Fishery Science Questions Surrounding the Proposed Klickitat Hatchery Program

Monitoring Information on Native Species Recovery, Harvest Goals, and Hatchery/Wild Interactions

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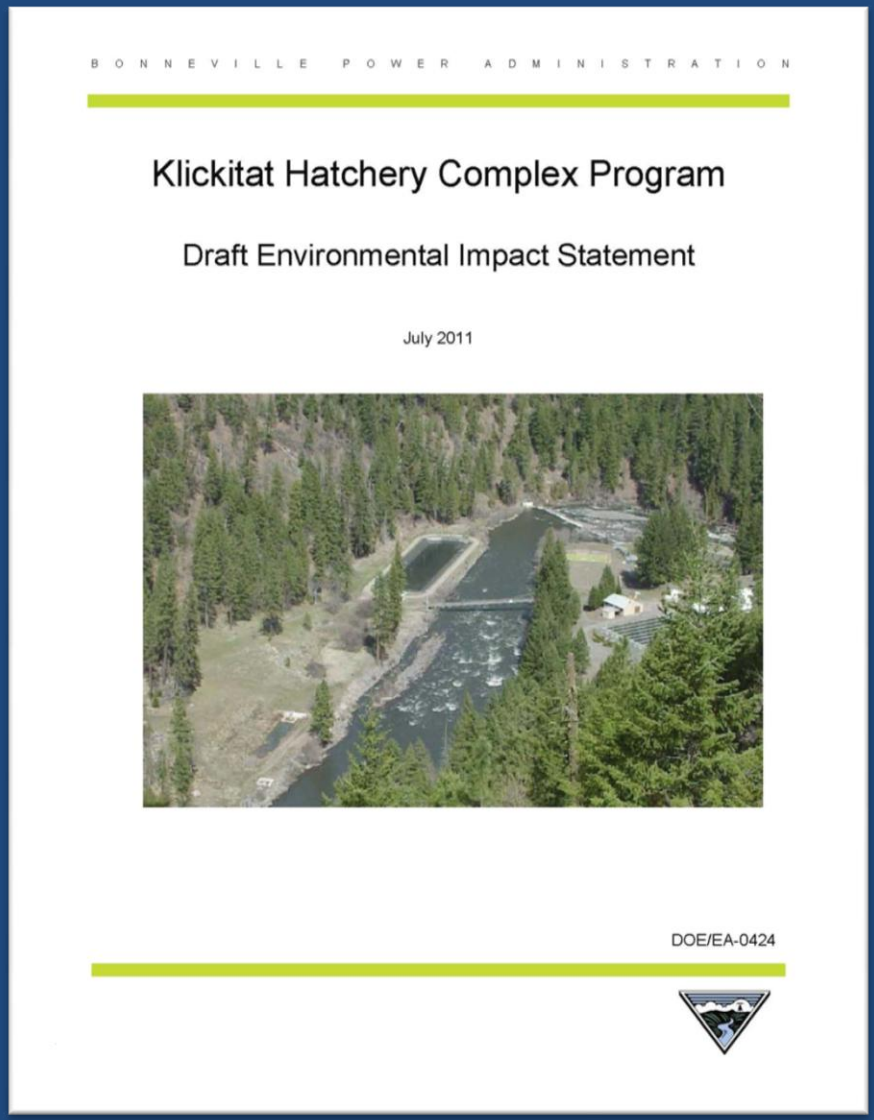
Environmental Impact Statement

- Bonneville Power Administration is lead agency
- Funding facility improvements and hatchery program reforms
- Public comments & responses



Comment: Expansion of hatchery program / Increase in hatchery fish released

- Numbers & locations
- Effort to reduce effects of current program & maintain harvest levels

