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Final Report for OWEB grant #208-8001

Oregon Plan Effectiveness: Effects of Contemporary Forest Harvest on Aquatic Ecosystems in Trask, Hinkle and Alsea Watersheds

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The Oregon Watershed Enhancement Board (OWEB) has funded the project, Effects of Contemporary Forest Harvest on Aquatic Ecosystems in Trask, Hinkle and Alsea Watersheds. This project is comprised of the watershed studies in the Watersheds Research Cooperative (WRC). In 2010, the WRC will complete its eighth year. The WRC started with the Hinkle Creek Paired Watershed Study but since has added two state-of-the-art paired watershed studies, the Alsea Revisted and the Trask, in the last several years. Since inception, the WRC has raised approximately \$8 million dollars to fund the cooperative research. The projects remain funded at a minimal level.

Hinkle Creek is, currently, going into the final two years of post-harvest data collection. The Alsea Study just installed their first harvest entry. The Trask Study is still in the calibration phase with roads and harvest scheduled for 2011 and 2012, respectively. It is a sign of the commitment of the cooperators that all three projects remain active and funded despite the current economic climate. Thank you to all of our cooperators for your continued support.

These projects have purchased instrumentation, supplies, and labor to support previously stated goals. Monies spent during the duration of the project are presented in Table 1.

Table 1

Project	
Alsea-Equipment	\$ 14,923
Alsea-Labor	\$ 26,411
Hinkle-Equipment	\$ 3,245
Trask-Equipment	\$ 287,702
Trask-Labor	\$ 67,718
Total	\$ 400,000

A summary of accomplishments for the three paired watershed studies include:

- **Hinkle Creek Paired Watershed Study**
 - First entry on non-fish bearing stream reaches and second harvest entry on fish-bearing stream reaches completed.
 - Data collection continues on post-harvest data.
 - Field tour for Board of Forestry Field.
 - Field tour for Society of American Foresters (SAF) in association with Oregon SAF meeting.
 - Theses awarded:
 - Lance George, M.S.,Hydrology
 - Aaron Burger, M.S.,Fisheries
 - Kelly Kibler, M.S., Hydrology
 - Tim Otis, M.S.,Hydrology
 - Mark Novick, M.S.,Fisheries
 - Nicolas Zegre, PhD,Hydrology
 - Nick Som, PhD, Statistics
 - Niels Leuthold PhD, Amphibians
 - Hydrology, fisheries, amphibians, statistics, and invertebrate oral presentations and posters presented at regional, national, and international meetings.
 - Publications:
 - Refereed Journal Articles

- Bateman, D. S., R.E. Gresswell, and A.M. Berger. 2009. *Passive integrated transponder tag retention rates in headwater populations of coastal cutthroat trout*. North American Journal of Fisheries Management 29:653-657.
- Submitted – In Review
 - Zegre, NP, AE Skaugset, NA Som, JJ McDonnell, and LM Ganio. *In lieu of the paired catchment approach: Hydrologic model change detection at the catchment scale*. Submitted to Water Resources Research.
 - Som, N.A., Zegre, N.P., Ganio, L.M., and A.E. Skaugset. *Prediction Intervals for Change Detection in Paired Watershed Studies*. Hydrological Sciences Journal.
- Written- In Internal Review
 - Cumulative watershed effect of contemporary forest harvesting on summer stream temperatures of Hinkle Creek, Oregon. For submission to FEM.
 - Mechanisms for Change of Summer Stream Temperatures Downstream of Forest Harvest in Headwater Streams, Hinkle Creek, Oregon. For submission to Hydrologic Processes.
 - Estimating the Effects of Summer Low Flow in Headwater Streams of Hinkle Creek Following Forest Harvest. For submission to JAWRA.
 - Energy Processes and Associated Effects of Forest Harvest on Summer Stream Temperatures of a Headwater Watershed, Hinkle Creek, Oregon. For submission to FEM.
 - Som, NA, LM Ganio, R Gresswell, D Bateman, and D Hockman-Wert. Sampling Headwater Streams for Autocovariance Parameter Estimation.
 - Som, NA, LM Ganio, and R. Gresswell. Assessing Autocovariance Measures of Patch Size in Coastal Cutthroat Trout.
 - Luethold, N, M Adams, & others. Short-term response of Pacific giant salamander to timber harvest in southwestern Oregon. For submission to the Journal of Wildlife Management.
 - Luethold, N, M Adams, & others. Response of Pacific giant salamanders and tailed frogs to threat of predation under differing sediment levels.
- Continued support

