Monitoring Puget Sound early winter steelhead hatchery releases

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Washington Department of Fish and Wildlife

Pacific Coast Steelhead Management Meeting
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Genetic and ecological concerns of hatchery programs

Evidence that hatchery-origin fish have lower reproductive fitness than natural-origin fish


Large hatchery releases may be associated with decreased survival of wild fish via ecological mechanisms

Kostow 2009 Rev Fish Biol Fisheries

• Competition for limited food or rearing territories
• Predation on smaller-bodied salmonids
Genetic and ecological concerns of hatchery programs

**Residual:** hatchery fish that fails to out-migrate with cohort

- Undersized, immature parr
- Large, precocial males
Release strategies and residualism

Volitional migrants: fish that volitionally migrate from hatchery
- Better survival, fewer residuals (Snow et al. 2013, Moran 2016, Tatara et al. 2016)
- Faster migration (Moran 2016)

Non-migrants: fish that fail to migrate from hatchery
- Greater chance of residualism (Snow et al. 2013, Moran 2016, Tatara et al. 2016)
- Undersized fish (parr) or precocious fish
Puget Sound early winter steelhead hatchery programs

- Support harvest opportunities
- Segregated program
- Intentional selection of early maturing fish to advance spawn timing
- 1-year accelerated smolt program

Programs authorized via 2016 BiOp (NMFS)
- Nooksack, Stillaguamish, Skykomish, Snoqualmie, Dungeness
- Stipulates < 2% gene flow from hatchery programs into wild populations
Early winter steelhead release guidelines

- Fully smolted fish
- Fish of uniform size, that meet minimum size criteria
- Volitional release

MINIMIZE ecological and genetic risks
MAXIMIZE adult returns
Objective: evaluate EWS hatchery releases

- Evaluate the potential for residualism *via release sampling*
  - Estimate rate of precocious male maturation

- Evaluate the potential for ecological effects during outmigration *via smolt trap catches*
  - Estimate rate of outmigration
2017 early winter steelhead releases

<table>
<thead>
<tr>
<th>Facility</th>
<th>Release Start</th>
<th>Release End</th>
<th>Fish Released</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whitehorse (Stillaguamish)</td>
<td>Apr. 15</td>
<td>May 15</td>
<td>102,167</td>
</tr>
<tr>
<td>Tokul (Snoqualmie)</td>
<td>Apr. 15</td>
<td>Apr. 30</td>
<td>66,895</td>
</tr>
<tr>
<td>Dungeness</td>
<td>May 1</td>
<td>May 10</td>
<td>10,195</td>
</tr>
</tbody>
</table>
2017 hatchery release sampling

Pre-release sample
Post-release sample (non-migrants)

N = 200
• Fork Length (mm)
• Wet weight (g)
• Smolt index

N = 100 (lethal samples)
• Metrics above
• Gender
• Gonad weight
• Visual maturation determination
Sex ratio

Tokul

Whitehorse

Dungeness

Percent of fish

Gender
- Male
- Female

Pre
Post

Pre
Post

Sample type
Maturation

![Maturation Graphs](image-url)
## Potential residuals

<table>
<thead>
<tr>
<th>Pre-release</th>
<th>Fish Released</th>
<th>Percent male</th>
<th>Estimated males</th>
<th>Percent mature</th>
<th>Mature males released</th>
<th>Percent of release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokul Creek</td>
<td>66,895</td>
<td>56%</td>
<td>37,461</td>
<td>1.8%</td>
<td>674</td>
<td>1.0%</td>
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<tr>
<td>Whitehorse</td>
<td>102,167</td>
<td>53%</td>
<td>54,624</td>
<td>5.6%</td>
<td>3,059</td>
<td>3.0%</td>
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<tr>
<td>Dungeness</td>
<td>10,195</td>
<td>51%</td>
<td>5,199</td>
<td>3.9%</td>
<td>203</td>
<td>2.0%</td>
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</tbody>
</table>
Characteristics influencing precocity

- Fork Length (mm)
- Body Weight (g)

