

Instream and Channel Restoration Projects

Durability of Pacific Northwest Instream Structures Following Floods

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Project Description

Instream structures are an important component of stream restorations and have been used throughout the world to alter stream characteristics and improve stream conditions for fish populations. They are particularly prevalent in the Pacific Northwest, and have been demonstrated to increase specific stream biota. This is the first study that specifically evaluates the physical durability of structures. Although a structure may increase fish production in the short term, if it has a short life span (<5 years), its overall benefit may be minimal.

The evaluation described here is part of a broad, multi-phased assessment of the effects of the 1995 and 1996 floods on U.S. Forest Service lands in the Pacific Northwest. This study focused on the instream structure durability, and had three objectives :

- to determine the overall durability of instream structures following floods with 5 to 150 year return intervals,
- to relate durability to geomorphic and stream conditions, and
- to provide recommendations to improve future performance of structural instream restoration treatments.

Criteria for Evaluation

The study examined flooded streams with return intervals exceeding 5 years, and that contained restoration structures. Initial surveys included about 4,000 structures in more than 100 streams. However, because of incomplete records, the data set used for analysis consisted of 3,946 in 94 streams. Overall durability was high; less than 20% of the 3,946 instream structures were removed from the site following floods exceeding a 5-year return interval.

Lessons Learned

- Magnitude of flood events had a significant effect on structure durability with higher magnitude floods reducing durability (see Figure 1).
- Stream order also affected structure durability; structures in large streams were 20 times more likely to have been removed from the site of original placement than structures in small streams (see Figure 2).

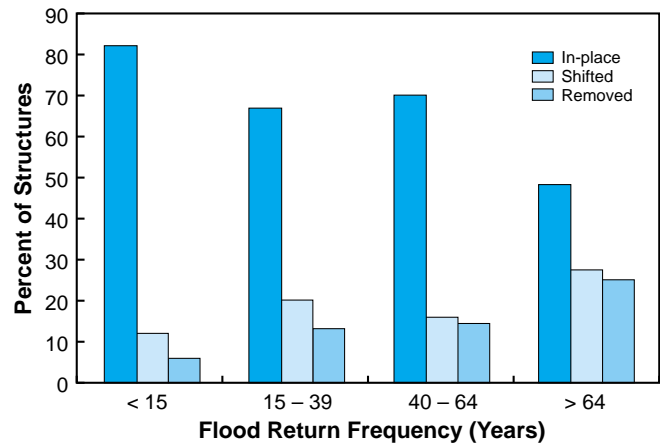


Figure 1. The relationship between flood magnitude and structure durability.

- Other conditions that affected structure durability included location of the structure within the stream channel, whether the structure was anchored or not, structure material and upslope landslide frequency. Structures designed with connections to the stream bank had greater durability. In addition, structures could be less durable in unconstrained stream channels. Consequently, durability is probably greatest for instream structures

Stream order	Sample size	Flood frequency (years)	Structure Movement Category		
			In place (%)	Shifted on site (%)	Removed (%)
2	176	<40	83	8	9
2	157	≥40	70	20	10
3	794	<40	70	21	9
3	702	≥40	64	19	17
4	711	<40	76	15	9
4	847	≥40	51	31	18
5	118	<40	60	20	20
5	334	≥40	41	17	42

Figure 2. The percentage of structures in each movement category stratified by stream order and flood frequency.

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used in constrained reaches of small- to moderate-sized streams (fourth order and smaller) and placed with a connection or connections to the stream bank.

- Instream structures are most appropriate when used as short-term tools to improve degraded stream conditions while activities that caused the habitat degradation are simultaneously modified.
- When instream structures are part of a properly sequenced watershed restoration strategy, they can improve habitat conditions through a range of flow conditions, including large floods. The relationship between instream structure durability and upslope variables indicates the importance of a watershed perspective when implementing stream restoration. ▲

Based on: Brett B. Roper, D. Konnof, D. Heller and K. Wieman, 1998. Durability of Pacific Northwest Instream Structures Following Floods. *American Journal of Fisheries Management*, 8:686-693. American Fisheries Society.

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Intensive Monitoring of Instream Works: Methodology and Year 1 Results

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Project Description

The prime objective for the intensive monitoring of restoration sites on Vancouver Island was to determine the “effectiveness” of instream structures based on site-specific biological and geomorphological targets, or “effectiveness standards.” A secondary objective was the collection of several biological and physical variables at both reach and site scales, to allow detailed inspection of relations between physical parameters (e.g., cover) and responses (e.g., fish abundance). The four geomorphic and two biological objectives associated with the restoration techniques are to:

- improve gravel accumulation or reduce percent fine sediment in bed,
- increase LWD cover,
- increase depth/reduce width (bank protection, bar stabilization),
- improve pool characteristics,
- increase fish production, and
- improve fish access to habitat.

Seven streams in five Vancouver Island watersheds underwent intensive monitoring in 1998. The *San Juan River watershed* contains Halliday, Five Mile and Renfrew Creeks, and is located 10-15 km east of Port Renfrew. The *Kootowis Creek watershed* contains Indian Bay tributary (test) and Staghorn Creek

(control), and is located 15 km south of Tofino. The *Nimkish River watershed* contains Lukwa Creek, the *Eve River watershed* contains Montague Creek, and the *Salmon River watershed* contains Big Tree Creek.

In the *San Juan watershed*, a culvert washout on a forestry road crossing adversely affected Halliday Creek. The road failure caused a large amount of sediment to enter the channel and fill pool habitat. The objective of the restoration work was to increase fish production and accessibility by excavating excess bedload and reconstructing riffle-pool sequences. Most of the LWD was removed from the reach at Five Mile Creek during stream cleaning practices during the 1980's. This resulted in a limited cover for fish during high flows and a lack of residual pool depth. The biological objective was to increase fish production by restoring cover and habitat complexity with the re-introduction of LWD. The lower reaches of Renfrew Creek have been affected by the loss of LWD cover and associated habitat complexity. Increased sediment inputs have resulted in infilling of pools. In 1997, restoration objectives were to increase LWD cover and habitat complexity by stabilizing LWD and introducing more LWD. Scouring during high flows will help to maintain residual pool depths.