Does acclimation and spawning site affect reproductive success of Upper Yakima River spring Chinook?

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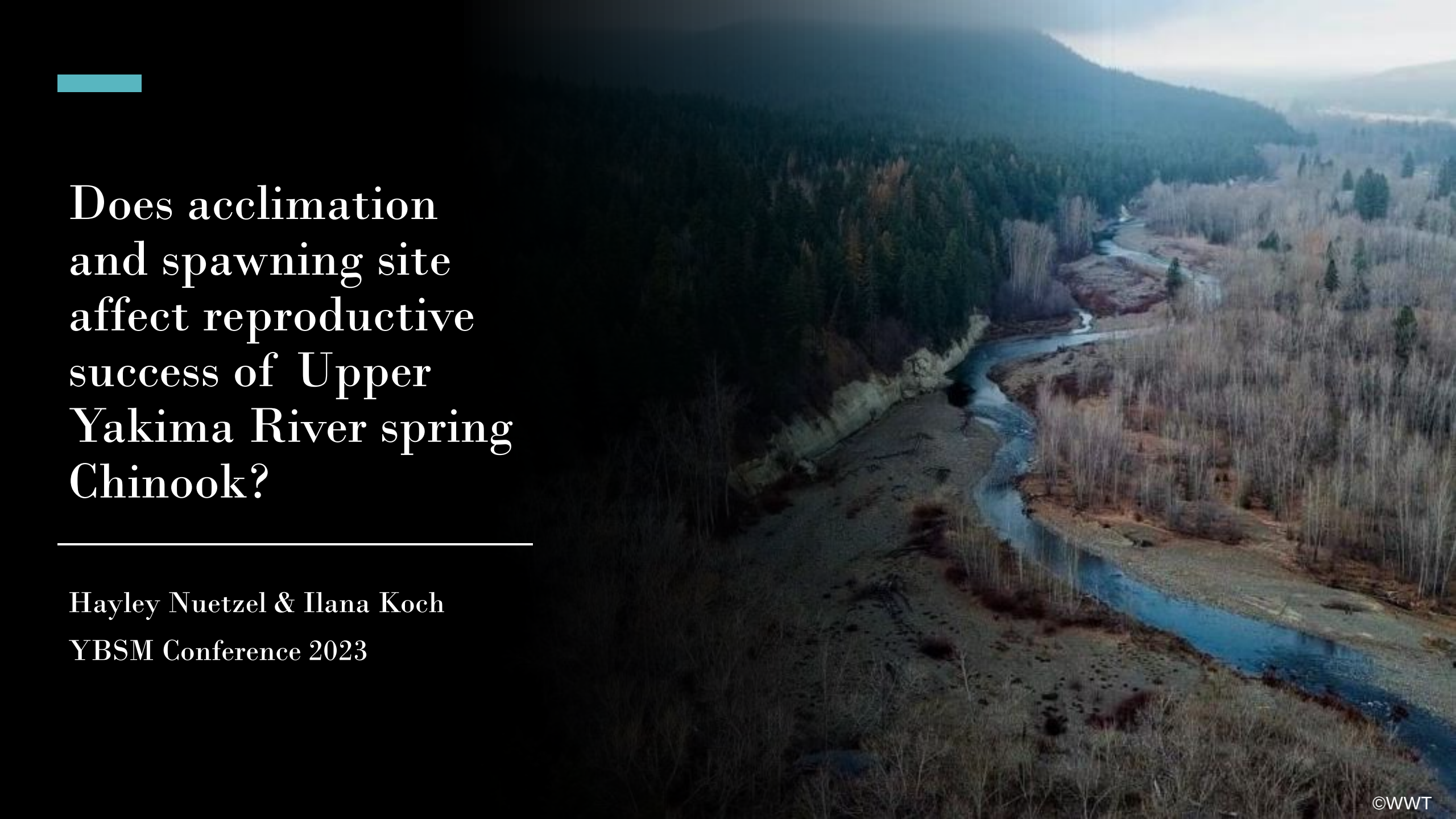
YBSM Conference 2023



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Project Collaborators

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Project Objective

- In the Yakima basin, hatchery-origin Chinook demonstrate lower reproductive success than natural-origin Chinook (spawn years 2007-2011; Koch et al., 2022).

