

# Kelt Reconditioning and Reproductive Success Evaluation Research

Columbia River Inter-Tribal Fish Commission, Portland, OR

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# Presentation Outline

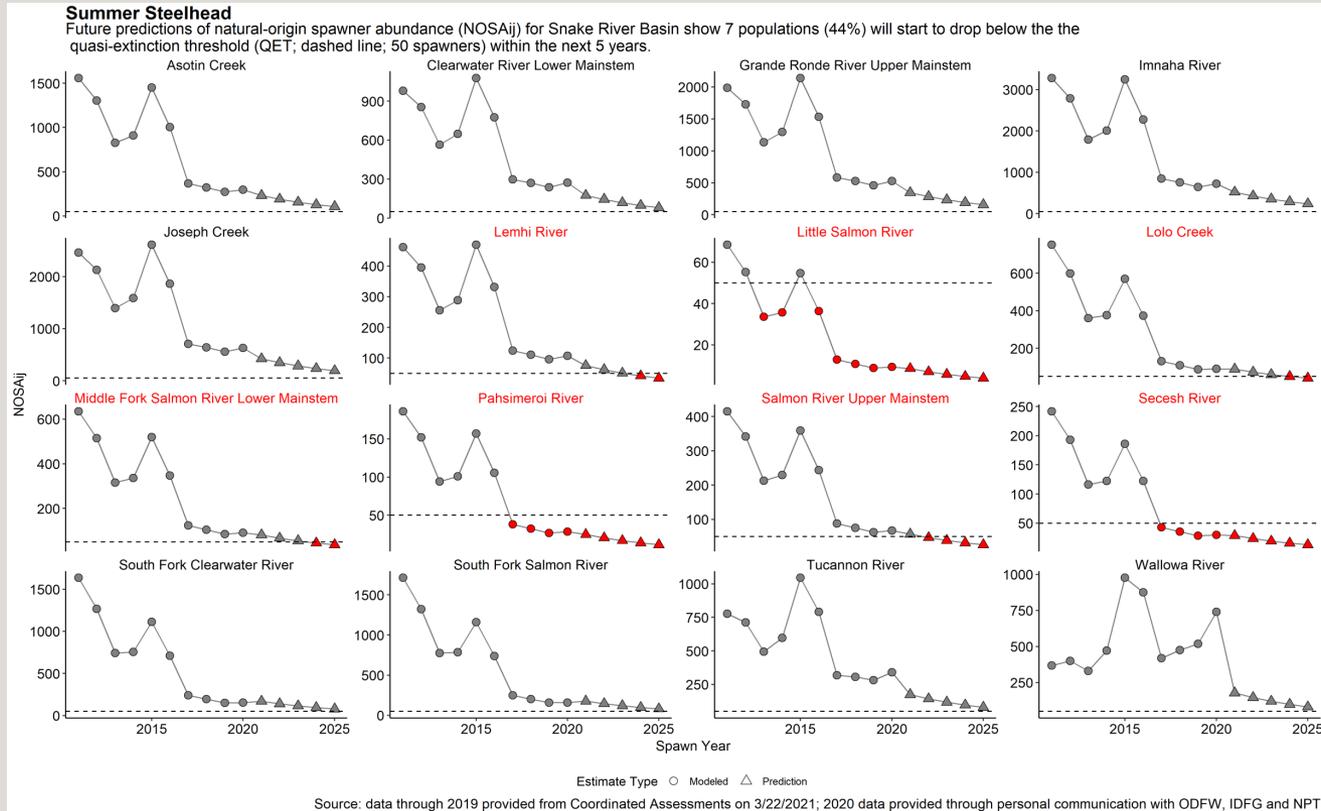
Project Goal: Attempt to enhance the natural-origin steelhead population by increasing repeat spawner rates (iteroparity) and evaluate effects from artificially reconditioning fish:

1. Define the problem / rationale for this effort
2. What are the benefits to the receiving population in terms of viable salmonid population parameters?
3. What is the reproductive success of reconditioned kelts?
4. What have we learned about kelt physiology and how does that inform decisions?
5. What is the homing fidelity of reconditioned kelts?



