Article 148

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The Longevity of Instream Habitat Structures

Instream structures play a key role in urban stream restoration, as they recreate the pools, riffles, over head cover and channel complexity that had been destroyed by increased stormwater flows. The same forces that degrade urban stream habitat—high flows, debris jams, and sedimentation—also work to lessen the effectiveness of artificial stream habitat structures. Therefore, a key question for urban stream managers is how long artificial habitat structures will persist before they too are damaged by urban stormwater flows. The question has enormous significance: is stream restoration a one-time intervention to reverse prior damage, or is it a constant struggle to try to maintain structure in streams that are dominated by erosive stormwater flows? If these structures fail, how often must they be replaced or repaired?

Urban stream restoration is such a new endeavor that we simply do not have enough of a track record to satisfactorily answer these questions. However, some insights into their longevity can be gleaned from an extensive study of the persistence of instream habitat structures in the Pacific Northwest conducted by Frissel and Nawa (1992). The researchers surveyed 161 fish habitat structures in 15 Oregon and Washington stream systems six months after a five- to 10-year flood event. The structures were one to five years old and were evaluated to determine how well they were functioning after the flood. The findings suggest that the expected longevity of structures is not as great as was once thought. In the 15 streams studied, more than half the structures had failed before the expected lifetime of 20 years. What's more, some of these "habitat improvement" structures had unintended and even negative effects on the stream morphology. For example, some had changed the course of the low-flow channel, or created barriers to fish migration rather than pools for breeding.

Are the observations from this large-scale study of undeveloped watersheds transferable to smaller, urbanized streams? It is important to remember that large and small streams differ in their vulnerability to physical forces (e.g., flood peak and sediment load) that damage structures.

The Causes of Structure Damage Are Multiple and Interacting

Of the eight Oregon streams studied, wider streams did tend to experience greater peak flows and greater damage and failure rates of structures than narrower streams (Table 1). The relationship between channel width and failure rate appears to be linear. Channel width appears to be one stream characteristic correlated with failure rates in the Oregon streams studied. No other single stream characteristic was a useful predictor of future failure; indeed, failure rates were quite high and variable in most streams studied (Table 2).

Although stream variables other than channel width (e.g. valley type, drainage area, channel slope) were generally a poor predictor of longevity of instream habitat structures, structure type was correlated with failure rates. Some types of instream habitat structures appeared to be more susceptible to failure or impairment. The majority of cabled debris jams and boulder clusters remained functional after floods, whereas the majority of log-weirs failed or were impaired (Table 2). The durability of the materials themselves is not a great factor in structure performance; structures may still be in one piece but washed away whole or buried under sediments. Placement is a factor, in the sense that a structure may be well-placed to begin with but becomes ineffectual or deleterious if the stream channel shifts.

Table 1: Active Channel Width and Structure Failure Rates (Frissel and Nawa, 1992)

Stream name and no. of structures (n)	Width of active channel (ft)	Flood peak (cfs)	Damage rate (%)	Failure rate (%)
Outcrop (5)	18.0	247.2	40	40
Crooked Bridge (6)	19.7	423.7	100	100
Silver (6)	29.2	600.3	50	17
Foster (15)	31.5	1,059.3	27	7
Bear (19)	35.8	988.7	79	32
Boulder (5)	39.4	ND	60	40
Shasta Costa (18)	60.0	1,589.0	83	55
Euchre (19)	98.4	3,248.5	100	95