Current and Proposed Program

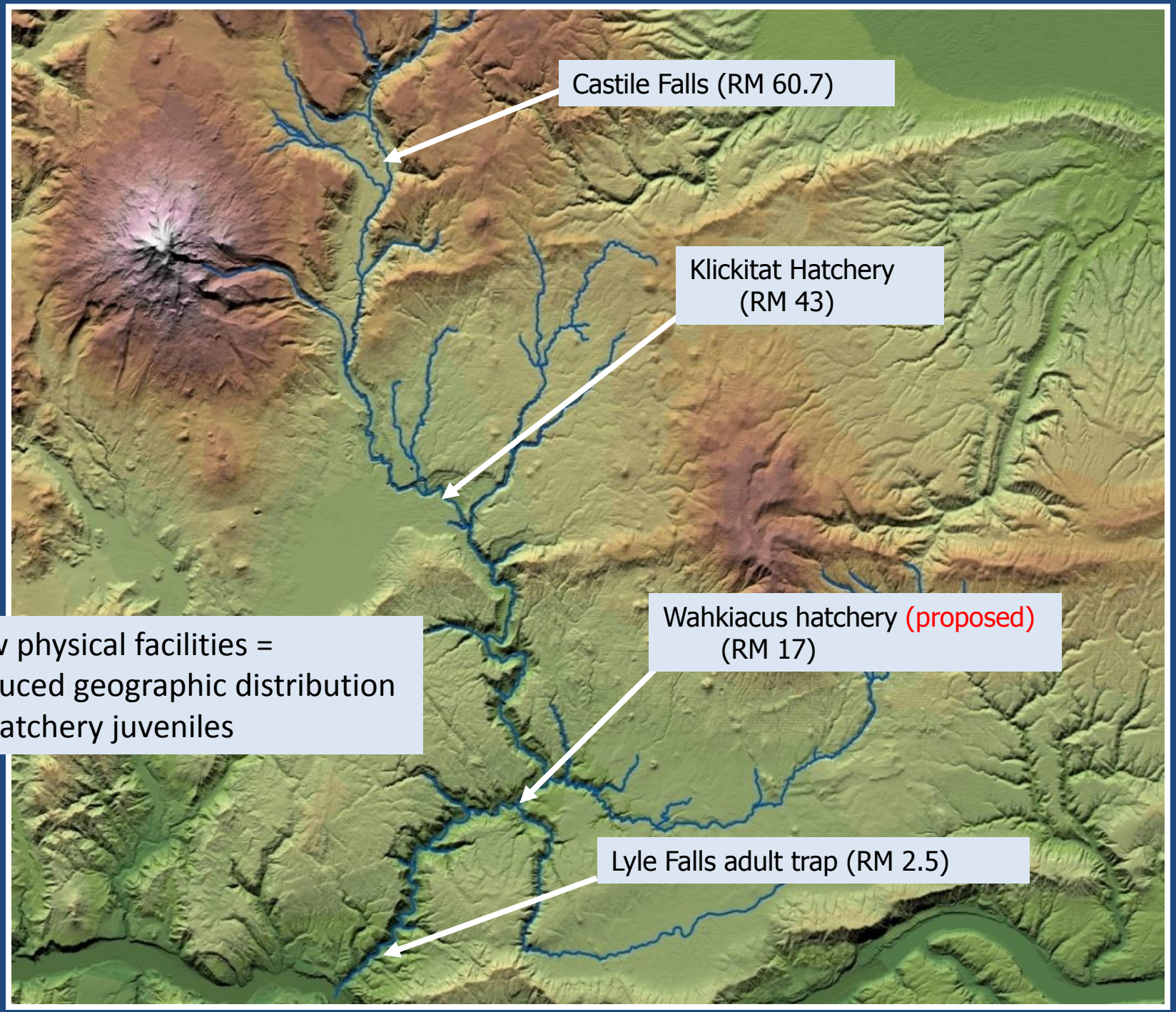
Spring Chinook
- 600K yearling smolt release (segregated)
- Integrated Program
- 800K yearling smolt release

