

Columbia River Basin Steelhead Kelt Reconditioning Research

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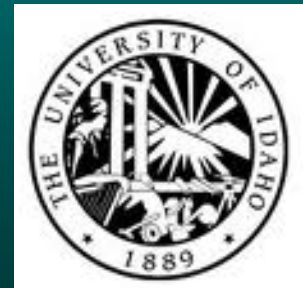
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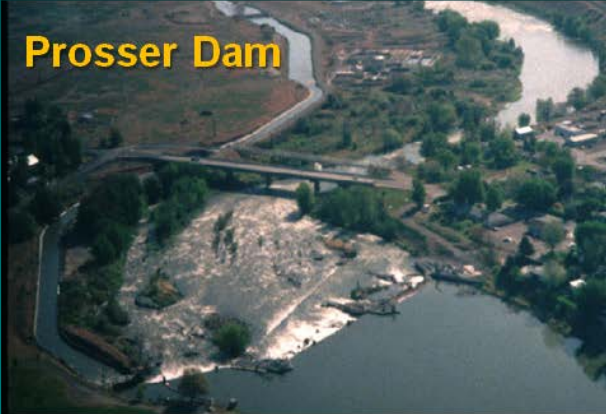
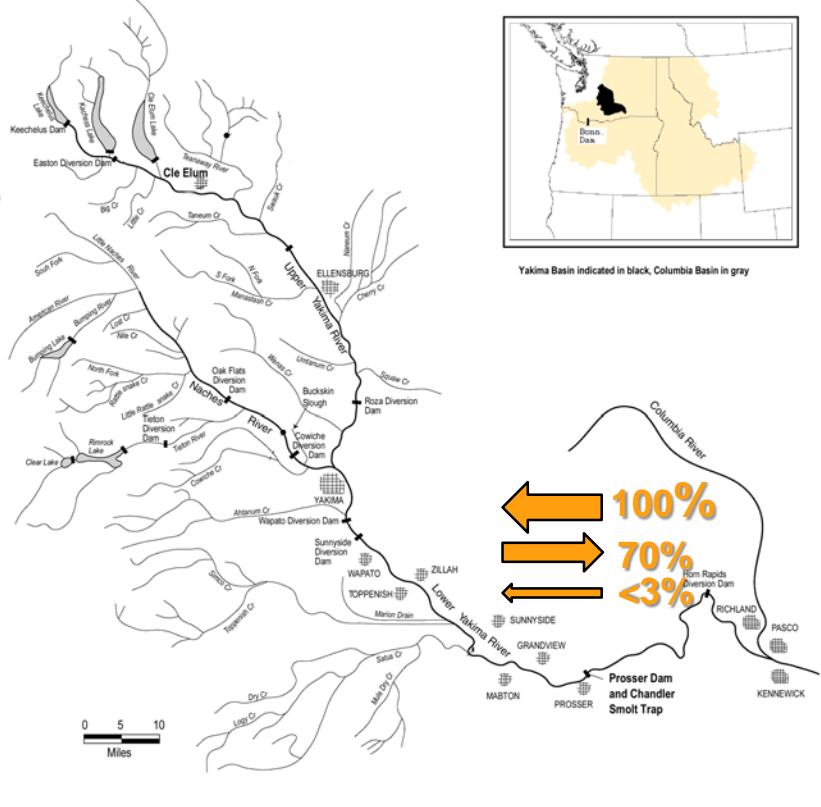
⁴Nez Perce Tribe, Lapwai ID



WDAFS 2017 Missoula



Kelt reconditioning is a restoration strategy that takes advantage of the repeat spawning life history of steelhead.



Intake

Reconditioning

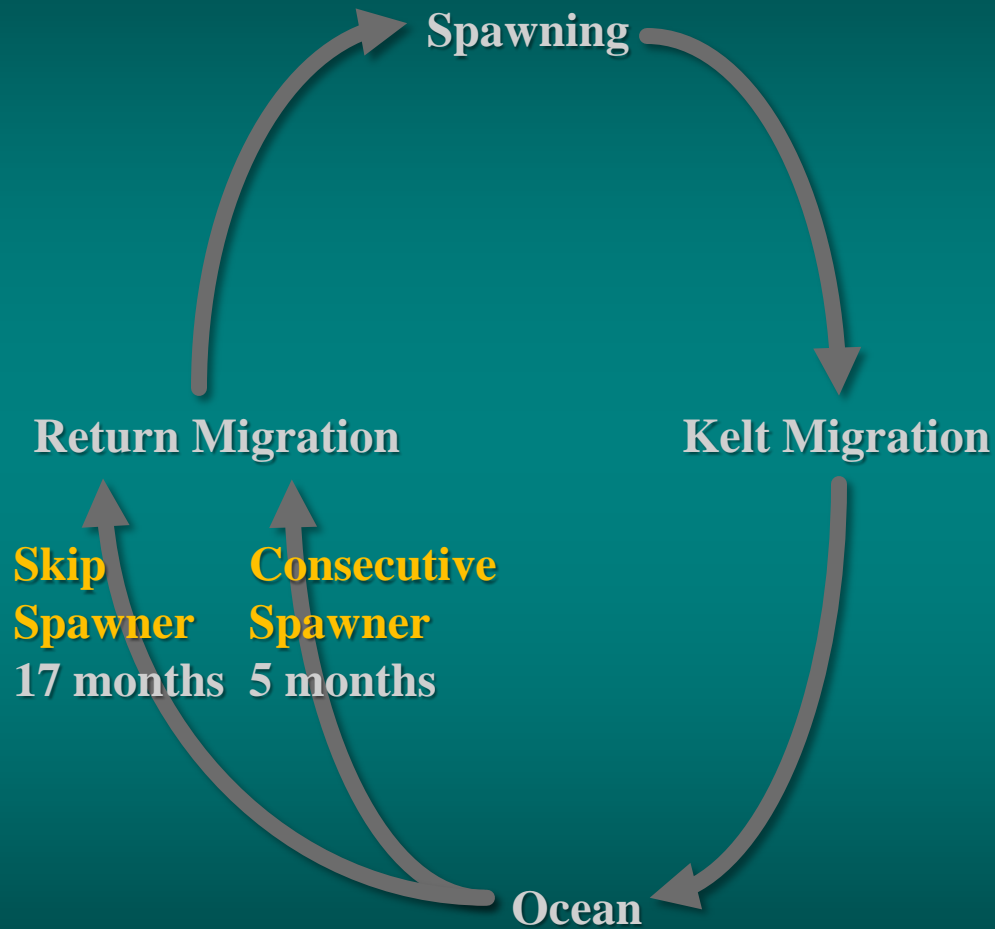
Release

Feb Mar Apr May Jun Jul Aug Sep Oct Nov

Kelt reconditioning is being implemented at multiple locations in the Columbia River Basin.



Natural repeat spawning female steelhead have two major post-spawning life histories.



