Network Structure as a Modulator of Disturbance Impacts in Streams

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EISI Study Area: H.J. Andrews Experimental Forest

From Jones et al., 2000:

- Western Cascade Range, OR
- 64 km²
- Old-growth Douglas-fir
- ~ 25 % of area harvested
- High road density (~2km/km²)

From Swanson, 1975:

- Volcanic influences (lava flows, pyroclastic deposits)
Study Area: H.J. Andrews Experimental Forest

Data courtesy of HJ Andrews Experimental Forest, Catalina Segura, EISI

Survey Locations

Streams

Upper McRae Creek

Lower McRae Creek

Central Lookout Creek

Upper Lookout Creek

Lower Lookout Creek

Middle Lookout Creek

Mack Creek

0 1 2 4 Kilometers
Methodology

- Wolman particle counts with gravelometers
  - Logarithmic transformation
- Channel geometry & gradient measurements
- Large woody debris size class estimates
  - Czarnomski et al. (2008)
- GPS locations
- Photos
## Segments

<table>
<thead>
<tr>
<th>Segment</th>
<th>Average Elevation (m)</th>
<th>Average Drainage Area (km^2)</th>
<th>Average Gradient</th>
<th>Average Wood Volume per 50 Meters (m^3)</th>
<th>Average Channel Width (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper McRae Creek</td>
<td>761</td>
<td>8.055</td>
<td>8.20%</td>
<td>66.3</td>
<td>9.1</td>
</tr>
<tr>
<td>Lower McRae Creek</td>
<td>592</td>
<td>15.514</td>
<td>3.50%</td>
<td>39.1</td>
<td>13</td>
</tr>
<tr>
<td>Upper Lookout Creek</td>
<td>713</td>
<td>17.016</td>
<td>4.50%</td>
<td>49.2</td>
<td>13.6</td>
</tr>
<tr>
<td>Middle Lookout Creek</td>
<td>571</td>
<td>34.188</td>
<td>2.70%</td>
<td>85.1</td>
<td>18.5</td>
</tr>
<tr>
<td>Central Lookout Creek</td>
<td>537</td>
<td>53.613</td>
<td>1.90%</td>
<td>31.2</td>
<td>31.4</td>
</tr>
<tr>
<td>Lower Lookout Creek</td>
<td>451</td>
<td>62.419</td>
<td>1.40%</td>
<td>23.3</td>
<td>18.2</td>
</tr>
<tr>
<td>Mack Creek</td>
<td>812</td>
<td>8.573</td>
<td>9.90%</td>
<td>124</td>
<td>9.2</td>
</tr>
</tbody>
</table>
Road and Harvest Disturbances

Potential impacts of roads:

- Conduits for sediment and water (Jones et al., 2000)
- Interactions with slope mass movements (Jones et al., 2000)
- “Plugged” culverts (Wemple et al., 2001)

Potential impacts of both road and harvest activities:

- Removal of sources of large woody debris to streams (Jones et al., 2000, Czarnomski et al., 2008)
- Destabilization of hillslopes (Swanson & Dyrness, 1975)
Conceptual Models for Disturbance Impacts
Conceptual Models cont’d
Conceptual Models cont’d
Conceptual Models cont’d
Study Questions:

1) Does the proximity of roads and forest harvest areas to streams affect sediment size?

1) If the above disturbance impacts are observed, how might the quantitative structure of the river network influence the location and magnitude of the above effects on channel substrate?
Longitudinal Trends in Grain Size

Distance from Cross Section to Outlet vs. D50 at Cross Section

Distance downstream from cross section to outlet (m)

D50 (mm)
Spatial Analysis

- Classifications based on proximity to roads, harvest areas in ArcMap
<table>
<thead>
<tr>
<th>Treatment</th>
<th>N</th>
<th>Mean D50 (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No roads on either side, no harvest on either side</td>
<td>96</td>
<td>92.6bc</td>
</tr>
<tr>
<td>No roads on either side, harvest on one side</td>
<td>32</td>
<td>106.2bc</td>
</tr>
<tr>
<td>No roads on either side, harvest on both sides</td>
<td>51</td>
<td>92.8bc</td>
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<tr>
<td>Roads on one side, no harvest on either side</td>
<td>20</td>
<td>333.3bc</td>
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<tr>
<td>Roads on one side, harvest on one side</td>
<td>10</td>
<td>1002.7ac</td>
</tr>
<tr>
<td>Roads on one side, harvest on both sides</td>
<td>3</td>
<td>95.3c</td>
</tr>
<tr>
<td>Roads on both sides, no harvest on either side</td>
<td>1</td>
<td>58.1c</td>
</tr>
<tr>
<td>Roads on both sides, harvest on one side</td>
<td>2</td>
<td>65.1c</td>
</tr>
<tr>
<td>Roads on both sides, harvest on both sides</td>
<td>2</td>
<td>60.7c</td>
</tr>
</tbody>
</table>
ANOVA & Tukey HSD Results cont’d
ANOVA & Tukey HSD Results cont’d
Network Influences?

- Cluster analysis and non-metric multidimensional scaling (NMDS)
Acknowledgements

- Desiree Tullos, Julia Jones, Catalina Segura, Fred Swanson, Rebecca Hutchinson, Stephanie Bianco, Cara Walter, Sharon Bywater-Reyes

- H.J. Andrews Experimental Forest

- EISI Students


Swanson, F. J. 1. (1975). Geology and geomorphology of the H.J. andrews experimental forest, western cascades, oregon. United States:
