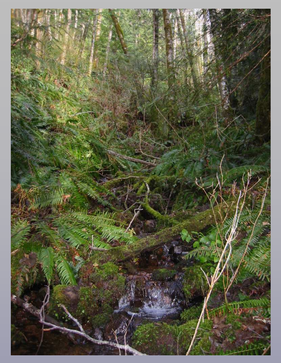
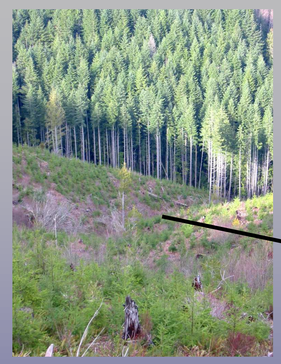
The Effects of Riparian Harvesting on Headwater Streams in Western Washington.

Garrett Liles[1], Bob Edmonds[1], Dan Vogt[1], Richard Bigley[2], Jeff Richey[3] and Pete Bisson[4]
University of Washington College of Forest Resources[1], Washington State Dept. of Natural Resources[2],
University of Washington School of Oceanography[3], USFS PNW Research Station Olympia[4]





Introduction

- Little is know about headwater stream (HS) hydrologic discharge and chemical characteristics in western Washington
- Current harvest practices leave little or no vegetative buffer around stream channels
- Employing the small watershed approach. A retrospective chrono-sequence has been established to assess stream characteristics and recovery after harvest with removal of riparian vegetation

Study Sites and Research Design

- Waddell Creek Watershed (WCW) at the Capitol State Forest near Olympia Washington.
- Quantify discharge and chemical parameters for individual streams and Waddell Creek (See table 1)
- 9 headwater streams under a range of stand conditions – Control (~70 yr-old Douglas-fir/western hemlock stands), Young open canopy (~5 – 7 year old) and Young closed canopy (~15 – 18 year old)

Stream Treatment	# Per Treatment	Chemical Analysis	Species	Sampling Frequency	Samples per treatment
Control	3	Total N, C, ions ** & pH	-Total N - DON, NO_3 & NH_4^+ -Total C - DOC, pCO_2 & Alkalinity **ICP analysis (Al, As, B, Ba, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, S, Se, Si, Zn)	1x month (March-Sept) 2x Month (Oct-Feb)	51
Young Open Stand ~ 5 yr. old	3				51
Young Closed Stand ~ 15 yr old	3				51
Waddell Creek	1				17
Totals	10				170

Table 1-Experimental Design, Chemical Parameters and Sample Frequency

Connecting Land to Stream

Riparian areas have intense biogeochemical N transformations. Better understanding of this zone is important to address current and future environmental problems.

To assess N transport and soil N status:

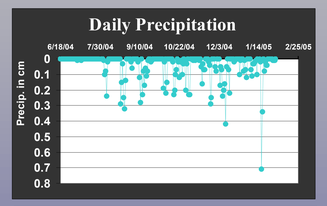
- Near-stream groundwater monitoring wells (~5 m from stream center)
- Ion Exchange Resins (IER)
- Soil C/N
- CEC

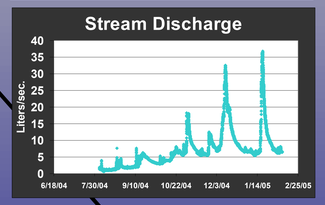
Soils analyzed represent conditions from streamside to upland slope for comparison to stream water chemistry.

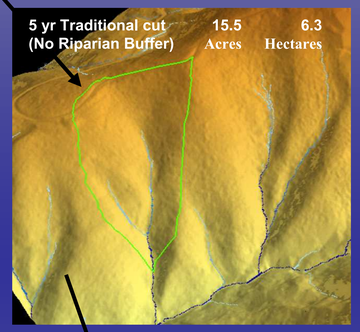
Harvested stand with continuous riparian buffer configuration

