Streamside Runoff

CENTER FOR STREAMSIDE STUDIES

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The mission of the Center for Streamside Studies is to provide the necessary information for the resolution of management issues related to the production and protection of forest, fish, wildlife, and water resources associated with the streams and rivers in the Pacific Northwest.

Hyporheic Nutrient Dynamics in Alaskan Salmon Streams

The ultimate fate of the large amount of fish biomass returned to spawning streams is a question of increasing interest to scientists and managers seeking to understand how natural and human-induced changes in salmon run sizes may affect future system productivity. Bald eagles, bears, and other animals depend on the seasonal abundance of returning salmon for a large proportion of their food. An increasing number of studies indicate that dead salmon are also an important resource supporting in-stream production of algae, invertebrates, fish, and even the growth of adjacent riparian trees, shrubs and grasses. How marine nutrients move from stream to riparian zone is not entirely known. Although feeding by bear and other animals is obviously important, the transfer of nutrients by water moving from the stream to the saturated zone beneath the riparian forest could also be an important vector. Within porous, gravel-bedded streams characteristic of the Pacific Northwest, large volumes of stream water flow back underground, forming an interactive habitat known as the hyporheic zone beneath the adjacent riparian terrace. Carried with this water are the various dissolved and particulate forms of nutrients in the stream, including those derived from decaying fish. A team of scientists from the Center for Streamside Studies spent last summer on Lynx Creek, in Lake Nerka, one of the research sites of the School of Fisheries Alaska Salmon Program, to begin the task of quantifying the importance of hyporheic transfers of marine nutrients to riparian forests. The research team, Tom O'Keefe, Scott Bechtold and Rick Edwards with assistance by Gilles Pinay, a visiting colleague from France, is part of an NSF-funded project designed to quantify the significance of marine nutrients to riparian forest growth.

Tom O'Keefe and Scott Bechtold installing piezometers in Alaska

The first summer of the project was dedicated to installing a grid of piezometers and wells to determine where, and at what rate stream water is moving beneath the forest. The sample site was a meander bend in the lower river about 80 meters wide and 80 meters long. Using tracer injections and plots of subsurface hydraulic heads, we mapped the extent of hyporheic flows beneath the terrace. We also determined the pattern of nutrients in surface and subsurface waters and quantified the rate at which nutrients were removed as they moved along subsurface pathways. As we have observed in streams within Washington, large volumes of stream water moved rapidly (about 3 meters per hour) into the riparian zone within the rooting zone of vegetation (30 to150 cm below the soil surface). Nitrate and ammonium injections, and maps of dissolved oxygen concentrations confirmed the presence of an active biological community that rapidly processed materials brought in with the stream water. Significant denitrification was detected along major flowpaths. We compared nutrient patterns before and after the summer's sockeye spawning run to try to detect the movement of marine nutrients into the hyporheic zone. This year's run was unusually low and nutrient patterns both within the stream and hyporheic zone did not show clear signs of enrichment by salmon. From this summer's work it is clear that hyporheic storage and transfer of marine nutrients has the potential to make them available both to riparian vegetation and the diverse community of invertebrates

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Research continued .....

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known to live in the hyporheic zone. Next year we will use more sensitive stable isotope techniques to look for marine nutrients, and more thoroughly characterize other nutrient sources such as nitrogen fixation by alder within the catchment. More information about this project can be found on the web at http://www.fish.washington.edu/people/naiman/Salmon_Bear/hyporheic.html.

(Rick Edwards is research faculty in the College of Forest Resources and the School of Fisheries.)

Aquatic Habitat Indicators Report

A new water quality report by the EPA, *Aquatic Habitat Indicators and their Application to Water Quality Objectives within the Clean Water Act,* is now available. An electronic version of the report, and a 79 page annotated bibliography (both in Adobe.pdf file format) can be downloaded at the EPA Region 10's website-www.epa.gov/r10earth (click on Index, then "A" for Aquatic Habitat Indicators). Full citation: Bauer, S.B. and S.C. Ralph EPA report # 910-R-99-014. (Report prepared by Idaho Water Resources Research Institute, University of Idaho and EPA Region 10).

Monitoring Urban Streams: Strategies and Protocols for Humid-Region Lowland Systems

Monitoring of stream systems has moved from a rarefied, academic pursuit to an activity required of progressively smaller and resource restricted government agencies and non-governmental organizations. These efforts are commonly being implemented as a consequence of legislative mandates, from the state or Federal level, or as a condition of construction permits. Public agencies and citizen groups are thus actively measuring a variety of suburban and urban stream parameters, either to evaluate the "health" of these systems or to track their environmental conditions over time. Yet many of these monitoring efforts lack either a coherent conceptual framework or appropriately chosen methods, and they rely on monitoring techniques that are simply infeasible for these institutional settings. A monitoring strategy and specific existing monitoring protocols are identified which will be useful for the management and rehabilitation of streams in urbanizing watersheds.