Maturity:
- Immature
- Mature
Conclusions: release sampling

• Evidence of precocious maturation

• Differences between pre-release and post-release fish (non-migrants)

• Volitional release strategy important to minimize number of residuals

• Impact likely varies
  o Annually
  o Survival of residuals
  o Spawning success

• Important to continue to monitor, collect empirical data
Puget Sound smolt sampling

Dungeness: WDFW & Jamestown S’Klallam

Stillaguamish: Stillaguamish Tribe

Snoqualmie: Tulalip Tribes

Smolt traps

Hatcheries

<table>
<thead>
<tr>
<th>Hatchery (Basin)</th>
<th>Release dates</th>
<th>Distance to smolt trap</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tokul (Snoqualmie)</strong></td>
<td>Apr. 15 to Apr. 30</td>
<td>41.3 RM</td>
</tr>
<tr>
<td><strong>Whitehorse (Stillaguamish)</strong></td>
<td>Apr. 15 to May 15</td>
<td>27.9 RM</td>
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<tr>
<td><strong>Dungeness</strong></td>
<td>May 1 to May 10</td>
<td>10 RM</td>
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</table>
Fish counters
Migration timing: hatchery release to smolt trap

**Tokul**
- Total release: 66,895

**Whitehorse**
- Winter release: 102,167
- Summer release: 65,685

**Dungeness**
- Total release: 10,195
Temporal overlap with wild steelhead

Whitehorse

Tokul

Dungeness

Number of outmigrants

Week

Wild
Hatchery
Conclusions: smolt trap catches

• Hatchery fish encountered at downstream smolt traps
• Time in system varied
  • Distance
  • Flows, weather
• Hatchery migration matched wild steelhead migration
• Impacts likely vary annually
• Continue to monitor, make improvements to methods
Future sampling

Release sampling & residualism
- Increase sample size
- Sample at all EWS facilities
- Sample closer to release date
- Histopathology - gonad development
- Residual stream surveys or PIT tags

Smolt trap catches
- PIT tags or marks
- Steelhead efficiency trials -> production estimates
## Acknowledgements

<table>
<thead>
<tr>
<th>Washington Department of Fish and Wildlife</th>
<th>Stillaguamish Tribe of Indians</th>
<th>Funding</th>
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<tbody>
<tr>
<td>Pete Topping</td>
<td>Stephen Chandler</td>
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<tr>
<td>Andrew Simmons</td>
<td>Tom Cox</td>
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<td>Dan Gorze</td>
<td>Katie Kelly</td>
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<td>Scott Williams</td>
<td>Matt Hayes</td>
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<td>Jeff Benjamin</td>
<td>Dave Whitmer</td>
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<td>Rick Grimsley</td>
<td>Will Irwin</td>
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<td>Jenni Whitney</td>
<td>Darin Combs</td>
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<td>Pete Verhey</td>
<td>Debi Sanchez</td>
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<td>Joe Short</td>
<td>Duane Richer</td>
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<tr>
<td>Kaili Park</td>
<td>Brodie Antipa</td>
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<tr>
<td>Ashley Caldwell</td>
<td>Edward Eleazer</td>
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| Jamestown S’Klallam Tribe                 | Chris Burns                   |         |
|                                          | Jason Griffith                |         |

| Tulalip Tribes                            | Matt Pouley                   |         |
|                                          | and many more!                |         |

| Funding Armstrong Fund                    | Stephen Chandler              |         |
|                                          | Tom Cox                       |         |
|                                          | Katie Kelly                   |         |
|                                          | Matt Hayes                    |         |
|                                          | Dave Whitmer                  |         |
|                                          | Will Irwin                    |         |
|                                          | Darin Combs                   |         |
|                                          | Debi Sanchez                  |         |
|                                          | Duane Richer                  |         |
|                                          | Brodie Antipa                 |         |
|                                          | Edward Eleazer                |         |

| Funding Washington State Wildlife Fund    | Charlotte Scofield            |         |
|                                          | Jason Griffith                |         |

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