Island Geoscience

Geoscience issues as they relate to water, land and air protection on Vancouver Island

Vol. 05, No. 03 – Fall 2008

That delicate balance

Perched on a rocky ledge 400 m above flatter ground, fingers delicately searching for the right hold, one tends to appreciate the nature of balance. Elkhorn is Vancouver Island's second highest peak at 2195 m, and our traverse was taking us across a bluffy section near the top. A miscalculation at the smallest scale would have severe, and for whoever survived, perhaps unknown consequences. Of course the unforeseen often does occur, and the more complex and dynamic the system, the harder it is to predict the long term outcome.

The precarious and occasionally unexpected interactions of the geomorphological world with the biological have been highlighted in several issues of Island Geoscience, and that theme is continued here. David Stauth of Oregon State University reports on some of the recent work by Robert Beschta that links land management decisions impacting wolves to channel stability.

At the summit, the roof of Vancouver Island, one was able look at "big picture geomorphology", see major processes at work and speculate on balance at a different scale. It is with that big picture view that we are using new technologies such as satellite imagery, climate models and change detection to consider other, coarser questions of balance, and how we are impacting and being impacted by the processes around us.

I hope you enjoy the articles.

Island Geoscience welcomes new submissions or ideas for articles. The newsletter is sent to a few hundred professionals in government and private industry in BC and abroad. Please send ideas or comments to: richard.guthrie@gov.bc.ca

Past issues of Island Geoscience are here: http://www.for.gov.bc.ca/hfd/LIBRARY/Island_Geoscience.htm

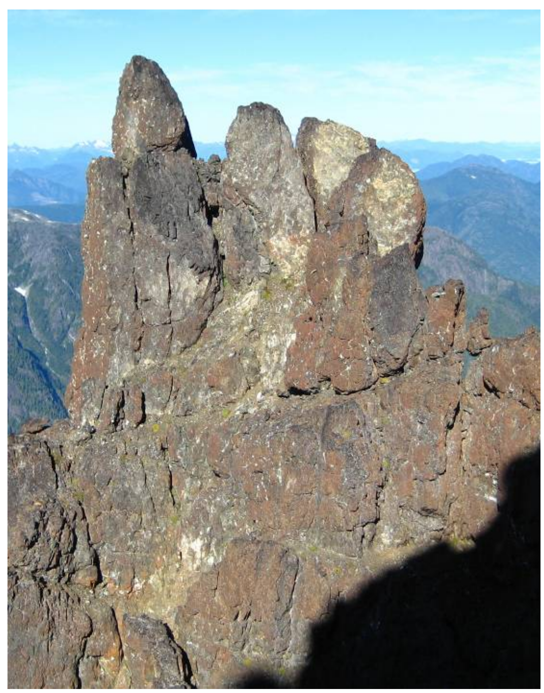
I continue to appreciate hearing that articles are being passed around the office or sent to friends.

Enjoy the autumn.

Rick.

Rick Guthrie, MSc, PGeo,
Regional Geomorphologist

Ministry of Environment,
Vancouver Island Region
2080 A Labieux Road
Nanaimo BC, V9T 6J9
250-751-3138



A gendarme on the Elkhorn summit approach. Even the rocks are achieving a balance between their inherent strength and the stress of weight and gravity. Photo by R.H. Guthrie

Wolf Loss and Ecosystem Disruption at Olympic National Park

David Stauth and Robert Beschta

New research into trophic cascades links wolf presence to intact streamchannel morphology.

Olympic National Park was created in 1938, in part "to preserve the finest sample of primeval forests in the entire United States" – but a new study at Oregon State University suggests that this preservation goal has failed, as a result of the elimination of wolves and subsequent domination of the temperate rainforests by herds of browsing elk.

The park, with streamside ecosystems that have been largely denuded of the young trees needed to replace the old ones, and stream systems that bear little resemblance to the narrower and vegetation-lined rivers of the past, is now anything but "primeval" and a very different place than it was 70 years ago, researchers say.

The extermination of wolves in the early 1900s set off a "trophic cascade" of changes that appear to have affected forest vegetation and stream dynamics (Figure 1).

In 1890, members of the Press Expedition found the banks of the upper Quinault River "so dense with underbrush as to be almost impenetrable," they wrote at the time. Logs jammed the rivers, dense tree canopies shaded and cooled the streams, and trout and salmon thrived, along with hundreds of species of plants and animals.