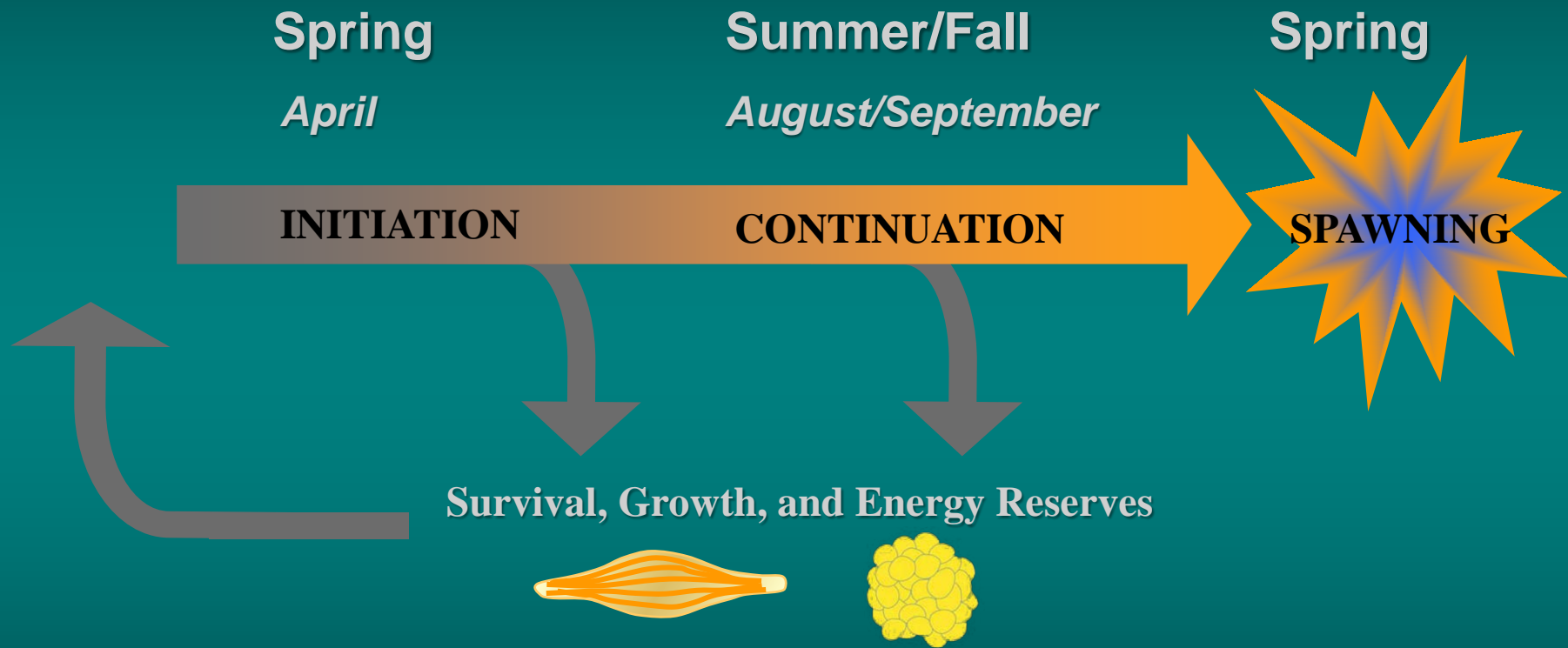
Skip spawning is common in seasonally breeding iteroparous fishes, and is driven by energetics (Rideout 2005).

Repeat spawners tagged at McNary Dam were 47% consecutive spawners/53% skip spawners (Keefer 2008).

Fecundity and egg size are greater in skip spawning than consecutive spawning Atlantic salmon (Reid & Chaput 2012).

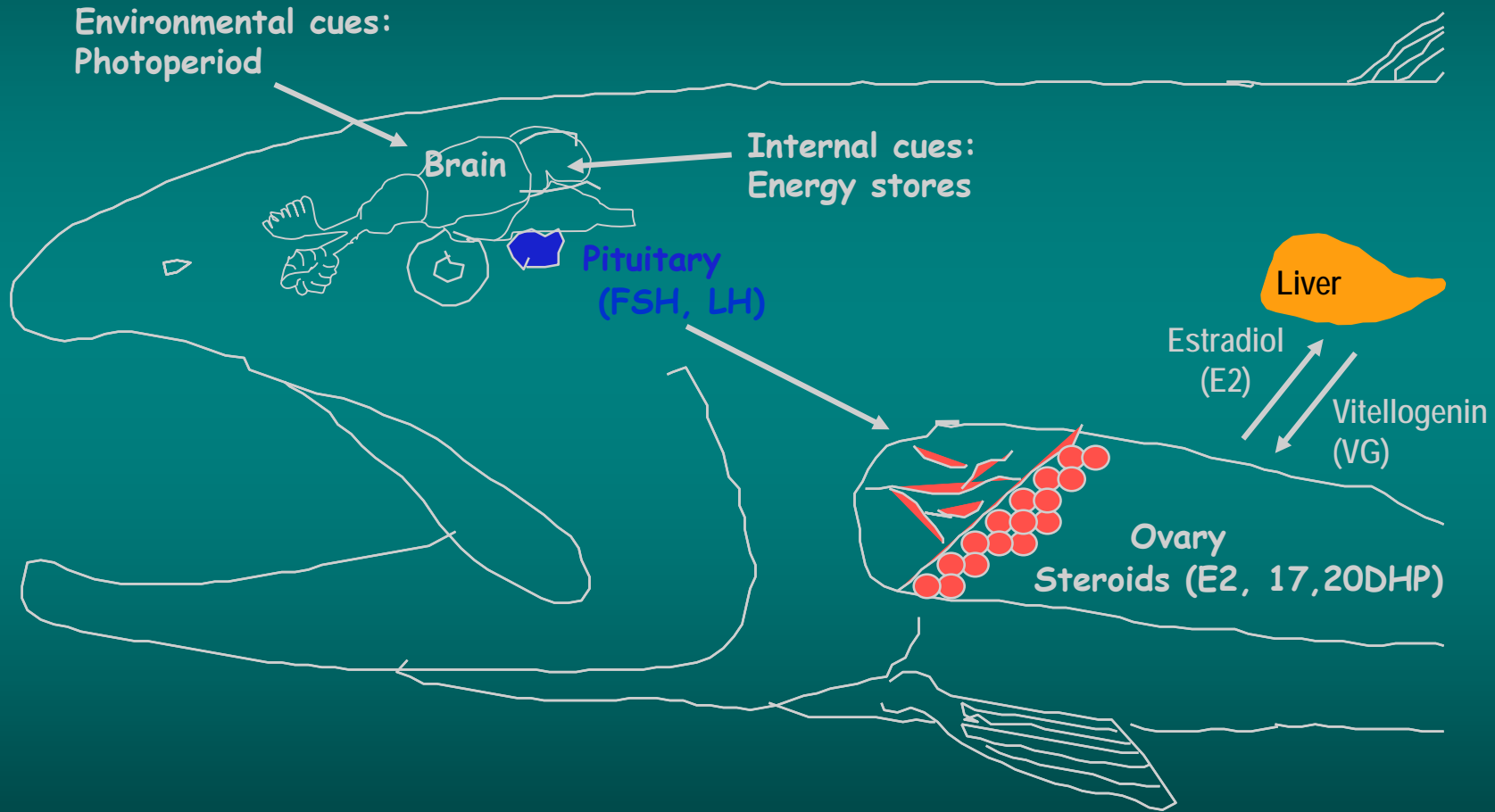
Hypothesis:
Reconditioned female steelhead may be consecutive or skip spawners.

