Reproductive Development in Artificially Reconditioned Female Yakima River Steelhead Kelts

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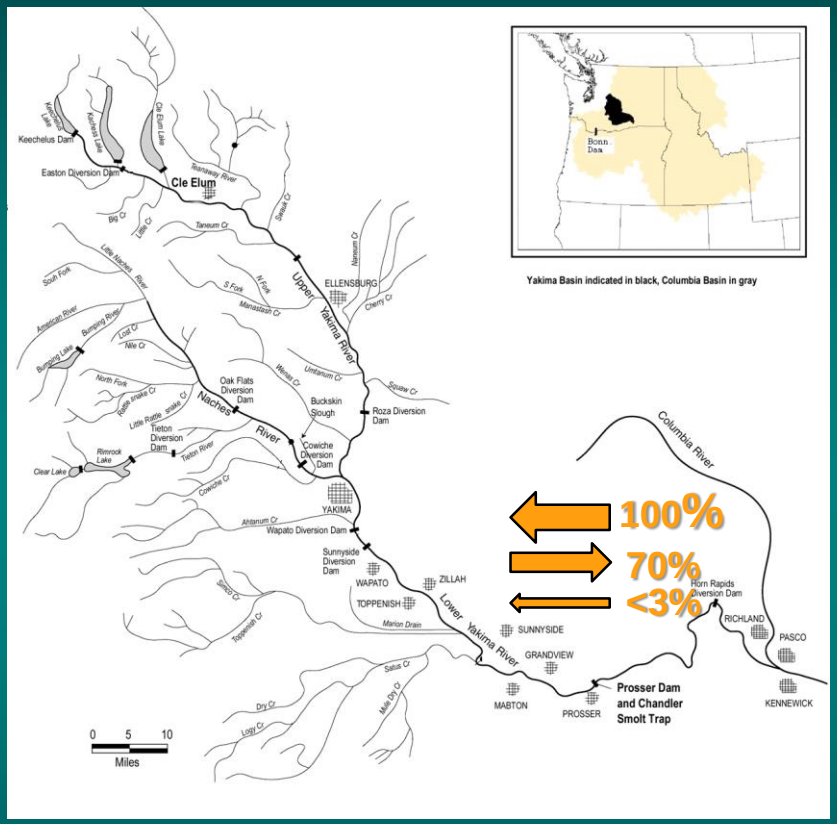
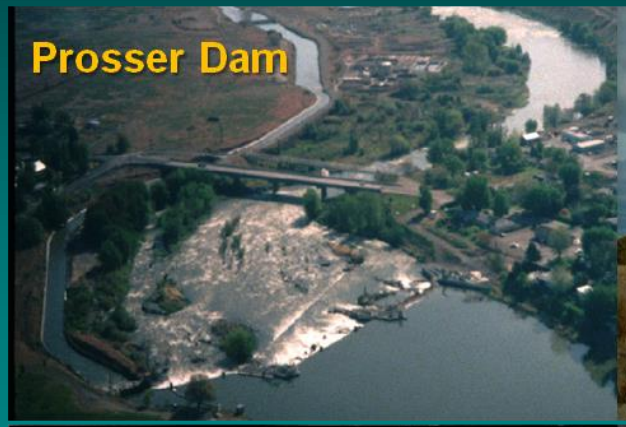
YBSM 2014