# 1. Define the Problem

## 7 (44%) Summer Steelhead Populations in the Snake River Basin Predicted to Be At or Below 50 spawners by 2025



From: Nez Perce Tribe [Presentation](#) to NPCC, May 5, 2021



# 1. Kelt steelhead availability (% of escapement) and repeat spawner rates (% of the run) in the Columbia Basin

## Kalama River

Kelt rate is unknown

Repeat spawner rate = 17%

## Yakima River

Kelt rate = 70% of escapement

Repeat spawner rate = 2%

**Kelts ~ 90% Female**

## Snake River

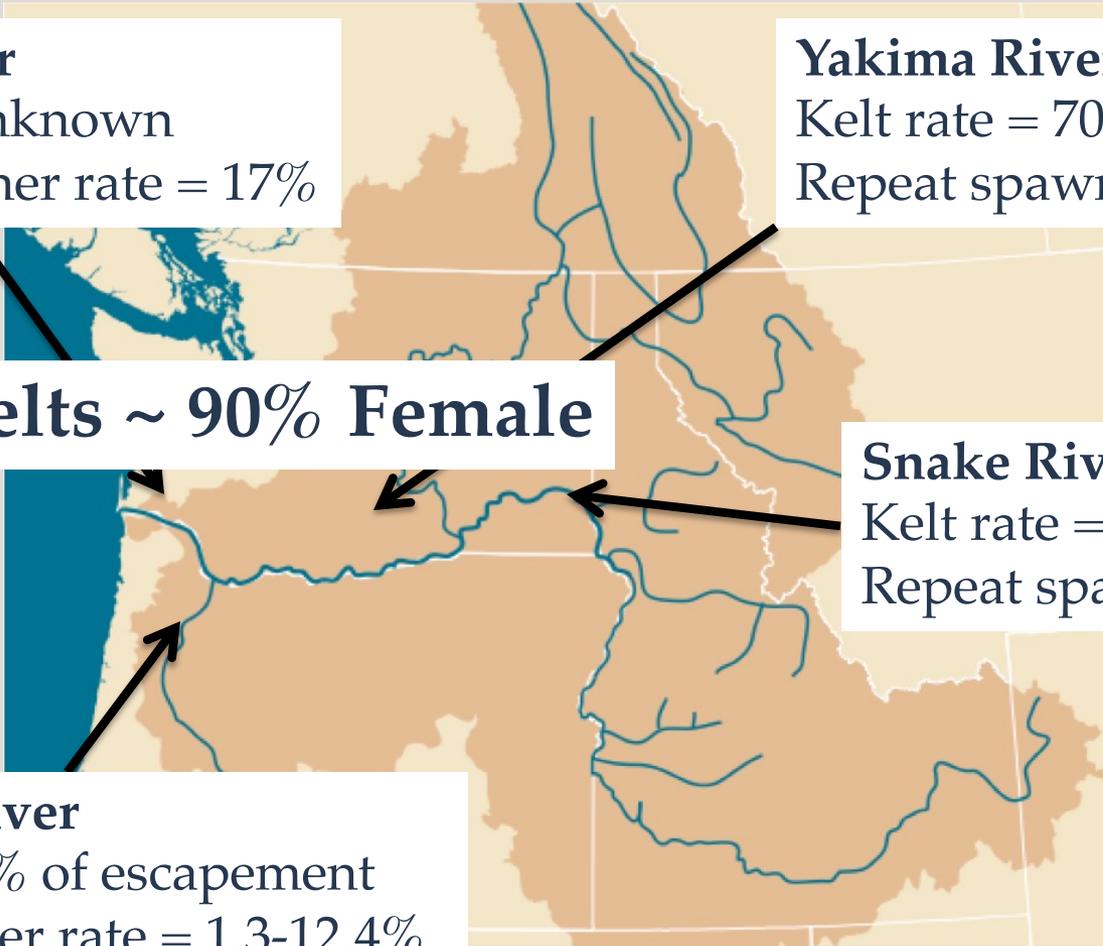
Kelt rate = 45% of escapement

Repeat spawner rate = 0.4%

## Willamette River

Kelt rate is 58% of escapement

Repeat spawner rate = 1.3-12.4%

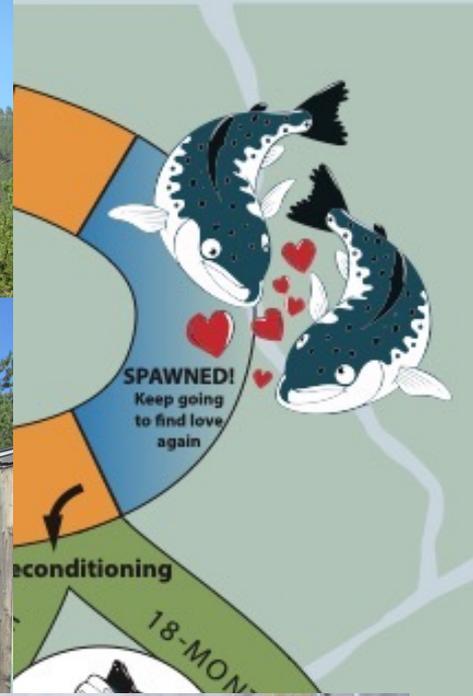