Summer Steelhead
- 100K Skamania direct plants
- 130K from localized/Skamania brood
- 70K conservation program (if needed above Castile)

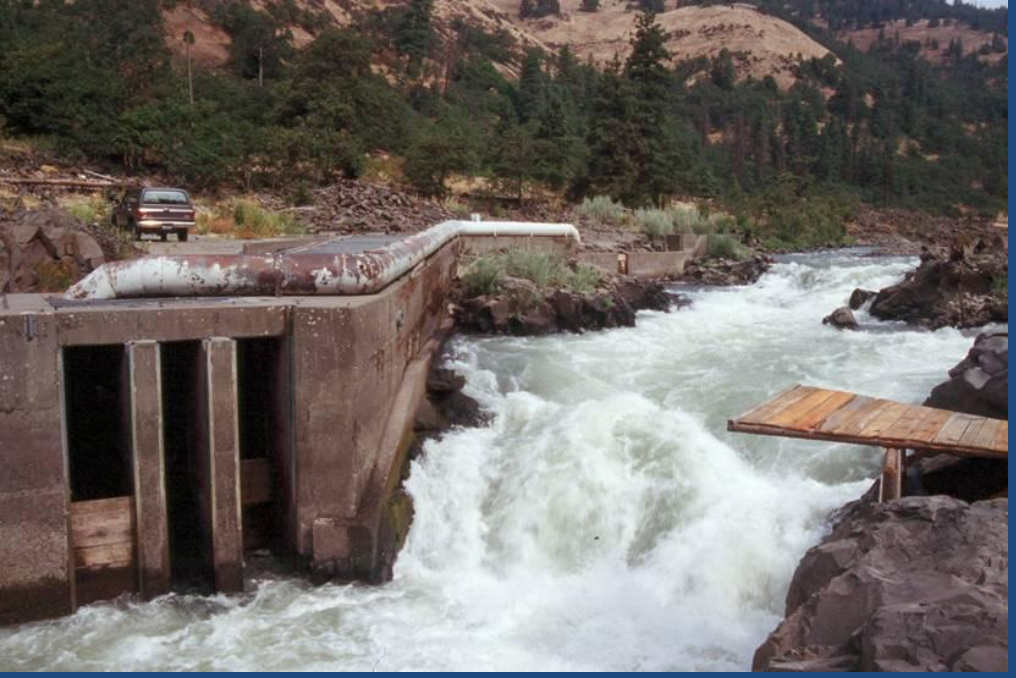
Fall Chinook (URB) Little White Salmon NFH
- 4M sub-yearling smolt
- 2M/2M sub-yearling smolt from local brood

Coho Lewis River Hatchery
- 1.2M yearling smolt release
- 2.5M Washougal direct plants
- 1M sub-yearling smolt from local brood