- In other systems, reduced reproductive success by hatchery-origin fish has been linked to spawning in suboptimal habitat that is adjacent to smolt release sites (Hoffnagle et al., 2008; Williamson et al. 2010; Ford et al., 2016; Hughes & Murdoch, 2017).

- If we could link spawn/acclimation site carcass data with reproductive success data, then we may uncover a potential mechanism for reduced productivity in the Upper Yakima.

Methods

- Received DNA from carcasses sampled in 2007-2010 by Andy Dittman & crew

- Then matched these individual samples to the RRS dataset by:
  1. PIT tags
  2. Genetic duplicate
     a. Only "goo factor" = 1 (i.e., least degraded)

- Ran GLM models to determine if spawning site predicts reproductive success

Yakima River Acc Sites

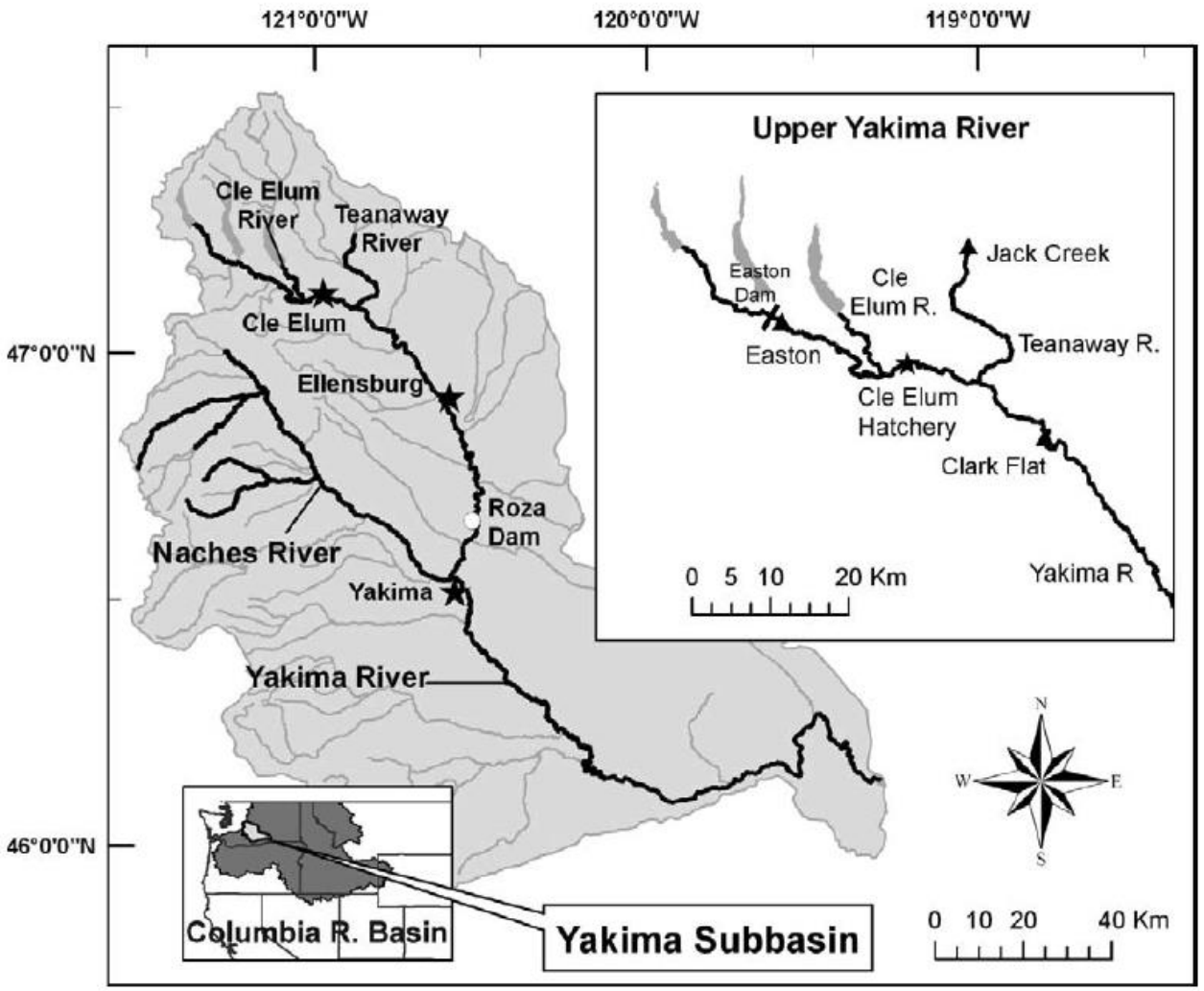


Figure 1, Dittman et al., 2010

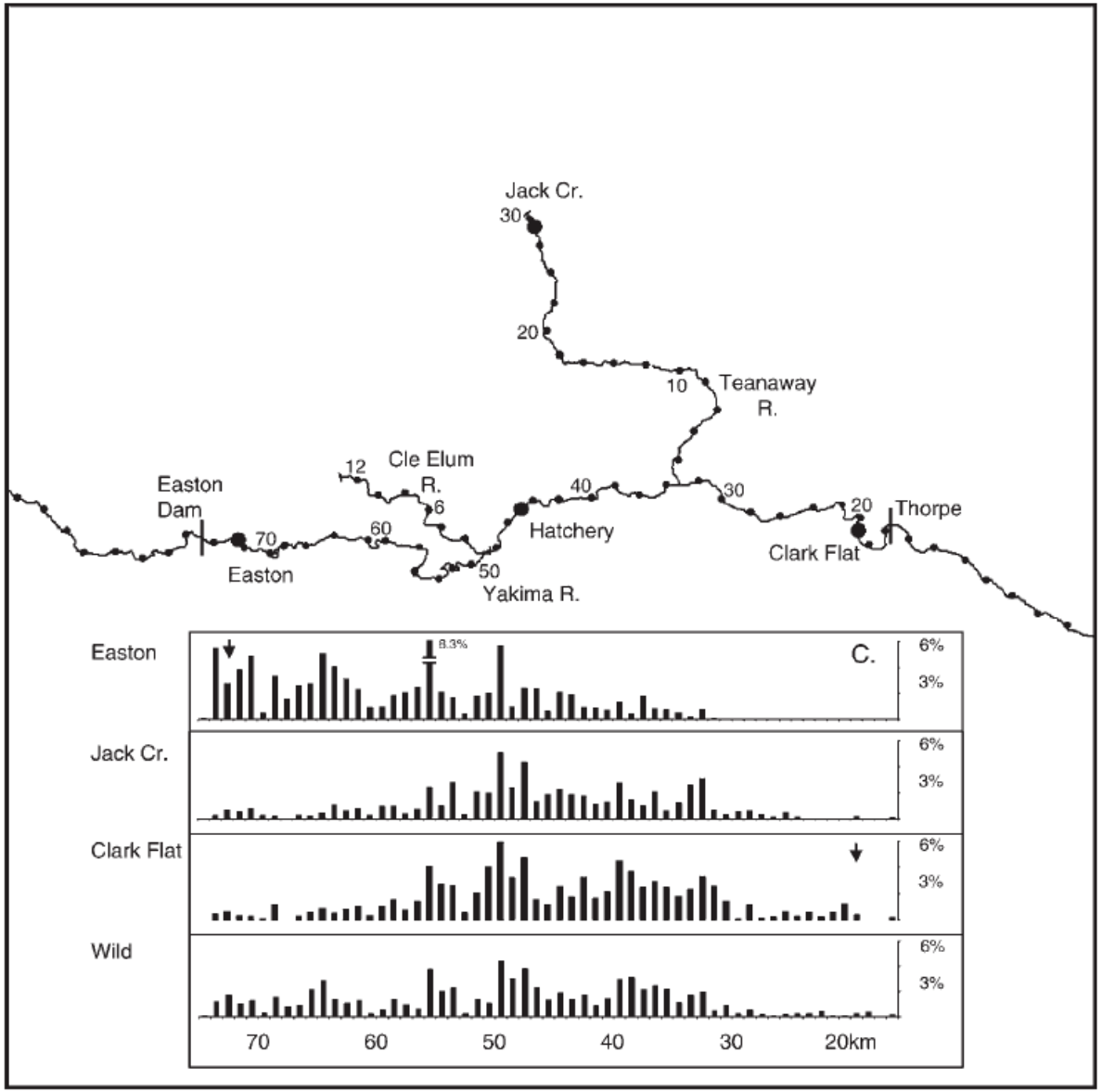
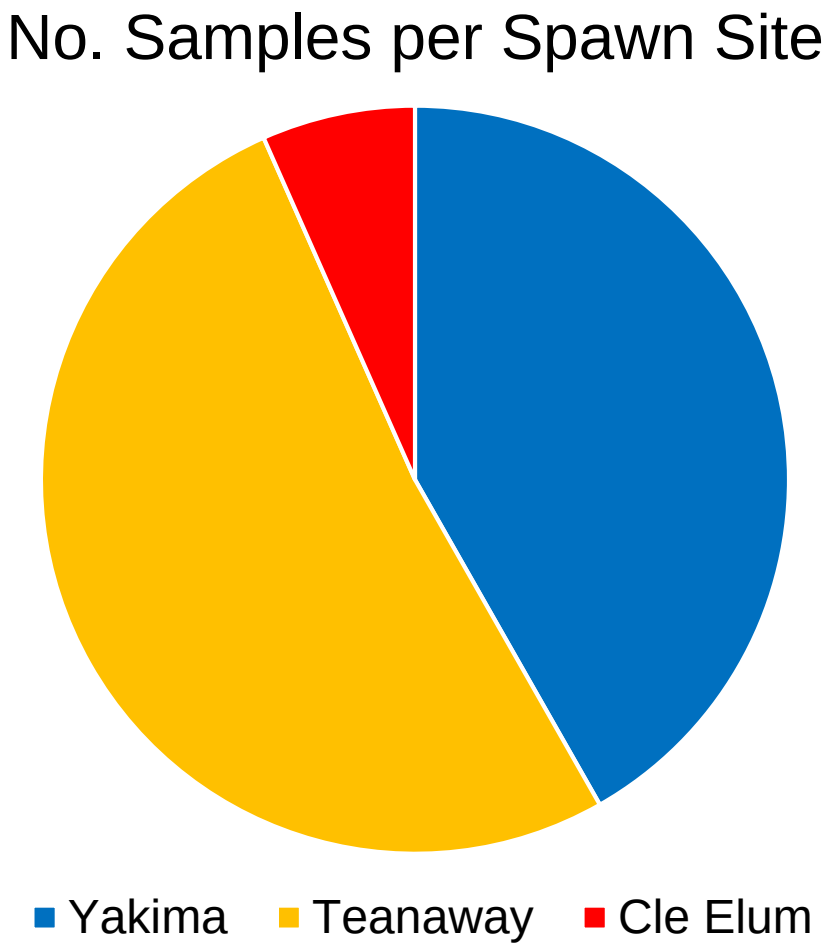