# Steelhead Collection and Reconditioning Facilities

Kelt Collection  
Yakima River Snake River

Kelt Reconditioning (rearing)  
Yakima River Snake River





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## 2. Summary of Reconditioning Benefits

### Collect downstream migrating kelts:

Control – PIT tag and release and systematic sample.

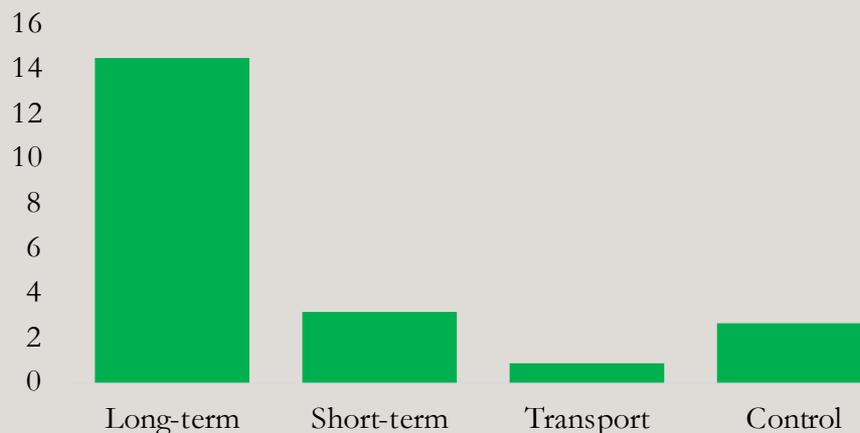
Transport – PIT tag, transport and release below Bonneville Dam. Timed with kelt run.

Short-term – PIT tag, place in tanks and feed for 6-8 weeks, then transport below Bonneville Dam. Timed with kelt run.

Long-term – PIT tag, place in tanks and feed for 5-6 months, then release back in river. Timed with the returning run.

