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

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

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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

Data based on 1,448 headwater electrofishing surveys between 2008 – 2011 (Forest & Channel Metrics, unpublished data)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

tailwater tank

headwater tank

flow direction
Cross-sectional hydraulic asymmetry

- higher velocity
- lower velocity
Cross sectional velocity profile

Looking upstream

From: Pearson et al. (2005)
Flow conditions

Looking upstream

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

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Size distribution of tested cutthroat trout

(n = 274)
Participation and passage

Average velocity (ft/sec)

Proportion (%)
Fish size & passage success

![Bar graph showing average fork length in mm (± SE) for different bulk velocities (ft/sec). The graph compares participants' success with successful passage. The x-axis represents bulk velocity (ft/sec), and the y-axis represents average fork length in mm (± SE). The graph shows that as bulk velocity increases, the average fork length also increases, indicating a higher success rate.]
Logistic regression

![Logistic regression graph]

- **Y-axis**: Passage Probability
- **X-axis**: Target Velocity (ft/s)

The graph shows the relationship between passage probability and target velocity, with logistic regression lines indicating the trend.
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
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