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





Intake Reconditioning Release

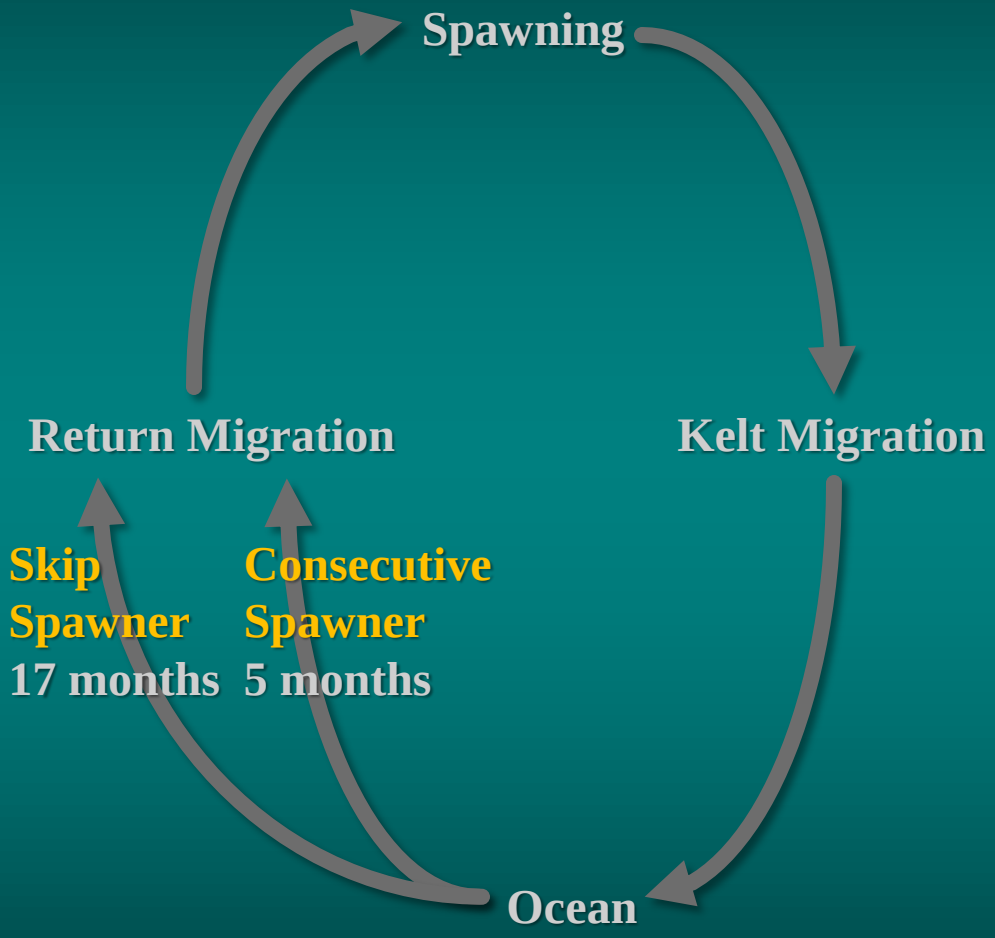
Feb Mar Apr May Jun Jul Aug Sep Oct Nov

To contribute to listed steelhead populations, reconditioned kelts must spawn successfully.

Approaches to assessing spawning success/potential success:

- Captive spawning.
- Tagging and tracking.
- Genetics: parentage analysis.
- **Physiology: reproductive development.**

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

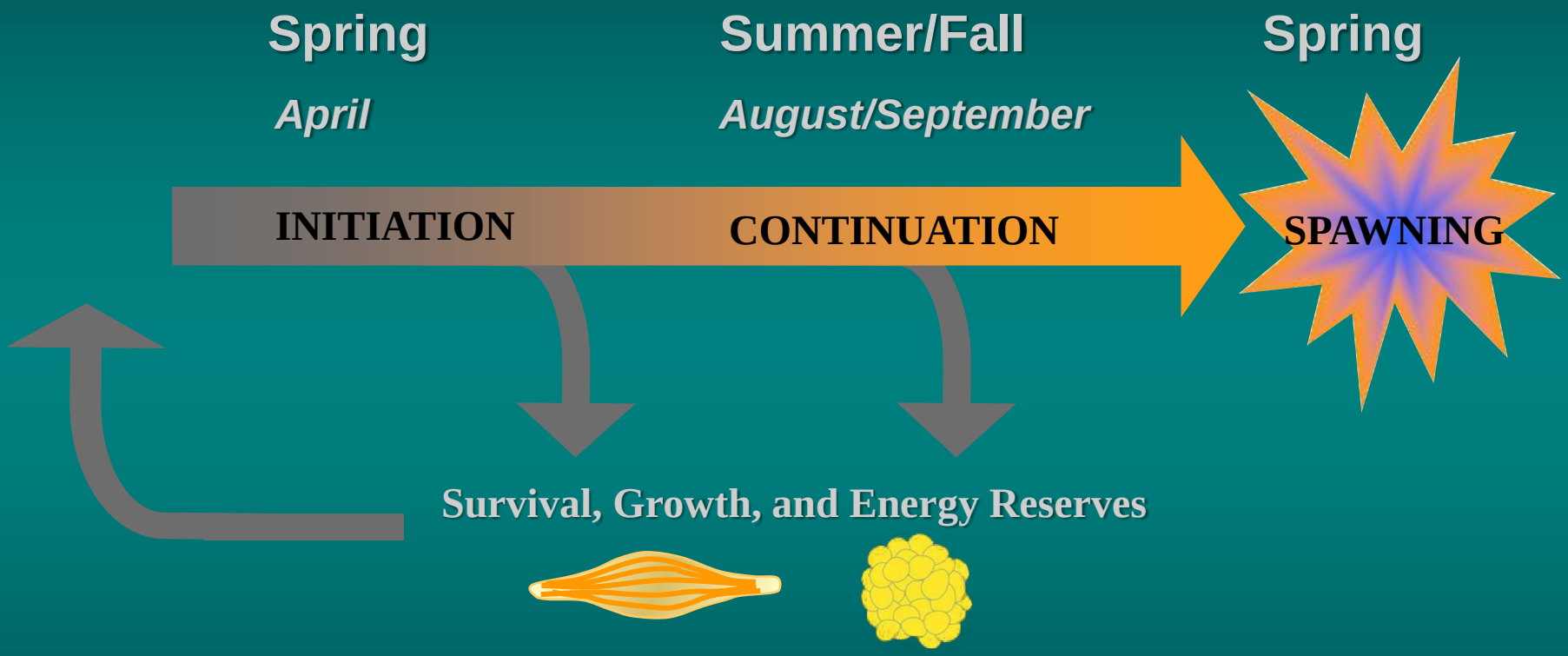


Skip spawning is common in seasonally breeding iteroparous fishes, and is driven by energetics (Rideout 2005).