### Management Option

Return Rate

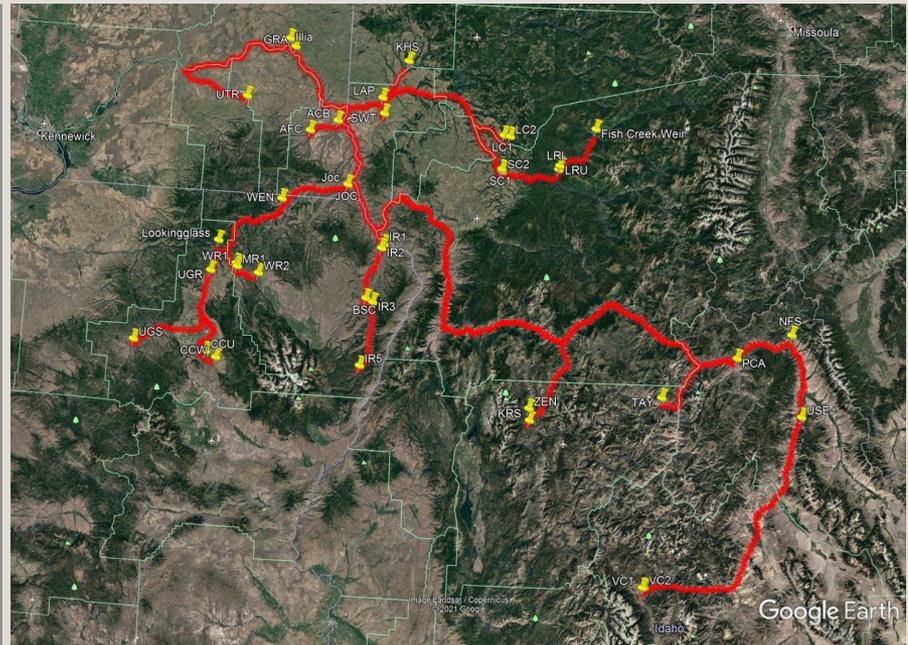
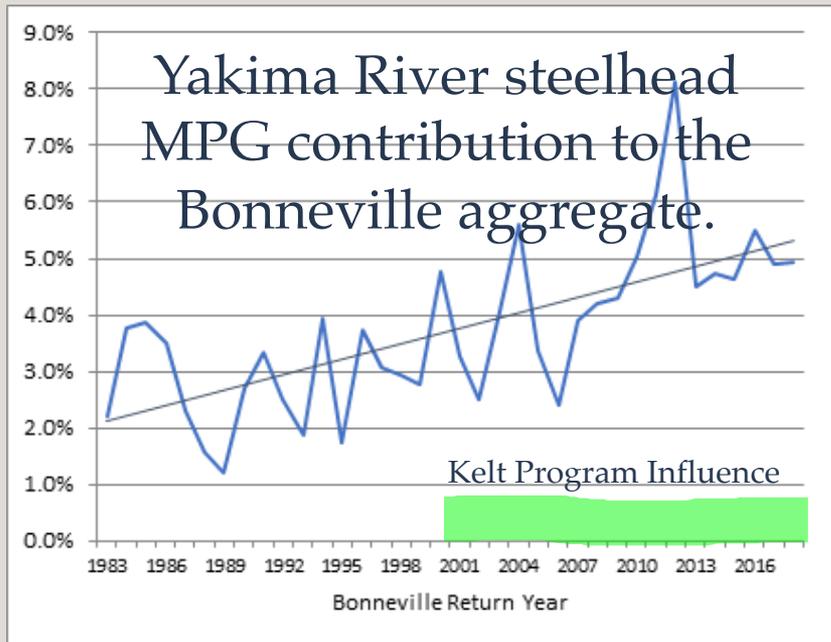


Trammell et al. 2016. NAJFM 36(4).



## 2. Summary of Reconditioning Benefits

Location	Years	N	S	Potential Benefit relative to fish left in river (survival/return rate)
Yakima	20	10,423	50%	15 x
Snake	10	1,811	39%	162 x



Hatch et al. 2013. NAJFM 33:615-625.

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# 3. Evaluations of Reproductive Success of Reconditioned Kelt Steelhead

Spawning success of reconditioned kelt steelhead relative to maiden steelhead in two Yakima River tributaries from 2013 - 2019. Based on parentage analysis of Age 0 juvenile O. mykiss. Lifetime reproductive success (LRS) is the sum of all spawnings.

Class	Sex	2013	2014	2015	2016	2017	2018	2019	AVG
Reconditioned Kelt Lifetime	Male	6.83	4.86	1.54	0.66	NA	NA	NA	3.42
Reconditioned Kelt Lifetime	Female	1.18	1.70	3.71	1.27	3.84	3.57	2.14	2.49



Stephenson et al. In prep.

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# 4. Summary of Physiology Studies

- **Predictors of Survival.** Plasma triglycerides and osmolality predict survival.
- **Life History Path:** consecutive and skip spawning. Plasma E2 indicates consecutive spawning. Consecutive spawning rate varies by time and geographic location.
- **Reproductive Performance.** Reconditioned kelts are more productive than maidens, and spawn timing is not changed significantly.

Buelow and Moffitt 2015. *Ecology of Freshwater Fish* 24:112-122.

Caldwell et al. 2013. *General and Comparative Endocrinology* 194:124-132.

