WRC Paired Watershed Studies Overview

Examining the Effects of Contemporary Forest Practices on Aquatic Ecosystems at Multiple Scales

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Oregon is Not Alone and Watershed Studies are Not New

From Ice and Stednick (2004, *Forest History Today*) chronicle contributions of Paired Watershed Studies

- 13 studies through United States: Wagon Wheel Gap 1910
  - Improved understanding of hydrology
  - Forest management affects on hydrology
  - Establishment and refinement of BMPS to protect watershed functions.
Cornerstone Findings and Policy Changes

- Temperatures increase without stream buffers: Leave trees around streams
- Dissolved oxygen decreases with excessive slash accumulation: Keep slash out of streams
- Roads major sources of sediment: BMPs to reduce sediment delivery from roads
✓ Studies designed to inform policy decisions
✓ Scientific findings are becoming available
✓ Need to make sure that findings are making their way to the policy dialogue
✓ Need to make sure the science is being framed in a way that supports the policy process
• Linking forest management to a range of aquatic responses.
• Further knowledge of ecosystem processes in the context of working forests.

Why watershed studies are important
What are the effects of forest harvest on small streams? If changes are observed are they also observed downstream?
If there are changes in the physical or chemical characteristics of the stream—what does that mean for the biology?
**Goal:** Quantify effects of contemporary forest practices on the physical, chemical and biological characteristics of streams at multiple spatial scales.

**Approach:** Cooperative, multi-disciplinary and long-term.
“Simple” connections within the forested aquatic ecosystems. Basis for predicting system responses to forest management.
First of the three contemporary paired watershed studies in Western Oregon.
Design: Nested, Paired
Watershed area: 4796 acres
Control watershed: 2117 acres
Treatment watershed: 2679 acres

Treatments: First harvest: 5 clearcuts adjacent to non-fish bearing streams (2005).

Second harvest: 4 clearcuts adjacent tributary and mainstem fish bearing streams (2008).

Status: Study ran from 2001-2011
Hinkle Creek

First Harvest in Small, Headwater Streams

Increase
Decrease
No change
Didn’t measure

Diagram showing the relationship between various factors and ecosystem components.

- Riparian vegetation
- Canopy cover
- Temperature
- Nutrient availability
- Hydrology
- Geomorphology & Soils
- Turbidity, Suspended sediment
- Primary producers (Algae, Bryophytes)
- Invertebrates (Density, %, chron, increase, richness decrease)
- Detritus, Leaf Litter, Organic Matter
- Amphibians
- Fish
Hinkle Creek

Second Harvest Along Fish-Bearing Streams

4 Clearcuts = 324 acres
Fish bearing streams
With Overstory buffer

Increase
Decrease
No change
Didn’t measure

Canopy cover
Primary producers
(Algae, Bryophytes)

Amphibians

Invertebrates

% chron. increase
Richness Decrease
Density no change

Fish

Detritus, Leaf Litter, Organic Matter

Riparian vegetation

Hydrology

Nutrient availability

Temperature

Geomorphology & Soils

Turbidity, Sus. sediment
Alsea Watershed Study (1966):

- Entire watershed harvested
- Burned with no stream buffers.

Current forest practice rules:

- Minimize clearcut to 120 acres
- Buffers on fish-bearing streams
- Prohibit excessive slash in streams.
Hydrology 1966
• Increases in low flows
• Small increases in peak flows

Hydrology 2009
• Increase during transition months
1966

- Sediment increased (hot prescribed fire and channel disturbance)

2009

- Preliminary results indicate no major increases in sediment
Stream Temperature Response to Harvest

Temperature 1966
• Increased >10 deg C

Temperature 2009
• Increased < 1.0 deg C in the buffered and un-buffered portion
Dissolved Oxygen Response to Harvest

Dissolved Oxygen 1966
• Decreases in DO concentrations

Dissolved Oxygen 2009
• Little to no change in DO
Fish 1966

• Long-term depression of cutthroat trout population

Fish 2009

• Increased cutthroat trout biomass and abundance post harvest
Trask Watershed Study Introduction

- The 6500 acres
- Headwaters of the Trask River
- West side of Oregon Coast Range Crest

Mostly State and Private ownership with some Federal lands
Numerous cooperators
Trask Study Design

**Nested design**: local and downstream sites

**Size**: 6500 acres

**Treatment**: Small headwater catchments (average of 93 acres)

**Extensive pre- and post-harvest study**: 4+ years of pre-harvest and 4 year post-harvest data collection.
• Effects of forest harvest on the physical, chemical and biological characteristics of small headwater streams
• Extent to which harvest influences the physical, chemical and biological characteristics in downstream fish reaches.
• Increase understanding of major processes that influence aquatic ecosystems through forest-stream interactions.
2006-11: Baseline data collection
2011: Road upgrades
2012: Headwater harvest in 8 basins
2012-16: Post-treatment data collection

Photo by Kelly James
Trask River

Understanding The Landscape

- Landscape key to understanding pattern and process,
- Physical and biological context as an early phase of research

- Trask Landscape Setting
- Physical Setting
- Fire History and Vegetation
- Recent Management
- The Aquatic Environment
Trask River

Low Flow Hydrology

The small watersheds with more earthflow terrain:
- Less responsive to rainfall
- Moderated drop in summer flow.
- N:P ratios indicate biological activity
- Most sites Phosphorus limited
- Pothole cluster is Nitrogen limited
- Some sites (example: Gus1) highly variable over time while some are more consistent
- Will pattern change after harvest and how does it affect aquatic biota?
**Amphibian Abundance and Movement**

**Initial Results**

- **Tailed frog larvae:**
  - Greater downstream movement than Pacific Giant Salamanders

- **Tailed frog abundance:**
  - Increases in a downstream direction
  - Higher abundance below downstream boundary of treatment areas (prior to harvest)

- **Downstream sites:**
  - Maintain mass during advanced development stages better than headwater sites

*Trask River*
Trask River - Linking Physical and Biological Responses: Fish

- **Fish Growth**: Fastest for small salmon and trout, and minimal for larger coastal cutthroat trout.

- **Movement**: Restricted for coastal cutthroat trout.

- **Overlap between seasonal patterns of diet and food limitation for salmonids and sculpins.**
Stable isotopes: Connections between elements of the food web

Nitrogen: Relative position
Carbon: Energy source

Will forest management shift this balance?
**Summary**

**Contemporary Forest Watershed Studies**

- **Hinkle Creek**
  - Designed Contemporary forest practices resulted in detectable changes (both increases and decreases).
  - Changes were often difficult to detect and were within observed variability of watershed.

- **Alsea**
  - Magnitude of changes far less than earlier forest practices.

- **Trask Watershed Study**
  - Builds on previous studies
  - Designed to measure differences in patterns and processes underlying those patterns
  - Understanding process allow inferences to other settings
  - Managed forests within ecosystem context
Summary: Science Findings and Policy Decisions

- Oregon has a long history of research informing forest policy and management
- Important that we continue to ask the hard questions
- Use scientific methods to provide insights
- How do science findings help inform your policy decisions?
The aim of science is not to open the door to infinite wisdom, but to set a limit to infinite error.

Bertolt Brecht