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Technical Tip

Monitoring and Evaluation of the Fish Response to West Kettle River Habitat Restoration

Wendell Koning and Pat Slaney

Figure 1. Lateral log jam structure ballasted 2.5 - fold to account for debris collection before scour.

An integral part of all watershed restoration work is monitoring, without which it is impossible to assess project effectiveness. Monitoring provides a level of accountability in the restoration process; it also offers opportunities for learning and adaptation as new knowledge is gained (Koning et al. 1998; based on the earlier work of Gaboury and Feduk 1996). Through monitoring, restoration successes can be noted and refined; recognition of project elements that have led to failures can provide equally valuable lessons. Such evaluation provides an adaptive management tool that increases the probability of restoration success.

In the past, most fish habitat restoration projects allocated insufficient time and resources to post-project evaluations. If conducted, evaluations frequently lasted for only the first one or two years following restoration. Typically, even these limited evaluations frequently found physical failures in instream structures such as log and boulder placements, rock weirs and groynes. Restoration works can fail due to variety of reasons, including:

- a general lack of biological understanding of fish habitat and stream hydrology (Kauffman et al.1997);
- failure to use natural analogues as design templates;
- imposing structures purely for mitigation purposes, e.g., to replace habitat lost to hydro-electric developments;
- failure to account for high channel instability and bedload movement due to upslope impacts;
- too narrow a focus on instream palliative treatment instead of watershed husbandry (Chapman 1996);
- failure to work within an interdisciplinary team which includes stream, riparian and upslope specialists (Roper et al. 1997).

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There are reports of losses of durability or function of instream structures during significant flood events for earlier work carried out in British Columbia (≥50% marginal successes and failures, in Miles 1995; Hartman and Miles 1995; and Kellerhals and Miles 1996), and in southwestern Alberta after a 100-year flood event (81% losses on larger streams, in Pattenden et al. 1996). A history of failure is one of the driving forces for evaluation. More recently Doyle (1997) and Heller et al. (1997) report failures of less than 20% for thousands of instream structures that recently withstood major flood events (50 to 100-year floods) in the Pacific Northwest (Washington and Oregon). The higher success rates reported recently in the Pacific Northwest region are a result of: project design and implementation that have addressed upslope risks; improvements in instream works design; a greater use of natural templates; and an annual evaluation, inspection and maintenance program for the installed instream structures.

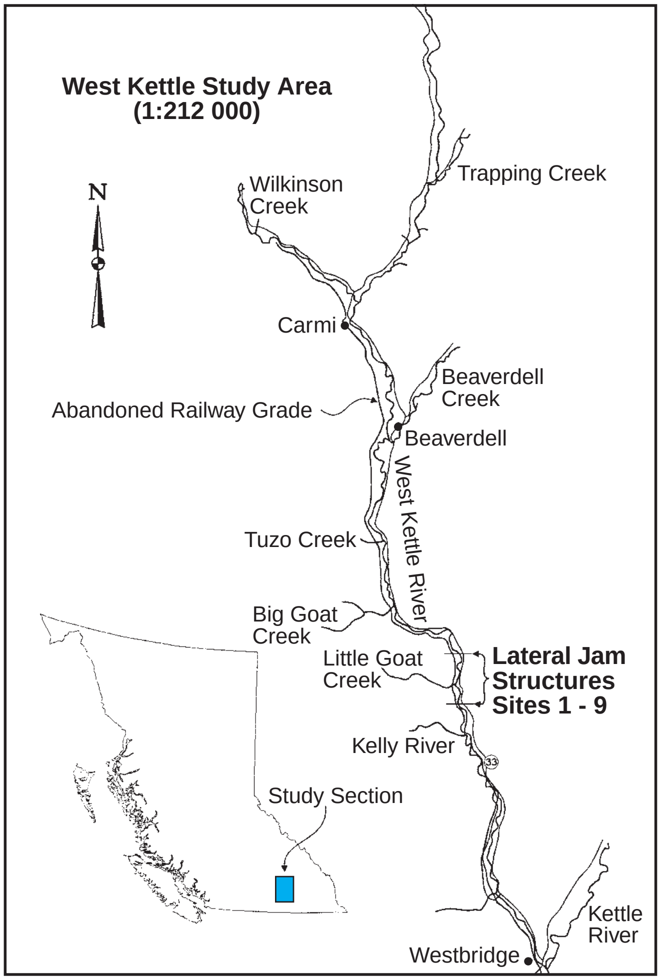

Figure 2. Kettle River study area near Beaverdell.

Since the late summer of 1996 and 1997, nine lateral log jam structures (Figure 1) were installed in the West Kettle River, 15 -17 km downstream of the town of Beaverdell, in southwestern B.C. (Figure 2). The West Kettle River has been adversely affected by past logging activities as well as by agriculture, road construction (Highway 33), and the now defunct Kettle Valley Railroad. Previous studies have estimated resident rainbow trout population numbers and habitat characteristics/capability in the West Kettle River and some of its tributaries. The West Kettle River, and key tributaries, damaged by past logging and other human impacts, were ideal candidates for fish habitat restoration, as there were existing historical data on fish populations and fish habitat characteristics, and the rainbow trout population supports a sport fishery for 20 - 50 cm trout where pool habitat is remaining. Near-shore, triangular-shaped lateral log jam structures were installed in the West Kettle River to create scour-pools (Figure 3), a design recommended as stable by Slaney, Finnigan and Millar 1997. These structures tend to duplicate natural lateral jam templates in trout rivers (Figure 4). By 1997, nine lateral log jam structures were installed in a 1km section of the river, where channel width is approximately 30 m.