Caldwell et al. 2014. *PLoS One* 9 e85700.

Jenkins et al. 2018. *Transactions of the American Fisheries Society* 147(5).

Jenkins et al. 2019. *Conservation Physiology* 7(1).

Jenkins et al. 2020. *Transactions of the American Fisheries Society* 149(2).

Penney and Moffitt 2014. *Reviews in Fish Biology and Fisheries* 24:781-801.

Penney and Moffitt 2014. *TAFS* 143:399-413.

Penney and Moffitt 2015. *Journal of Fish Biology* 86:105-120.

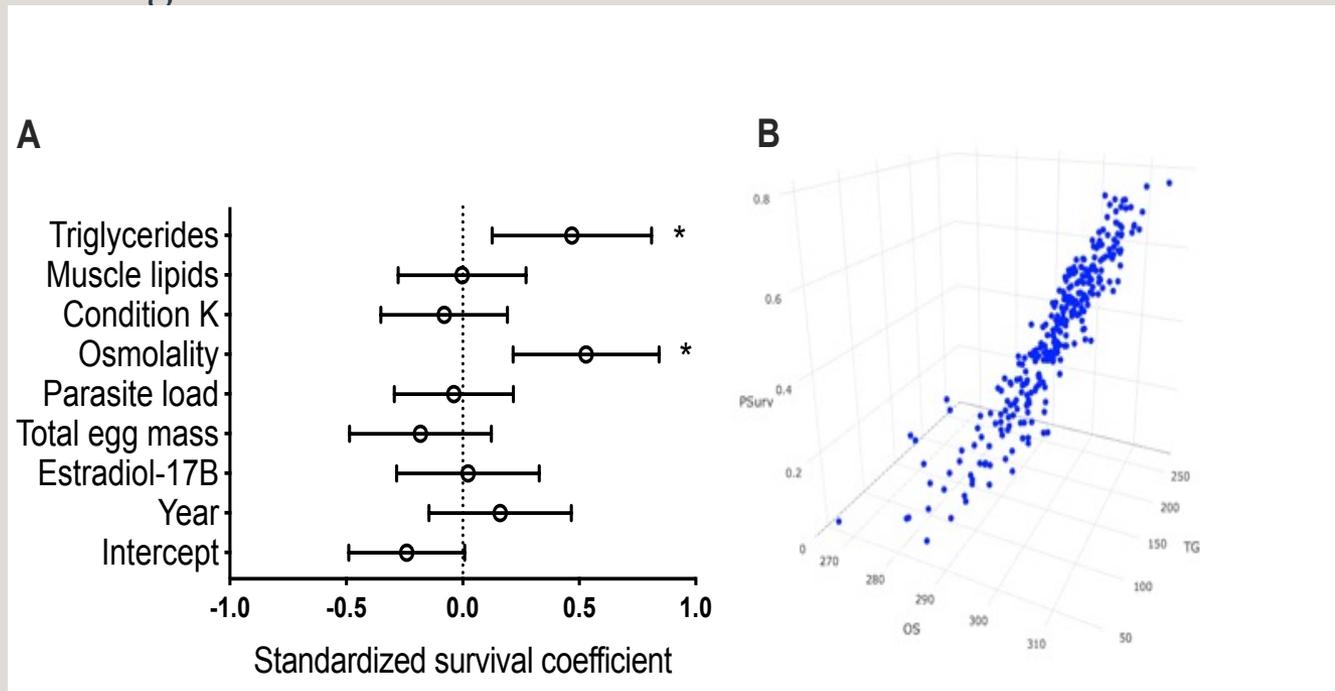
Pierce et al. 2017. *Canadian Journal of Fisheries and Aquatic Sciences* 74(7)



# 4. Summary of Physiology Studies

## Survival

Fish with higher plasma triglyceride level and osmolality at spawning were more likely to survive for at least 10 weeks after spawning.