Total Smolt Releases
- 8.4M
- ~ 5.9 - 6M



New physical facilities =
Reduced geographic distribution of hatchery juveniles

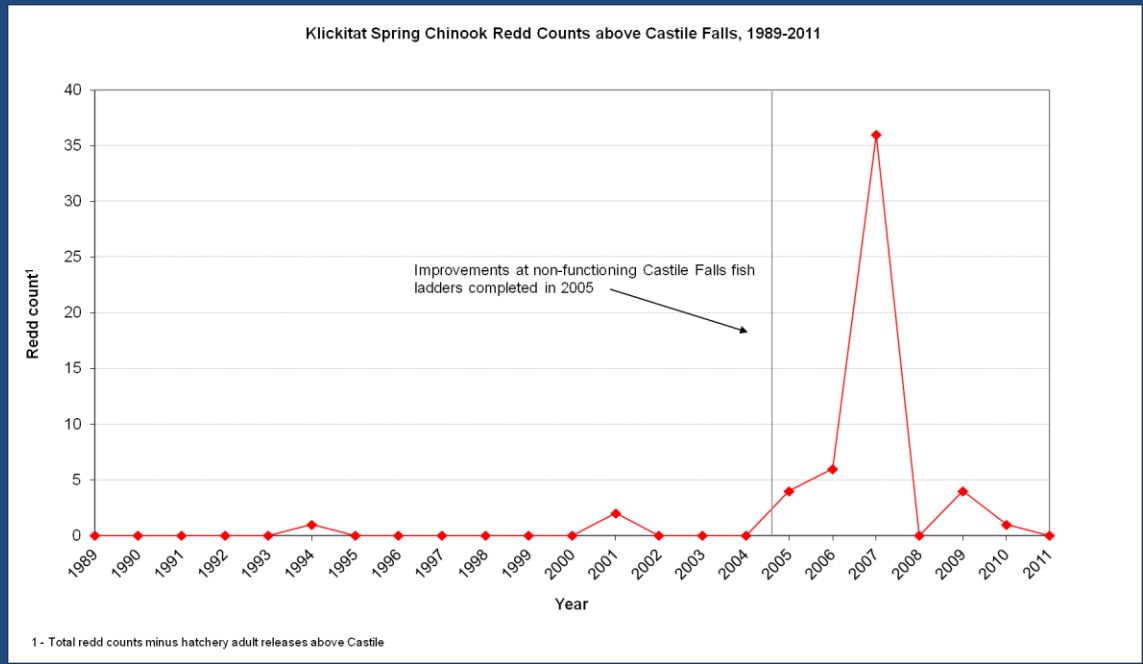


Comment: Remove all hatchery fish at Lyle Falls

- Not physically possible
- Most fish ascend natural falls

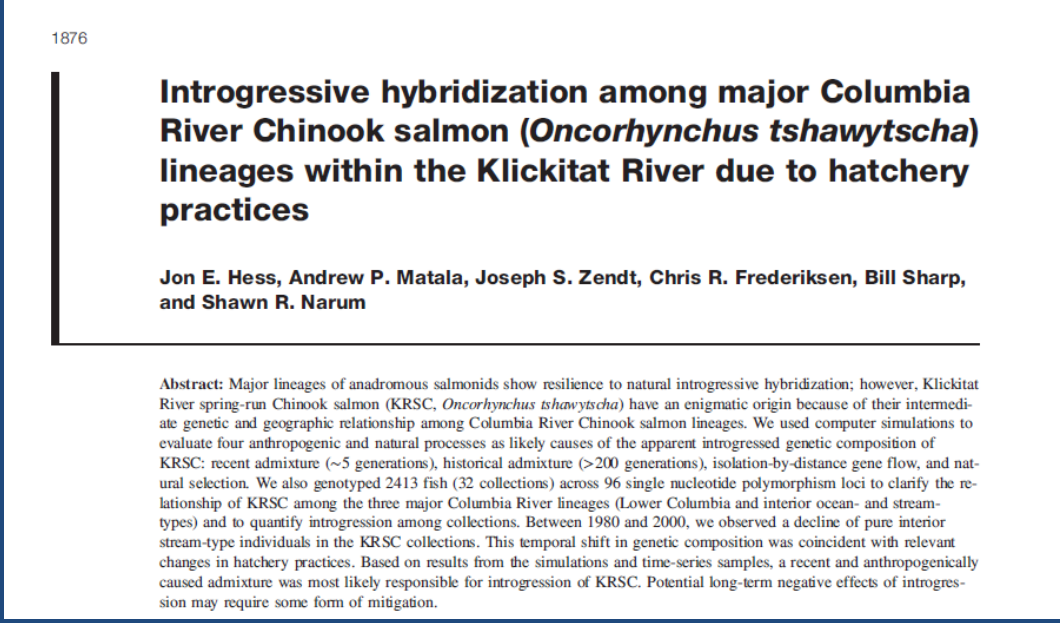
Comment: Spring Chinook broodstock collection threatens wild run

