven times, and drought conditions (i.e., a lack of available water) persisting in the coarse gravel bars in the summer leading to conditions that impeded natural revegetation. Fish habitat was degraded as a result of these changes.

With funding from the BC Hydro Bridge Coastal Fish and Wildlife Restoration Program (BCRP), work began in 2004 on the Elk River Channel Stabilization Project (see Cuthbert and Redden 2005). This project aimed to stabilize the unvegetated gravel bar through the soil bioengineering process of live gravel bar staking. To make conditions favourable for natural revegetation, live stakes were planted deep enough so that moisture became available to the roots during summer and the plants survived. Three sites totalling 1.9 ha were planted with live stakes in 2004. This article reports on the first year of monitoring results. [For further background on the project, see *Streamline* Vol. 8, No. 2, Spring 2005.]

### Post-staking Baseline Survey (2004)

Immediately after completing the live-stake planting in 2004, 51 monitoring plots were established on the

gravel bars, including 44 plots in the planted areas (treatment plots) and 7 unplanted control plots. Each monitoring plot has a 3-m radius (28.3 m<sup>2</sup>). The number, species, and size of stakes planted in each plot were documented, as were the characteristics of all other vegetation in each plot. In a subset of 16 plots, three 0.5-m<sup>2</sup> areas in each plot were established and photographed to document changes in the bed material (substrate) composition. Based on the post-staking surveys, the sites were planted at a density of 17 200 stakes per hectare with a species mix of 85% Scouler's willow (*Salix scouleriana*) and Sitka willow (*Salix sitchensis*), 6% black cottonwood (*Populus balsamifera*), and 9% red-osier dogwood (*Cornus stolonifera*). Overall, 60% of the stakes were the target size of 2 cm or greater in diameter, and the remaining 40% were less than 2 cm in diameter. Panoramic site photographs were taken at three fixed locations per site, and a total station survey was completed to document the site area, channel profiles, and cross-sections.

### First-year Monitoring (2005)

In June 2005, the channel surveys were repeated, and substrate and vegetation monitoring were completed in

late July. At that time, it was discovered that permanent plot markers had been removed from three of the treatment plots. Therefore a total of only 41 treatment plots along with the 7 control plots were monitored in 2005. The 2005 vegetation monitoring included remeasuring variables surveyed in 2004; recording stake survival rate, and the number of epicormic branches per stake (branches that emerge from dormant buds along the trunk or branch of a tree); and noting evidence of browse by deer and elk. As a measure of stake performance, the approximate mean and maximum epicormic branch heights were visually estimated and recorded in each plot.

Performance of the live stakes after 1 year is summarized in Table 1. The survival rate of willow stakes was highest at 91% while the red-osier dogwood stakes had lowest survival



Figure 1. Live-staked area in June 2005, early in the growing season.

rate at 62%. Unfortunately, due to misidentification of several cottonwood stakes as willow stakes in baseline monitoring the cottonwood survival rate could not be calculated. However, observations indicated that the rate was high, and likely on par with the willow survival. A typical area of staked gravel bar early in the growing season is shown in Figure 1.

Utilization of the areas by elk and deer was known to be high, and the potential for significant browse mortality was a concern. The results of the

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monitoring demonstrated that that red-osier dogwood was the preferred browse species as 71% of the growing live stakes were browsed, followed by cottonwood (27%) and willow (3%). The willow may have experienced some mortality, possibly due to an infestation of willow leaf beetle (e.g.,



Figure 2. Beetle larvae and damaged willow leaves, June 2005.

*Plagiodera versicolora*; Figure 2). These beetles are not known to cause tree mortality; however, in the case of the cut and transplanted stakes, the cumulative stress may have led to some mortality.

The project measured the number of epicormic branches per stake to further assess live-stake performance. In general, most willow stakes had between 1 and 10 branches, and only 9% had 11 or more branches (Figure 3). Cottonwood stakes had similar results (Table 1). In contrast, nearly all of the red-osier dogwood stakes (96%) had 1 to 5 branches with an approximate mean epicormic branch

height of 29 cm. The average of the maximum heights was 53 cm per plot and the overall maximum height recorded was 72 cm. These approximate mean and maximum heights were not differentiated by species; however, most of the heights were recorded from willow stakes. In a few instances, cottonwoods were the tallest in the plots.

As a result of heavier deer and elk browse, red-osier dogwood stakes consistently had the shortest branches and least amount of growth in the observed plots. While data were not collected on the performance of stakes based on their basal diameter at the time of planting, it was qualita-

tively observed that the undersized stakes planted in 2004 did not appear to have a mortality rate greater than the full-sized (>2 cm) stakes. The relationship between stake diameter and survival/performance was studied in 2006, and analysis and reporting of the results are in progress.

Other vegetation measured in the monitoring plots did not show changes in species composition or relative abundance compared with baseline conditions. Changes in bed material composition were generally small, as it appeared that the river had not inundated many of the areas over the winter. Where gravel bars had been inundated during peak flows,



Figure 3. Willow live stake growth, June 29, 2005.

Table 1. Summary of live-stake performance after 1 year

	Total stakes planted in 2004	Live stakes showing growth in 2005	Epicormic branches per live stake			% of live stakes browsed	% survival
			1-5	5-10	11+		
Willow (Scouler's and Sitka)	1500	1358	47%	45%	8%	3	91
Black cottonwood*	N/A	123	54%	40%	6%	27	N/A
Red-osier dogwood	158	116	96%	3%	1%	71	62
All species combined	1781	1597	51%	41%	8%	10	90

\*In the baseline monitoring, several cottonwood stakes were incorrectly identified as willow. The baseline numbers have been adjusted to reflect this; however, it is not possible to determine overall cottonwood survival without accurate baseline data. The misidentification affects the results when broken down by species, but not the overall survival results.

fine sediments and small organic debris had accumulated at the base of stakes as expected (Figure 4).

Precise repeat measurement of the cross-sectional and longitudinal channel surveys was complicated due to the lack of permanent markers along the survey route. The sites are located within Strathcona Provincial Park and visible permanent markers for the surveys were prohibited according to the terms of the Park Use Permit. Therefore the survey locations may have varied slightly between the two years. The localized accumulations of debris and substrate that were associated with the live staking were generally not large enough to cause any appreciable changes in gravel bar elevations. Monitoring at the control plots, as well, did not show any obvious changes in vegetation or in substrate composition.

The results of the first year of monitoring were positive, with a stake survival rate of 90% and indications that, when inundated, the stakes are effectively trapping fines and organics. Over time, this process will allow the successive establishment of riparian vegetation, which in turn is the key to long-term channel stabilization.

### Summary of Results

- Overall, 90% of the stakes survived into the first growing season.
- Ungulates showed preference for browsing on red-osier dogwood followed by cottonwood. This likely alleviated the browse pressure on the willow, which made up most of the stakes.



Figure 4. Fine sediment and small organic debris collected around live stake.

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Future projects should consider adding these preferred browse species when willows are the primary species planted.

- Undersized stakes planted in 2004 did not appear to have a mortality rate greater than the full-sized (>2 cm) stakes. This is being further investigated in 2006.
- Identification of stock can be difficult after planting (before leaf out). If monitoring is to be based on species, a more permanent means of tagging and monitoring the performance of individual stakes/plots might be considered.

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#### Literature Cited

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