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

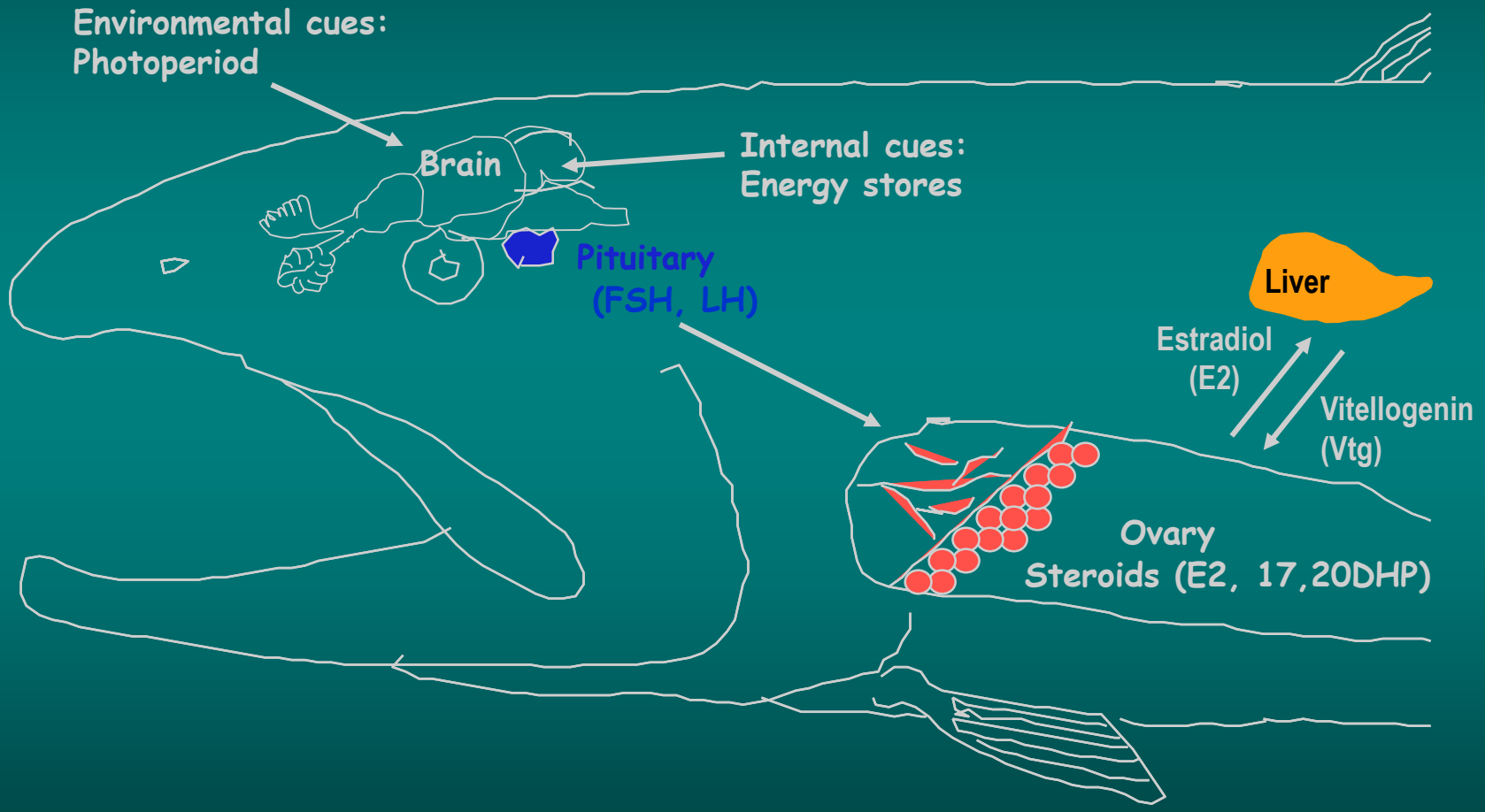
Hypothesis:
Reconditioned female steelhead may be consecutive or skip spawners.