The extermination of wolves in the early 1900s set off a "trophic cascade" of changes that … affected forest vegetation and stream dynamics.

"Today, you go through the same area and instead of dense vegetation that you have to fight through, it's a park-like stand of predominantly big trees," said Bill Ripple, a co-author of the study and forestry professor at Oregon State University. "It's just a different world."

"Our study shows that there has been almost no recruitment of new cottonwood and bigleaf maple trees since the wolves disappeared [Figure 2], and also likely impacts on streamside shrubs, which are very important for river stability," said Robert Beschta, lead author of the study and professor emeritus of forest hydrology at OSU. "Decreases in woody plant communities allow river banks to rapidly erode and river channels to widen."

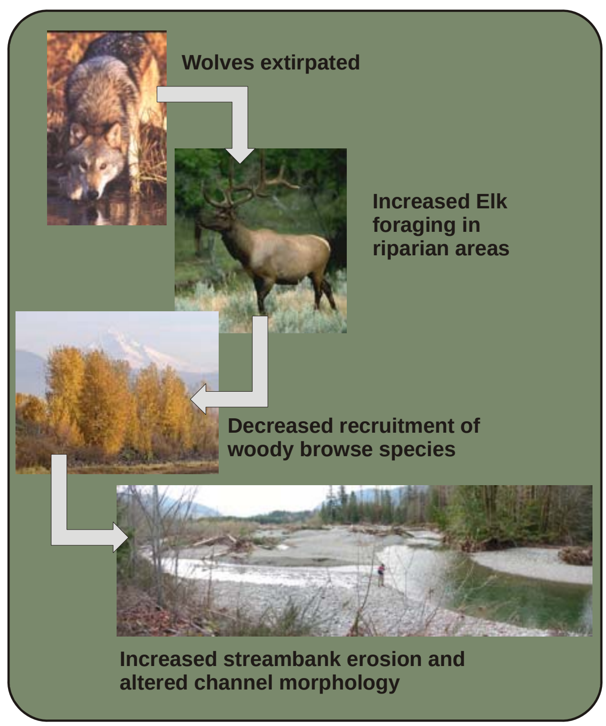


Figure 1. A conceptual diagram showing a cascade of ecological events associated with hunting and trapping of wolves in the Olympic Peninsula (adapted from Beschta and Ripple, 2008).

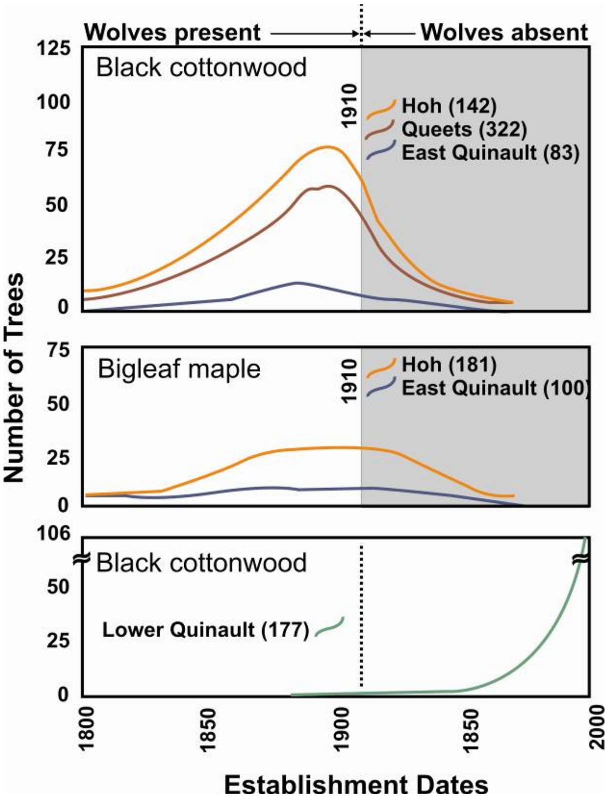


Figure 2. Frequency of establishment of new trees in the riparian corridor along three rivers. Year of tree establishment along the Hoh, Queets and Quinault rivers in Northern Washington was determined using dendrochronology (sample size for each river is indicated in brackets). Wolf extirpation within the Olympic National Park (top two graphs) was functionally complete by 1910. Wolves are more common on adjacent Quinault Indian Nation lands and the relative establishment of new trees is high. Figure adapted from Beshta and Ripple, 2008.

