

Life History Diversity in Post-Spawn Female Steelhead Trout Assessed Using Plasma Estradiol-17 β : Relationship with Growth and Energy Reserves

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Introduction

Post-spawning female steelhead trout (*Oncorhynchus mykiss*, kelt) reconditioning is a recovery tool addressing ESA-threatened Snake River steelhead populations.

Kelt 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 migrate upstream, and spawn naturally without a return to the ocean. Hatchery-origin kelts are reconditioned as a research model.

After maiden spawning, kelts may spawn again after 1 year (**consecutive spawner**) or after 2 years (**skip spawner**). Kelts on the consecutive trajectory (**rematuring**) can be distinguished from kelts on the skipping trajectory (**non-rematuring**) by elevated plasma estradiol-17 β (E2) levels 6 months prior to spawning.

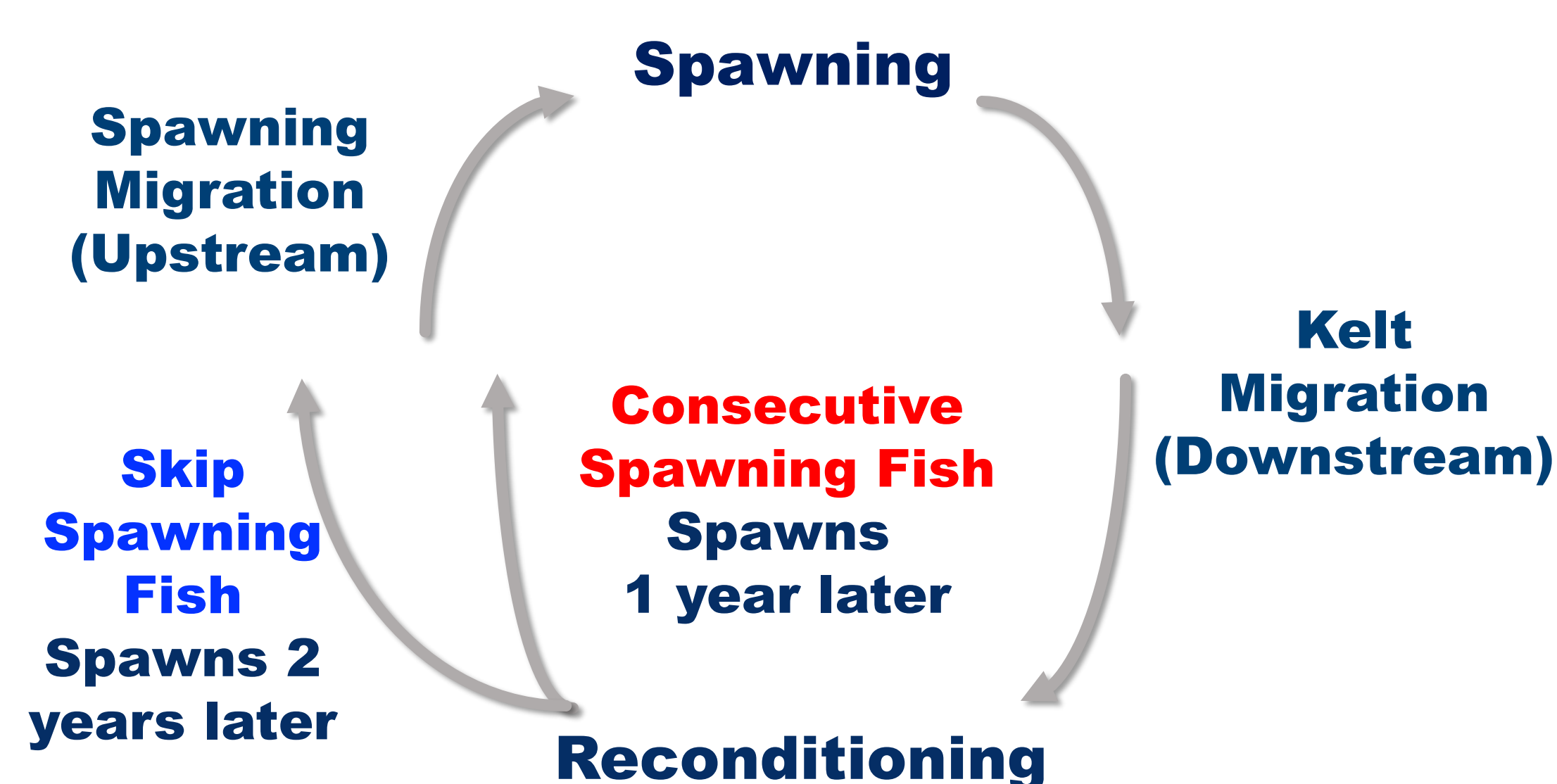


Figure 1. Life cycle of adult iteroparous steelhead beginning at spawning.

