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Rock Barbs Enhance Fish Habitat and Water Quality in Oregon's Tillamook Bay Watershed

Demonstrating Practical Tools for Watershed Management Through the National Estuary Program

Tillamook Bay, Oregon

Characteristics:

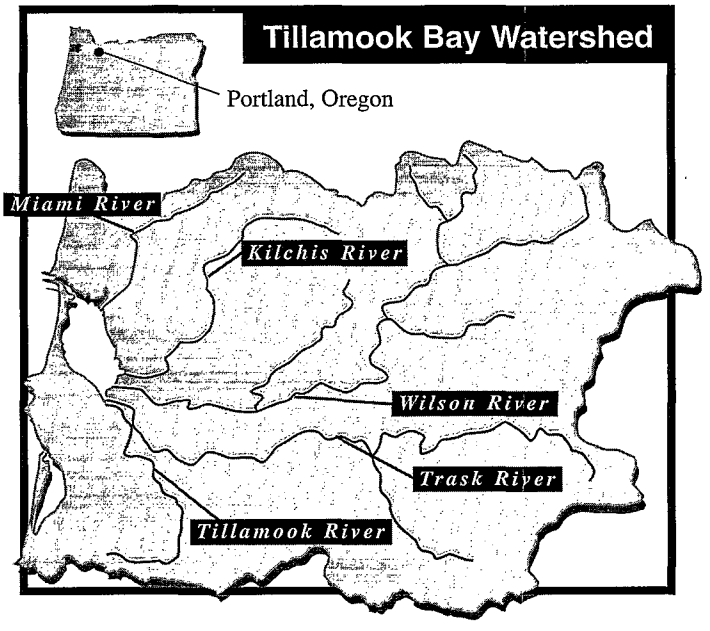
- The watershed for Oregon's Tillamook Bay extends over 570 square miles and is drained by five rivers.
- The watershed supports several resource-based economic activities, including logging, fishing, shellfishing, and dairy and crop agriculture, which are vital to the region's economy.

The Problem:

- The intensive nature of resource-dependent economic activities over the past 150 years has altered the system's natural processes and contributed to an array of environmental problems in the Tillamook Bay estuary and watershed.
- Priority concerns of local residents include bacterial contamination, erosion within the watershed and resultant sedimentation within the bay, and degradation of habitat for salmonid spawning and rearing.
- Both sedimentation and loss of salmonid habitat can be traced, in part, to excessive stream bank erosion, lack of stream type diversity, and limited riparian vegetation.

The Project:

- The Biotechnical Barb Structure and Gravel Bar Stabilization Project was designed to be a low-cost, easily implemented, fish-friendly method of stream restoration which lessens erosion and sedimentation while improving fish habitat.



The National Estuary Program

Estuaries and other coastal and marine waters are national resources that are increasingly threatened by pollution, habitat loss, coastal development, and resource conflicts. Congress established the National Estuary Program (NEP) in 1987 to provide a greater focus for coastal protection and to demonstrate practical, innovative approaches for protecting estuaries and their living resources.

As part of the demonstration role, the NEP offers funding for member estuaries to design and implement Action Plan Demonstration Projects that demonstrate innovative approaches to address priority problem areas, show improvements that can be achieved on a small scale, and help determine the time and resources needed to apply similar approaches basin-wide.

The NEP is managed by the U.S. Environmental Protection Agency (EPA). It currently includes 28 estuaries: Albemarle-Pamlico Sounds, NC; Barataria-Terrebonne Estuarine Complex, LA; Barnegat Bay, NJ; Buzzards Bay, MA; Casco Bay, ME; Charlotte Harbor, FL; Columbia River, OR and WA; Corpus Christi Bay, TX; Delaware Estuary, DE, NJ, and PA; Delaware Inland Bays, DE; Galveston Bay, TX; Indian River Lagoon, FL; Long Island Sound, CT and NY; Maryland Coastal Bays, MD; Massachusetts Bays, MA; Mobile Bay, AL; Morro Bay, CA; Narragansett Bay, RI; New Hampshire Estuaries, NH; New York-New Jersey Harbor, NY and NJ; Peconic Bay, NY; Puget Sound, WA; San Francisco Bay-Delta Estuary, CA; San Juan Bay, PR; Santa Monica Bay, CA; Sarasota Bay, FL; Tampa Bay, FL; and Tillamook Bay, OR.

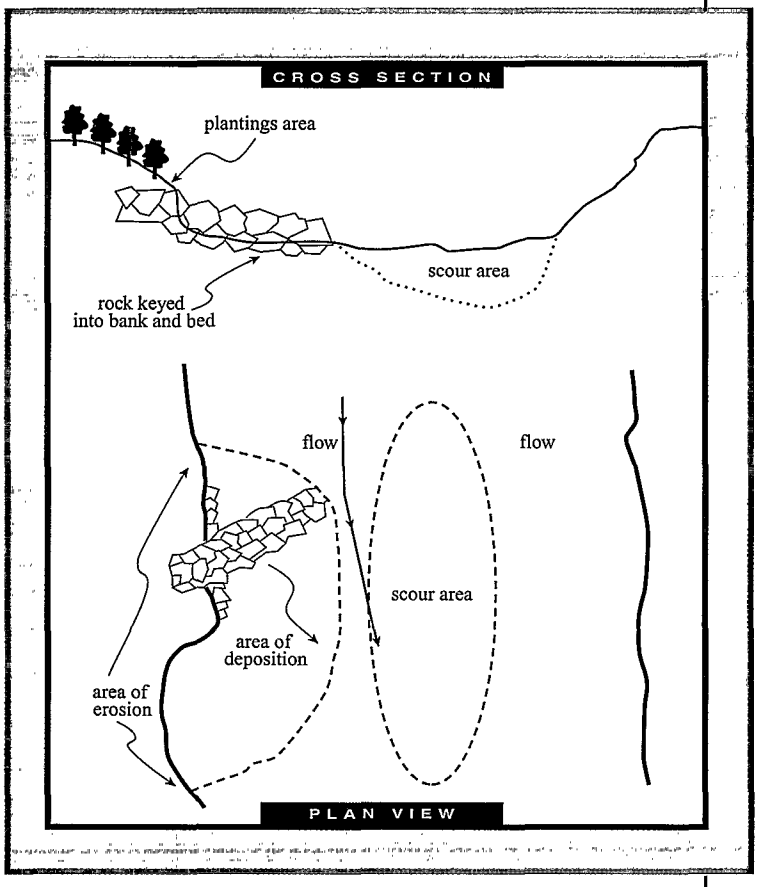
Introduction to Tillamook Bay

Representative of the estuaries nestled between the Northwest Coast Range and Pacific Ocean, Tillamook Bay and its surrounding watershed provide critical habitat for countless plant and animal species. Since the area's settlement in the 1850s, these resources have supported the growth of the region; many of the industries which developed over a century ago still exist today.

Forestland accounts for roughly 50% of the upper watershed. Virtually all of the private forestlands have been harvested at least once this century, while public lands, having suffered a series of fires, will again be ready for harvest in the near future. In the lower watershed, 20,000 cattle produce much of the milk for the state's largest creamery.

The 13-square mile estuary produces a rich harvest of shellfish. Although commercial salmon fishing in the bay was closed in 1962, sport fishing remains important to the local economy. Over the past quarter century, however, Tillamook Bay has witnessed dramatically reduced fish runs and repeated closures to shellfishing.

Only 80 miles from the Metro-Portland area, the watershed is a very popular tourist destination and second home and retirement site for the region's 1.5 million residents.



Overview of The Biotechnical Barb Structure and Gravel Bar Stabilization Project

As the environmental impacts of the watershed's resource-based economy became more evident, concerned citizens petitioned the US EPA to establish the Tillamook Bay National Estuary Project as a means to address the bay's declining health and productivity—particularly pathogenic contamination, erosion in the watershed and sedimentation in the bay, and salmonid habitat degradation.

To help address the latter two issues, the Estuary Project supports the Biotechnical Barb Structure and Gravel Bar Stabilization Project. Now completing its second year, this effort is showing significant returns from a relatively minor investment.

By strategically pointing rock structures known as barbs into the stream channel and following up with tree planting, this effort fosters channel structure diversity and increased riparian vegetation. The stabilization project provides a low-cost, fish-friendly means of addressing sediment loading and degraded salmonid habitat.

Project Objectives:

Through strategic in-stream placement of rock barbs, followed by riparian plantings, the Project aims to improve salmonid habitat by achieving the following objectives:

- stabilizing stream banks,
- improving stream channel structural diversity, and
- improving or establishing riparian vegetation.

Implementing the Project:

The concept is simple; rocks are placed in the stream to alter flow and create new habitats. Specifically, a barb is constructed pointing into the stream, diverting the stream's thalweg (area of highest velocity flow) away from eroded streambanks, and creating slack water on the barb side of the stream. Sediment collects behind the barb while scouring occurs off its point. As sediment continues to fall out in the slack water, a bar forms which is then stabilized by willow plantings.