In salmonids, maturation is initiated during a critical period about 1 year before spawning.

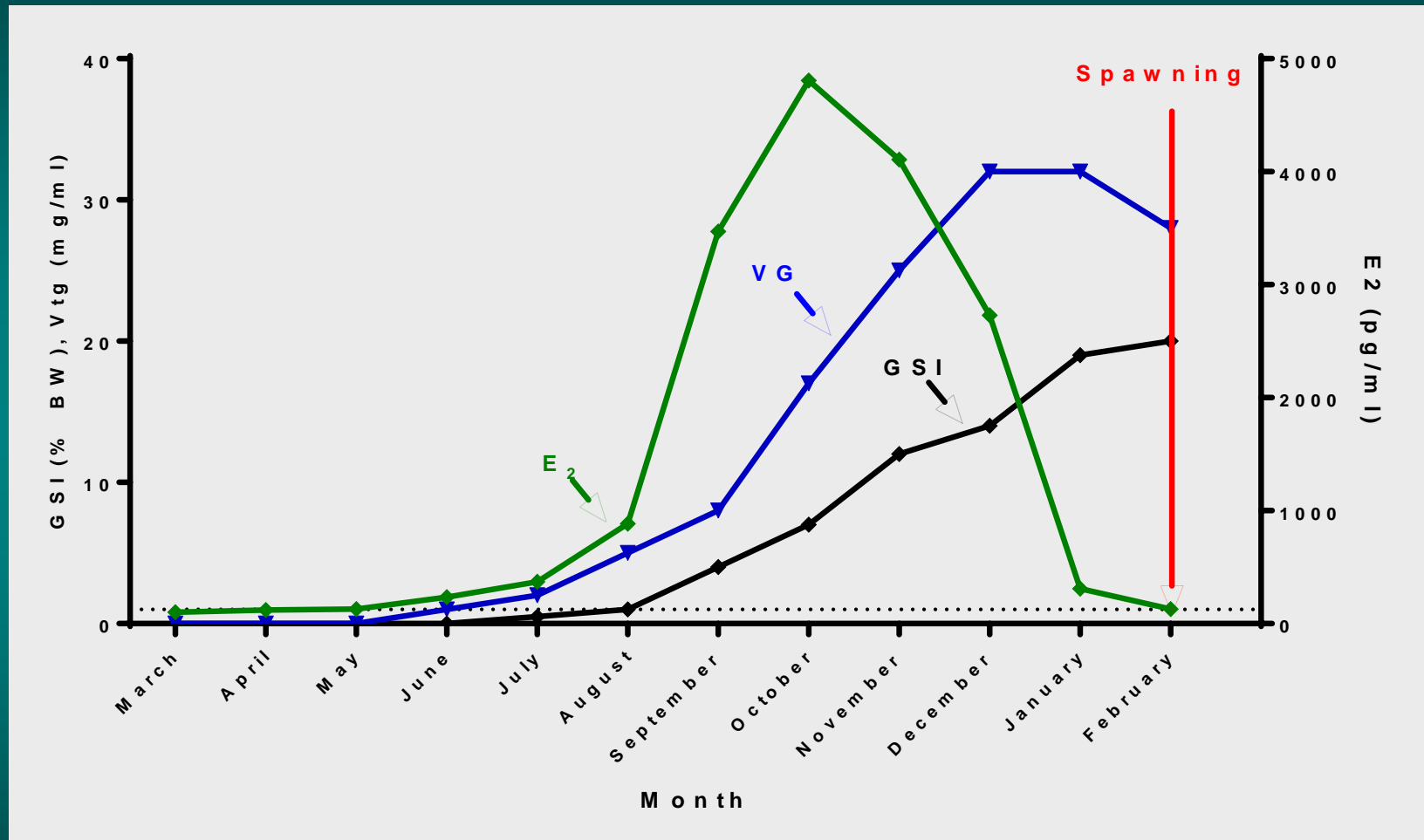


Questions: When is rematuration determined in steelhead kelts? What are the inputs to the decision?

The Reproductive Endocrine Axis regulates reproductive maturation in female salmonids.



In rainbow trout, E₂, VG, and Gonadosomatic Index increase beginning 6-9 months before spawning.



Sources: Bromage, Whitehead & Breton 1982 Gen Comp Endocrinol; Whitehead, Bromage & Breton 1983 Gen Comp Endocrinol; Tyler, Sumpter & Witthames 1990 Biol Reprod; Prat, Sumpter & Tyler 1996 Biol Reprod

Overall Approach

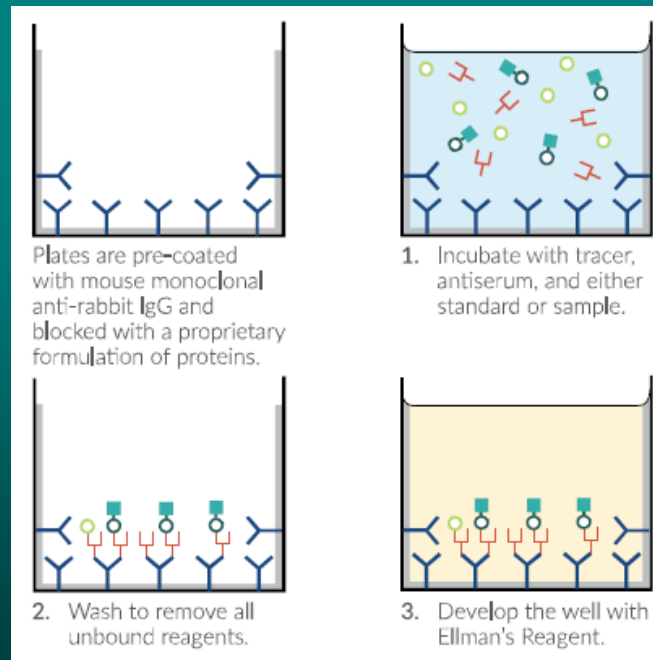
Apply tools from fish physiology and endocrinology to questions and issues in kelt reconditioning.

