Headwater Streams: How Much Protection do They Need?

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Headwater Streams 101

- Small in size, but can be 50% of stream mileage
- High Biodiversity
- Impact Downstream Processes—Cumulative Effects
- Source of Organic and Inorganic Nutrients to drainage Network
- Influence Stream Network Temperature and Sediments

Fisher et al. 2004
Indicators of Change

- Stream flow
- Nitrate concentrations and losses; changes in N form
- Temperature
- Sediments
Many stream chemistry studies have focused on nitrogen (N) because it is a limiting nutrient and in excess it is a pollutant.

Studying N cycling gives an understanding of natural ecosystems functioning and the influence of management practices such as clearcut harvesting.

Stream N forms
DIN – Dissolved inorganic N (NO$_3$ and NH$_4$)
DON – Dissolved organic N
Particulate N
Some salamander species are sensitive to nitrate -N concs of 1 mg/L
Drinking water standard - 10 mg/L
Two Headwater Studies
1. What can we learn from long-term monitoring of old-growth headwater streams? - West Twin Creek Olympic National Park

2. What is the influence of clearcut harvesting and riparian buffers on harvested headwater streams? - Capitol Forest, Olympia, WA
West Twin Creek water samples

pH

NO₃ (µeq L⁻¹)

Debris flow


0.7 mg/L
Before debris flow  After debris flow in Dec. 1999
INFLUENCE OF CLEARCUT HARVESTING AND RIPARIAN BUFFERS ON HEADWATER STREAMS
Capitol Forest, Department of Natural Resources, Olympia, WA
Watershed 2

Harvested and herbicided

Small watershed studies at Hubbard Brook New Hampshire
Forest Stream Protection using Riparian Buffers in Harvested Sites in Western Washington

Forest and Fish Agreement
Graphic Representation of Riparian Zones

Jeff Grizzel, WA DNR
Type Np waters

Sensitive Sites = seeps, springs, Np confluences, alluvial fans

Jeff Grizzel, WA DNR
Considerable harvesting occurs in lowland Douglas-fir forests in western Washington (0-3000 ft ASL) that contain headwater streams (types 4 - Np and 5 - Ns).
WADDELL CREEK WATERSHED, CAPITOL FOREST

180-396 m
1-8 ha
Typical weirs and pressure transducers
**Average concentrations June 04 – June 05**

<table>
<thead>
<tr>
<th></th>
<th>NO3-N</th>
<th>NH4-N</th>
<th>DON (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffered</td>
<td>0.27</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>5-8 yr clearcut</td>
<td>0.04</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Control</td>
<td>0.04</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Waddell</td>
<td>0.11</td>
<td>0.04</td>
<td>0.02</td>
</tr>
<tr>
<td>Creek</td>
<td>0.29</td>
<td>0.07</td>
<td>0.07</td>
</tr>
</tbody>
</table>

**ANNUAL EXPORT FROM TUMS**

( kg/ha)

July 2004-July 2005

- NO3-N - 9.2
- NH4-N - 1.3
- DON - 0.6
# Stream Temperatures

(June 04- June 05)

<table>
<thead>
<tr>
<th>Stand/Watershed</th>
<th>Avg. Mean</th>
<th>Avg. Max</th>
<th>Avg. Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-8 yr clearcut cut</td>
<td>9.0</td>
<td>13.8</td>
<td>5.7</td>
</tr>
<tr>
<td>buffered</td>
<td>10.1</td>
<td>16.2</td>
<td>5.0</td>
</tr>
<tr>
<td>70-80 yr control</td>
<td>8.8</td>
<td>13.5</td>
<td>5.6</td>
</tr>
</tbody>
</table>
CONCLUSIONS

• Are headwater streams being protected enough?
• Timber harvesting does not have a dramatic impact on N concentrations, stream temperatures, and turbidity in headwater streams.
• Buffered streams may have slightly higher nitrate-N concentrations than clearcut harvested and non-harvested streams because of red alder; but concentrations are low. N discharge is not excessive.
• Do they need more, less or the same amount of protection? Perhaps depends on what you measure. What about stream invertebrates, salamanders, etc.
• What do you think?
Acknowledgements

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