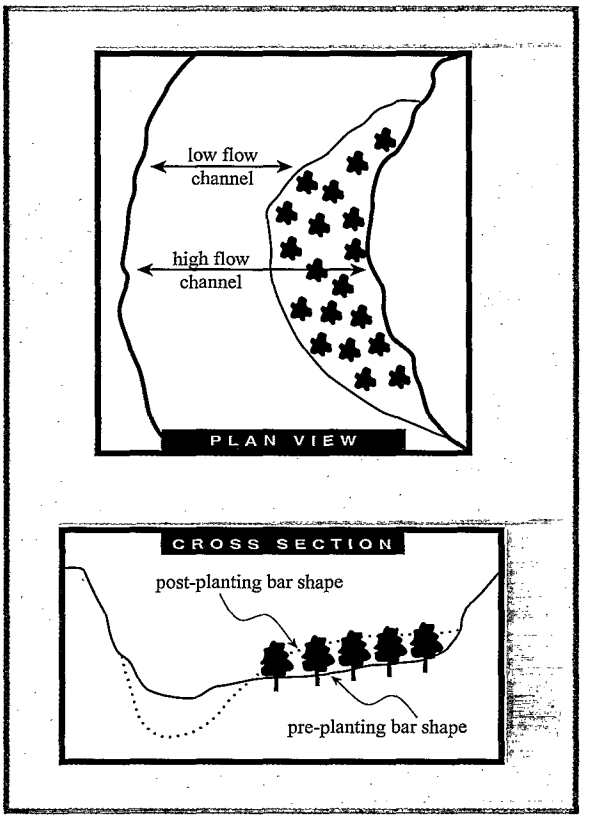
The engineering of the barb depends on the nature of the river segment. The velocity of the stream determines the

size of the rock used, while channel morphology determines the angle of the barb. Once the composition and shape of the barb are established, the rocks are built into the channel bed and stream bank to avoid destabilization and a layer of riprap is placed on the bank upstream and downstream from the barb.

After the barb and riprap are in place, the streambank is graded and vegetated. The upper bank is planted with willow posts and the top with conifers. When enough sediment has collected behind the barb, the newly-formed bar and lower bank are planted with willow posts or other flood-tolerant species. Willow posts range in size from two to four inches in diameter and four to five feet in length.

Success Stories

Stream restoration practices are often criticized for incurring high costs, while producing negligible returns. Planting trees to stabilize banks without first altering stream flow is generally not successful in areas of high velocity flows. Stream bank stabilization using riprap is costly and does not add to the diversity of the stream. The barb project succeeded in meeting both of these concerns. The cost of the barbs varied, depending on a number of factors, but generally ran between $2,000 - $3,000 per structure.



The Tillamook County Soil and Water Conservation District began the Barb Project in the spring of 1996 by constructing seven barbs in the Kilchis River. After the first two years, which included several significant winter flood events, the barbs produced noticeable benefits. In addition to reducing sediment loads from eroded banks, the barbs protected vegetation introduced on the bar and in the riparian zone. As the vegetation becomes more established, it will contribute to a more natural stream channel and further dissipate the energy of the system. This system uses the natural flows and recruitment of the stream to establish the channel.

The barbs trapped sediments, which increased the size and elevation of the bar and created a deeper, narrower stream channel at low flows than had previously existed. The increase in depth and reduction in water surface area at low flows resulted in maintained stream temperatures. For summer- and fall-run (as well as local) fish, these deep, lower-temperature areas offer refuge. At higher flows, when the bar was flooded or overtopped, the plantings served as refuge for fry.

Finally, the barbs returned stream morphology and channel diversity to a more natural state. Increased meander and newly-created scour areas increased salmonid habitat while reviving some of the Kilchis' natural sinuosity. Spring and Fall Chinook now take refuge in the deep scour pools off the tip of the barb as well as the eddies which form behind it. The barbs trapped a great deal of organic material, which is good for river channel complexity and, when plantings take hold, the area will receive increased organic matter. This increase will, in turn, create more habitat. In addition to the increased supply of coarse woody debris, riparian vegetation will also provide canopy cover which will maintain low stream temperatures.

In sum, the barbs have begun to achieve their stated goals of stabilizing stream banks, improving stream channel structure, and adding salmonid habitat. Riparian plantings withstood high water levels due to the barb's flow diversion and are expected to flourish in newly-stabilized banks. Adult Chinook salmon were seen using the newly-created scour pools for refuge while smolts used the slack water behind the barb for cover. Over time, the barbs and vegetative plantings will continue to produce the following benefits:

- re-establishment of meander geometry and scour pools,
- diversion of flows from high erosion areas resulting in reduced sediment loading,
- reduced water surface area at low flows resulting in maintained water temperatures and deeper pools,
- increased stream structural diversity through reintroduction of gravel bars and loadings of coarse woody debris,
- increased aquatic refugia at high and low flows,
- increased stream shading/cover, and
- increased natural nutrient input.

Lessons Learned

Of the twelve barbs constructed as part of the demonstration project, all but one held entirely in place. The one failure yielded an important lesson. Depending on the condition of the bank, the flow rate, and angle of the current, it is critical to use large enough rocks and "key" the barb far enough into the bank. Experience helps in recognizing the size and amount of rock needed in any given location and there is no formula for what is appropriate. As a rule of thumb however, at least 10% of the barb's total length should be build it into the bank. Another useful rule is, when placing riprap upstream, bring it to a point even with the upper end of the barb. This will ensure that the bank doesn't erode and displace the riprap or barb.

For further information, contact:

For additional information on the Biotechnical Barb Structure and Gravel Bar Stabilization Project, contact Randy Stinson, Soil & Water Conservation District Hydrologist, 6415 Signal Street, Tillamook, OR 97141; phone: (503) 842-2240 ext. 108; fax (503) 842-2760.

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