Reproductive Success of Artificially Reconditioned Kelt Steelhead in the Yakima River

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Outline

• Provide some background on the kelt reconditioning program
• Present research questions for this study
• Preliminary results and some interpretation of parentage analysis
Natural Reproductive Success

• Seamons & Quinn 2010 studied 19 Brood years of a wild population of steelhead
  – Theorized that: “lifetime reproductive success (LRS)… should scale with the number of breeding seasons”
  – Found that: female repeat spawners had “nearly twice” the success of one time spawners
Life history of natural kelts in Yakima
Spawning → Incubation → Kelts → Outmigration
Upstream Migration → Resident → Rearing → Estuary & Ocean → ~70% of the Yakima run is moving downstream of Prosser
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12% to 35% survival of Yakima kelts to the ocean
Spawning

Incubation

Kelts

Rearing

Outmigration

Estuary & Ocean

Resident

Upstream Migration

~70% of the Yakima run is moving downstream of Prosser

12% to 35% survival of Yakima kelts to the ocean

high seas samples contain 7.2% previous spawners
Repeat spawners typically comprise 60% consecutive and 40% skips.

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In incubation

Kelts

Outmigration

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Resident

Rearing

Repeat spawners typically comprise 60% consecutive and 40% skips

Upstream Migration

Estuary & Ocean

12% to 35% survival of Yakima kelts to the ocean

2.7% of the run at Prosser are natural repeat spawners

high seas samples contain 7.2% previous spawners
Artificial Reconditioning In the Yakima River to date

- Capture and feed for 6 to 9 Months
- Collected 8,110 kelt steelhead
- Reconditioned and released 3,305
- Survival to release ~ 40%
- Individual survival correlated with fish condition

*Hatch et al. 2013. NAJFM 33(3)*
Research Questions

1. Do artificially reconditioned kelt steelhead reproduce in the wild?
2. What is the relative reproductive success (RRS) of artificially reconditioned kelt steelhead?
3. What is the lifetime reproductive success (LRS) of artificially reconditioned kelt steelhead?
Logistical Issues

- Limited power due to sampling a small proportion of the population
- Incidental sampling of resident offspring
- Need to know juvenile age
- No data for skip spawners
- No data for naturally reconditioned kelts
- Currently have only two years of data
Parent Collections-Female Only

- Pre-spawn maidens. Upstream at Prosser
- Post-spawn maidens. Downstream at Chandler
- Reconditioned Kelts. Upstream at Prosser
  – Includes known non-rematuring fish
Offspring collections

- Electrofished in August and September
- Targeted areas with known steelhead spawning
- Targeted age-0 young of the year
Genotyping Methods

• Genotyped 192 SNP markers using targeted amplicon sequencing on Illumina Hiseq 1500

• Dropped 40 markers
  – 35 with low diversity (MAF < 0.05)
  – 3 cutthroat diagnostic
  – 1 poor genotypes
  – 1 sex marker
Sample with Genotypes

- **1,440 Genotyped Parents**

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<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
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<tbody>
<tr>
<td>Pre-spawn maidens</td>
<td>306</td>
<td>287</td>
</tr>
<tr>
<td>Post-spawn maidens</td>
<td>307</td>
<td>239</td>
</tr>
<tr>
<td>Reconditioned kelts</td>
<td>209</td>
<td>92</td>
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- **1,161 Genotyped Offspring**

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<thead>
<tr>
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<tbody>
<tr>
<td>Satus Creek</td>
<td>248</td>
<td>234</td>
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<tr>
<td>Toppenish Creek</td>
<td>300</td>
<td>257</td>
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<tr>
<td>Naches River</td>
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<tr>
<td>Big Creek</td>
<td>19</td>
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<tr>
<td>Ahtanum Creek</td>
<td>14</td>
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Parentage Method

• Used the Program CERVUS
• Simulations ran to determine a 99% confidence interval for LOD scores (natural log of overall likelihood ratio).
• Progeny assignments were used if
  – Met 99% confidence interval
  – Had one or less mismatching loci. Allows for minor genotyping error
Parentage Results

• Juveniles assignment rates
  – 2013: 19% (105 of 548) to at least 1 parent
  – 2014: 30% (148 of 491) to at least 1 parent

• Parent assignment rates
  – 2013: 5.6% (46 of 822) had at least 1 progeny
  – 2014: 7.9% (49 of 618) had at least 1 progeny

• Low detection rates are the result of the low proportions of parents and progeny sampled throughout the Yakima Basin
1. Do artificially reconditioned kelt steelhead reproduce in the wild?
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1. Do artificially reconditioned kelt steelhead reproduce in the wild? YES

![Bar chart showing progeny assignments for pre-spawn maidens and post-spawn maidens, with a separate category for reconditioned kelts. The chart compares 2013 and 2014 data.]
2. What is the relative reproductive success of artificially reconditioned kelt steelhead?

Standardized to pre-spawn maidens
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3. What is the lifetime reproductive success (LRS) of artificially reconditioned kelt steelhead?
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3. What is the LRS of artificially reconditioned kelt steelhead relative to first-time spawners?

1.83

“Almost twice”
Preliminary Conclusions

• Kelts represent an important life history for steelhead
• Reconditioned kelts reproduce in the wild
• Reconditioned kelts had a LRS level similar to natural kelts (Seamons & Quinn 2010)
• Reconditioned kelts have the potential to increase productivity of natural populations