Objectives

- To characterize kelt life history trajectory using plasma E2
- To assess changes in growth, condition, and energy reserves in reconditioned kelts

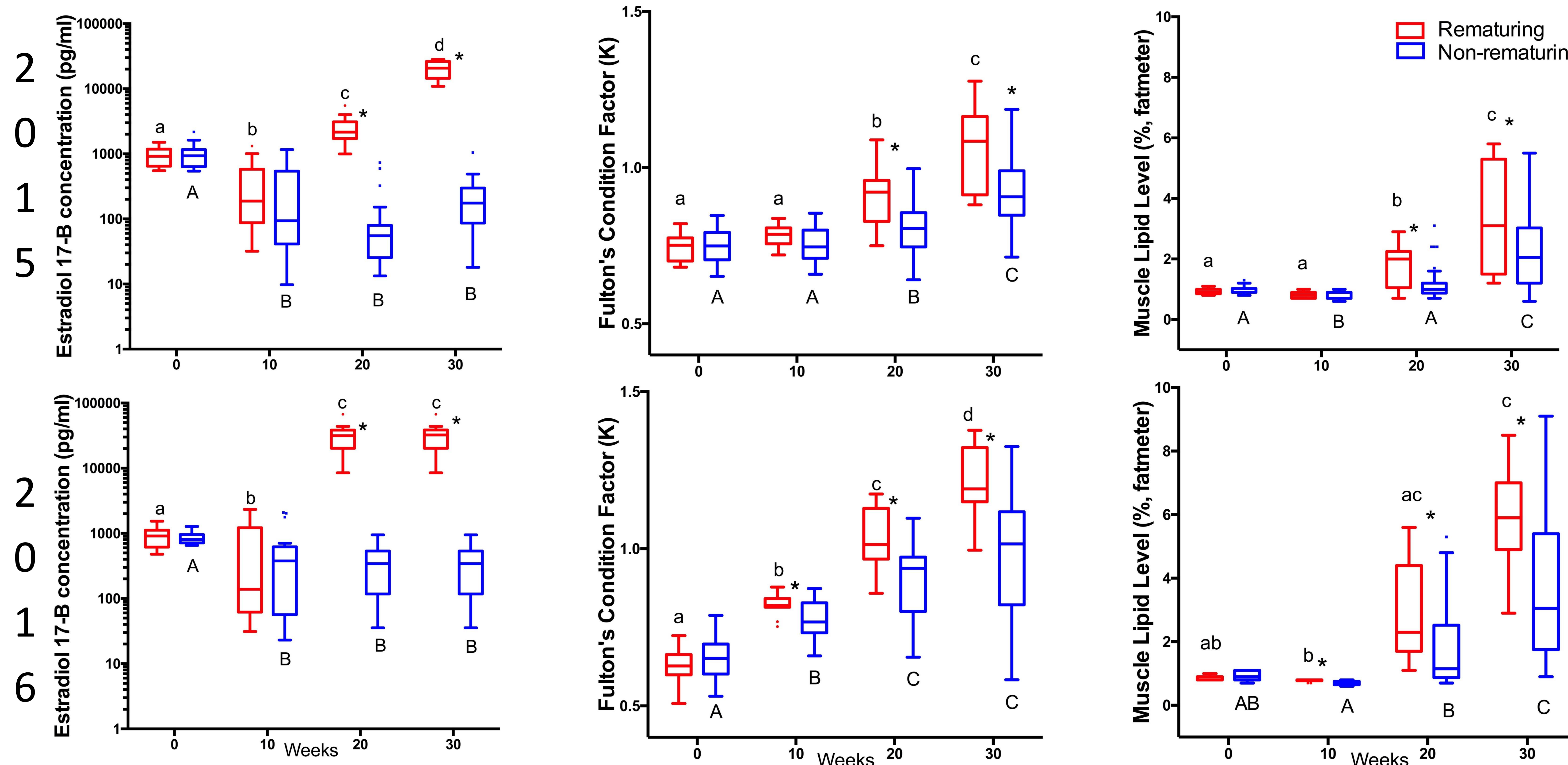
Methods

- Dworshak Hatchery females were used as a model for native Clearwater River steelhead trout.
- Females were air-spawned upon return to the hatchery.
 - 2015 (148 kelts): Feb 10, 28, Mar 3
 - 2016 (165 kelts): Feb 9, 23, Mar 1
- Kelts were fed, treated for diseases & parasites (reconditioned).
- Fish were sampled for length, weight, fat (Fatmeter, %), and blood at spawning & every 10 weeks thereafter (~Apr, Jul, Sept)
- Blood plasma was assayed for E2 concentration (pg/mL).
- Maturation was determined at 30 weeks after spawning
 - 13/43 survivors matured in 2015 (30%)
 - 12/30 survivors matured in 2016 (40%)
- Maturation status was confirmed by spawning fish twice in captivity and/or by performing necropsy.

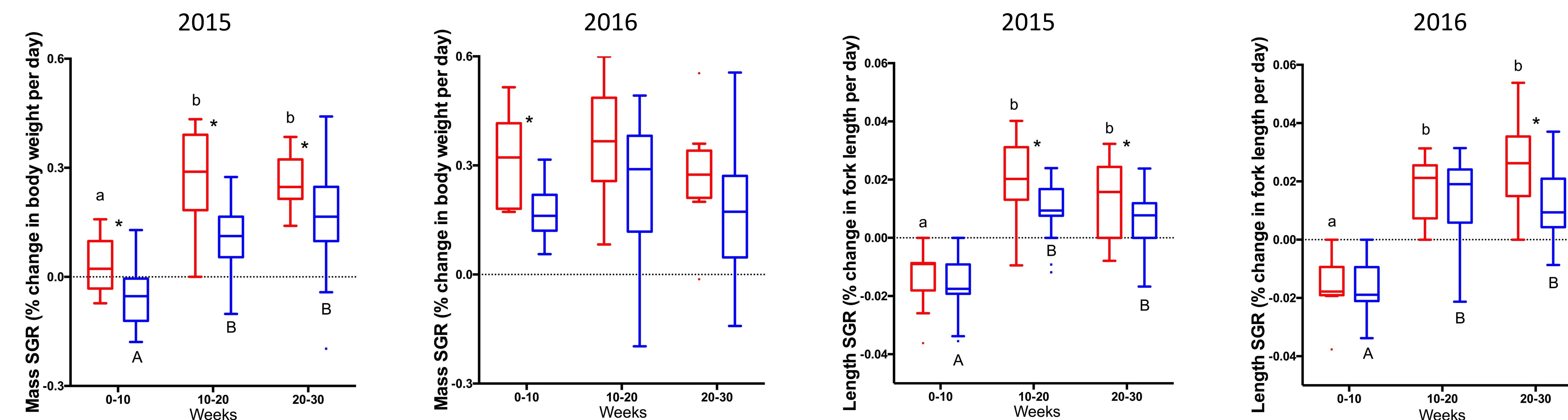
Analysis

- Transformations: E2 – Log10, Fat – ASIN-SQRT
- Calculations: $K = W/L^3$; $SGR = 100 \cdot \ln(V2/V1)/\text{days}$
- 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



Figures 2-7. Physiological parameters were tracked at 10 week intervals starting at spawning. In 2015, N = 13 rematuring, 30 non-rematuring. In 2016, N = 12 rematuring, 18 non-rematuring. Within each treatment group, time points sharing the same letter are not significantly different (Tukey's HSD). 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 "*".



Figures 8-11. Specific growth rates in mass and length were tracked at 10 week intervals after spawning in 2015 and 2016. Significance is demarcated as in figures 2-7 (above).

Acknowledgements



Special thanks to Dworshak National Fish Hatchery for including us in spawning & providing kelt facilities.

Conclusions

- Two distinct post-spawning life history trajectories exist in Clearwater River kelts
- Increased growth and energy reserves are evident soon after spawning in consecutive spawners
- Consecutive and skip spawners can be separated as soon as 20 weeks after spawning, enabling individuals of the two life histories to be managed separately