- 400-700 wild fish return at Lyle Falls
- 18-31% of wild fish collected for broodstock
  - May be ~ 30% initially
  - Ultimately ≤ 25%
- Some risk, but also substantial risk with current program
  - Wild population not quickly rebounding
  - Hatchery population introgression



Comment: Fall Chinook introgression threatens Spring Chinook

- Recent study: Introgression likely came from summer Chinook stocked in late 1970s
  - 1950s-1980s Tule Chk had little effect on SpChk genetics
  - SpChk genetic changes coincided with SuChk introduction
  - Current URB Fall Chk stock has little overlap in spawn timing or locations with SpChk



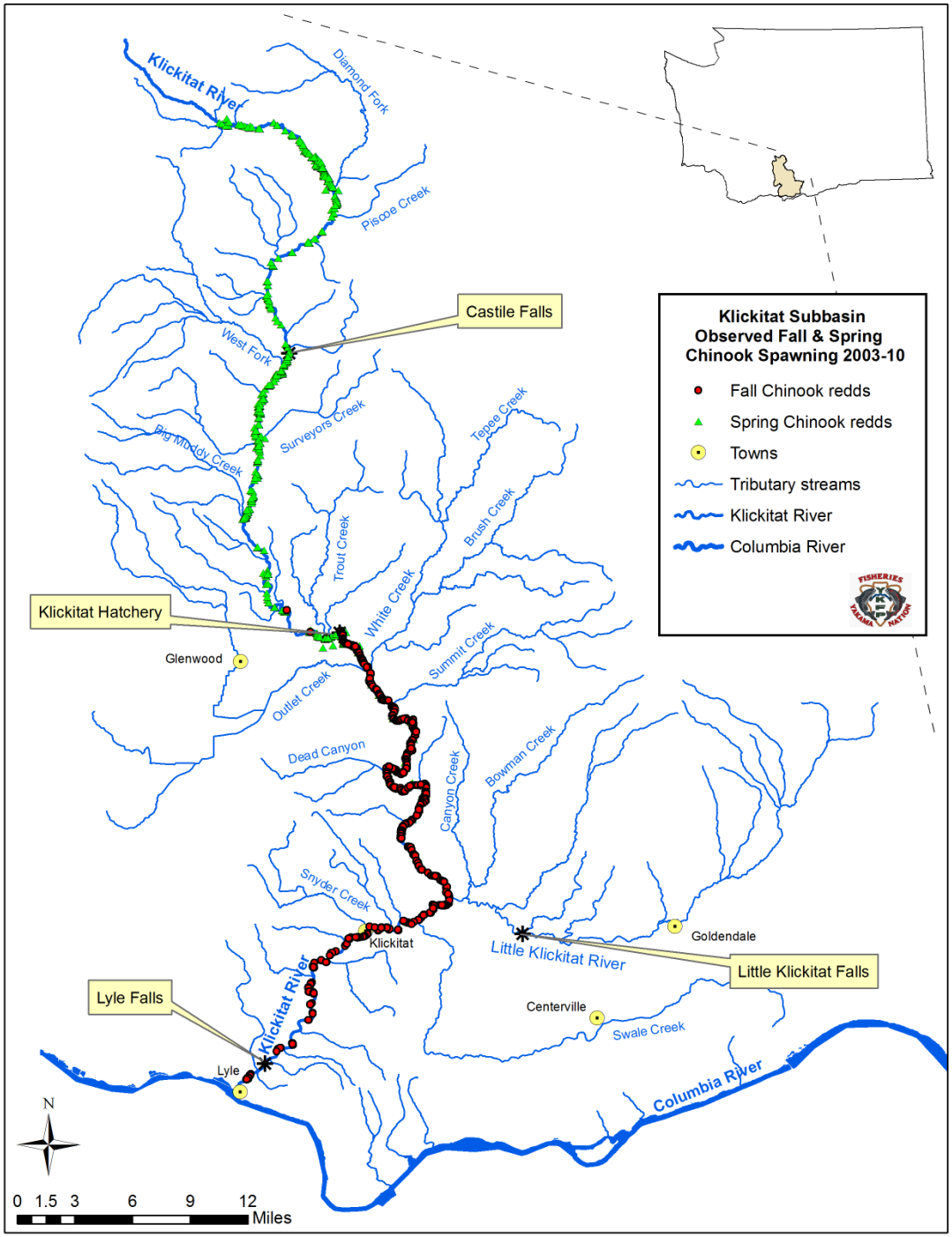
1876

Introgressive hybridization among major Columbia River Chinook salmon (*Oncorhynchus tshawytscha*) lineages within the Klickitat River due to hatchery practices

Jon E. Hess, Andrew P. Matala, Joseph S. Zendt, Chris R. Frederiksen, Bill Sharp, and Shawn R. Narum

Abstract: Major lineages of anadromous salmonids show resilience to natural introgressive hybridization; however, Klickitat River spring-run Chinook salmon (KRSC, *Oncorhynchus tshawytscha*) have an enigmatic origin because of their intermediate genetic and geographic relationship among Columbia River Chinook salmon lineages. We used computer