An abandoned mine site near a headwater tributary of the Methow River in Okanogan County, WA

A monitoring strategy starts by:

1) identifying the management question(s) being addressed,

2) determining the institutional level of effort required (and available) to make particular kinds of measurements effectively, and

3) identifying what specific parameters should and can be measured.

Only a limited set of parameters show much utility or feasibility in addressing the most common management questions faced by municipalities in urbanizing, humid-area regions of the United States. These include measures of riparian canopy, bank erosion and bank hardening, and in-stream large woody debris. With some additional expertise useful data can also be included on channel gradient, substrate composition, and pools. Nearly all other physical parameters that have historically been measured on rivers and streams show little apparent monitoring value in these situations.

(Jenna G. Scholz is a graduate student in Forest Resources and Derek B. Booth is the director of the Center for Urban Water Resources Management.)

Environmental Impacts of Hardrock Mining in Eastern Washington

Hardrock mines, which extract a non-renewable resource, operate from 5 to 15 years until the minerals are depleted. In contrast, metals contamination that occurs as a consequence of hardrock mining can continue for hundreds or thousands of years following the cessation of mining operations. For example, acid mine drainage still occurs from hard-rock mines in Europe that were worked by ancient Romans prior to A.D. 476.

In the United States, more than 500,000 inactive and abandoned mines are estimated to exist in 32 states. Thousands of abandoned mines in eastern Washington are located in sensitive mountain watersheds. In Okanogan County, there are more than 150 sites that are threats to human health and the environment, while new open-pit, cyanide-leaching mines are under development. The Alder Mine, Red Shirt Mill, Crescent Mine, Alder Mill, New Light Mine and Antimony Queen Mine are examples of sites producing heavy-metal effluent that affects water quality and poses risks to human health, endangered fish and other resident biological communities in the Methow River basin.

Mine contaminants affect the biological, recreational, industrial, and municipal use of larger rivers many miles downstream from mining. In Okanogan County, acid mine drainage and heavy metals from abandoned mines are affecting communities of aquatic invertebrates, fish, mammals, riparian vegetation, and domestic water supplies.

Metal Contamination of Water Supplies Following Mining Operations

Water becomes contaminated when it comes in contact with solid mining waste that remains after mining has ceased. Rain and snow fall on the waste rock and tailings. The runoff produced becomes contaminated with metallic sulfides in the ore that oxidize, dissolve, and release heavy metals. Acid mine drainage and metals contamination is the greatest concern, but the leaching of chemicals from the milling and concentration process, most notably cyanide, can also be a serious problem. Water contaminated with metal sulfides and chemical additives are often discharged into surface waters that seep into the groundwater. Domestic water from wells located near abandoned mill sites has been found to contain heavy metals at levels that exceed drinking water criteria.

Biological Hazards of Mine Waste Contamination

Using the principles of epidemiology, strong relationships have been established between elevated levels of heavy metals, and the condition of invertebrate communities in impacted creeks. Elevated concentrations of cadmium, copper, selenium, and zinc in streamwater and sediments have reduced species diversity and abundance in these aquatic communities. Contaminated headwater streams are significant hazards to the environment and threaten juvenile salmonids, including bull trout, native steelhead, and chinook salmon, which use the lower portion of contaminated tributaries to the Methow River as rearing habitat. For more information about the impacts of mining, see the fact sheet, *Environmental Impacts of Hardrock Mining* (available from the CSS office).

(Dan Peplow is a graduate student in the College of Forest Resources.)

Are Electrofishing Myths Making Us Miss the Boat in Stream Studies?

In the Pacific Northwest, redd counts and trapping of downstream-migrating smolts have been brought to a high art, but electrofishing remains poorly developed. Electrofishing can be effective for measuring fish population size, particularly in small streams. However, in Washaington people typically use pulse DC electricity which can lead to unnessesary fish kills. A safer method is to use straight DC (unpulsed) units. Combined with easily manipulated catching gear and well-trained personnel, electrofishing can be a reliable tool for research. A more detailed fact sheet will be out soon.

(Thanks to Ray White, consulting biologist, for this information.)

