Jun 29th, 11:00 AM - 11:20 AM

Session A7 - Passage of native cutthroat trout through small culverts on steep slopes: what are the limits?

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Forest & Channel Metrics

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Passage of native cutthroat trout through small culverts on steep slopes: what are the limits?

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National Conference on Engineering & Ecohydrology for Fish Passage
June 27-29, 2011
University of Massachusetts Amherst
Fish passage: context from the Northwest

- **Washington State private forest lands**
  - 6,505 barriers identified in 1997
  - 50% have been replaced to date (total cost $100-200M)
- **Washington State DOT**
  - 1,904 barriers identified at a cost of $900M
  - 75% of blocked streams contain significant habitat upstream
- **US Forest Service lands in WA and OR**
  - 4,800 barriers at a cost of 331M, estimated to take 100 years to complete
- **Oregon DOT**
  - 733 barriers identified in W. Oregon (total cost >$100M)
- **British Columbia**
  - 76,000 culverts estimated to exist on fish streams
  - 58% pose a moderate to high risk for passage problems
Culvert passability
Uppermost species present in PNW headwater streams

- **Coastal cutthroat trout**: 75%
- **Rainbow trout**: 13%
- **Sculpin**: 8%
- **Coho salmon**: 3%
- **Other**: 1%

Data based on 1,448 headwater electrofishing surveys between 2008 – 2011 (Forest & Channel Metrics, unpublished data)
Coastal cutthroat trout

- Life history: both sea-run and resident forms
- Resident populations represent the most common fish species found in small headwater streams
- Resident populations often thrive above migration barriers
Study objective

Assess the passability of wild coastal cutthroat trout through a culvert over a range of modeled bulk average velocities
Culvert Test Bed facility
WDFW Skookumchuck Hatchery

-Slope capacity: 0 – 10%
-Flow capacity: ≤ 25 cfs
-Adjustable tailwater pool depth
-Capacity for testing multiple pipe diameters & shapes
PIT antenna development

Pass-through antenna

Right side pass-under antenna

Left side pass-under antenna

Pass-through antenna
PIT antenna development

Plan View

flow direction

tailwater tank

headwater tank
Cross-sectional hydraulic asymmetry

- higher velocity
- lower velocity
Cross sectional velocity profile

From: Pearson et al. (2005)
Flow conditions

8.0 feet/sec velocity  (8.6 % slope; 12 cfs discharge)
Passage trials: velocity, flow & slope

<table>
<thead>
<tr>
<th>Average Velocity</th>
<th>Flow</th>
<th>Slope</th>
<th>Date</th>
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<td>2.02</td>
<td>0.52</td>
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<td>4.28</td>
<td>0.52</td>
<td>6/26/2010</td>
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<tr>
<td>3</td>
<td>7.40</td>
<td>0.52</td>
<td>6/24/2010</td>
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<td>5.10</td>
<td>3.14</td>
<td>7/10/2010</td>
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<td>7.63</td>
<td>3.14</td>
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<td>8.03</td>
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<td>9.80</td>
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<td>8</td>
<td>11.94</td>
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Size distribution of tested cutthroat trout

Size distribution of tested cutthroat trout

(n = 274)
<table>
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<tr>
<th>Average velocity (ft/sec)</th>
<th>Participation</th>
<th>Success</th>
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<tr>
<td>2</td>
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<td>33%</td>
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<td>7</td>
<td>77%</td>
<td>77%</td>
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<tr>
<td>7.5</td>
<td>75%</td>
<td>79%</td>
</tr>
<tr>
<td>8</td>
<td>62%</td>
<td>31%</td>
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</tbody>
</table>
Fish size & passage success

![Bar chart showing fish size and passage success](chart.png)

- **Average fork length in mm (± SE)**
- **Participants**
- **Successful**

**Bulk velocity (ft/sec)**: 2, 2.5, 3, 4.5, 5, 5.5, 6, 6, 7, 7.5, 8
Logistic regression

![Logistic regression graph](image)
Summary

• High voluntary participation by wild test fish
• PIT tag detection system provides fine scale spatial and temporal insight into fish movements
  – Demonstrates use of low-velocity ‘sweet spot’
  – Fish size becomes important at high end of test conditions
• Wild cutthroat were successful in average passage conditions well beyond those predicted by most passage criteria
• Conversion to fish passage probabilities provides a quantitative decision space where science and policy intersect
• Decisions on what constitutes a barrier, and whether barrier removal is vital, require additional input
• The Culvert Test Bed is a unique research facility
  – ready for other studies
Acknowledgments

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