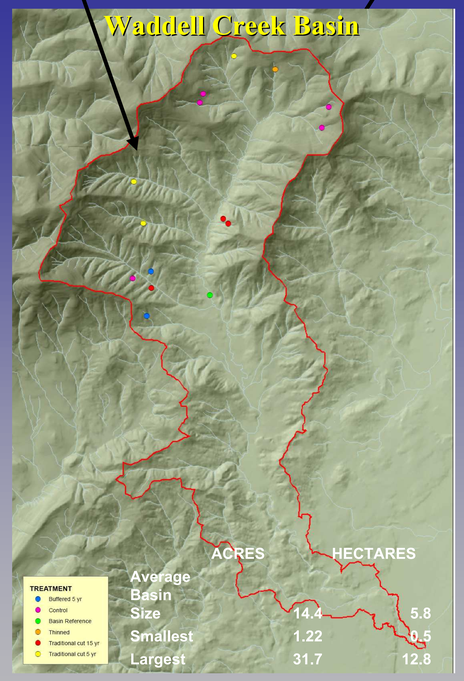
Objectives

- Establish chronological sequence of headwater streams in stands ranging from uncut control → young open canopy (~ 5 yr. old) → older closing canopy (~ 15 yr. old) stand in low elev. Douglas Fir/ Western Hemlock forest stands.
- Quantify discharge and chemical concentrations to generate flux rates
- Characterize soil in stream basins for comparison to stream chemistry
- Provide data for modeling activities

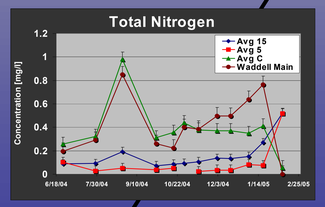


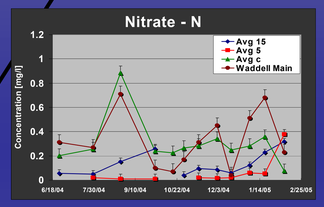


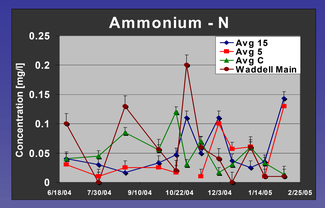


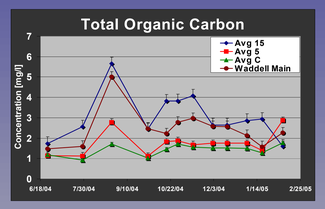


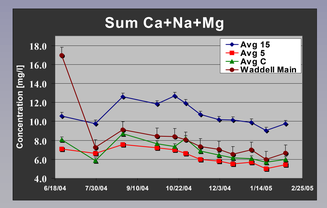
Weir and Stilling Well Installed in the Field







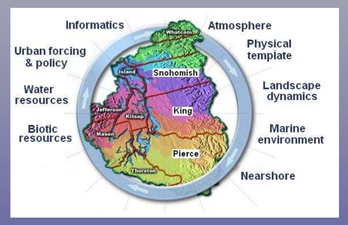




Measurements, Modeling and Synthesis

- Modeling natural systems is complex and requires high resolution data
- WCW research is generating data for development and validation of coupled hydrologic/solute transport model, within PRISM, prediction water flux, soluble carbon and nitrogen
- Model is scalable from headwater (<1 km2) to small watershed (30-100 km2) and to (sub) regional scales (1000's-50,000 km
- Operational model will be used to investigate environmental issues like the low dissolved oxygen issue in the Hood Canal

Hood Canal, Puget Sound Washington



Schematic View of PRISM

Preliminary Results

- Total Nitrogen and Nitrate - N: Control > Waddell > Young Closed Stand > Young Open Stand
- Ammonium – N: No Apparent Trends
- Total Organic Carbon: Young Closed Stand > Waddell > Young Open Stand > Control
- Sum Ca – Mg - Na: Young Closed Stand > Waddell > Control > Young Open Stand

Conclusions

This Research is: advancing knowledge of physical and chemical parameters in HS, providing data for modeling activities, and has established the foundation for future research into the ecological role of riparian buffers. Preliminary data show low concentrations of nutrients exported from these systems in all streams. Stream chemical parameters are moving towards recovery from young open to young closed canopy stands for Nitrogen. Considering > 50 % of steam mileage in western Washington is comprised of similar HS better understanding is important to balance future management decisions, protect habitat and promote environmental quality.

This Work Funded by:
Olympic Natural Resource Center (ONRC), UW Center for Water and Watershed Studies (CWWS), Washington State Department of Natural Resources (WADNR), USFS PNW research station Olympia, UW PRISM.
Special Thanks for Support:
USFS PNW Lab Olympia for data, Jeff Ricklefs-WADNR GIS support, Porranee Rattanaviwatpong (Model Creator)- UW Department of Chemical Engineering and Dongsen Xue (Analytical Support)- UW CFR