- Douglas County, BLM RAC, and OFIC
- Allyn Ford, President of Roseburg Forest Products, was awarded the Environmental Excellence Award by the Associated Oregon Industries.
- **Alsea Watershed Study Revisited**
 - First harvest entry completed.
 - Data collection continues for post-harvest results.
 - Field tours for Corvallis EPA colleagues, Mid-Coast Watersheds Council, Mary's Peak Chapter of the SAF, and Mid-Coast Watersheds TMDL technical advisory committee.
 - Hydrology and forestry oral presentations and posters presented at regional and national meetings.
 - Fisheries: Purchased Mezura Palm computers to collect field data.
 - Hydrology: Purchased and installed a flume at headwater location.
- Publications:
 - Submitted – In Review
 - Hale, V.C., Schoenholtz, S.S., Ice, G.G., and Stednick, J.D. 2010. Forest harvesting and streamflow: Assessing long-term hydrologic recovery in the Oregon Coast Range. *Journal of Hydrology*. In review.
 - In Preparation:
 - Hale, V.C., McDonnell, J.J., and Brooks, J.R. 2010. Mechanisms of dry-season forest-stream connections in Pacific Northwest headwater catchments. In preparation for *Hydrological Processes*.
 - Hale, V.C. and McDonnell, J.J. 2010. Scaling runoff processes through catchment inter-comparison: importance of geology, topography, soils, and vegetation. In preparation for *Water Resources Research*.
 - Hale, V.C. and McDonnell, J.J. 2010. Bedrock groundwater controls on catchment storage, runoff response, and residence times in steep, headwater catchments. In preparation for *Water Resources Research*.
 - Hale, V.C., Schoenholtz, S.S., Ice, G.G., and Stednick, J.D. 2010. Patterns and controls on dissolved nitrate in streams draining managed and natural forests. In preparation for *Journal of Hydrology*.

- PhD student, Cody Hale, received the Horton award for achievement in hydrology
 - Theses awarded:
 - Cody Hale, M.S., Hydrology
- Continued funding
 - Plum Creek and NCASI
- **Trask River Watershed Study**
 - Calibration phase of study continues, including, data collection in fisheries, hydrology, macroinvertebrate, amphibians, stream chemistry, and trophic levels.
 - Hydrology: Installed eight flumes at headwater locations to measure water discharge, stream temperature, and specific conductance.
 - Climate/energy budgets: Purchased portable climate stations for calculating onsite and upstream/downstream budgets.
 - Fisheries: Purchased both full- (FDX) and half- (HDX) duplex, pit tags and associated handheld and swim through antenna readers and two Smith-Root Electrofishers to collect fisheries data.
 - Nutrients and Habitat: Purchased dissolved oxygen, temperature and specific conductance instruments, small battery-powered pumps, digital hemispherical camera and analytical software, and temperature sensors and software. Field crew performed basin-wide surveys of stream channel morphology and to characterize the riparian area.
 - Fisheries, nutrients and habitat, and macro-invertebrate oral presentations and posters presented at regional and national meetings
 - Theses awarded:
 - Heidi Vogel Anderson, M.S., Fisheries
 - Mark Raggon, M.S., Fisheries
 - Fisheries field tour for the U.S. Fish and Wildlife Service, Regional and OR/WA staff and overall study tours for private, state, and federal groups (See Table 1).
 - Continued Funding
 - Weyerhaeuser and Oregon Department of Forestry
- **Watersheds Research Cooperative**
 - Various supporters of the WRC have written letters of support for the projects.

- The WRC sponsored a conference entitled “Assessing the Response of Streams to Contemporary Forest Practices: A Conference on Paired Watershed Studies” to disseminate results of the WRC watersheds project to the public.

Table 2, Field tours in the Trask Watershed

Date	Presentation	field tour	Participants/Audience	participant Institution or Agency	number of people	Presenter or Leader
9/18/2007	x		Resource managers	BLM/ODF		Jason Dunham
12/12/07	x		researchers	USGS FRESC	20	Jason Dunham
12/18/07			forest managers and collaborators	WRC		Johnson, Dunham, Adams, Li
2/7/08	x		university, agency, industry	FRL committee	25	Jason Dunham
	x		researchers	Stream Team Monday Morning Meeting	15	Jason Dunham
3/3/2008	x		agency managers	BLM state Fisheries	25	Jason Dunham
4/2/2008	x		agency, university	Western Division AFS	5	Jason Dunham
5/6/2008	x		researchers	NABS Annual Meeting	40	Heidi Anderson
6/4/2008	x		Compton/Perakis	EPA/USGS	40	Li, Johnson
7/17/2008		x	TEP, channels and ODF recreation	ODF/ TEP	5	Sherri Johnson
7/28/2008		x	North Valley Operations	Weyerhaeuser	10	Liz Dent
8/4/2008		x	stream ecologists	PSU/USGS/Taiwan	4	Maryanne Reiter
9/3/2008		x	BLM managers	BLM/USGS	5	Sherri Johnson
9/23/2008		x	Trask researchers and agencies	OSU/USGS/PSU/PNW/ODF/BLM	15	Ruth Jacobs, USGS
10/1/2008	x		university and researchers	OSU Fisheries and Wildlife	16	Liz Dent
			industry, university, agency	WRC Workshop, OSU campus	30	Heidi Anderson
10/13/2008	x		Weyerhaeuser Technology	Weyerhaeuser	150	Adams, Ashkenas, Dunham, Li, Johnson, Bilby
10/28/2008		x	Lead Team	Weyerhaeuser	20	Bilby, Reiter
2/14/2009	x		agency, university	TWC Oregon chapter	40?	Stephanie Jenkins