Methods

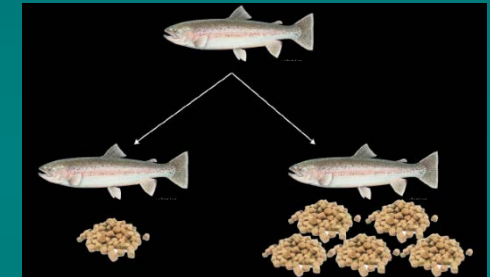
Blood Sampling



Plasma hormone assay



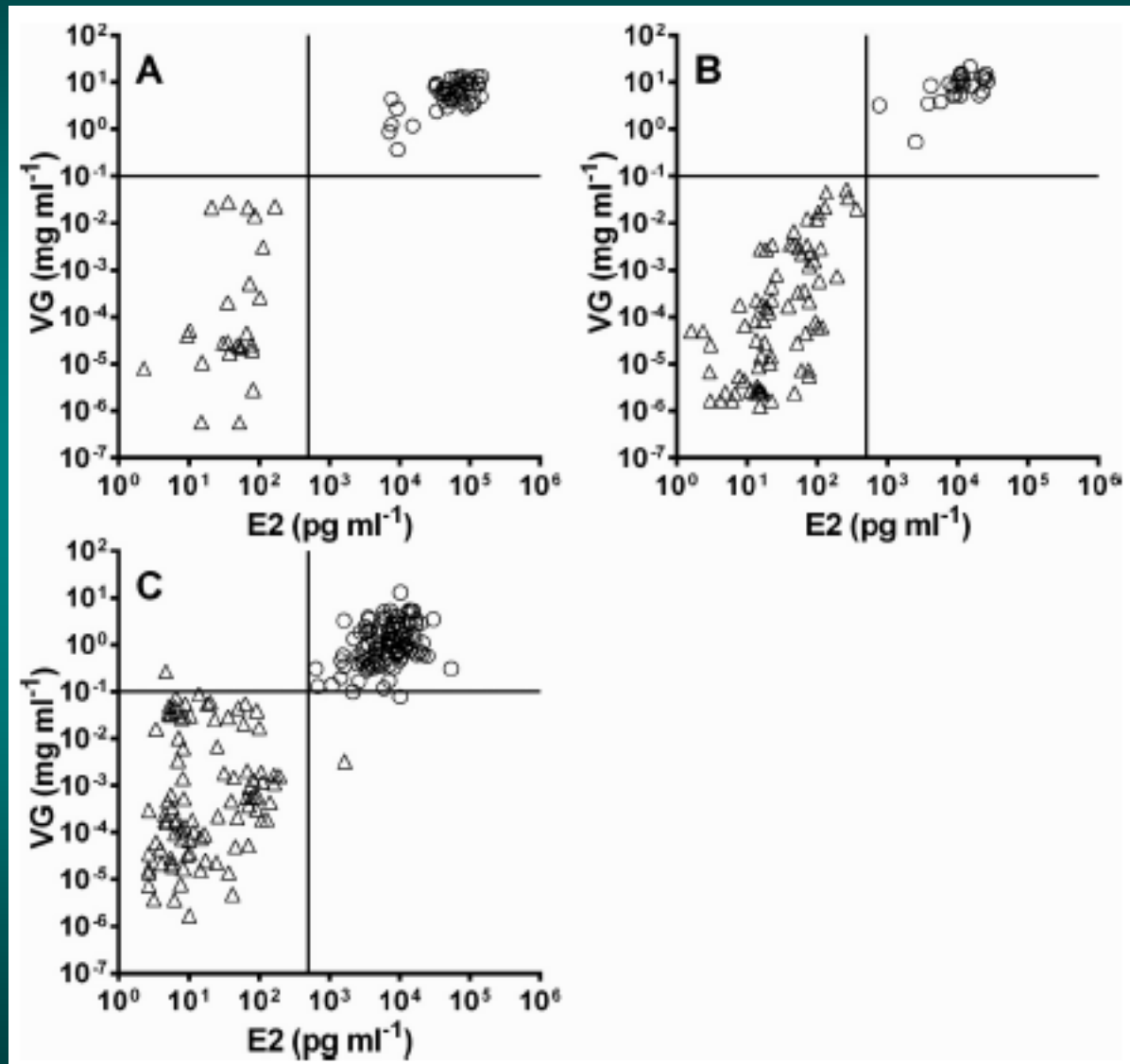
Post-spawning rainbow trout model



DNFH hatchery steelhead model

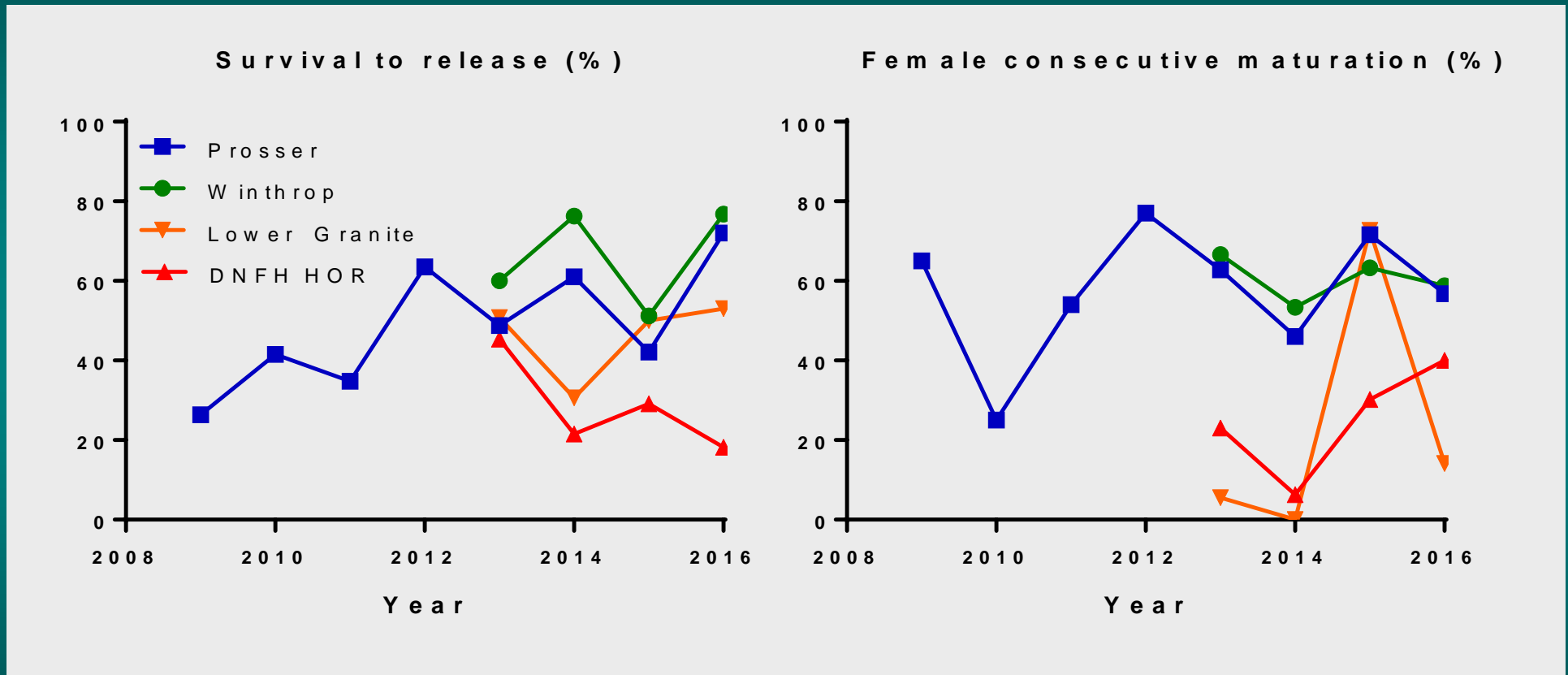


Consecutive and skip spawning life histories are found in captive reconditioned kelts.



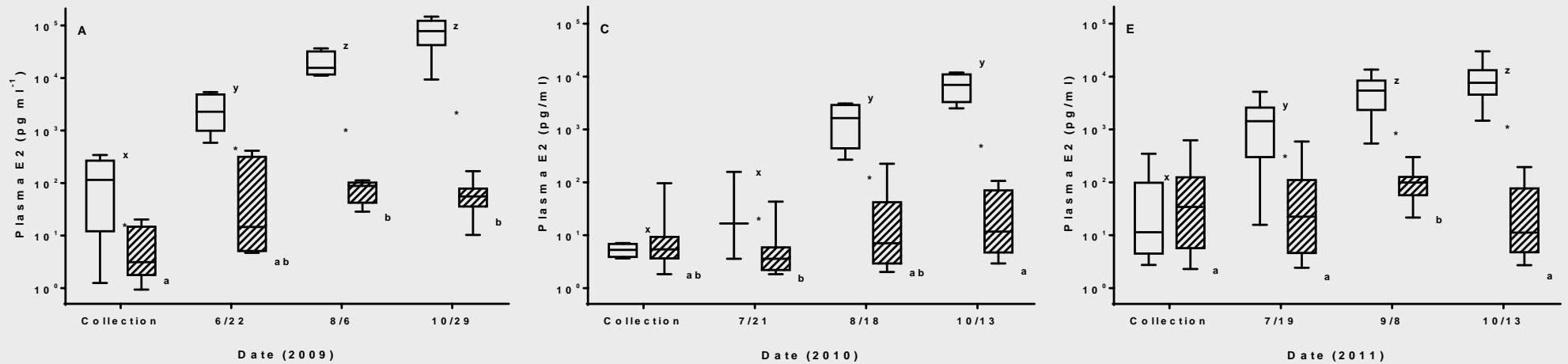
Plasma estradiol (E2) and vitellogenin (VG) levels in Prosser female kelts sampled in October in 2009-2011 (A-C). Fish were grouped by cluster analysis, and thresholds for maturation status are indicated by lines.

Survival and maturation rates vary over time in Columbia River Basin kelt reconditioning projects.



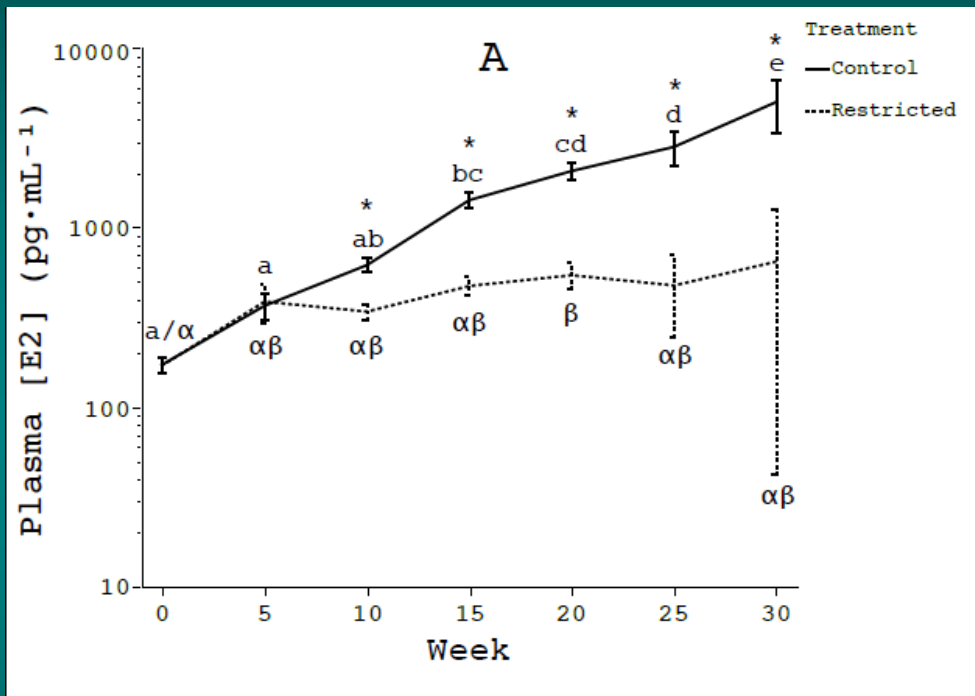
D. Hatch et al., Kelt Reconditioning and Reproductive Success Evaluation Research 1/1/2016-12/31/2016, Bonneville Power Administration Annual Report.

Fish can be screened for maturation status using plasma E2 level from mid-August onward.