simulations to evaluate four anthropogenic and natural processes as likely causes of the apparent introgressed genetic composition of KRSC: recent admixture (~5 generations), historical admixture (>200 generations), isolation-by-distance gene flow, and natural selection. We also genotyped 2413 fish (32 collections) across 96 single nucleotide polymorphism loci to clarify the relationship of KRSC among the three major Columbia River lineages (Lower Columbia and interior ocean- and stream-types) and to quantify introgression among collections. Between 1980 and 2000, we observed a decline of pure interior stream-type individuals in the KRSC collections. This temporal shift in genetic composition was coincident with relevant changes in hatchery practices. Based on results from the simulations and time-series samples, a recent and anthropogenically caused admixture was most likely responsible for introgression of KRSC. Potential long-term negative effects of introgression may require some form of mitigation.

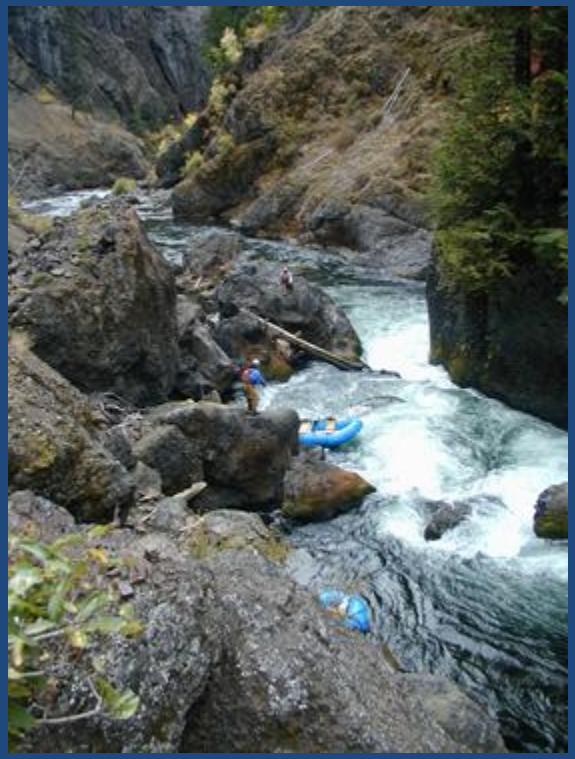
Hess et al. 2011. Canadian Journal of Fisheries and Aquatic Sciences 68: 1876-1891.



Spawn Timing:

- Spring Chinook
  - Aug – early Oct
    - Peak in late Aug – early Sept.

- URB Fall Chinook
  - mid Oct – Dec.
    - Peak in Nov.