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

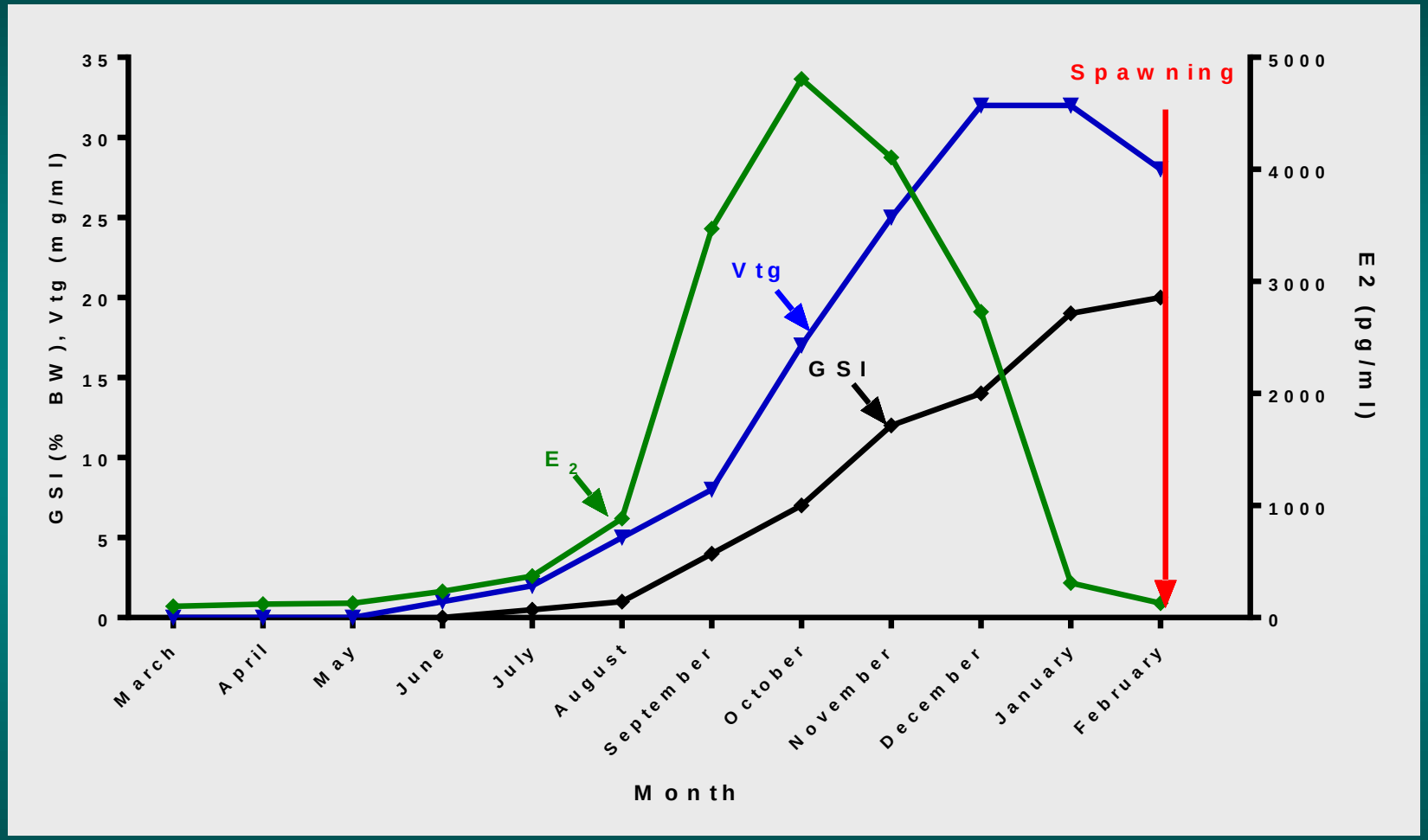


Hypothesis: In female steelhead kelts, reproductive trajectory is determined by energetic status during the 1 to 2 month period after spawning.

The Reproductive Endocrine Axis regulates reproductive maturation in female salmonids.



In rainbow trout, E2, Vtg and Gonado-Somatic Index increase strongly beginning about 6 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 & Tyler1996 Biol Reprod

Objectives

Assess the maturation status of reconditioned female kelts at release.

Establish methods for determining maturation status prior to release.

Determine when reproductive trajectory is set.

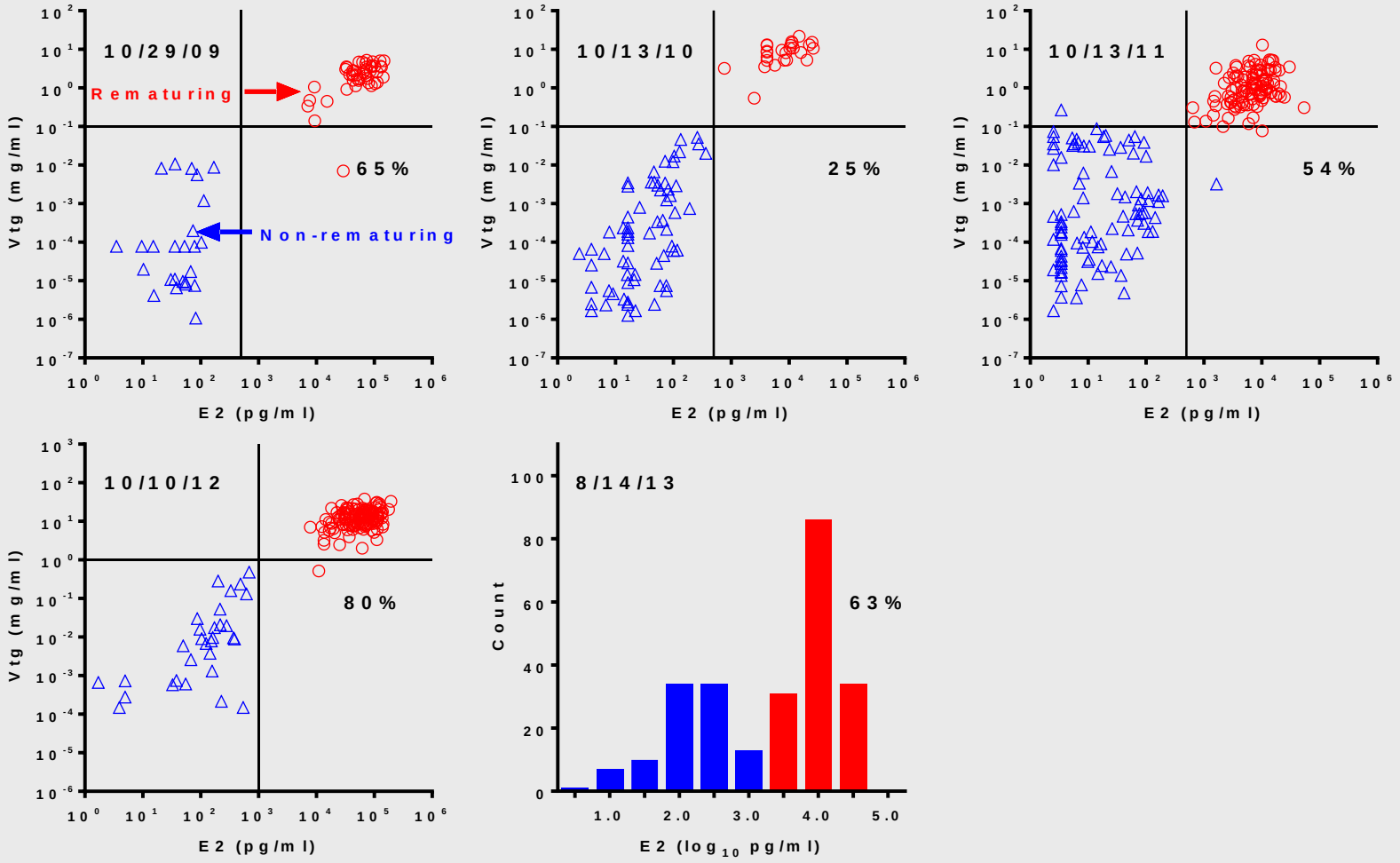
Evaluate the effect of artificial reconditioning on rematuration rate.

