Snake River Sockeye Salmon Recovery - Historical Perspective and Progress Towards Meeting Recovery Objectives

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Presentation Outline

• Overview of recovery effort for Snake River (Redfish Lake) Sockeye Salmon
  • Background
  • Three-phase approach to implementation
  • Challenges following Program expansion
Background

Sawtooth Hatchery
Eagle Hatchery
Springfield Hatchery
Population Status

Adult sockeye salmon returning to Idaho 1962 - 1990
(Snake River dam counts)

Number of Adults

Adult Return Year


0
Implementation

- Phase 1: Captive broodstock phase
- Phase 2: Re-colonization phase
- Phase 3: Local Adaptation phase
Captive Broodstock Phase

- In Phase 1, conservation hatchery protocols established early-on to protect the remnant population

- Protocols developed:
  - BMPs to rear sockeye in captivity
  - Redundant broodstocks (IDFG and NMFS)
  - Spawning plans that maintain genetic diversity and avoid inbreeding
  - Biosecurity & 100% fish health screening
Captive Broodstock Phase

- High egg survival to the eyed-stage of development (about 80%)
- High in-hatchery life-cycle survival (about 70% fry to adult)
- Effectively maintained population genetic variability (about 95%)\(^1\)
- Identified smolt releases as the most successful strategy to return anadromous adults

Captive Broodstock Phase

- Releases to date include:
  - ~1.1M eyed eggs
  - ~1.6M pre-smolts
  - ~2.9M smolts
  - ~13K pre-spawn adults
Captive Broodstock Phase

- Adult count at upper-most Snake River dam (1962 – present)
- Adult count at terminal collection sites (1999 – present)

> 7,000 adult returns to date to basin
Program expansion

- Phase 1: Captive broodstock phase
- Phase 2: Re-colonization phase
- Phase 3: Local Adaptation phase
Program Expansion

Springfield Hatchery - 2013
Phase 2: Re-colonization phase

- Smolt production to increase ~ 5-fold to 1M
- Objective to re-colonize habitat by producing greater numbers of smolts and returning greater numbers of anadromous adults
- Anadromous adults used to re-seed the habitat and to replace captive adults in hatchery spawning designs
Re-colonization Phase

• In this Phase, the proportion of hatchery to natural fish released to the habitat (pHOS) will not be strictly controlled.

• To maintain genetic continuity between hatchery and natural spawning components 10% of the broodstock will be comprised of natural-origin anadromous adults.
Local Adaptation Phase

- Phase 3: Local Adaptation

- Objective to emphasize local adaptation and promote fitness gains through integrated program management that follows HSRG guidance for: pHOS, pNOB, and PNI\(^1\)

- Smolt production reduced to 400,000 to 600,000

- Test assumptions that local adaptation and integrated broodstock management can effectively grow the natural population to sustainable levels that effectively address recovery objectives

\(^1\)Paquet et al. 2011. Fisheries 36(11):547-561
Re-colonization Phase

Phase 2 so far:
Into 4th production cycle at Springfield – three smolt releases conducted

- Hatchery dedicated 9/6/2013
- First eggs to Springfield 12/2013
- 214,876 smolts
- 540,665 smolts
- 734,492 smolts
2015 Releases (BY13)

- 214K+ smolts released
- Fish in poor condition, gaping mouths, frayed fins, embolisms
- 37% survival from Lower Granite to Bonneville

MORTALITY RELATED TO GAS SUPERSATURATION?

2016 Releases (changes)

- Degassing addressed at Springfield
- Water-up night before hauling to reduce TDG levels
- New Transport route – lower elevation

Challenges – Low Survival
Challenges – Low Survival

2016 Releases (BY14)
- 540K+ smolts released
- Fish in poor condition, signs of physical trauma
- Substantial descaling observed
- 12% survival from Lower Granite to Bonneville

MORTALITY RELATED TO PUMPING TRAUMA, (DE)SMOLTIFICATION? WATER QUALITY?

2017 Releases (BY15)
- New 6” fish pump purchased
- Stock fish earlier, add salt
- Look at water quality differences
- Develop study design to evaluate smoltification/transport stress

Low Survival
540K+ smolts released

12% survival from Lower Granite to Bonneville
## Challenges – Low Survival

### Water quality parameters measured

- Hardness
- Alkalinity
- pH
- Gill ATPase
- Plasma Glucose
- Plasma Cortisol
- Hematocrit

### Table: Water Quality Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Springfield Hatchery</th>
<th>Redfish Lake Creek</th>
<th>Salmon River</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkalinity</td>
<td>194-202 mg/L</td>
<td>1-8 mg/L</td>
<td>66 mg/L</td>
</tr>
<tr>
<td>Hardness</td>
<td>234-248 mg/L</td>
<td>11-12 mg/L</td>
<td>68 mg/L</td>
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<tr>
<td>pH</td>
<td>7.70-7.75</td>
<td>7.41-7.72</td>
<td>7.94</td>
</tr>
</tbody>
</table>
Researching – Low Survival

2017 Releases (BY15)

- 730K+ smolts released
- Smolts looked good but mortality increased
- 18% survival from Lower Granite to Bonneville

Water quality - stress
RESULTS SUGGEST STRESS FACTOR(S) REMAINS POST-RELEASE

2017 Results

CORTISOL (ng/mL)
Researching – Low Survival

EXPERIMENT CONDUCTED W/PRE-SMOLTS  OCTOBER 2017

SAMPLED BLOOD CHEMISTRY BEFORE AND AFTER TRANSPORT AND RELEASE TO DIFFERENT WATER SOURCES
SPRINGFIELD WELL
- Alkalinity = 188 mg/L
- Hardness = 232 mg/L
- pH = 8.18

SALMON RIVER
- Alkalinity = 66 mg/L
- Hardness = 68 mg/L
- pH = 7.94

REDFISH LAKE CREEK
- Alkalinity = 17 mg/L
- Hardness = 11 mg/L
- pH = 7.33

RESULTS SUPPORT WORKING HYPOTHESIS RELATED TO WATER CHEMISTRY
Next Steps
250K pre-smolts released to Redfish Lake in October, 2017

~700K smolts to acclimate at Sawtooth Hatchery
½ to be released in Redfish Lake Creek
½ to be released in the Salmon River

~50K smolts to be released to Redfish Lake Creek as control (no acclimation)
Moving Forward – 2019 Release

Release strategies TBD – based on 2018 findings

300K smolts to be reared full term at Sawtooth Hatchery to be released to Redfish Lake Creek

Experiment with in-route water softening

Hope we found the smoking gun!
Acknowledgements

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Time for questions?