

Introduction

Steelhead trout (*Oncorhynchus mykiss*) are an important anadromous salmonid of conservation concern in Idaho's Clearwater River, where populations are in decline. Post-spawn female steelhead trout (kelts) are reconditioned as a recovery tool in the Columbia River Basin. Reconditioning capitalizes on iteroparity, the ability to repeat spawn, and natural selection that occurs prior to initial spawning. Wild kelts are captured, fed, and released to spawn again naturally in the river without returning to the ocean. Hatchery-origin kelts are reconditioned as a research model. After maiden spawning, kelts may spawn again either after 1 year (**consecutive spawner**) or after 2 years (**skip spawner**). Females on the consecutive spawning trajectory (**rematuring**) can be distinguished from those on the skipping trajectory (**non-rematuring**) by elevated plasma estradiol-17 β (E2) levels 6 months prior to spawning.

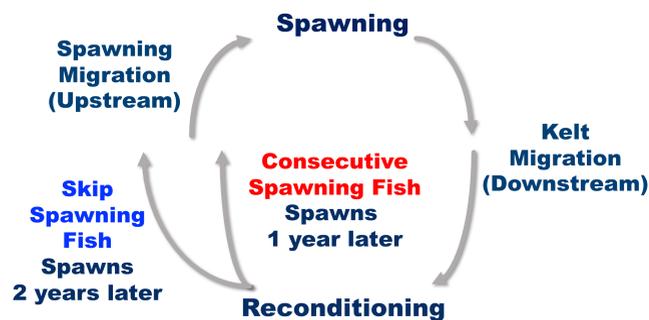


Figure 1. Life cycle of adult iteroparous steelhead trout beginning at spawning.

Objective

- To characterize kelt life history trajectories using plasma E2 pattern and concentration

Methods

- Kelts were obtained from Dworshak National Fish Hatchery on the Clearwater River, Idaho from February-March in 2015 and 2016.
- Females were air-spawned upon migratory return to the hatchery.
- Blood sampling occurred at spawning and every 10 weeks afterward (approximately April, July, and September).
- Kelts were placed in 4.6m outdoor tanks, supplied with ambient river water, fed, and treated for infection, parasites, fungus (i.e. reconditioned)
- Blood plasma was assayed by ELISA for E2 concentration (pg/mL).
- Life history trajectories were determined at 30 weeks after spawning. Kelts were placed in either a rematuring or non-rematuring group for analysis based on plasma E2 concentration.
- Maturation status was confirmed by spawning fish twice in captivity and/or by performing necropsy.



Figure 2 (far left). Blood is drawn from a caudal blood vessel of a female steelhead trout.

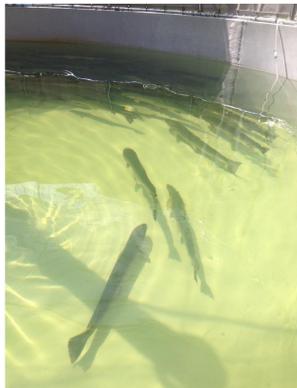


Figure 3 (left center). Kelts in reconditioning tanks at Dworshak National Fish Hatchery.



Figure 4 (right, top). A consecutive rematuring kelt.



Figure 5 (right, bottom). A kelt prior to sampling.

Analysis

- Transformations: E2 – Log₁₀
- 2-way ANOVA found significant time, treatment, and interaction effects.
- 1-way ANOVA and Tukey's HSD tested for differences over time within and between groups at each time point.

Results

Table 1. Number and survivorship of kelts spawned each year, and proportions surviving to re-mature on the consecutive spawner trajectory.

	2015		2015 (skip)		2016	
Spawned	148		[23]		165	
Survived to 30 weeks	43	29%	21	91%	30	18%
Re-maturing (% of survivors)	13	30%	18	86%	12	40%

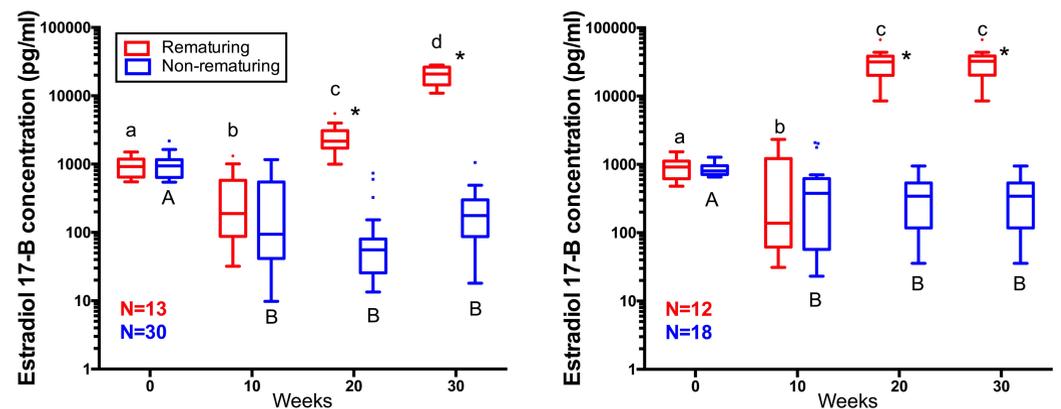


Figure 6. Plasma E2 concentrations in kelts sampled every 10 weeks after spawning in 2015 (left) and 2016 (right). Within each treatment group, time points sharing the same letter are not significantly different. Lower case letters refer to rematuring fish. Upper case letter refers to non-rematuring fish. When comparing groups, mean values differ significantly at a time point when marked "**".

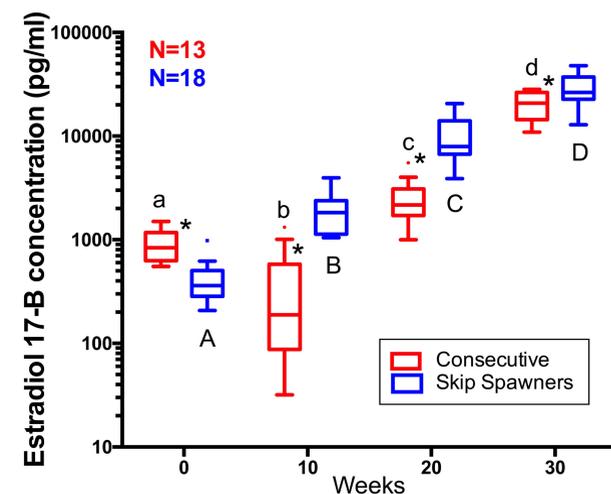


Figure 7. A comparison of plasma E2 concentrations in consecutive and skip spawning kelts from the 2015 cohort as they began to remature. Sampling occurred every 10 weeks after spawning, with time 0 for skip spawners ~1 year after they spawned for the first time.

Conclusions

- Two distinct post-spawning life histories exist in Clearwater River kelts, with 30%-40% of survivors re-maturing on the consecutive spawning trajectory
- Life history groups are distinguishable using plasma E2 levels at 20 weeks post-spawn
- E2 trajectories differ between consecutive and skip spawners in the year during which they are rematuring

Acknowledgements

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