Methods

Fish were blood sampled.

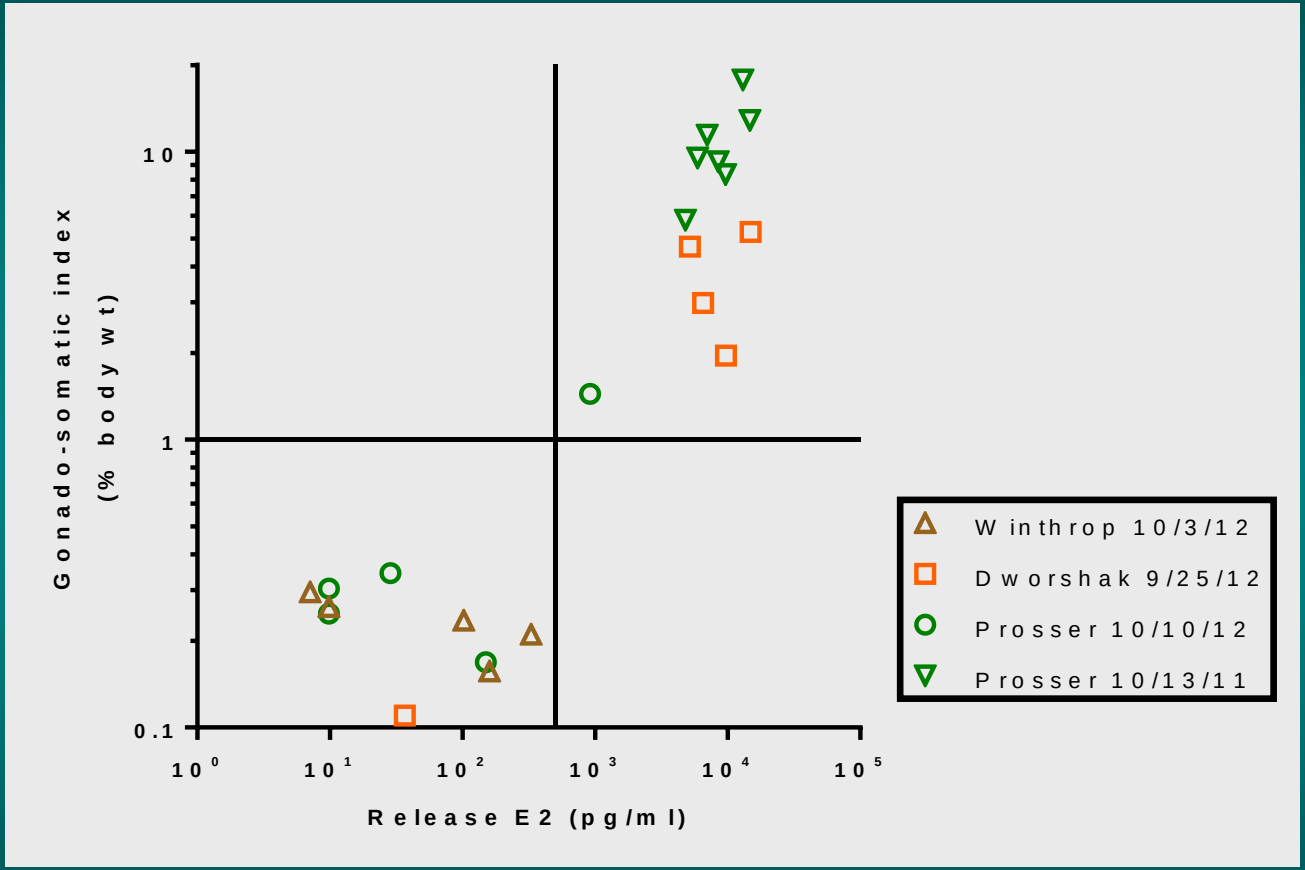
Plasma Estradiol (E2) and Vitellogenin (Vtg) levels were determined.

