



Habitat Restoration

SALMONID HABITAT RESTORATION
How-To-Guide for Washington State

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HABITAT RESTORATION

Habitat is critical to successful salmon stocks. From its inception, Fish First has worked to restore and create habitat on the North Fork of the Lewis River.

This is one in a series of Salmonid Habitat Restoration How-To-Guides for projects in Washington State. It was written to help groups and individuals undertaking similar projects and presumes some knowledge of salmon, habitats and project planning.

Other guides in the series:

- Rearing Pens
- Culvert Replacement
- Nutrient Enhancement
- Live Plants
- Habitat Restoration
- Permitting
- Project Funding
- Streamside Incubation

Over the course of nearly 50 projects, volunteers have returned pools and riffles to the stream, replaced gravel for spawn, installed woody debris for cover, and fixed riparian zones.

Restoring habitat is just one step toward saving natural salmon stocks. For more information on other steps, including nutrient enhancement and streamside incubation, please refer to the entire set of Fish First's related How-to Guides.

This guide is meant to be an overview to habitat restoration for salmonid projects in Washington State. Specific details and laws governing similar projects may vary from state to state and when dealing with other species. Please ensure all local and federal requirements are met before beginning restoration projects.

AN OVERVIEW

Habitat restoration is a broad term covering a range of actions that create, or re-create, stream features critical to a healthy environment and fish population. The methods and techniques used in restoration work vary, and improve with experience and technology.

Fisheries scientists and others who study streams and habitats regularly update their knowledge, and techniques and beliefs change as monitoring data and other information trickles in over time. Habitat restoration is a long-term process that requires a view of the big picture.

While various state and federal government agencies are concerned with fisheries and habitats, none has the overall, all-encompassing view of “salmon habitat” as its mission or goal. There is no agency devoted to salmon. Much of the onus of responsibility, then, falls to volunteer groups and nonprofits such as Fish First.

To some extent, habitat restoration work translates from one stream to the next. The laws of physics say that water runs downstream—methods applied to one area can work in another, but a systematic review and analysis of the stream and watershed characteristics must be done to avoid making serious mistakes. Before beginning a restoration project, it’s important to gather as much information as is available about similar projects in the area to find out what works and what doesn’t, and how to ensure a successful project.

Ultimately, successful restoration projects are long-term, and meant to bridge the gap between a spoiled habitat and nature taking its course to remedy it. Habitat is restored, and repopulated by salmon, over time—such work requires patience and vision. By returning streams to normal parameters and complexities, restoration groups can speed the natural process up and give nature a head start.

By way of example, consider spawning gravel. It is created and moved into place on a stream bed over centuries, by both the hydraulics of the river and by generations of salmon sweeping it into place with their tails. Well-designed restoration projects can mimic this process in a time span of weeks or months.

But habitat restoration is a sum of its parts. Each stage in the restoration process builds upon those that precede it, and relies upon those that will follow.

Without healthy salmon stocks, spawning gravel is useless. Without a healthy nutrient base, salmon stocks can not survive. And without the carcasses of spawned-out salmon, there are no nutrients. All the pieces of the restoration puzzle are interlocking.

Because of this, restoration design is part science and part philosophy. Projects have a better chance at success if they build upon the experiences of other successful projects, and to succeed at all they must play to a location’s natural strengths.

All habitat restoration projects should be designed in conjunction with experienced personnel, should take into consideration historical data of the target location, and should be performed in collaboration with local and regional fish and wildlife agencies.

METHODS & TECHNIQUES

Actual habitat restoration work involves reshaping streambeds and banks, re-channeling stream flow, planting vegetation, adding in-stream structure that re-balances the stream, and other actions to help bring an area back to historically healthy status.

What follows is a high-level overview of different types of restoration work. This is not meant to be a technical manual—many quality technical manuals already exist. At the end of this guide is a bibliography of such materials.

Structure

There are two main types of structures that can be added to streams to prevent erosion, root wads and rock vanes.