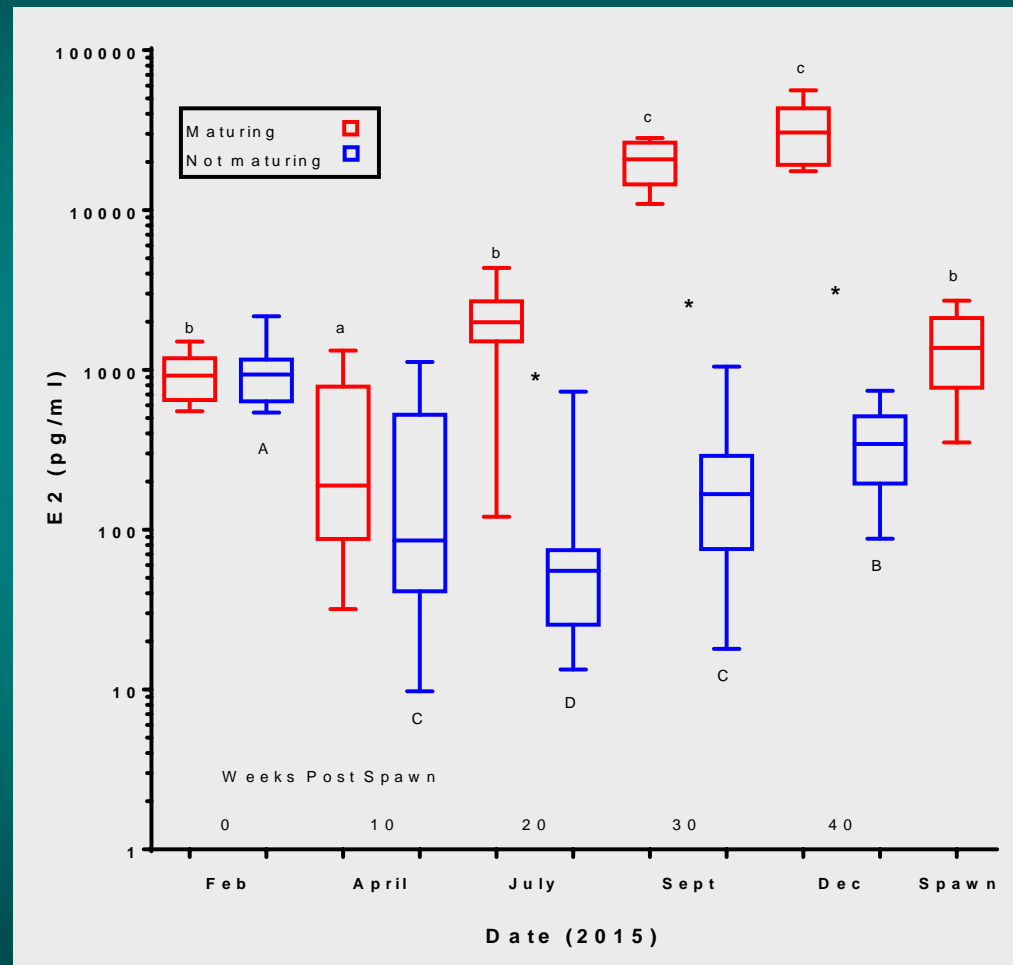


A. Pierce et al., 2017, *Canadian Journal of Fisheries and Aquatic Sciences*.

Studies in post-spawning rainbow trout and a hatchery kelt model suggest that the maturation decision is made by 10-20 weeks after spawning.

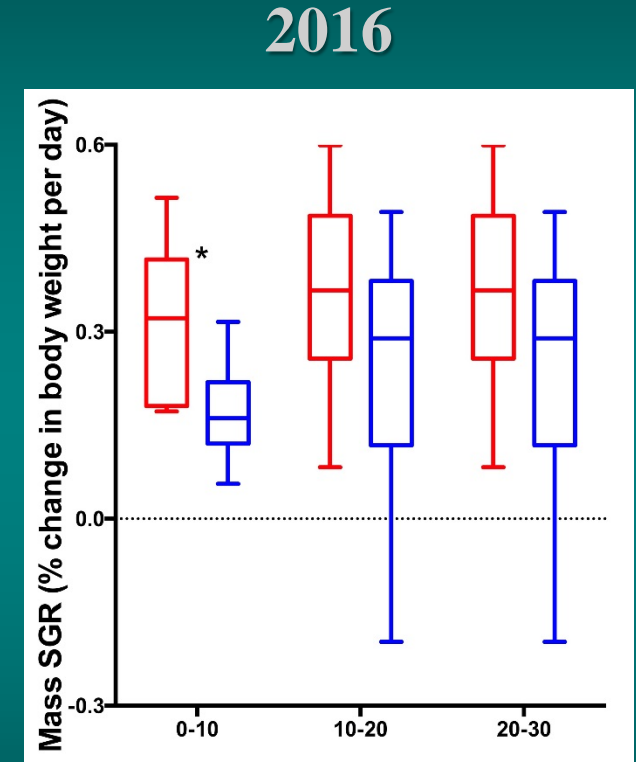
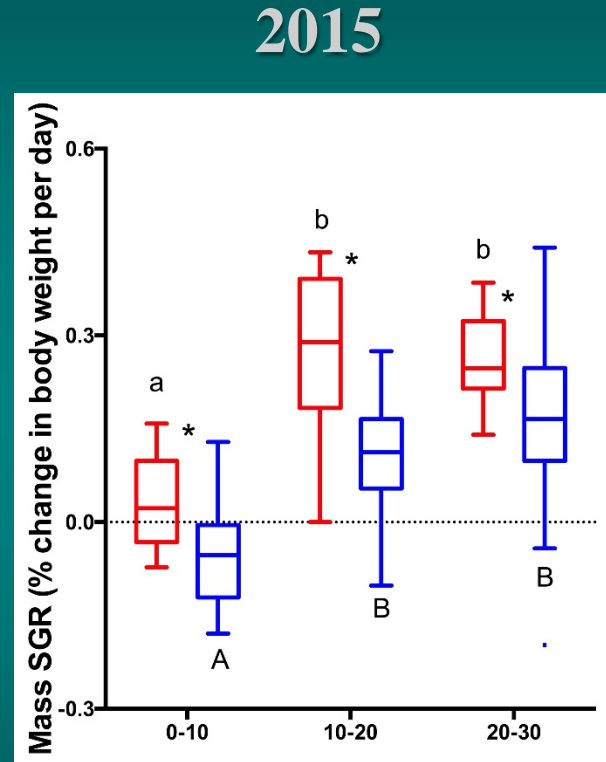
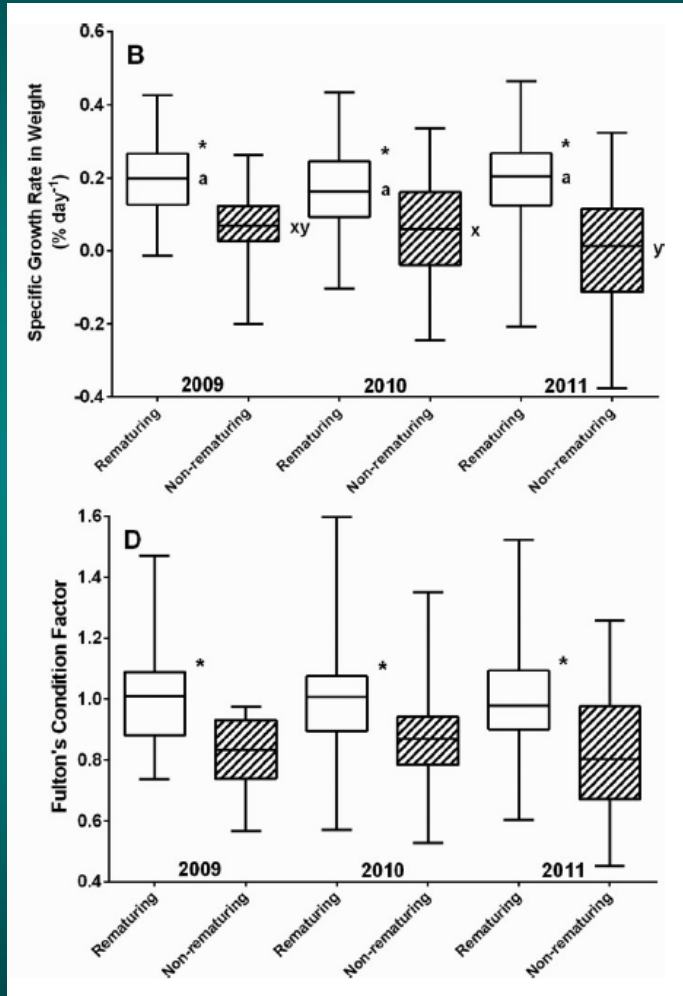


Energy restricted post-spawning rainbow trout.
L. Caldwell et al., 2014, *PLOS One*.



