Stream-Associated Amphibian Response to Manipulation of Forest Canopy Shading

James G MacCracken
Jennifer L Stebbings
Marc P Hayes
Julie A Tyson

Forests & Fish
Adaptive Management Program
Study Area & Focal Species

- Olympic Range
- Waketickeh Creek
- Jorsted Creek
- Sund Creek
- Washington
- Coast Range
- KM Mountain
- Oregon
- Soapstone Creek
- Humbug Mountain
- Cascade Range
- Rock Creek
- Beacon Rock
- Texas Creek

Amphibians:
- Coastal tailed frog
- Giant salamanders (2 species)
- Cascade torrent salamander
- Columbia torrent salamander
- Olympic torrent salamander
# Study Treatments

<table>
<thead>
<tr>
<th>Shade Reduction Treatment</th>
<th>Treatment Target (% overhead cover)</th>
<th>Actual Treatment (% overhead cover; $\bar{x} \pm SE$)</th>
<th>Sample Size (n =)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate</td>
<td>70</td>
<td>77 ± 3</td>
<td>8</td>
</tr>
<tr>
<td>Low</td>
<td>30</td>
<td>61 ± 3</td>
<td>9</td>
</tr>
<tr>
<td>No</td>
<td>0</td>
<td>40 ± 4</td>
<td>8</td>
</tr>
<tr>
<td>Reference</td>
<td>Unmanipulated</td>
<td>Unmanipulated</td>
<td>25</td>
</tr>
</tbody>
</table>
Treatment Stream Configuration

Reference reach 50 m

50-90 m

Treatment reach 50 m

Direction of Flow
Treatment Example

Intermediate Shade Reduction Treatment
Olympic Block

Pre

Post
## Study Timelines & Variables

<table>
<thead>
<tr>
<th>Blocks</th>
<th>NW Oregon</th>
<th>SW Washington</th>
<th>Pre-Treatment</th>
<th>Trtmt</th>
<th>Post-Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olympics</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Year</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation Cover</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x (x)</td>
<td>x (x)</td>
<td>(x)</td>
<td>(x)</td>
</tr>
<tr>
<td>Light (as PAR - Photosynthetically Active Radiation)</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x (x)</td>
<td>x (x)</td>
<td>(x)</td>
<td>(x)</td>
</tr>
<tr>
<td>Water Temperature</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x (x)</td>
<td>x (x)</td>
<td>(x)</td>
<td>(x)</td>
</tr>
<tr>
<td>Biofilm/Periphyton</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x (x)</td>
<td>x (x)</td>
<td>(x)</td>
<td>(x)</td>
</tr>
<tr>
<td>Stream Drift (Detritus, Macroinvertebrates)</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x (x)</td>
<td>x (x)</td>
<td>(x)</td>
<td>(x)</td>
</tr>
<tr>
<td>Amphibians Abundance</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x (x)</td>
<td>x (x)</td>
<td>(x)</td>
<td>(x)</td>
</tr>
<tr>
<td>Amphibians Body Condition</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x (x)</td>
<td>x (x)</td>
<td>(x)</td>
<td>(x)</td>
</tr>
<tr>
<td>Amphibians Growth</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x (x)</td>
<td>x (x)</td>
<td>(x)</td>
<td>(x)</td>
</tr>
</tbody>
</table>
PAR (Photosynthetically Active Radiation)
Water Temperature (Seasonal 7-day Moving Average Maximum)
Water Temperature
(Seasonal Mean Maximum)
Variation in Biofilm Accrual
Variation in Coarse Particulate Organic Matter Drift
Variation in Fine Particulate Organic Matter Drift
Variation in Macroinvertebrate Gathering Collector Drift
Variation in Macroinvertebrate Gathering Collector Drift 2

![Graph showing variation in macroinvertebrate gathering collector drift 2. The graph depicts ranked effect size against different treatments: no, low, and intermediate. The pre-treatment and post-treatment data points are indicated.](image-url)
Variation in Macroinvertebrate Predator Drift
Variation in Macroinvertebrate Scraper Drift

![Graph showing variation in macroinvertebrate scraper drift with ranked effect size plotted against different treatments: No, Low, Intermediate. The graph includes pre-treatment and post-treatment data points, indicating a decrease in ranked effect size from no treatment to intermediate treatment.]
Variation in Macroinvertebrate Shredder Drift
Variation in Total Macroinvertebrate Drift
Variation in Counts of Giant Salamanders
Variation in Counts of Cascade Torrent Salamanders

![Graph showing variation in counts of Cascade Torrent Salamanders with effect sizes for pre-treatment and post-treatment conditions.]
Variation in Body Condition of Coastal Tailed Frog Larvae
Variation in Body Condition of Cascade Torrent Salamanders
Enclosures: Evaluating Growth
Variation in Growth Rate of Coastal Tailed Frog Larvae
Variation in Growth Rate of Cascade Torrent Salamander Larvae
Variation in Growth Rate of Columbia Torrent Salamander Larvae
Variation in Growth Rate of Olympic Torrent Salamander Larvae
Amphibian Count & Body Condition Response Summary

Shade Treatment

- No
- Low
- Intermediate

Count of Direction of Response

Positive
Negative
No change
Amphibian Growth Response Summary
Highlights

- We achieved a shade reduction gradient.
- That gradient translated strongly to a light gradient.
- The shade reduction gradient also translated to increases in temperature…but the increases were only clear in the two treatments with the most reduced shade.
- The light gradient also translated to a biofilm production gradient.
- The shade reduction gradient also translated to declines in Coarse and Fine Particulate Organic Matter, but only in the most severe shade reduction treatment.
- Several changes in macroinvertebrate production seemed to track aforementioned shade reduction gradient-induced changes.
- Some stream-associated amphibian responses are also consistent with expectations linked to shade reduction gradient-induced changes.
- Considering amphibians collectively, we saw more positive and fewer negative responses in the Intermediate Shade treatment than in either the No or Low Shade treatments.
- Selected changes or lack thereof among macroinvertebrates and SAAs lack a clear explanation directly linked to shade reduction.
- We designed this field experiment to distinguish among levels of shade reduction, not identify the precise basis of the responses.