Comment: Steelhead broodstock collection threatens wild run

- Proposed segregated program
  - No wild broodstock collection initially
  - Monitor returns to upper Klickitat and genetic effects
- If integrated program, wild broodstock collections would be 3 - 10% of wild run
  - Live spawning, return to river

Comment: Hatchery steelhead introgression threatens wild steelhead

- 2006 study: 4% of naturally produced juveniles were offspring of Skamania H. fish
- Recent analysis: Still strong distinction between wild Klickitat sthd and Skamania Hatchery sthd
- Ongoing analysis

North American Journal of Fisheries Management 26:147–155, 2006

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[Article]

Microsatellites Reveal Population Substructure of Klickitat River Native Steelhead and Genetic Divergence from an Introduced Stock

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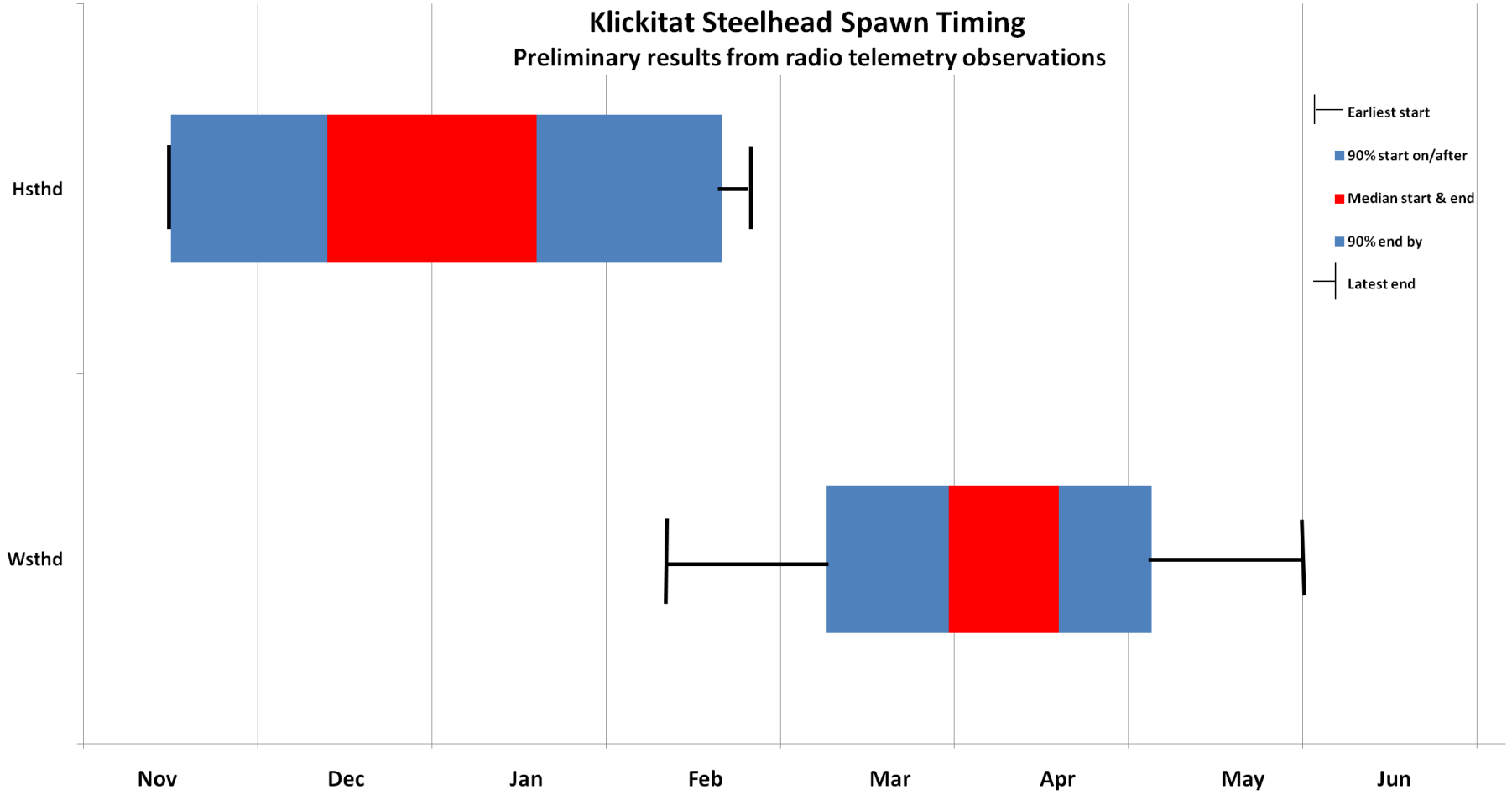
Abstract.—Determining fine-scale genetic diversity and structure is critical for the conservation and management of populations, especially those under heavy anthropogenic influence. We analyzed 446 individuals at nine microsatellite loci to determine the local population structure of naturally produced steelhead *Oncorhynchus mykiss* and genetic differentiation from introduced hatchery strain steelhead in the Klickitat River of the Pacific Northwest. We detected significant genetic structure among steelhead in various tributaries to the Klickitat River; the most divergent population was located above a waterfall that acts as a partial upstream migration barrier (average pairwise $F_{ST} = 0.13$; $P < 0.0001$). Analysis of mixtures indicated an estimate of six to seven genetically distinct populations of naturally reproducing steelhead in this river system. The hatchery strain appears to remain genetically distinguishable from native stocks (average pairwise F_{ST} of 0.078 with $P < 0.0001$), as only 4.0% of naturally produced steelhead had their most likely assignment to the hatchery strain. These results indicate that the genetic integrity and variation of native Klickitat River steelhead have been maintained despite repeated hatchery introductions and that the potential is high for restoring this threatened population. Further, this study suggests that hierarchical analyses of mixtures to identify distinct populations in a watershed are a valuable method for directing management of reproductively isolated populations.