As part of the monitoring program at the West Kettle restoration site we measured the impact of the restoration activities on the resident rainbow trout fish population. We established temporal and spatial controls, critical for this type of monitoring. By temporal controls we refer to baseline fish abundance data, prior to installation of the lateral log jam structures. Data for one year prior to construction is an absolute bare minimum for use as a temporal control. Although seldom available, two to five years of pre-construction data would be ideal. A 600 m section upstream of the treatment section was used as the spatial control. This provided what is referred to as a "before and after controlled impact design." The control section is similar to the treatment section prior to treatment, in that it is devoid of habitat complexity, and contains few pools and little LWD (except for one naturally present lateral log jam). Ideally, a monitoring program requires an external control such as a reach in a nearby stream, with features similar to those of the treatment reach. An external control offers a better measure of variation in fish abundance due to natural causes, such as variation in weather patterns. To identify fish species present and measure species abundance we used an adaptation of the snorkel technique described in Slaney and Martin 1987, whereby swimmers float downstream counting all fish between them. We completed the work with two swimmers. In wider streams, or where turbulence or sediment reduces

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Figure 3. The construction of a lateral log jam in 1996. Note the shallow water.

Figure 4. The same location as above, one year later. Note the extensive jam and the deep water, similar to natural lateral log jams.

underwater visibility, more swimmers are required.

Preliminary results are encouraging (Figure 5). Within the treated section we counted 114 rainbow trout at parr stage and larger near the constructed lateral log jam structures, and only 9 specimens away from the structures in open water. In comparing the treated and control sections, swim counts revealed a density of 154 rainbow trout/km in the treated section, and 23 rainbow trout/km in the control section. Rainbow trout densities from the treated section one year prior to treatment were similar to the current figures for the control section. More than 50% of the rainbow trout were between 10 - 20 cm in length, and about 15% were between 20-30 cm. A few > 30 cm were counted, and the remainder were under 10 cm. Trout >40 cm have been observed in pools in the fall when they redistribute to winter habitats. We also observed and counted mountain whitefish, red shiners and brook trout (one only) at the lateral log jam sites.

The increase in rainbow trout in the treated section one year after restoration treatment is likely due to fish attracted to the area from other parts of the river, rather than to a net increase in fish numbers in the river. Adult trout redistribute after spawning in tributaries in the spring and again in the fall when pool habitat provides protection from anchor ice. Parr (ages 1 - 3 years) are recruited annually from nursery tributaries of inland rivers. Over time, however, we expect a net increase due to the greater amount of high quality restored pool habitat. Whole river monitoring, by snorkel census or by mark-recapture procedures of sufficiently long sections of stream, can provide data regarding future increases in fish numbers. Indices of fish condition (fish length and weight measurements, aging by scale analysis) can also provide good monitoring data with fish sampled by gee traps, catch-and-release angling, and electrofishing. Fish in abundant, high quality habitat, provided there are no other unaccounted for limiting factors, such as food sources, will be larger than the same age fish in poor quality habitat.

Lateral pools are restored by ballasting triangular LWD structures, thereby trapping drifting woody debris and causing local scouring.Field and anecdotal observations suggest pools associated with these lateral structures are now being fished relatively heavily by anglers, but as the area is within a catch-and-release zone on the river, the removal of fish should be low. Future evaluation, planned for 1999, includes a creel census to survey the number of fishers and "catch per unit effort." This will assist in economic evaluation. Estimates of dollars spent per angler-day and "willingness to pay" values from previous economic studies (Scarfe 1997) are available. We estimate 2 "angler-days" per catchable trout, with an angler-day valued at $40 per day.

Are we are doing the right thing in adding lateral log jam structures to the West Kettle system? We believe so, as we observed some natural jams approximately 10 km upstream of treatment sites and are using these as template designs. Monitoring of restoration efforts confirms this. Historically, the West Kettle would have had high densities of LWD as single large pieces and LWD tied up in log jams, which initiated scour pool development and thus provided fish habitat and cover. Historical logging to the streambanks in most reaches has resulted in loss of new recruitment of LWD to the stream and loss of habitat complexity, especially pools. Adding lateral log jams is one component in restoring the West Kettle River watershed to a healthy and diverse system.