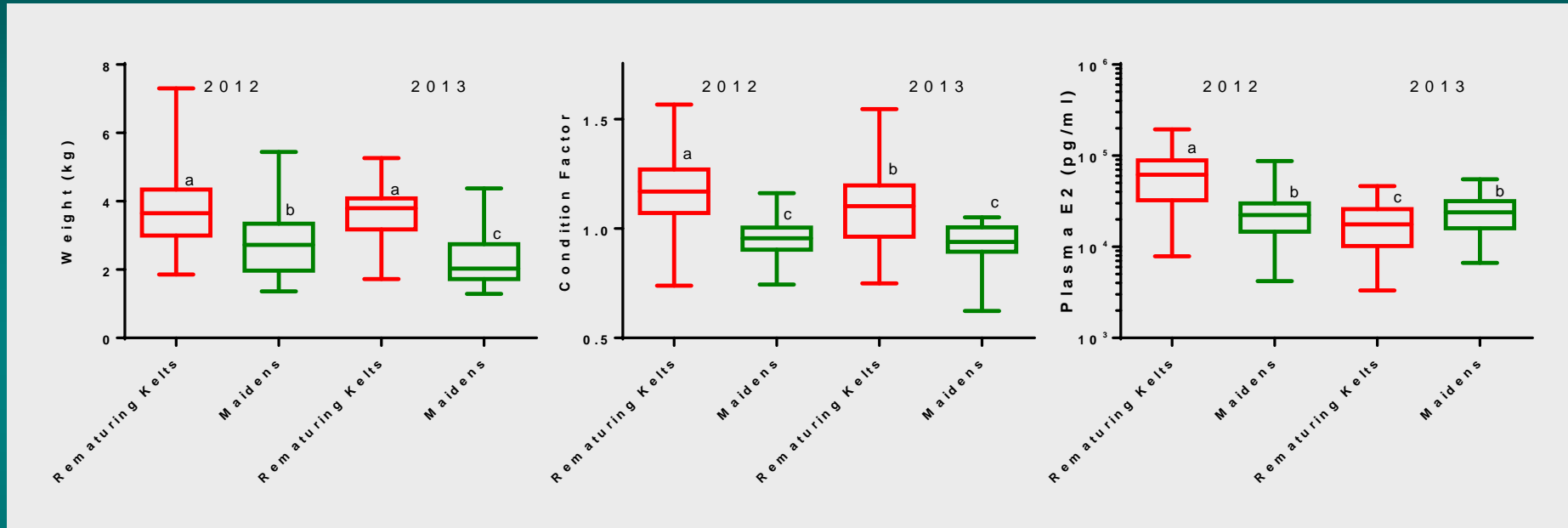
DNFH hatchery kelt model.
L. Jenkins in preparation.

Increased growth and energy reserves are associated with consecutive maturation.



DNFH hatchery kelt model.
L. Jenkins in preparation.

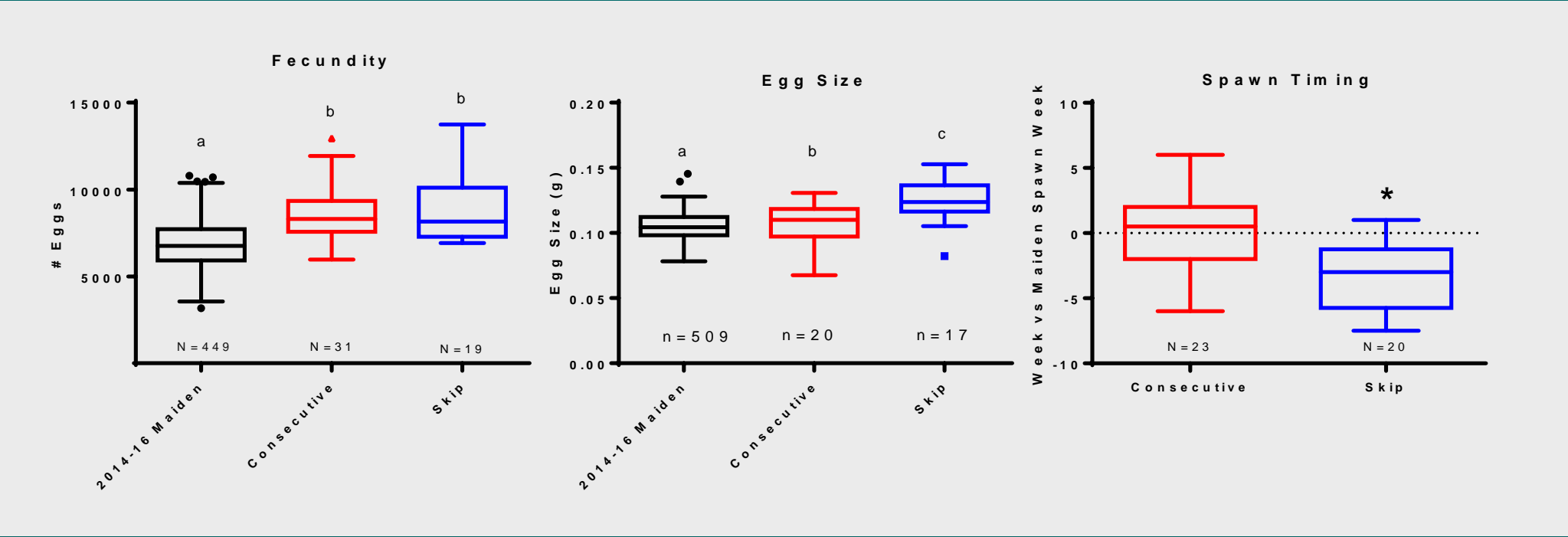
Compared with maiden spawners, reconditioned kelts were larger, had greater energy reserves, and had similar or higher plasma E2 levels at the same point in migration.



Maiden steelhead were sampled at Prosser Dam from late September to early November in 2012 and 2013, and compared with rematuring kelts released at the same location in October.

D. Hatch et al., Kelt Reconditioning and Reproductive Success Evaluation Research 1/1/2015-12/31/2015, Bonneville Power Administration Annual Report.