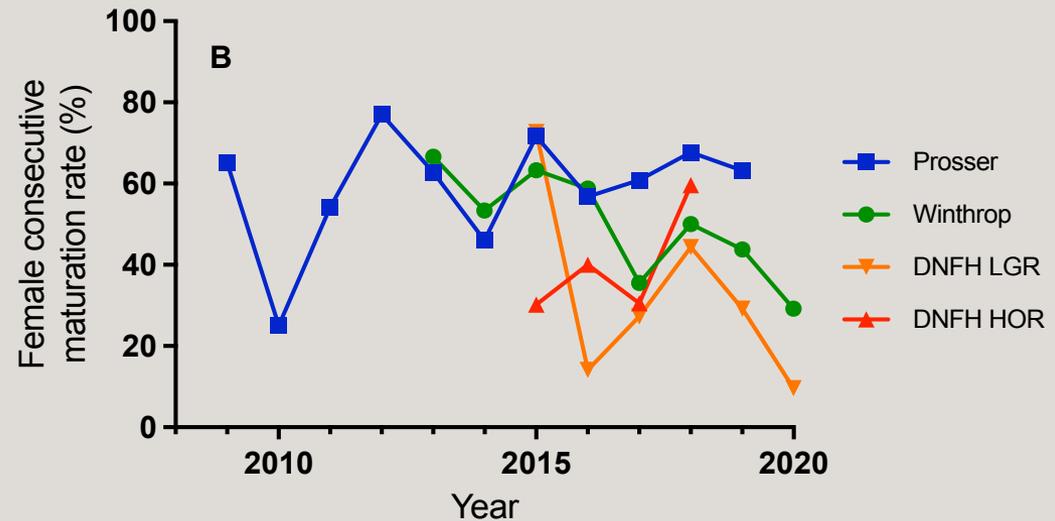
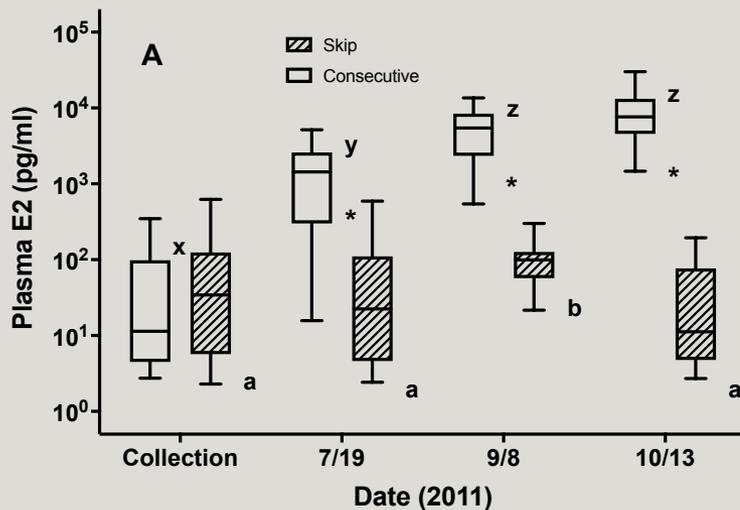
Jenkins et al. 2020. Transactions of the American Fisheries Society 149: 213-224. (A) multiple logistic regression model on standardized predictors variables; (B) predicted survival probabilities from the model containing plasma triglyceride level (TG) and osmolality (OS).



# 4. Summary of Physiology Studies

## Alternative Life Histories: Consecutive and Skip Spawning

Plasma estradiol (E2) level indicated consecutive spawning by September. Consecutive spawning rates varied over time and between locations.



(A) Pierce et al. 2017. Canadian Journal of Fisheries and Aquatic Sciences 74: 1049-1060, Prosser.