Fact Sheets

CSS now has fact sheets covering several topics including:

- Urban Stream Monitoring Protocols
- Environmental Impacts of Mining
- Engineered Large Woody Debris
- Riparian Silvicultural Monitoring Protocols
- Stream Restoration Guidelines
- Horizontal Viewing Discs
- Electrofishing Methods

These will be availalable on the website soon at http://depts.washington.edu/cssuw or from the CSS office 206-543-6920.

Funding

On-line Riparian Bibliography

The new 11,000 citation Riparian Bibliohgrapy product emerging from the joint efforts of CSS and USFS Stream Technology Center has grown to approximately 11,600 citations. The Stream Technology Center granted $45,000 to maintain and update the bibliography. CSS hired graduate students Jody Brauner (Quantitative Ecology Resources Management) and Barbara Nightingale (School of Marine Affairs) to collect new references and improve some of the key words. They are working on getting it on-line and accessible by web with an easy to use search tool to access abstracts and source information. It should be on-line and operational by January 20th, 2000. Look for a poster presentation on this project at the CSS 10th Annual Review.

Graduate Student Fund

CSS has established a UW Foundation Fund that is dedicated to graduate student support. Contributions to this fund are tax-deductible. This year the Center will use the funds to award $200 to the best student talk and poster at the Annual Review. For information on how to donate, please call Leslie Wall at the Center 206-543-6920.

CONGRATULATIONS

Kudos to the following students who received their Master of Science degrees**: Tracy Drury** (Civil Engineering) ***Stability and Pool Scour of Engineered Log Jams on the North Fork Stillaguamish***; **Tom Kahler** (Fisheries) ***Summer Movement and Growth of Individually Marked Juvenile Salmonids in Western Washington Streams;*** **Marit Larson** (Civil Engineering) ***Evaluation of Large Wood in Urban Watershed Stream Rehabilitation Projects***; **Kurt Marx** (Civil Engineering) ***Nutrient Removal Effi-***

Assessment of CSS and Future Funding

Two years ago, CSS underwent an assessment review to examine the future of the Center. Several recommendations came out of the Assessment Review, and the overwhelming response indicated that CSS should continue to exist and fulfill its mission of providing managers with information on stream-riparian issues. After that assessment, the UW provided three to five years of funding to CSS. We are beginning the third year of the UW funding plan. A decision will be made in the next six months whether to continue funding CSS for another year or two. Your input will help the UW in its decision-making process. We would like to know what you think about the direction the Center has taken over the last two years. If you would like to send a letter, please call Leslie Wall at 206-543-6920 for the addresses.

CONGRATULATIONS cont...

ciency of a Pacific Northwest Treatment Wetland Receiving Sewage Lagoon Effluent; **Margaret McCauley** (Civil Engineering and Forest Resources) ***What are Those Plants Doing? A Comparison of the Water Quality Treatment Effectiveness of Three Plant Species in a Constructed Wetland for Municipal Wastewater Treatment;*** **Hakjun Rhee** (Forest Resources) ***Modeling Forest Road Surface Erosion Using the Water Erosion Prediction Project (WEPP) Model.*** **Tim Abbe** (Geology) defended his dissertation on ***Patterns, Mechanics and Geomorphic Effects of Wood Debris Accumulations in a Forest River System;*** and **Ashley Steel** (Quantitative Ecology Resources Management) completed her dissertation on ***In-Stream Factors Affecting Juvenile Chinook Salmon Migration.***

CALENDAR OF EVENTS

January - June, 2000 - **CSS Tuesday Morning Seminars**, 22 Anderson Hall, UW, Seattle, WA. Seminars run almost every Tuesday, 8:30 - 9:30 AM. If you would like a schedule mailed to you, contact Leslie Wall at cssuw@u.washington.edu or 206-543-6920.

January 20, 2000 (Thursday) - **10th Annual Review**, HUB West Ballroom, UW, Seattle, WA. For an agenda, please contact Leslie at the Center.

March 29-30, 2000 - **Private Forest Forum "Summit 2000"**, Olympia, WA. For information call Kelley Duffield at 206-543-0867.

June 21-23, 2000 - **Watershed Management Conference**, Fort Collins, CO. Check out http://www.asce.org/gsd/sections/colorado/wm2000/ for more information.

August 27-31, 2000 - **Riparian Ecology and Management in Multi-Land Use Watersheds**, Portland, OR. For more information go to http://www.awra.org/meetings/Portland/Portland.html

October 23-27, 2000 - **Wood in World Rivers**, Oregon State University, Corvallis OR. The website http://riverwood.orst.edu will provide more details.

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