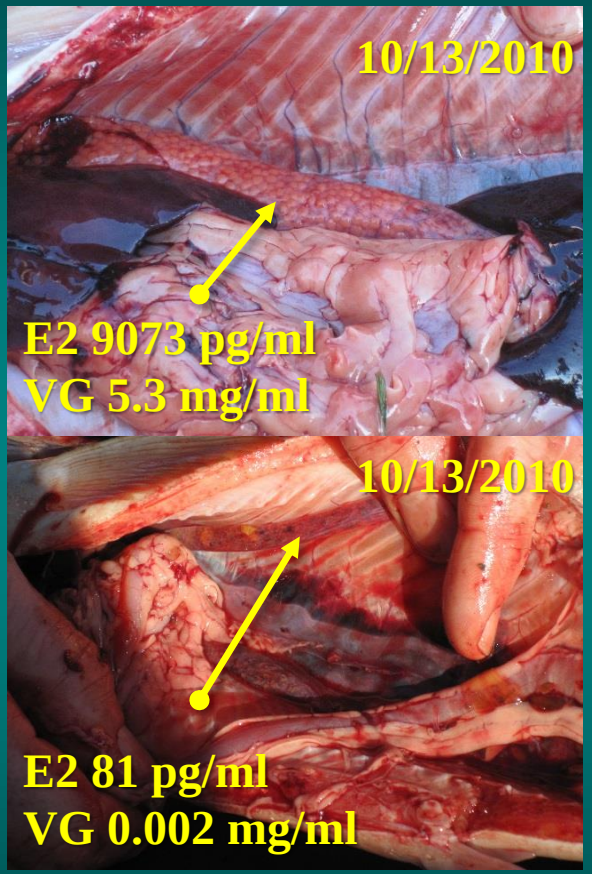
Plasma estradiol and vitellogenin levels divided female fish into rematuring and non-rematuring groups at release in October.



Random subsample of 25-98% of female fish.
Groups identified by cluster analysis (hierarchical by Ward linkage, 2 groups).

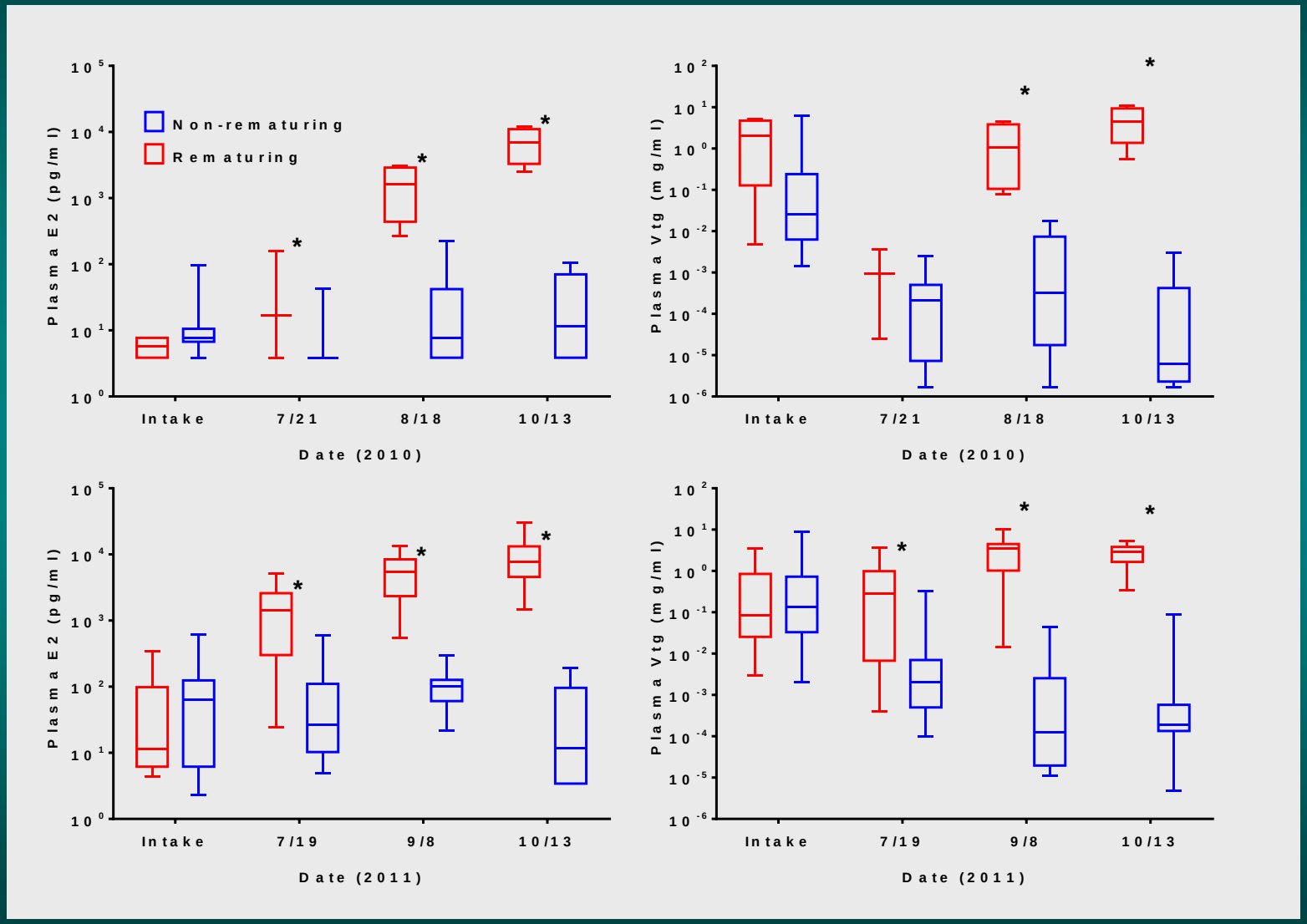
Classification of maturation status based on blood hormone levels was confirmed by examining the ovaries of mortalities.