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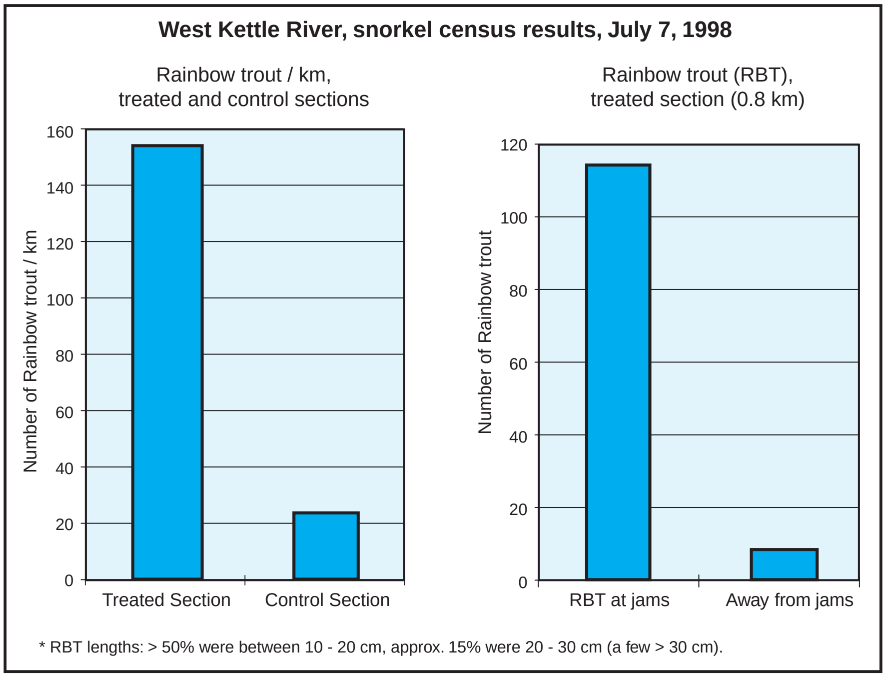

Figure 5. Rainbow trout counted within treated and control reaches, and numbers inhabiting log jams vs. open water.

Various types of monitoring have been defined previously for watershed restoration projects. These include: trend, baseline, implementation, effectiveness, project, validation and compliance monitoring (MacDonald et al. 1991). Monitoring methods that are not mutually exclusive may differ according to type (research focused or project-specific), and whether the project to be monitored will be of short or long duration. Evaluation within the instream portion of the Watershed Restoration Program has been divided into two major types: research evaluation and operational or effectiveness monitoring. This is often described as an "evaluation pyramid" (Figure 6). The bottom portion (the bulk of the pyramid) is made up of operational monitoring; the much smaller, upper portion, research evaluation.

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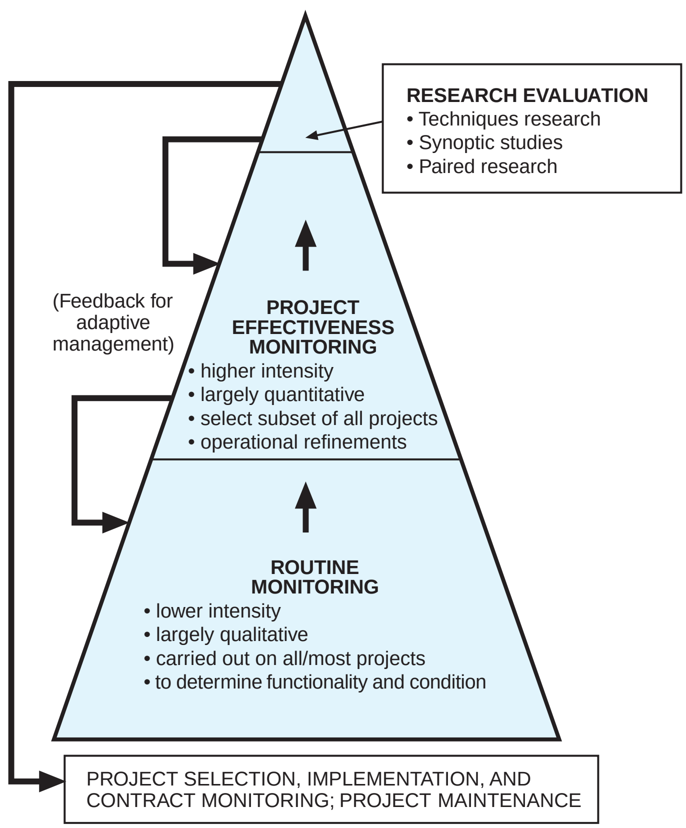

Figure 6. Evaluation pyramid (Koning et al,1998).

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Update

Conferences

Monitoring for Forest Land Managers: Managing the Process. December 1-2, 1998. CH2M Hill Alumni Center, Corvallis, Oregon. Organized by the Western Forestry and Conservation Association. For further information or to register, contact the Association at 4033 SW Canyon Road, Portland, Oregon 97221, Tel: 503-226-4562, Fax: 503-226-2515, or E-Mail: richard@westernforestry.org

At Risk: Biology and Management of Species and Habitats at Risk. February 15 - 19, 1999. University College of the Cariboo, Kamloops, B.C. Some topics that will be included are evaluation of risk, transboundary management issues, fine filter vs. coarse filter conservation strategies, tool boxes for private and public land management, public involvement, and stewardship. For further information Tel: 250-371-5579, or Fax: 250 Web site at http://www.cariboo.bc.ca/speciesatrisk