Fifteenmile Creek Fish Passage
Improvements at Channel Obstacles

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Presentation Overview

- Project Background
- Constructed Riffles
- Fish Passage Evaluation at a Natural Obstacle
Project Background

- Middle Columbia River Steelhead listed as Threatened (1999)
- Fifteenmile Creek has easternmost population of winter-run Steelhead in Columbia River basin
- Herbicide spill (August, 2000)
- Emergency restoration activities included repair of log weirs to facilitate passage
- Damage assessment included monitoring 2001 adult Steelhead run (concern for avoidance)

Location
Sites

Bedrock Chute

Bedrock Chute
Lower Weir

Upper Weir
Fish Ladder

![Fish Ladder Image]

Design

![Design Diagram]

- first step of fish ladder
- water surface
- weir 6.7 ft
- weir
- riffle 5.7 ft
- riffle
Construction Access

Natural Channel Alternative

Before  After
Natural Channel Alternative

Before

After

Natural Channel Alternative
Fish Passage Evaluation at a Natural Obstacle

Recap:
- Herbicide spill August 2000
  - Concern that returning steelhead may avoid Fifteenmile Creek.
- Monitor steelhead migration
  - Low flow year (2001)
Fish Passage Evaluation

- Early steelhead observations suggested a potential problem.

Possible Explanations:

- Temporary passage barrier (low flows) → Conduct Screening Level Barrier Analysis
- Unequal observation efficiency → Utilize more effective method
Barrier Analysis

- Barrier Geometry
- Stream Hydrology
- Barrier Hydraulics
- Fish Capabilities
- Passage Analysis

Powers & Osborne (1985)
Barrier Analysis

- Barrier Geometry
- Stream Hydrology

  - Barrier Hydraulics
  - Fish Capabilities

  Passage Analysis

Powers & Osborne (1985)

Stream Hydrology

- Migration Period (Feb-Apr 2001)
- Flows
  - 21 cfs, measured 2001
  - 93 cfs, Q80% (OWRD)
  - 178 cfs, Q10% (ODFW passage criteria)
Barrier Analysis

Barrier Geometry → Stream Hydrology → Barrier Hydraulics → Fish Capabilities → Passage Analysis

Powers & Osborne (1985)

Barrier Hydraulics

\[ \text{water surface} \rightarrow \text{bedrock} \]
Barrier Analysis

Powers & Osborne (1985)

Fish Capabilities

Powers & Osborne (1985)

burst speed x fish condition coefficient = swim speed

- 19.9 ft/s, 5 sec
- 10.3 ft/s, 10 sec

Hunter & Mayor (1986)

a x fish length$^b$ x swim duration$^c$ = swim speed

- 13.7 ft/s, 5 sec
- 9.6 ft/s, 10 sec
Barrier Analysis

Powers & Osborne (1985)

Passage Analysis

Step 1: Jump or Swim?
Passage Analysis

Step 2: Swimming speed > water velocity?

<table>
<thead>
<tr>
<th>Fish Speed (ft/sec)</th>
<th>V barrier? Q_{10%} 11 ft/sec</th>
<th>V barrier? Q_{80%} 10 ft/sec</th>
<th>V barrier? Q_{2001} 7 ft/sec</th>
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<tbody>
<tr>
<td>19.9</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>13.7</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>10.3</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>9.6</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
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</tbody>
</table>

Passage Analysis

Step 3: Flow depth > 6 inches?

<table>
<thead>
<tr>
<th>Flow, (cfs)</th>
<th>Min Depth, (in)</th>
<th>Barrier?</th>
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<tbody>
<tr>
<td>178</td>
<td>13</td>
<td>No</td>
</tr>
<tr>
<td>93</td>
<td>11</td>
<td>No</td>
</tr>
<tr>
<td>21</td>
<td>5</td>
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</table>
Passage Analysis

Step 4: Length to exhaustion > chute length?

\[(V_{\text{fish}} - V_{\text{water}}) \times T_{\text{failure}} = L_{\text{swim}}\]

<table>
<thead>
<tr>
<th>Fish Speed (ft/sec)</th>
<th>Water Velocity (ft/sec)</th>
<th>Time to Failure (sec)</th>
<th>Distance Fish Can Swim (ft)</th>
<th>Chute Length (ft)</th>
<th>Velocity/Distance Barrier?</th>
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<tbody>
<tr>
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<td>10</td>
<td>5</td>
<td>49</td>
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<td>10</td>
<td>10</td>
<td>3</td>
<td>61</td>
<td>yes</td>
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<tr>
<td>13.7</td>
<td>10</td>
<td>5</td>
<td>19</td>
<td>61</td>
<td>yes</td>
</tr>
</tbody>
</table>

Fish Passage Evaluation

Potential explanations:

- Temporary passage barrier  Yes??
- Unequal observation efficiency??
  - Utilize more effective observation method
Fish Passage Evaluation

- Installed time-lapse video monitoring station on April 11th.

How do these steelhead pass the chute?
- Leaping insufficient
- Burst swimming speed only lasts seconds
  - Not enough time to traverse required distance
- Behavioral adaptations
  - Selection of reduced velocity pathways
  - Energy conservation strategies
    - Resting areas
    - Other innovative tactics
Rest Area

Summary

• Constructed Riffles
  ➢ Natural channel alternative to structures

• Fish Passage
  ➢ Research - rules for fish behavior
  ➢ Research - method that combines complex hydraulics, fish behavior, and physiology to predict performance