ROOT WADS

Root Wads are lengths of downed tree that include a portion of the trunk as well as the root mass, or ball. They reduce shear stress by deflecting stream flows away from the bank, and provide structural support, habitat for fish and other aquatic animals, and food for aquatic insects.

For Washington State salmon projects, root wads are mainly cedar and Douglas fir, species that can stand up over time and not deteriorate in the water. They can be as long as 20 feet, and are knocked down rather than cut to maintain the roots.

There are two primary ways to install root wads—the “drive-point” method, and the “trenching” method.

The **drive-point method** disturbs the least amount of soil and is more cost effective, but may not hold under repeated high water flow. It involves inserting the root wad directly into the bank. The end of the trunk can be sharpened with a chainsaw before it is driven into the bank. This method is best used only in silty banks with no rock.

Root wads should face upstream so they meet the stream flow at a 25-to-30-degree angle, deflecting water away from the bank.

The other, preferred method is **trenching method**. This method involves excavating a trench in which the trunk of the root wad will sit. A footer log can be installed beneath it, becoming the stable point for the root wad so water won't infiltrate underneath the root wad and lift it up hydraulically.

The trench should run 25-to-30 degrees to the bank and well below the bankfull flow level so that one-third of the root wad remains below the water surface in normal flow. After installing the root wad in the trench, backfill the trench and rebuild the bank.

VANES

Vanes are essentially “walls” constructed from boulders, other stones, or wood, and help create desired

adjustments in the streambed by redirecting the flow away from the bank and into the center of the channel. They also improve in-stream habitat by providing cover for fish and helping oxygenate the water. Vanes should only be installed by experienced specialists.

The three most common types of vanes are single, J-hook, and cross vanes. Regardless of the type, vanes should be oriented upstream at a 20-30 degree angle from the bank, just downstream from the point where stream flow hits the bank at acute angles.

Vanes should be highest where they are closest to the bank, and slope down as they point upstream at no more than a 30 degree angle. Rock size depends on the stream, but generally use the largest size possible, choosing flat rocks when available.

- Single vanes can span as much as two-thirds of the channel width at bankfull. With some exceptions, the rocks in all vanes must touch each other, and have footer rocks to scour depth—or the depth of the bed when sediment is washed away.
- J-hook vanes are built just like single vanes except for the last two or three rocks, which are spaced apart about one-half of the rock diameter. J-hooks also push stream velocity away from the high bank and provide a pool.
- Cross vanes provide grade control by keeping the deepest part of the channel in the center. They also protect the bank. A cross vane consists of a single vane extending from either bank joined by a centerpiece perpendicular to the flow. The centerpiece is the lowest point, and as water rises the vane concentrates the stream flow to the center, taking stress away from the banks.¹

Spawning Gravel

Streambeds in Washington have been largely modified over the years, and now tend to have natural cobble and boulder bottoms rather than a good distribution of gravel. Creating spawning gravel in a stream is one way in which restoration projects can quickly improve habitat.

Gravel should match naturally occurring gravel in a given stream for the mix of salmonid species using that stretch of stream. Upstream cross vanes can also be used to help distribute gravel.

Nutrient Enhancement

When Pacific salmon spawn out and die, their carcasses decompose, creating nutrients for young salmon to feed on. As salmon populations decrease, nutrient levels decrease. Future generations face stacked-up odds.

Traditionally, nutrient enhancement projects manually distribute carcasses into a stream. Carcasses are provided by hatcheries, and come from fish that have been stripped of eggs. However, this method has its limitations. Because of concerns about disease, most salmon enhancement programs only allow carcasses that originate from the same watershed. Also, while this method is feasible in streams accessible by roads, more remote locations may not allow for it.

A newly developing method of nutrient enhancement is the use of bio-technologically manufactured “carcass analogs.” Analogs are processed fishmeal that is pasteurized and sterilized to minimize the likelihood of spreading disease, and are designed to dissolve over time when placed in a stream.

Because they are compact and mess-free, analogs can be easily distributed. A handful of volunteers can carry analogs to remote stream sites in backpacks where a truck full of decomposing salmon carcasses can not.

