Survival and Traits of Reconditioned Kelt Steelhead *Oncorhynchus mykiss* in the Yakima River, Washington

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Outline

• The Problem: Dramatic decline of steelhead in the Columbia River Basin
• Taking advantage of steelhead iteroparity
• Describe the reconditioning process
• Provide data on survival and traits of reconditioned steelhead
• Recommendations
The Problem

Steelhead ESUs

Status
- Red: Endangered
- Green: Not Warranted
- Yellow: Threatened or Of Concern
Taking advantage of steelhead iteroparity

Percentage of the upstream run seen as kelts

- Yakima River: 70%
- Snake River: 20%
Taking advantage of steelhead iteroparity

- Although most steelhead try to return to the ocean after spawning. Repeat spawner rates of inland populations are low.
- Burgner et al. 1992 reported 7.2% kelts in the high seas population.
- Repeat spawners comprise < 3% of the Yakima River run.
- Repeat spawners comprise ~ 1% in the Snake River.
Taking advantage of steelhead iteroparity
The reconditioning process

- Spawning
- Incubation
- Rearing
- Kelts
- Outmigration
- Estuary & Ocean
- Resident
- Upstream Migration

[Diagram showing the reconditioning process with images of fish and a facility.]
Survival and traits

When did they cross Prosser Dam?
## Survival and traits

### At Collection
- Pre-spawner abundance
- Kelt abundance
- Proportion of run seen as kelts
- Fork length
- Weight
- Fulton’s K
- **Condition** *(Good-1, Fair-2, Poor-3)*
- **Color** *(Bright-1, Intermediate-2, Dark-3)*
- Flow *(Monthly, Spring, SH run)*
- PIT tag

### At Release
- Kelt abundance
- Kelt survival \( \frac{N_1}{N_0} \)
- Fork length and \( \Delta FL \)
- Weight and \( \Delta WT \)
- Fulton’s K and \( \Delta K \)
- Fat meter
- **Plasma** *(vitellogenin and estradiol)*
## Survival and traits

### Pre-spawner and Kelt Metrics

<table>
<thead>
<tr>
<th>Years</th>
<th>Pre-spawn Steelhead</th>
<th>Kelt Steelhead at Collection, Chandler Juvenile Monitoring Facility (CJMF)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Abundance</td>
<td>Median date of passage</td>
</tr>
<tr>
<td>2000/01 – 2010/11</td>
<td>1,537</td>
<td>18-Oct</td>
</tr>
<tr>
<td></td>
<td>6,796</td>
<td>26-Dec</td>
</tr>
<tr>
<td></td>
<td>3,577</td>
<td>9-Nov</td>
</tr>
</tbody>
</table>
## Survival and traits

### Kelt Metrics

<table>
<thead>
<tr>
<th>Years 2001 - 2011</th>
<th>Number Reconditioned</th>
<th>Number Released</th>
<th>Survival (%)</th>
<th>Mean Fork Length (cm)</th>
<th>Mean Weight (kg)</th>
<th>Mean Fulton’s K</th>
<th>Means At Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>279</td>
<td>85</td>
<td>20.1</td>
<td>Collect: 59.29 Release: 60.45 Change: -0.46</td>
<td>Collect: 1.59 Release: 2.00 Change: 0.30</td>
<td>Collect: 0.027 Release: 0.033</td>
<td>Condition: 1.548 Color: 1.500</td>
</tr>
<tr>
<td>Maximum</td>
<td>1100</td>
<td>426</td>
<td>62.4</td>
<td>Collect: 67.35 Release: 68.03 Change: 2.65</td>
<td>Collect: 2.08 Release: 3.22 Change: 1.22</td>
<td>Collect: 0.035 Release: 0.048</td>
<td>Condition: 1.672 Color: 1.786</td>
</tr>
<tr>
<td>Average</td>
<td>545</td>
<td>208</td>
<td>40.0</td>
<td>Collect: 63.05 Release: 63.35 Change: 0.61</td>
<td>Collect: 1.92 Release: 2.41 Change: 0.50</td>
<td>Collect: 0.030 Release: 0.037</td>
<td>Condition: 1.615 Color: 1.620</td>
</tr>
</tbody>
</table>
Survival and traits

Survival of kelt steelhead in long-term reconditioning
Fish collected April-June and released in October

![Graph showing survival rates from 2001 to 2012. The graph indicates variability in survival rates with a peak in 2003 and a consistent 40% survival rate highlighted by a red line.]
Survival and traits

Survival as a function of collection week

- Slight advantage toward fish collected early
- No explanation for the dip at WK 18
Survival and fish condition

- Fish are rated as Good-1; Fair-2; and Poor-3.
- Good and Fair fish have survivals that are not significantly different.
- Poor fish = dead
Survival and traits

Survival and fish color

- Fish are rated as Bright-1; Medium-2; and Dark-3.
- Survivals are not significantly different among fish color ratings.
Survival and traits

Survival and fish fork length

• There is a slight decrease in survival with increasing length.
Survival and traits

\[ r = .81 \]
\[ P = .002 \]
Survival and traits

Kelt Proportion of Prespawn Run

Prespawner Abundance

$r = -.64$

$P = .035$
Survival and traits

Kelt Proportion of Prespawn Run vs. Kelt Condition

- Good
- Fair

$r = -.66$
$P = .026$
Survival and traits

Correlation between Kelt Proportion of Prespawn Run and Percent Kelt Survival in LT Reconditioning:

- Pearson's correlation coefficient ($r$): 0.68
- Significance level ($P$): 0.022

The graph shows a positive correlation, indicating that as the proportion of kelt run increases, the percent survival in LT reconditioning also tends to increase.
Survival and traits

Percent Kelt Survival in LT Reconditioning

Kelt Condition

Good

Fair

r = -.70
P = .017
Survival and traits

Kelt Condition vs. Kelt Color

- Good
- Bright
- Fair
- Dark

$r = .05$
$P = .90$
Recommendations

• The empirical results we observed demonstrate the potential of kelt reconditioning to provide recovery benefits for imperiled wild repeat spawning populations in highly developed river systems.

• Fish condition, collection date, and pre-spawn abundance influenced reconditioning survival, suggesting that selection of fish at intake and the number of fish collected for reconditioning can be tailored to achieve program goals.
Recommendations

• Achieving reasonable survival rates by reconditioning wild kelt steelhead is a first step toward the development and implementation of this new stock recovery tool.

• Additional studies of the reproductive success of reconditioned kelts are required to quantify the benefit of the reconditioning program.
Questions
Skip spawner