Reproductive success of steelhead (Oncorhynchus mykiss) in Little Sheep Creek: As Time Goes By...

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Little Sheep Creek, Imnaha basin
Pedigree project sampling

Trap intercepts migrating adults

Sample parent tissues

Sample juvenile offspring

Sample outmigrants
Pedigree analysis

- Genotyped for 15 microsatellites
- Pedigrees reconstructed by exclusion
- Relative Reproductive Success (RRS) calculated, normalized to wild
- GLM’s compared to determine which factors are most important in determining RRS (coming soon).
Little Sheep Creek steelhead program
History of the Little Sheep program

- Established 1982, ~6 generations
- Large resident population
- Local broodstock, new influx each year

<table>
<thead>
<tr>
<th>Year</th>
<th>N Brood</th>
<th>% Wild</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>218</td>
<td>13</td>
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<tr>
<td>2001</td>
<td>221</td>
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<td>2002</td>
<td>216</td>
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<td>2003</td>
<td>174</td>
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<td>2004</td>
<td>191</td>
<td>5</td>
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<tr>
<td>2005</td>
<td>191</td>
<td>9</td>
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<tr>
<td>2006</td>
<td>164</td>
<td>7</td>
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<tr>
<td>2007</td>
<td>159</td>
<td>8</td>
</tr>
<tr>
<td>2008</td>
<td>133</td>
<td>11</td>
</tr>
<tr>
<td>2009</td>
<td>133</td>
<td>22</td>
</tr>
</tbody>
</table>
Little Sheep returning adults passed over the Weir
Hatchery vs. Wild RRS
Adult-to-Adult (by origin)
GLM analysis
(Adult to parr only)

• Factors considered:
  – sex
  – Origin (H vs. W)
  – date of return
  – length
  – density

• Best model:
  – Origin
  – Length
  – number of same-sex competitors
GLM results

• Hatchery fish had significantly lower RRS
• Larger fish had significantly higher RRS
• Lower RRS with more same-sex competitors, particularly hatchery fish
  – Wild fish better able to compete with higher numbers of same-sex competitors?
  – Wild fish able to spawn in better habitat?
Conclusions from Little Sheep

- Hatchery steelhead have significantly lower RRS than wild counterparts in Little Sheep Creek.
  - No consistent difference between hatchery males and hatchery females in performance.
  - Lower hatchery RS seen at both juvenile and adult stages.
Contrasted to Chinook RRS (by Origin)
Potential causes of lowered hatchery RS

- Inbreeding?
  - Likely not
Effective population size
Potential causes of lowered hatchery RS

- Inbreeding?
  - Likely not

- Differential survival of juveniles
  - Lower RS evident as early as zeros
  - Same lowered RS as returning adults
  - Same-sex competition more significant for hatchery fish
Potential causes of lowered hatchery RS

• Inbreeding?
  – Likely not

• Differential survival of juveniles
  – See lowered success as early as zeros
  – Same lowered RS as returning adults

• Changes in life history or behavior
  – Spawning behavior?
  – Spawning location?
Spawning location vs. parental cross

River Mile

HH HW WH WW
The goal of supplementation: produce “wild-like” fish

• What is overall performance of naturally spawning fish?
  – numbers of offspring produced
  – return timing
  – spawning location/behavior
  – etc.
• How do these change over time?
• Why such big differences between species and systems?
Acknowledgements

- This project was funded through BPA contract # 198909600
- Sampling, fieldwork and encouragement by ODFW
Pedigree analysis match-up

![Pedigree analysis diagram](image-url)
Supplementation programs in the Columbia River basin

Triangles = egg-to-parr/smolt, Diamonds = adult-to-parr/smolt, Squares = lifetime

Species: Dark blue = steelhead, yellow = Chinook
Microsatellite markers—simple sequence repeats

Allele designations typically related to fragment size

“102” — CA CA CA CA CA CA CA CA CA CA CA

“100” — CA CA CA CA CA CA CA CA CA CA

“96” — CA CA CA CA CA CA CA CA

“94” — CA CA CA CA CA CA CA
Example of microsatellite genotypes
Two strategies for genetic monitoring of hatchery supplementation

Gene frequency monitoring design:
    Change in allele frequencies through time among hatchery, natural, and wild populations

Reproductive success design:
    Pedigrees in natural populations and hatchery broodstocks
RRS Adult-to-Adult (by crosses)