At the second spawning, Dworshak hatchery kelts increased in fecundity and egg size. Spawn timing of consecutive spawners was similar to maiden spawning, whereas skip spawners were shifted slightly earlier.



DNFH hatchery kelt model. L. Jenkins in preparation.

Conclusions

Reconditioned kelts express the consecutive and skip spawning life histories.

Fish can be screened for maturation status before release.

Maturation is determined early in reconditioning.

Rematuring kelts appear to be on track to spawn.

Questions

What is the reproductive success of reconditioned kelts in the wild?

Is there a genetic basis for successful iteroparity?

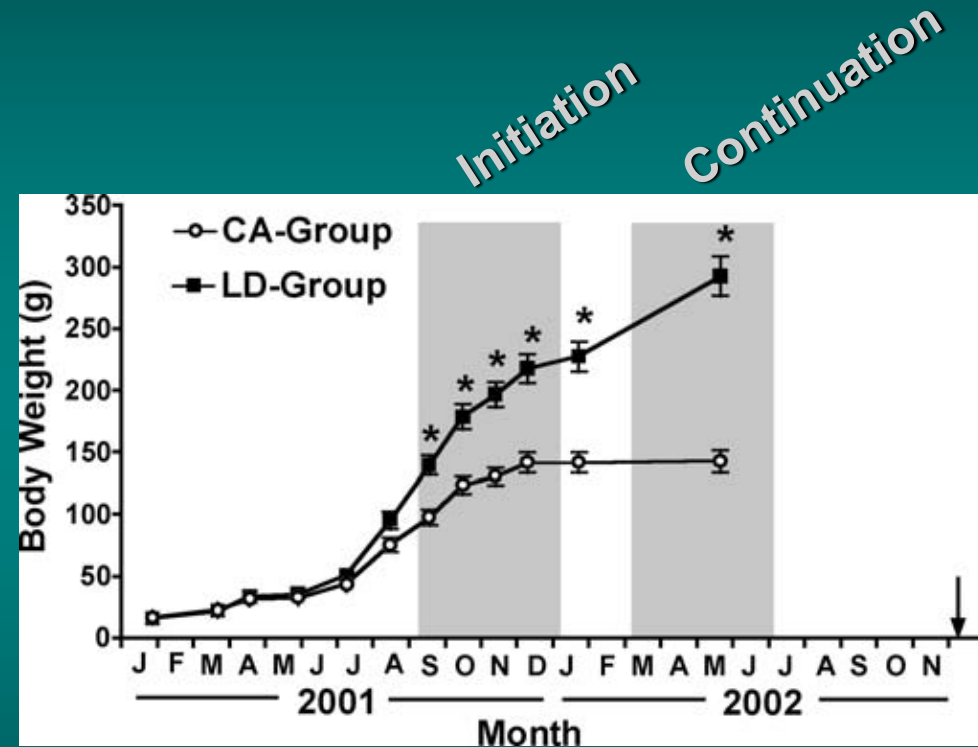
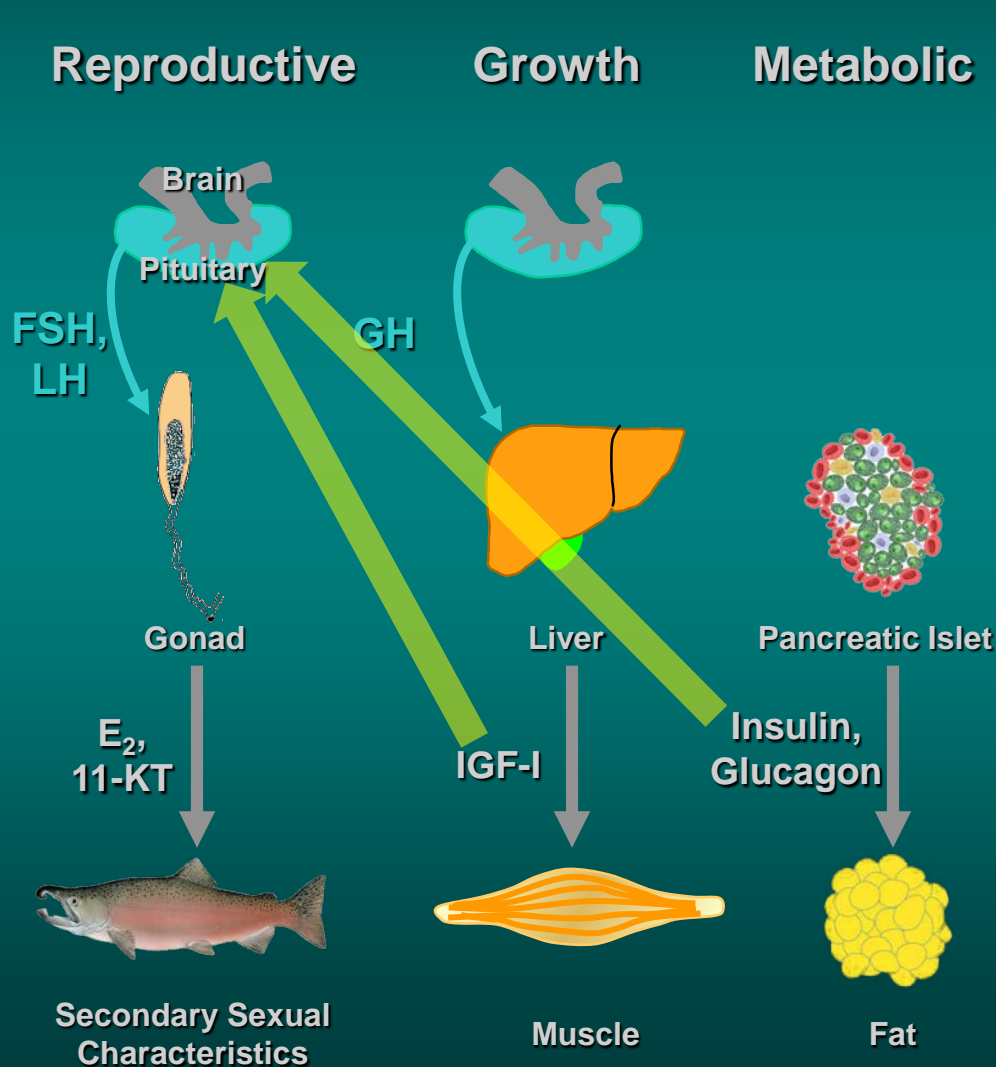
Do ESA-listed target populations have sufficient spawning and rearing habitat to accommodate reconditioned kelt spawners and their progeny?

What is the best way to handle skip spawners?

How is information about energy stores transmitted?

When are the critical developmental windows?

What is the neuroendocrine mechanism?



B. Campbell et al., 2006. *Biology of Reproduction*.

Kisspeptin and GnIH neuronal networks are thought to be major stimulatory and inhibitory regulators of pituitary gonadotropin secretion.