"Once tree and shrub communities along stream banks and floodplains started crashing, then the rivers began to unravel," Beschta said. "Now we have large areas where the forest understory vegetation is mostly just grasses and ferns."
The study, which was recently published in the journal Ecohydrology, showed that river dynamics are quite different than they were historically. Streams that once were held together in tight channels by heavy bank vegetation are now wider and braided, with exposed gravel bars a common feature. The water is open to the warming sun and less enriched by plants and insects.

"We've seen the impact of wolves on the ecosystem in Yellowstone, the effect of cougars in Yosemite National Park, the same basic story about the importance of key predators being played out in many different places," Ripple said. "What's so surprising here is that it's happening in a temperate rainforest, which is hugely productive and has such high levels of vegetation growth. But even there, when the ecosystem gets overwhelmed with many large herbivores, the vegetation just can't keep up."

…Our study shows that there has been almost no recruitment of new cottonwood and bigleaf maple trees since the wolves disappeared…

Since the Olympic National Park ecosystem bears some similarity to much of the temperate rainforests in the Coast Range of Oregon, Washington and British Columbia – with a mild climate and heavy levels of rainfall – it's reasonable to believe similar forces are at work elsewhere when historic predators have been removed, the scientists said.

References:

Beschta, R.L. and Ripple, W.J. 2008. Wolves, trophic cascades, and rivers in Olympic National Park, USA. Ecohydrology, 1, 118-130.

David Stauth is a science writer in the Department of News and Information Services at Oregon State University. He has covered forestry, natural resource, science and engineering issues for 24 years.

Bob Beschta is an emeritus professor of forest hydrology in the Department of Forest Ecosystems and Society at Oregon State University. He has been active in teaching and research related to forest and range hydrology, riparian management, and landuse practices for 34 years. Recent research activities have focused on the interacting role of large predators and large herbivores on riparian plant communities and rivers in the western US and Canada.

Change detection on Vancouver Island

Climate models predict, for Vancouver Island, winters with more frequent more intense storms than what currently receive. If correct, the results will likely be significant: river morphology will change with increased magnitude of channel forming flows, landslides will increase in abundance, bridges and culverts that have historically been 'sized' on a 200 year return may be insufficient to pass flows, and high winds may increase the extent of their damage.

In November 2006, a storm blew across Vancouver Island causing widespread damage by way of landslides flooding and windthrow. With the damage, however, came opportunity to look at the potential impact of climate change on a regional scale.

The Ministry of Environment along with other government and industry partners acquired 2.5 m and 5 m resolution satellite imagery for all of Vancouver Island, about 32,000 km^2, for each of three years: 2004, 2006 and 2007. These represent the best complete coverage of Vancouver Island by government since 1987.

Images were overlaid in the digital environment and changes between images were identified automatically (Figure 1).

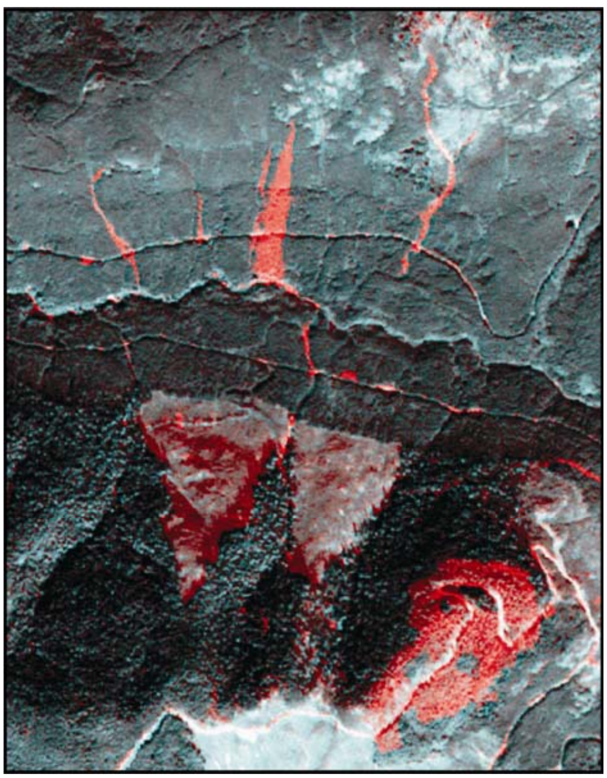


Figure 1. A satellite image of a river valley showing the river running across the middle of the image (right to left). Automated change detection occurs by applying a formula whereby the computer looks at the position and reflected qualities of every pixel in each image. Pixels that are tolerably the same come back in a shade of blue. Pixels that are sufficiently different come back red. The interpretation of the change is then done manually to differentiate between, for example, landslides (top of picture), cutblocks (bottom right) and artefacts such as shade (middle cutblocks).