A summary of results for the watershed studies include:

- **Trask River Watershed Study**

- Preliminary fisheries results at Trask are showing: 1) The phenology of emergence of young-of-year coastal cutthroat trout varies among years and can be substantially delayed in some sites; 2) there is a consistent pattern of higher maximum growth rates in coastal cutthroat trout from Gus Creek; 3) seasonal survival shows a weak influence of size, with larger fish showing lower probabilities of survival, consistent with work on Hinkle Creek; 4) whereas there is considerable variability in responses we have measured, it is

- the pattern of variability itself that is more interesting than trends in mean or median values.
- In fisheries research, further analysis and interpretation will be conducted in 2010 and the first manuscript on annual monitoring will be prepared for publication in a scientific journal.
 - In amphibian research at Trask, key response variables differ among reaches and over time. Our emphasis at this stage of the study is to characterize this heterogeneity so that we can compare it to post treatment patterns to determine treatment effects.
 - There are highly significant differences in initial body size of *Ascaphus* between reaches.
 - Within developmental stages, body size of *Ascaphus* declines steeply over the summer despite individual growth. This decline differs significantly between reaches.
 - There was a 40% increase in numbers of adult *Ascaphus* captured over 2008 despite fewer searches completed. Despite the overall increase in *Ascaphus* captures, the majority of plots were remarkably similar in the abundance of *Ascaphus* between years. The increase was due to changes at a minority of plots.
 - Movements were reduced in 2009 from 2008 for *Ascaphus* but not for *Dicamptodon*.
 - Lab experiments at Oregon Hatchery Research Center (OHRC) suggest that a change of 3 degrees Centigrade during growing season for autumnal emerging invertebrates could result in changes in growth and time of emergence, though the specific changes are taxa-specific.
 - Completed analysis of OHRC experiment suggests that response to increased temperatures varies among fall emerging taxa. Earlier emergence occurred for Psychoglypha, particularly for males. For other species, as in the response of the mayfly *Paraleptophlebia*, current conditions may be optimal, and heated temperatures resulted in smaller sizes and/or less synchronous emergence between sexes. A manuscript is in preparation for submission to Journal of the North American Benthological Society.
 - Community analyses of invertebrates in Trask streams using NMS-Ordination shows no distinctive grouping by sites among any of the four basins or by year. Spring versus summer 2007 show some seasonal differences in assemblages. Headwater benthic

- assemblages are distinctive from downstream. Benthic differences between headwater and downstream sites persisted in Spring 2007 samples.
- A comparison with other Watershed Research Cooperative basins shows spring benthic invertebrates at the Trask tended to be higher in taxa richness than in the Alsea watershed, and comparable to uncut reaches at Hinkle Creek. Benthic densities were not different from those at Alsea and higher than at Hinkle.
 - Stream metabolism studies indicate that all streams are strongly heterotrophic, i.e., respiration is greater than primary production. This is the norm in heavily shaded, forested streams with large inputs of terrestrial plant material.
- **Hinkle Creek Paired Watershed study**
 - No impact was detected in maximum stream temperature at the watershed scale, which means that spatial variability in maximum stream temperature was greater than the treatment impact.
 - Streamflow and sediment yield increased after harvesting in headwater catchments and at the basin-scale in the Hinkle Creek Paired Watershed Study.
 - Increases in streamflow were consistent with previous studies and were attributed to reduced transpiration and canopy interception.
 - Increases in sediment yield were attributed to increased stream power from the increased streamflow.
 - The largest increases in streamflow and sediment yield occurred during the winter season and corresponded with the occurrence of storms.
 - There were no detectable changes in stream-bottom invertebrate measures (density, total richness and EPT richness) attributable to upstream timber harvest in tributary or mainstem sites. Similarly, examination of ordination plots gave no indication that upstream harvest affected the relative abundances of invertebrate taxa.
 - There were no significant differences in annual relative growth rates of coastal cutthroat trout (*Oncorhynchus clarkii clarkia*) among pre- and post-harvest periods in the treated and reference watersheds.
 - No detectable relationship between total biomass of salmonids or the density of age 1+ year old cutthroat trout and annual relative growth rate was observed.

- Downstream impacts from timber harvest on coastal cutthroat trout growth in South Fork Hinkle is minimal.

For additional information, please visit <http://watershedsresearch.org/> .