Narum et al. 2006. North American Journal of Fisheries Management 26: 147-155.

Radio telemetry study

- Hatchery and wild steelhead and spring Chinook

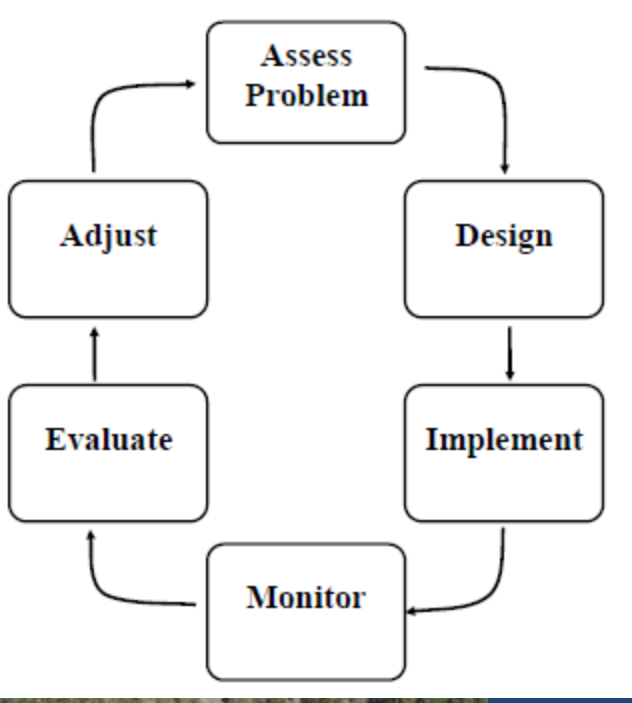
- Passage issues
- Harvest, mortality
- Spatial/temporal overlap of hatchery & wild fish



17% of tagged Hsthd observed spawning in wild (N=41)

52% of tagged Wshtd observed spawning in wild (N=94)

Adaptive Management



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