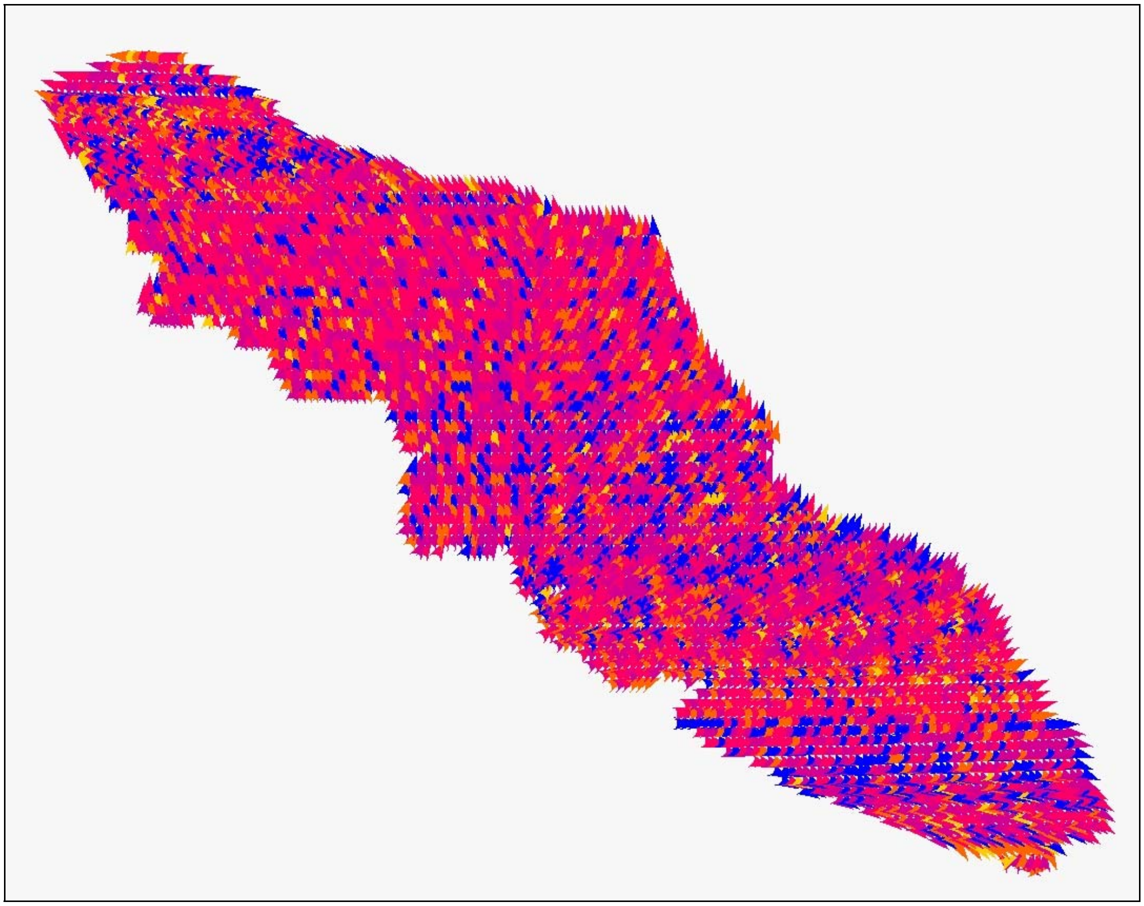
Interpretation of those changes was then carried out for the entire island by a team of experts and new landslides, cutblocks, roads, and even identified windthrow were digitized and given attributes that could be analyzed in the Geographic Information Systems environment.