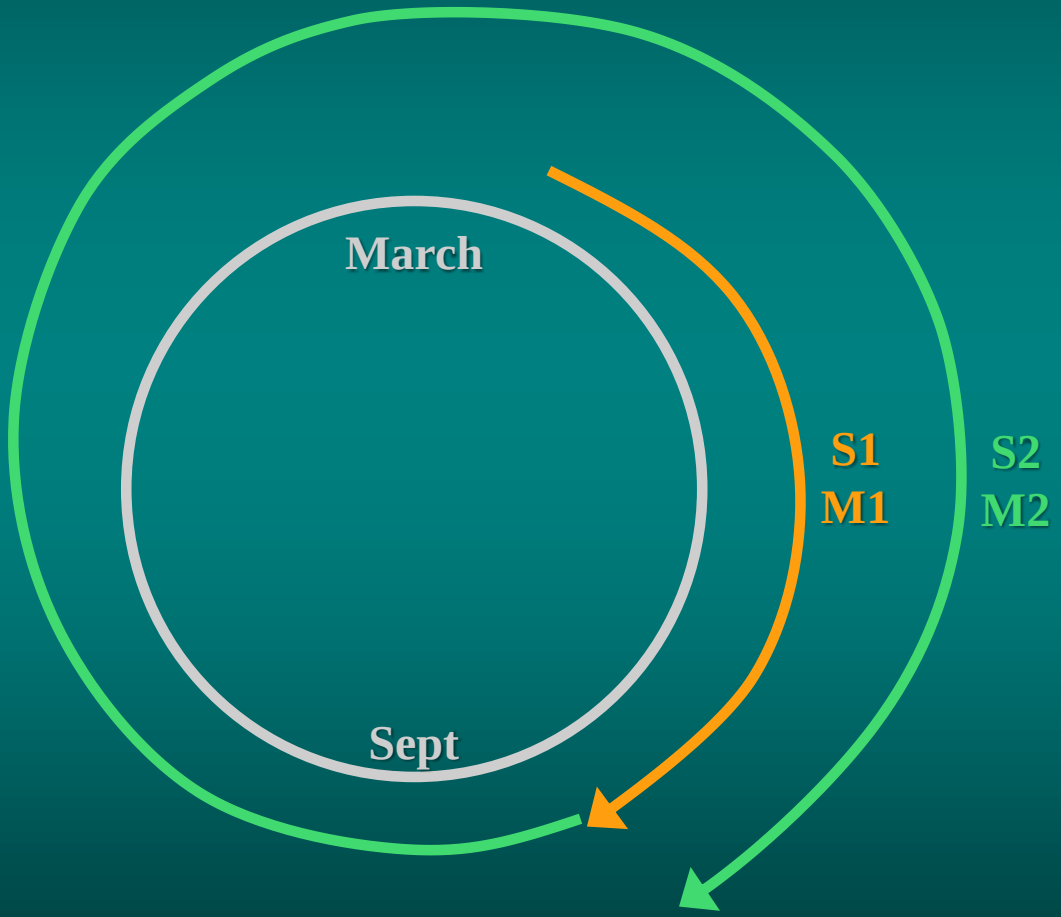
GSI increases to over 1% by 6 months prior to spawning in rainbow trout (e.g. Bromage 1982, Prat 1996). Thanks to Scott Everett (Nez Perce Tribe) and Matt Abrahamse (Yakama Nation Fisheries) for lethal samples of reconditioned hatchery origin kelts.

Plasma E2 was elevated in rematuring females by mid-July. Separation of fish by E2 and Vtg level was possibly by mid-August to September.