Analog is new enough that the technology is evolving, and monitoring and evaluations still taking place. At this stage, however, they appear promising as a more affordable and convenient method of nutrient enhancement. For more information, please refer to the related How-to Guide on Nutrient Enhancement.

Plantings

Riparian planting, or planting on the banks and in the general area of a stream, is also a component of habitat restoration. Riparian zones maintain critical ecosystem functions by mediating the cycling of nutrients and sediments, increasing the retention of water in vegetation, and providing habitat for wildlife.

Planting is important for its effect on terrestrial species, which interact with aquatic species. In one example, beaver create dams that slow the stream flow during summer months and raise the water level. Water level affects native fish.

Riparian planting also can help prevent erosion if steps are first taken to stabilize stream banks. Different types of vegetation have different effects on the habitat. Cedar and Douglas fir can provide shade from higher elevations that maintains natural river temperatures. Willows, which grow along the banks, are an important food source for wildlife in riparian areas, and unlike most vegetation species—especially grasses—provide a stable protein source throughout the summer months.

In many cases, however, permitting- and construction windows specify that work be done during summer months, which is the worst time for planting. There are ways to work around this for the plants to survive. When planting willows, mature trees should be used rather than young saplings. Twenty-to-30-foot willows should be cut down to three or four feet, then dug up with a back hoe. A hole is dug with an excavator, and the willow is replanted, roots and all.

Plantings should also be “caged” using chicken wire or similar materials to keep them safe from beavers.

OTHER CONSIDERATIONS

Projects don't end with construction or installation. Monitoring should be scheduled and followed-up with regular maintenance or repair. This is true with structural installations, with plantings, and with all aspects of habitat restoration.

Cultivate good relationships with contacts in government agencies. Keep them up-to-date on your long-term plans. Not only will it help future projects, but you'll find experienced personnel with a lot of knowledge who can make or break your project and save you time, money and work.

When your project is completed, invite agency personnel to see it. They'll get confidence that you can do what you say you're going to do, and that you do it well. This will help green-light future projects.

ADDITIONAL INFORMATION & RESOURCES

Copies of this document are available through Fish First, and can be found on the Web at www.fishfirst.org. You'll also find a library of how-to guides and fact sheets as well as other resources and information to help with salmon restoration projects.

Some of the information in this document came from the following material, an excellent resource for root wad and rock vane projects including technical details, diagrams and photos.

- "River Course: Using Root Wads and Rock Vanes for Streambank Stabilization, Fact Sheet No. 4," North Carolina Stream Restoration Institute, North Carolina A&T State University Cooperative Extension. <http://www.bae.ncsu.edu/programs/extension/wqg/sri/rv-crs-4.pdf>

Additional information can be found in the following documents:

- "Stream Restoration Design Handbook," United States Department of Agriculture-Natural Resources Conservation Service, September 2005.
- "Stream Corridor Restoration: Principle, Processes and Practices," U.S.D.A, Revised 2001. http://www.nrcs.usda.gov/technical/stream_restoration/PDFFILES/ALL-SCRH-08-01.pdf
- "Fluvial Processes in Geomorphology," Leopold, L.B., Wolman, M.G., and Miller, J.B. Dover Publications, New York, NY, 1992.
- "A Framework for Analyzing the Hydrologic Conditions of Watersheds," U.S. Government Inter-agency Task Force, USDA Forest Service and U.S. Department of Interior Bureau of Land Management, Technical Note 405. 1998.
- "Manual of River Restoration and Natural Channel Design," Rosgen, D.L., Wildland Hydrology Institute, Pagosa Springs, CO. 1999.

In addition, the Washington Division of Fish and Wildlife maintains a thorough list of links to resources for habitat restoration, vegetation, bank protection and other information at:

- <http://wdfw.wa.gov/hab/ahg/weblinks.htm#restore>

FOOTNOTES

1. "River Course: Using Root Wads and Rock Vanes for Streambank Stabilization, Fact Sheet No. 4," North Carolina Stream Restoration Institute, North Carolina A & T State University Cooperative Extension. <http://www.bae.ncsu.edu/programs/extension/wqg/sri/rv-crs-4.pdf>

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