

Western Ecological Research Center

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Contact:
Dr. Mary Ann Madej

Phone:
707-825-5148

Email and web page:
mary_ann_madej@usgs.gov
<http://www.werc.usgs.gov/redwood/madej.asp>

Redwood Field Station, USGS Western Ecological Research Center, 1655 Heindon Road, Arcata, CA 95521

Optimization Strategies for Sediment Reduction Practices on Roads in Steep, Forested Terrain

Watershed restoration is of growing interest to both public agencies and individual landowners. Abandoned forest roads commonly result in accelerated erosion, and road decommissioning is a regularly used restoration technique. Much of the restoration work to date, however, has been implemented on a site-by-site basis, and does not necessarily encompass a watershed-wide perspective. Land managers struggle with designing the most effective road treatment plan to minimize erosion, while keeping costs reasonable across a large land base. In a study published in *Earth Surface Processes and Landforms*, USGS scientist Dr. Mary Ann Madej and her coauthors developed a method to evaluate the trade-offs between costs of different levels of treatment and the net effect on reducing sediment risks to streams. They combined field-based investigations and modeling of sediment savings to assess the effectiveness of various restoration strategies in steep, forested terrain in reducing sediment loads to streams.

Optimization is a tool that businesses use to calculate the best possible utilization of resources such as money, time, equipment, and staff, which can help reduce costs and increase productivity. The authors applied these methods to the restoration problem to determine the most efficient way of minimizing sediment input to streams through road decommissioning. Roads can be decommissioned through a variety of techniques, each of which has its own cost and sediment savings. The optimization tool can formulate the most cost-efficient strategy for restoration across a watershed. The method used to develop restoration strategies involved two types of optimization programs, dynamic programming and genetic algorithms.

Management Implications:

- Currently, many road restoration projects are conducted site-by-site and road-by-road, without an assessment of whether the road treatments are really the most effective approach in saving sediment from streams on a watershed basis.
- Optimization programs, which focused restoration work on a combination of high risk sites with high potential for success, were able to maximize sediment savings better than two other restoration strategies for the same cost.
- The optimization approach may be helpful to develop the most cost-effective strategy for sediment reduction on a watershed scale.

The authors tested the models in a sample watershed having 618 road segments, each with four possible treatments, and 73 road-stream crossings, each with three possible treatments. The erosion risks at each of these sites depended on its hillslope location (upper, middle, or lower hillslope) and were part of the rating in the model. Low and moderate budgets were assessed, neither of which had enough money to treat every site at the maximum level. Next, the sediment savings predicted through the optimization programs were compared to sediment savings generated by the current land management policies. Optimized restoration strategies saved more sediment under the constrained budgets than the currently used approaches.

Madej, M. A., E. A. Eschenbach, C. Diaz, R. Teasley, and K. Baker. 2006. Optimization strategies for sediment reduction practices on roads in steep, forested terrain. Earth Surface Processes and Landforms 31:1643–1656.