Figure 2. Density plot of 739 landslides on Vancouver Island between 2006 and 2007. Concentrations of landslides occurred in the Somerset range east of Cowichan Lake and west of the Alberni Inlet, and north of Gold River. These concentrations may now be analyzed against precipitation and wind data.

In all, 1278 new landslides were recorded and mapped, along with 120 km^2 of windthrow, more than 700 km^2 of new cutblocks and over 3500 km of new roads.

Several hundred of the new landslides were identified in the 2006-2007 intervals, suggesting that the storm had a major impact on the ground. Similarly, the windthrow was largely from that period. Landslide densities were considered across the island, and initial analysis suggests that the focal points of the storm were north of Gold River, and in just east of the Alberni Inlet (Figure 2).

The data are not perfect, and problems with interpretation due to scale, image quality, and 2-dimensional errors do occur. However, the completeness of the coverage allows us to analyze against detailed weather models of wind and precipitation (Figure 3) and consider the outcomes in light of updated climate data. That analysis is being carried out right now and results are expected before the fiscal year end.



Figrue 3. A model of wind speed and direction for November 16 2006 on Vancouver Island. Wind speed increases from yellow to blue. The data resides in a GIS environment and will be compared to the distribution of landslides to consider the role that wind plays in regional landslide initiation. Similar analysis is being conducted using precipitation as a variable and then combining the two.

In addition, the change detection results are being used for monitoring under FRPA, they are being used by habitat staff to look at potential losses to wildlife habitat areas, and by forestry and parks to look at timber supply analysis and trespass issues.

As we try to understand the regional issues of import, satellite data and change detection analysis combined with GIS techniques are technologies that show considerable promise.

- RHG

Recent Publications

Research scientists from the BC Ministry of Forests and Range and the Pacific Climate Impacts Consortium (http://pacificclimate.org/) have recently collaborated to produce three reports on climate change effects on watershed hydrology:

Pike, R.G., D.L. Spittlehouse, K.E. Bennett, V.N. Egginton, P.J. Tschaplinski, T.Q. Murdock and A.T. Werner. 2008. **A summary of climate change effects on watershed hydrology.** B.C. Min. For. Range, Res. Br., Victoria, B.C. Exten. Note 87. http://www.for.gov.bc.ca/hfd/pubs/Docs/En/En87.htm

Pike, R.G., D.L. Spittlehouse, K.E. Bennett, V.N. Egginton, P.J. Tschaplinski, T.Q. Murdoch and A.T. Werner. 2008. Climate change and watershed hydrology: part I **- recent and projected changes in British Columbia.** Streamline Watershed Management Bulletin. Vol. 11. No 2. www.forrex.org/streamline

Pike, R.G., D.L. Spittlehouse, K.E. Bennett, V.N. Egginton, P.J. Tschaplinski, T.Q. Murdoch and A.T. Werner. 2008. Climate change and watershed hydrology: part II - **hydrologic implications for British Columbia.** Streamline Watershed Management Bulletin. Vol. 11. No 2. www.forrex.org/streamline

Introducing:

Deepa Filatow is a P.Geo. currently serving as the Provincial Bioterrain Specialist at the BC Ministry of Environment. She is a natural science generalist who took 6 years of undergraduate courses graduating with a B.Sc in Geography at UBC. She worked for 8 years terrain mapping with June Ryder and Associates Terrain Analysis and has mapped and correlated over 10 million hectares of terrain inventory in BC. Her current job in government includes managing the ecosystem and terrain inventory data for the province; writing and updating provincial data standards and best management procedures; providing expert advice on the use of soil and terrain data; and chairing working groups for soils and terrain mapping.

Deepa's passion for BC's landscape extends to recreation. She enjoys activities that involve going up and coming down hills including: mountain biking, hiking and skiing (all types).

Deepa is an active member of the Division of Engineers and Geoscientists in the Forest Sector (DEGIFS) and has served on the DEGIFS council.

She is mother to Nikhil (age 4.5) and Jasmine (age 2.5) and wife to Chef Mark Filatow.

Deepa can be contacted at (250) 861-7675or Deepa.Filatow@gov.bc.ca.

Upcoming issues:

Landslides through the Holocene: 10,000 years of erosion on Vancouver Island – what has changed?

Controls to landslide runout: How far will it go?

If you have topics you'd like to see, let me know. Have a great fall!

- *RHG*

The Salmon River Estuary.