Figure 4, Dittman et al., 2010

Sample Sizes

- 239 samples matched via PIT tag
- Successfully genotyped 55% of the least degraded samples (n=177).
  - Out of 177, we genetically matched 168 to fish in Roza database with RS estimate
- Samples that matched via PIT + genetics with an RS value = 407 total:
  - 2007 = 59
  - 2008 = 22
  - 2009 = 48
  - 2010 = 278

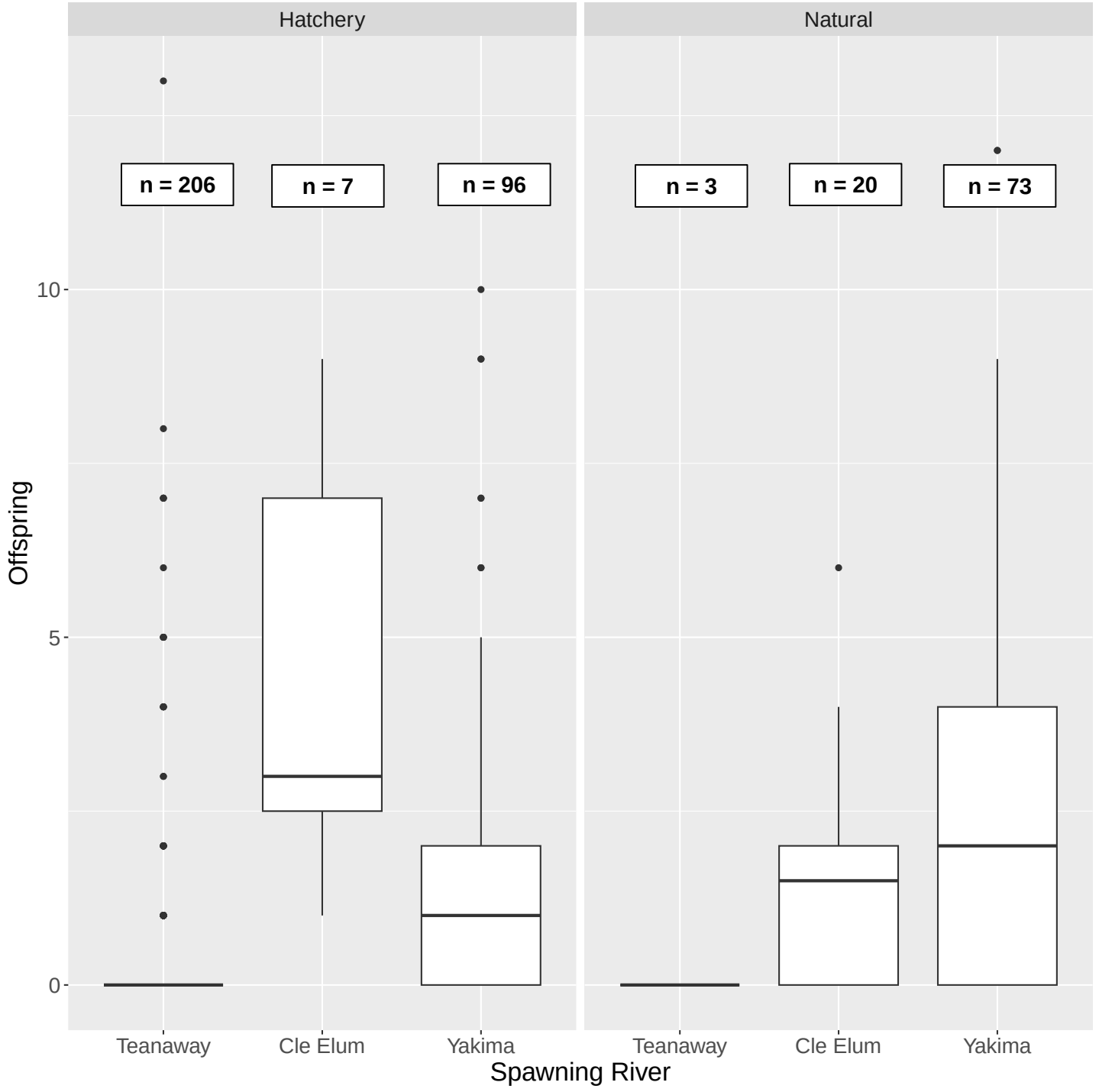


Results – Spawn Site

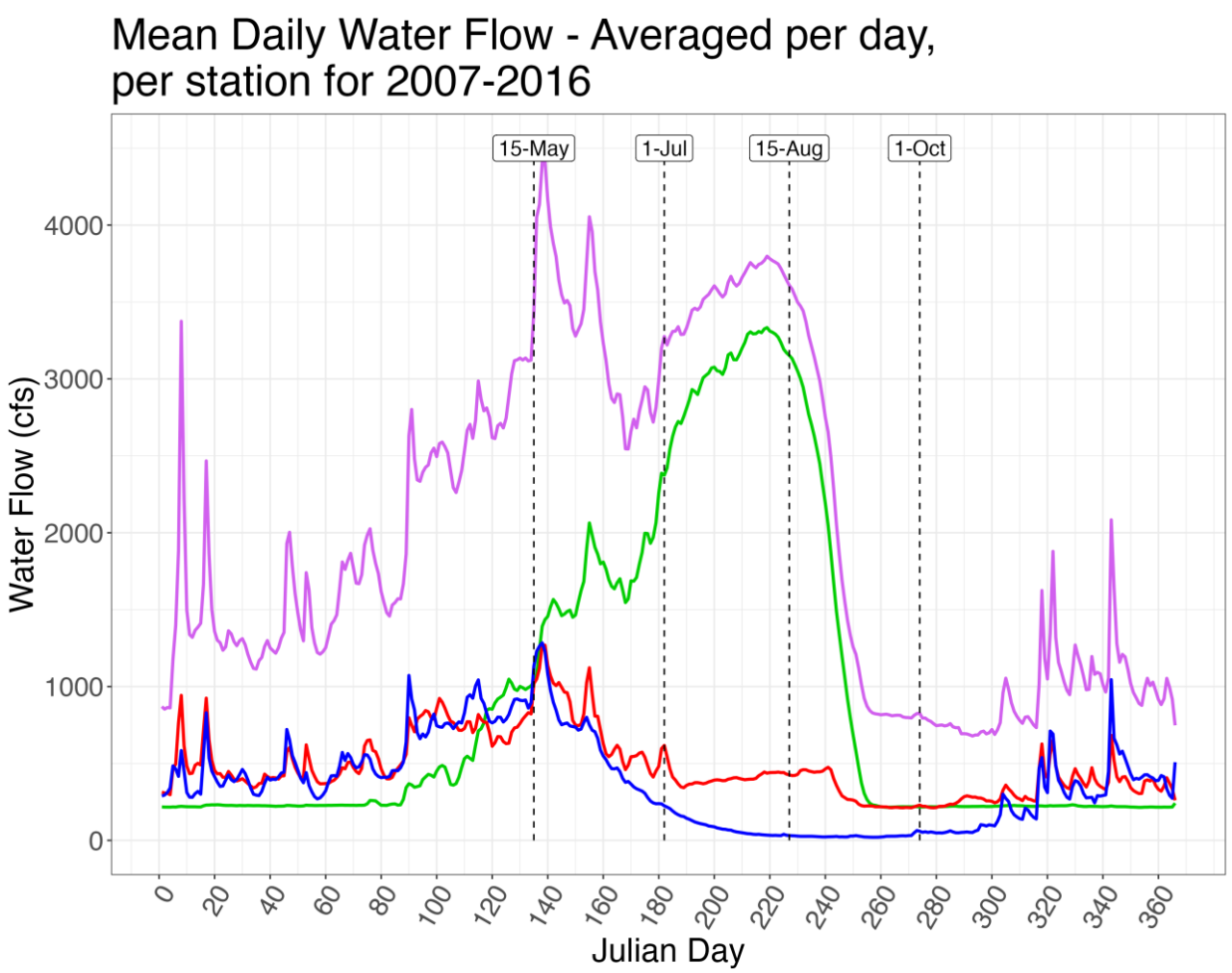
- Best fitting GLM for predicting reproductive success included terms:
  - Spawning River (Teanaway significantly lower than other rivers)
  - Sampling Year (2007 significantly higher than all other years)
  - Sex & Origin (neither significant)

