The Trask River Watershed Study

Responses of Aquatic Ecosystems to Contemporary Forest Management

Photo by Kelly James
Coop established in 2006 by OSU College of Forestry

Agency, industry and academic organizations participated

**Goal:** Quantify effects of current OR forest practices on streams

**Approach:** Watershed-scale experimental studies; cooperative, multi-disciplinary and long-term (decade).
• Collaborative effort-involved scientists from multiple organizations; state, federal, private

• Funding from multiple sources
  • Base funding: ODF, Weyerhaeuser
  • Infrastructure funding – OWEB
  • Fish, amphibians, birds – USGS
  • Other support – counties, OSU, USFS, BLM, NCASI
Objectives

- Quantify effects of forest harvest on the physical, chemical and biological characteristics of small, headwater streams

- Examine extent to which harvest in headwaters influences the physical, chemical and biological characteristics in downstream fish-bearing reaches

2600 ha (6500 acres)
Treatment Types

- **Private Lands** – clear-cut with no buffer (leave trees at some sites)
- **State Lands** – modified clear-cut or retention cut with 25ft buffers
- **BLM Lands** – thinning with 50ft buffers
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<table>
<thead>
<tr>
<th>Timeline</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-11</td>
<td>Baseline data collection</td>
</tr>
<tr>
<td>2011</td>
<td>Road upgrades</td>
</tr>
<tr>
<td>2012</td>
<td>Headwater harvest in 8 basins</td>
</tr>
<tr>
<td>2013-16</td>
<td>Post-treatment data collection</td>
</tr>
</tbody>
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*Photo by Kelly James*
Variability in geology dominates background levels of sediment yields.
Other sites include road improvement PH2 & PH4 on State Forest and the reference site PH3.
• Minimal increases in sediment & turbidity
• Local disturbances important in headwaters
• Natural variability within/between streams
Deposited sediment on stream beds was not higher at harvested sites.
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Water Quality Metrics

-Clean Water Act directs EPA to set water quality guidelines for drinking water and especially where there are threatened or endangered cold water fish species

-States implement water quality regulations

- Thresholds are common water quality metric and used to quantify effects of land use change – simple to calculate, but not site specific

-Streaming data, sensor technology, and updates in computing allow us to go beyond simple thresholds and binary classifications to duration, frequency as well as magnitude
Change in Light

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<table>
<thead>
<tr>
<th>Harvested</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearcut –No Buffer 2013</td>
<td>Pre-Harvest 2008</td>
</tr>
<tr>
<td>Clearcut with Buffer 2013</td>
<td>Reference 2013</td>
</tr>
<tr>
<td>Thinned with Buffer 2013</td>
<td></td>
</tr>
</tbody>
</table>

Percent of full light reaching stream

- CC_No Buffer
- CC_Buffer
- Thinned
Increase in maximum stream temperatures at sites with reduced riparian cover

AGENDA ITEM B
Attachment 2
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A comprehensive metric would go beyond a single value for each summer and examine full distribution of temperatures that biota are exposed to.
- Water temperature increases were localized – no downstream response.

- Even large temperature increases (harvest and/or beaver activity) had no detectable effect downstream.
Why Stream Invertebrates?

1. Good indicators of stream conditions: varied sensitivities, different life spans

2. Abundant and quickly responsive to change
Why Stream Invertebrates?

3. Multiple functions and roles in stream food webs

- Grazers
- Shredders
- Filterers
- Predators
Total abundance of invertebrates changed at 2 non-buffered sites

Macroinvertebrates

![Graph showing the total abundance of invertebrates at different sites with error bars representing variability. The graph compares different harvest cycles: Pre-harvest 2006-2011, CC_NB 2013-2016, CC_B 2013-2016, Thinned 2013-2016, and REF 2013-2016. The sites are labeled GS3, UM2, UM3, PH1, PH4, PH3, PH2, GS1, UM1, RK1, PH3, and RK3.]}
Increases at 2 non-buffered sites were a quickly responding “weedy” species.
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Headwater Responses: Clearcut with No Buffers

- Riparian Vegetation
- Stream Flow
- Geomorphology & Soils
- Light
- Temperature
- Nutrients
- Turbidity & Sediment
- Primary producers
- Benthic Organic Matter
- Invertebrates
- Amphibians

Green boxes = Change after harvest
Blue boxes = No Change
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Headwater Responses: Clearcut with Buffer

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Downstream Sites:

1. Fish response in relation to upstream forest harvest
2. Fish response in relation to water temperature, stream discharge and competition
• No response to upstream harvest in either species
• Sculpin more abundant than trout
• Biomass = fish density X average weight
Growth

- Integrates biological processes
- Measurable in the field
- Responds quickly to environmental variability
- Key component of individual fitness
No harvest effect detected at downstream sites on fish growth

- Growth = Temperature + Discharge + Biomass + e
  - Temperature = mean during growth period
  - Discharge = mean during growth period
  - Biomass = biomass of conspecifics (competition)
  - e = random effect of stream site
• Positive effect of water temperature on fish size and growth
  – Variation among sites in summer temperature related to growth
  – Growth rate for both trout and sculpin slightly higher at warmer sites:

• No observable relationship of growth to discharge or competition
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• Synthesis of results from multiple studies examining similar treatments
  • Hinkle Cr.
  • WA Type N study
• Modeling
  • Hydrology/water quality models
  • Biological models (individual-based models for fish)
• Watershed classification
  • Watersheds with physical characteristics comparable to study watersheds most likely to respond similarly
• Examined forested watersheds in western Oregon
• Watershed delineation from USGS EROS (Earth Resources Observation System) data
• 5528 watersheds delineated – about 2 sq. mi. each
• Characterized using multiple features
  • Climate
  • Land use
  • Vegetation cover
  • Geology
  • Topography
• Calculated relative similarity to the WRC watersheds determined
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Similarity Results

<table>
<thead>
<tr>
<th></th>
<th>HA &lt; 2.5</th>
<th>% Landscape</th>
<th># of Basins</th>
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</thead>
<tbody>
<tr>
<td>Trask</td>
<td>1915568</td>
<td>39.4</td>
<td>2117</td>
</tr>
<tr>
<td>Hinkle</td>
<td>2120057</td>
<td>43.6</td>
<td>2385</td>
</tr>
<tr>
<td>Alsea</td>
<td>2319306</td>
<td>47.7</td>
<td>2534</td>
</tr>
<tr>
<td>All WRC Basins</td>
<td>3215564</td>
<td>66.2</td>
<td>2796</td>
</tr>
</tbody>
</table>
• Limitations of scientific studies
  • Rarely consider social, economic or political drivers
  • Uncertainty in science
  • System response varies spatially
  • Dueling science – Ripstream example
  • Address one question at a time – policy issues often involve of multiple factors
  • Some policy issues may lack, or have limited, relevant scientific finding
  • Apply study results with appreciation of limitations
• Make better use of existing science
  • Synthesize research results – compile and interpret science in a manner aligned with key policy questions
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