Hydraulic and Biologic Effects of Engineered Large Woody Debris in Stream Rehabilitation

As part of the effort to save salmon populations in the Pacific Northwest, researchers have examined the life cycle of salmon in great detail. It has been determined that among other causes, a lack of fresh water habitat has contributed to the decline of salmon. Fresh water streams provide areas for adult salmon to spawn and for juveniles to rear for up to two years before they return to the ocean. Research has shown that large woody debris (LWD) in streams serves many functions, including absorbing the force of high flows and preventing bank erosion, directing the flow of water causing scour in streambeds that in turn creates pool habitat for fish, and providing cover and food for salmon and other aquatic species. ELWd™, an organic, engineered alternative to large woody debris, is being tested in a research project conducted by the University of Washington's Center for Streamside Studies.

Stream restoration projects often include adding large woody debris (LWD) to improve habitat for aquatic organisms. However, large logs are becoming increasingly rare as foreign and domestic markets for wood expand. As a result, large wood is expensive and difficult to obtain. Furthermore, large logs are hard to place in streams due to their size and weight.

ELWd™, an organic, engineered alternative to LWD, consists of an interlocking complex of small diameter poles that can be carried by hand and assembled on site. Like LWD, ELWd™ has a high surface roughness that traps sediment and debris. Unlike LWD, these structures are hollow and have a larger surface area that is convoluted with gaps. The engineered structures are filled with rock to increase their weight, making them less buoyant than the LWD in the study.

Partially assembled ELWD™

Only a few people are needed to install ELWD™

Wood components that maintain more contact with the channel bed induce greater amounts of scour (which creates fish habitat) than those that do not maintain contact. The majority of scour associated with both the engineered structures and natural wood takes place at the tip of the log that generally maintains contact with the streambed. Native wood generally lifts off the bottom when high flows occur. ELWd™ tends to maintain contact with the stream bottom because of decreased buoyancy due to the ballast. As a result, engineered structures produce more scour during high flows than is produced by natural wood.

There were no statistically significant differences (all p values > .18) between the invertebrate samples collected from the traditional LWD and and from the ELWd™ for ten metrics or the total Index of Biological Integrity (IBI) score. No strong relationships were found between the water quality parameters and the biological measures using either simple linear regression or curvilinear estimation techniques ($r^2 < 0.33$).

Distribution of Coho Salmon, Griffin Creek, July 1999

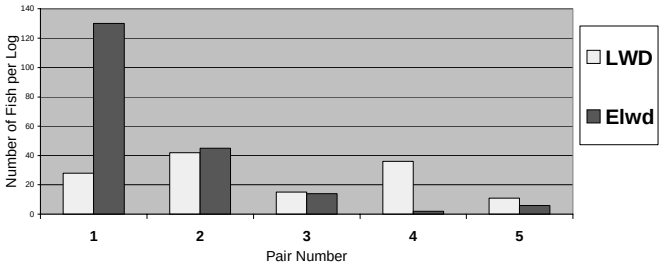

Figure 1

The fish data collected from snorkel surveys revealed that independent factors were more critical in fish distribution than the type of wood placed. Figure 1 shows the number of coho salmon observed at each log during a July 1999 snorkel survey at Griffin Creek. At pair number one, the ELWd™ recruited other wood that created significant backwater habitat. In pair number four, there was no significant scour associated with the ELWd™ structure, resulting in a lack of backwater habitat.

Elwd™ is best suited for use in small stream systems (<200 cfs average maximum flow) that are lacking in woody debris. Increased scour around the tips of ELWd is most likely caused by the ballast added to the structures. The ballast decreases buoyency and keeps the log in contact with the streambed. The study showed that high water flows did not differ markedly between natural logs and engineered structures. The ballast caused the once hollow structure to behave like a solid object.

Elwd™'s performance as a substrate for invertebrate colonization is comparable with that of larger diameter single logs. Fish distribution is independent of the type of log placed, but in smaller systems the engineered wood functions as well or better than traditional LWD. Elwd™ is not intended to supplement the natural recruitment of wood in the long term, but may serve as an adequate temporary improvement for fish habitat until the natural riparian corridor regenerates. The use of this type of technology may provide necessary alterations to degraded sections of spawning and rearing habitat for anadromous and resident freshwater fish without the cost of acquiring and manipulating large pieces of wood.

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Fully assembled ELWD™