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Western Ecological Research Center http://www.werc.usgs.gov

Watershed Restoration Research

Watersheds can be disturbed in many ways, some natural and some caused by humans. Timber harvest, grazing, highway and dam construction, mining, wildfires and floods are all disturbances that can modify a watershed and its relative ability to provide various ecosystem services (water, sediment, wood, nutrients, aquatic habitat and energy). These changes, in turn, affect the flora and fauna living in the watershed. For example, in the Pacific Northwest, increases in sediment production due to road construction have degraded the spawning and rearing habitats needed for successful salmon reproduction and growth. In recent decades, land managers have been trying to reverse the damage of past land-use disturbances by restoring hillslopes and streams in steep, forested environments.

Research is still needed on:

- What techniques are most cost-effective in preventing sheetwash, gullying, bank erosion and landslides, and which are the most important to implement on a watershed-wide scale?
- Should the restoration strategy focus on intensive work in a few areas or less intensive work over a broader portion of the watershed?
- Can we show that road removal really improves the fisheries in a watershed, and if so, how long does it take?
- How can we combine social, economic, and recreational values with the goal of road removal (which restricts access to parts of the watershed)?

To restore a landscape, a land manager needs to know what natural processes were active before a disturbance, and how those processes are functioning today. Usually an undisturbed area is used as a model to define desired, future conditions for a disturbed area. Restorationists then prescribe methods they believe will restore conditions at the disturbed site to the desirable state as quickly and efficiently as possible. Of course, not all past damage can be repaired, and it is likely that the original, undisturbed conditions will not be attained, no matter what level of work is performed. It is important to judge which are the most critical elements to restore, and to test the feasibility of bringing them back. The field of restoration science is relatively new, and much needs to be learned about the most effective ways to restore damaged lands. Surprisingly little is known about what techniques work best under various conditions.

In north coastal California, the National Park Service, U.S. Forest Service, Bureau of Land Management, and private landowners have conducted watershed restora-

Before restoration: An abandoned logging road in Redwoods National and State Parks. The culvert, buried under road fill, is not visible. Photo: NPS

After restoration: The road bench is obliterated and the hillslope is recontoured to mimic the natural hillslope uncovered during excavation. Exhumed stumps indicate the location and elevation of the original hillslopes. Photo: NPS

Before treatment, this abandoned logging road in Redwood National and State Parks (left photo) crossed grasslands to access timber harvest sites farther downslope. Gullies frequently form on this type of road. **During road removal work,** heavy equipment excavated the road bench and reshaped the hillslope to mimic natural topography (center photo). **Two years following restoration work,** the scar of the original road is barely visible (right photo). Note that the tree in the right foreground appears in the first photo. Photos: NPS

tion work since the mid-1970s. The programs have focused on obliterating abandoned logging roads with the goal of reducing sediment input into sensitive salmon-bearing streams. Many techniques using a mix of heavy machinery and revegetation have been attempted during the last two decades. Road restoration entails removing culverts from roads and reshaping the road bench to more closely simulate a natural hillslope. WERC scientists are evaluating the effectiveness of this type of watershed restoration work in terms of reducing sediment loads, improving stream habitat, protecting streamside forests, and increasing populations of salmon and other species.

WERC scientists are beginning to address some of these questions. Following a "test" of restoration techniques by a large storm in 1997, they documented which types of restored terrain are most susceptible to continued erosion and which restoration techniques worked best in steep watersheds. They are modeling a range of conservation strategies across large watersheds to see how to apply lessons learned at a site scale to the thousands of culvert and landslide problems in large watersheds. And finally, they are investigating whether road restoration is really resulting in improved stream health and increasing salmon populations.

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