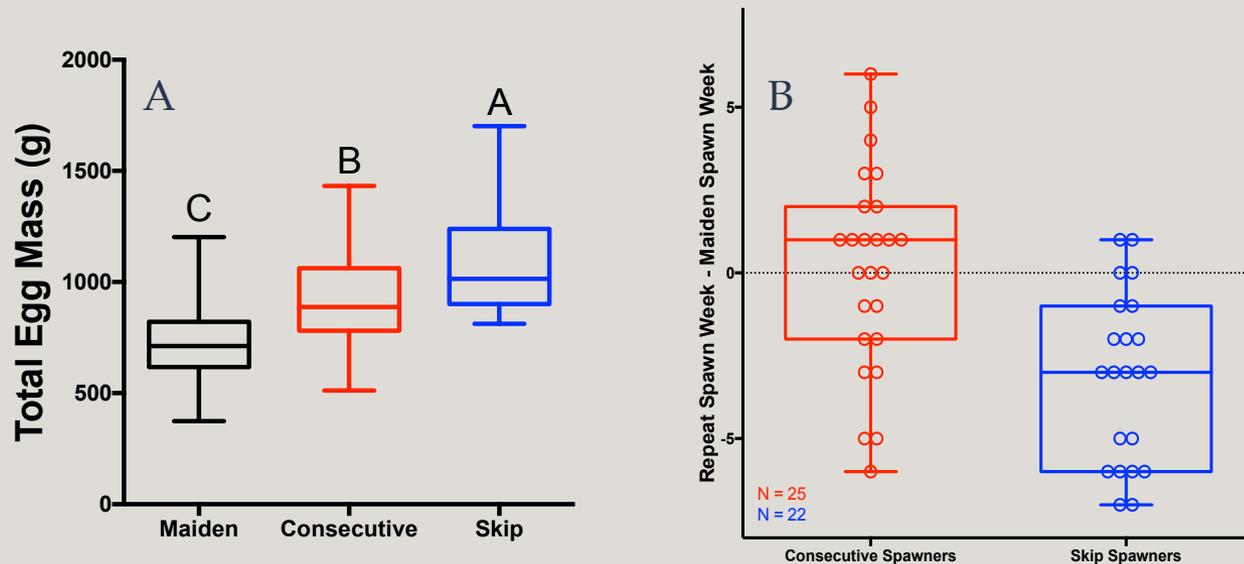
(B) Hatch et al. 2020. BPA report. DNFH LGR: fish collected at Lower Granite Dam; DNFH HOR: DNFH hatchery-origin fish artificially spawned at DNFH. Non-representative years removed. We collaborate with the separate Winthrop kelt project.



# 4. Summary of Physiology Studies

## Reproductive Performance

Productivity increased progressively from maiden to consecutive to skip spawners. Spawn timing was shifted slightly earlier in skip spawners.



Jenkins et al. 2018. Transactions of the American Fisheries Society 147: 959-971 . (A) Absolute, not adjusted for fish size. See publication for size-standardized data. Fecundity also increased in both types of repeat spawners, but egg size only increased significantly in skip spawners. (B) Difference was significant versus maiden spawning in skip spawners, and between consecutive and skip spawners.



# 5. Effects of Artificial Reconditioning on Homing of Kelt Steelhead



# 5. Effects of Artificial Reconditioning on Homing of Kelt Steelhead

**Out of 137 kelts, every fish returned to its maiden stream**



Newell et al. in prep.

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# Summary

1. Columbia River steelhead populations are plummeting down and need novel recovery strategies.
2. There is a relatively large abundance of kelt steelhead in the Columbia River, even in the uppermost areas.
3. In general, repeat spawning steelhead make up a very small proportion of the spawning run.
4. Increasing repeat spawners in steelhead populations can have many positive effects on populations, including increasing abundance, genetic and life history diversity, lifetime fecundity, and fitness.
5. Long-term reconditioning kelt steelhead provides 15 to over 150 times more repeat spawners than leaving the fish in the river.
6. Reproductive success studies in the Yakima River are showing that lifetime reproductive success of reconditioned kelts is approximately 2.5 times that of steelhead that spawn only once.



# Summary

7. Physiology experiments identified predictors of survival, life history pathway, and reproductive performance.
8. Artificially reconditioned kelt steelhead appear to repeat home with high fidelity.
9. The kelt reconditioning program is the only hatchery program / tool in the Basin that is targeted to improve productivity of natural origin steelhead.



# What Else Could We Do?

1. Stop kill spawning hatchery steelhead. Live spawn and recondition broodstock for use next year.
2. Recondition wild kelts to incorporate in hatchery broodstock.
3. Recondition kelts for reintroductions.
4. Additional collection locations both aggregates and specific streams.
5. ?





# Questions?

“It’s not what you don’t know that can come back to bite you; it’s what you know for sure that ain’t true.”

–Mark Twain

Photo credit Sara Thompson