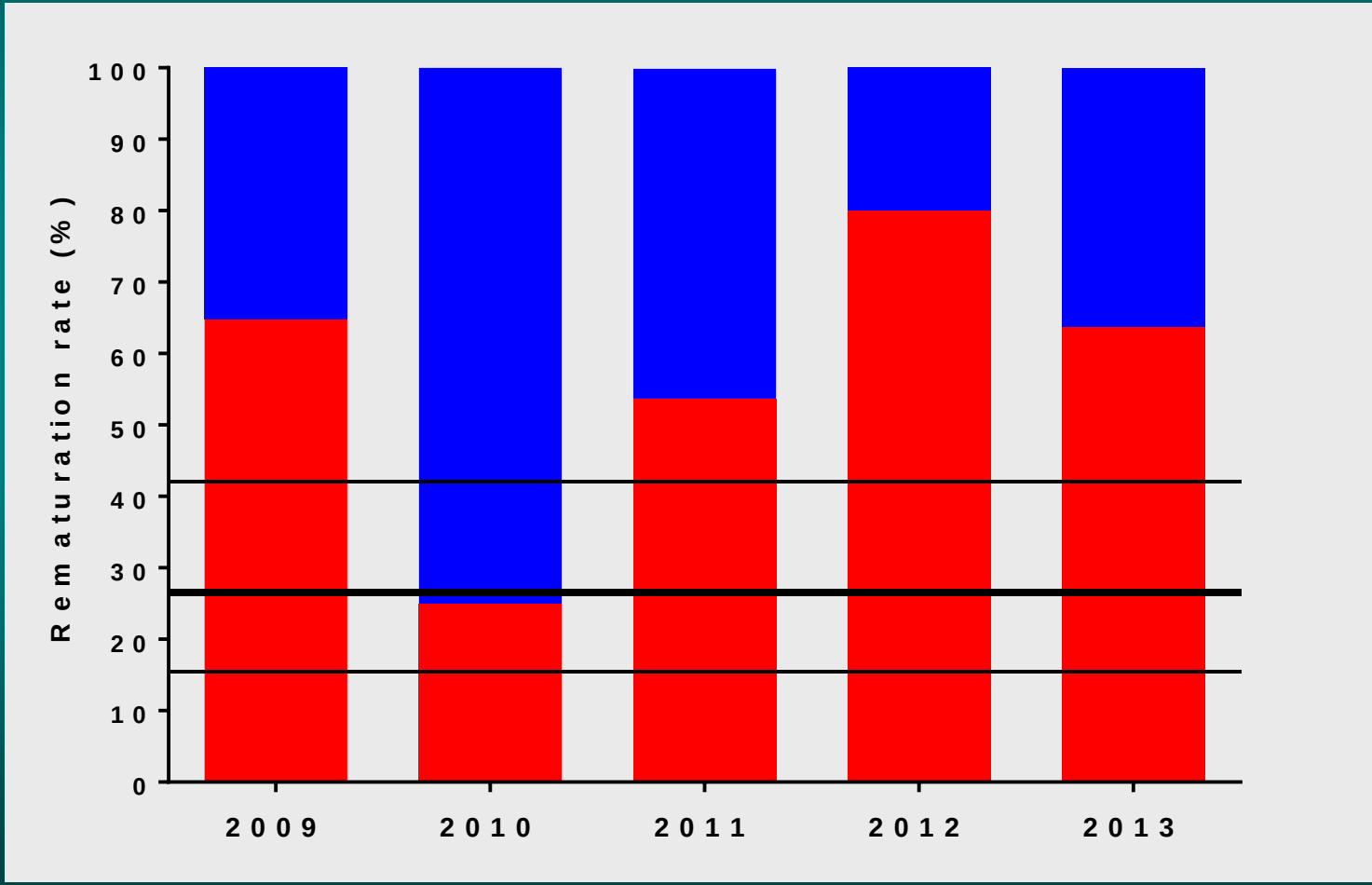
Serially sampled fish. Maturation category assigned by release E2 and VG levels. Differences tested by t-tests.

Modeling suggests that the rematuration rate of fish in the ocean after 1 summer is probably in the 20-30 % range.



Parameter	Formula	Ocean-1	Ocean-2	Ocean-3
S1		0.036	0.056	0.097
M1		0.419	0.265	0.153
S2		0.800	0.400	0.200
M2		0.900	0.900	0.900
Consec	S1*M1	0.015	0.015	0.015
Skip	S1*(1-M1) *S2*M2	0.015	0.015	0.015
Itero	Consec+Skip	0.030	0.030	0.030
pC	Consec/Itero	0.500	0.500	0.500
pS	Skip/Itero	0.500	0.500	0.500

The rematuration rate in captivity is probably higher than in the ocean. Captive rematuration rate varies between years, suggesting influence of the pre-capture environment.



Conclusions

The kelt reconditioning project at Prosser releases both rematuring and non-rematuring females. Rematuration percentage varies between years.

Maturation status can be determined by blood estradiol and vitellogenin level from mid-August onward.

Artificial reconditioning probably increases rematuration rate versus natural repeat spawners.

Environmental factors also influence rematuration rate.

Management Implications

Strategies to further increase maturation rate and handle skip spawners should be developed.