Natural Variability in Water Quality and Changes after Forest Harvest in the Trask Watershed

Jeff Hatten\(^1\), Alba Argerich\(^1\) and Sherri Johnson\(^2\)

\(^1\)Department of Forest Engineering, Resources & Management, OSU; \(^2\)US Forest Service, Pacific Northwest Research Station

Collaborators: Jeremy Groom, ODF; Arne Skaugset, OSU FERM; Maryanne Reiter, Weyerhaeuser; Catalina Segura, OSU FERM

Relevance of topic to program mission: This proposal falls into the topics Water quality standards and Ecological responses to disturbances.

According to the 2006 Oregon Water Quality Assessment, 67.5% of rivers and streams in Oregon are impaired and this number increases up to 95% when analyzing streams designated to salmonid spawning and rearing (ODEQ, 2014). Excess of nutrient concentrations is the second most important cause of impairment and forest management practices such as forest harvesting and fertilizing can increase nutrient concentrations in streams.

In an effort to improve the health of aquatic ecosystems and to prevent excess nutrient delivery to the oceans, USEPA and state agencies are developing water quality standards based on the estimation of nutrient reference conditions (USEPA, 2000). Although headwater streams comprise 70-80% of the total length of perennial channels in a catchment (Allan and Castillo, 2007), and their nutrient concentrations are highly responsive to catchment-specific factors (Argerich et al. 2013), water quality data used to identify reference conditions are usually based on large rivers and not smaller streams.

Additionally, because the ecological effects of exceeding nutrient criteria are determined not only by the magnitude but by the frequency, duration and timing of nutrient pulses in relation to their natural regime, it is essential to have adequate characterization of natural variability in nutrient concentrations to establish ecologically relevant nutrient criteria. Unfortunately, and because of the economic costs, the sampling frequency of most water quality programs has limited capacity to characterize natural temporal variability (e.g. seasonal samplings).

All these limitations have led to a poor understanding of water quality variability in headwater streams both what is achievable at reference sites and what would be expected after forest harvest. For instance, NCASI (2001), in a detailed review of stream chemistry from unmanaged forested watersheds, found that almost half of them could not meet the recommended criteria for their ecoregions. One of these basins was WS9, an old-growth reference watershed in the H.J. Andrews Experimental Forest (Oregon Cascade Range), where total phosphorus was five times greater than the ecoregion guidelines (Ice and Binkley, 2003). Rhoades et al. (2011), in an analysis of stream nitrogen data from 19 reference catchments at 8 Experimental Forest sites found that nitrogen concentrations exceeded draft criteria to varying extents at all sites.

Objectives: In this study we aim to improve the current understanding of patterns and causes of variability in water quality across forest watershed landscapes by characterizing natural and post-disturbance variability in stream nutrients at the Trask River watershed.

Specifically, we will characterize variability in background nutrient concentrations across time, by analyzing water chemistry samples collected over the pre-harvest period, and across space, by comparing water chemistry data across sub-catchments. Secondly, we will analyze responses in nutrient concentrations to forest harvest by comparing pre- and post-harvest nutrient concentrations. Finally, we will compare pre- and post-harvest data to nutrient criteria under consideration for this ecoregion.
**Study site:** The Trask River Watershed is located in the Coast Range and it has been site of research since 2006. It is part of the COF Watersheds Research Cooperative (WRC), with the mission to conduct research on the effects of current and expected forest practices on water quality, fisheries and other water-related values.

**Methods:** We will analyze 2010-2014 biweekly water chemistry samples from five subwatersheds for phosphorus and nitrogen species (Upper Main 1 (UM1), Upper Main 2 (UM2), Pothole 3 (PH3), Pothole 4 (PH4), and Gus 3 (GS3)). Biweekly grab samples at the five sub-watersheds have been already collected, filtered, and frozen since 2010. Selected TTS storm water samples from the downstream gages have also been collected over time and archived. A subset of samples has already been analyzed through COF water chemistry laboratory, CCAL. Biweekly grab samples and the TTS storm samples at the downstream gages for 2014 are being collected by the regular water sampling program of the Trask River Watershed Study. We will also evaluate additional water quality parameters from low flow samples collected since 2006 on 18 nested catchments (14 upstream and 4 downstream sites).

We will characterize spatial and temporal variability by estimating variability descriptors at each of the study sites at different temporal scales (monthly, seasonal, and annual variability). Response to forest harvest will be evaluated considering magnitude and duration of the response in relation to pre-harvest conditions. We will relate stream nutrient natural variability and response to disturbance with possible explanatory factors (e.g., area of the watershed, streamflow, precipitation, geology, forest treatment).

**Timeline:**

<table>
<thead>
<tr>
<th></th>
<th>FY 14-15</th>
<th>FY 15-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water sampling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissemination and writing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**References:**


**Budget Total:** $76,444  
**Year 1:** $37,623  
**Year 2:** $38,821