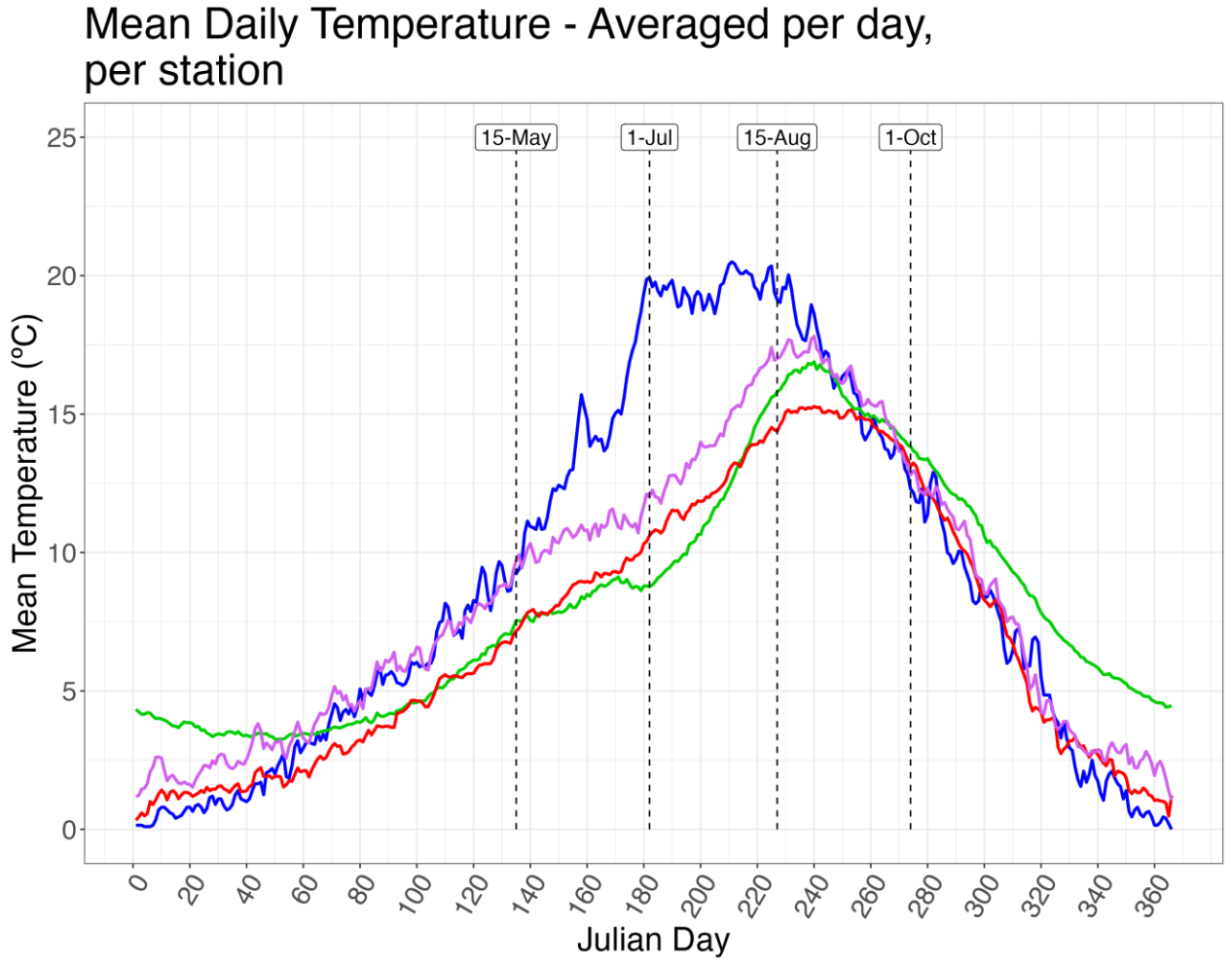
Mean RS by Spawn Site & Origin

	Teanaway	Cle Elum	Yakima
Hatchery	0.64	4.57	1.68
Natural	0.00	1.55	2.40



Teanaway River – Environmental Conditions





Cle Elum River
Yakima at Easton
Teanaway River at Forks/Red Bridge
Yakima River at Horlick

Results – Acc Site

- Teanaway River largely used by Jack Creek acclimated fish (N=198):
  - 28 spawned in Yakima main
  - 3 spawned in Cle Elum River

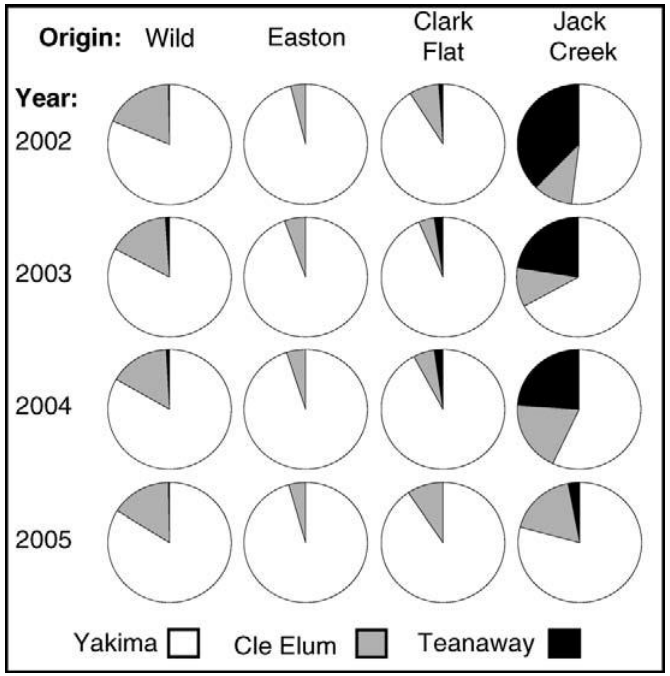
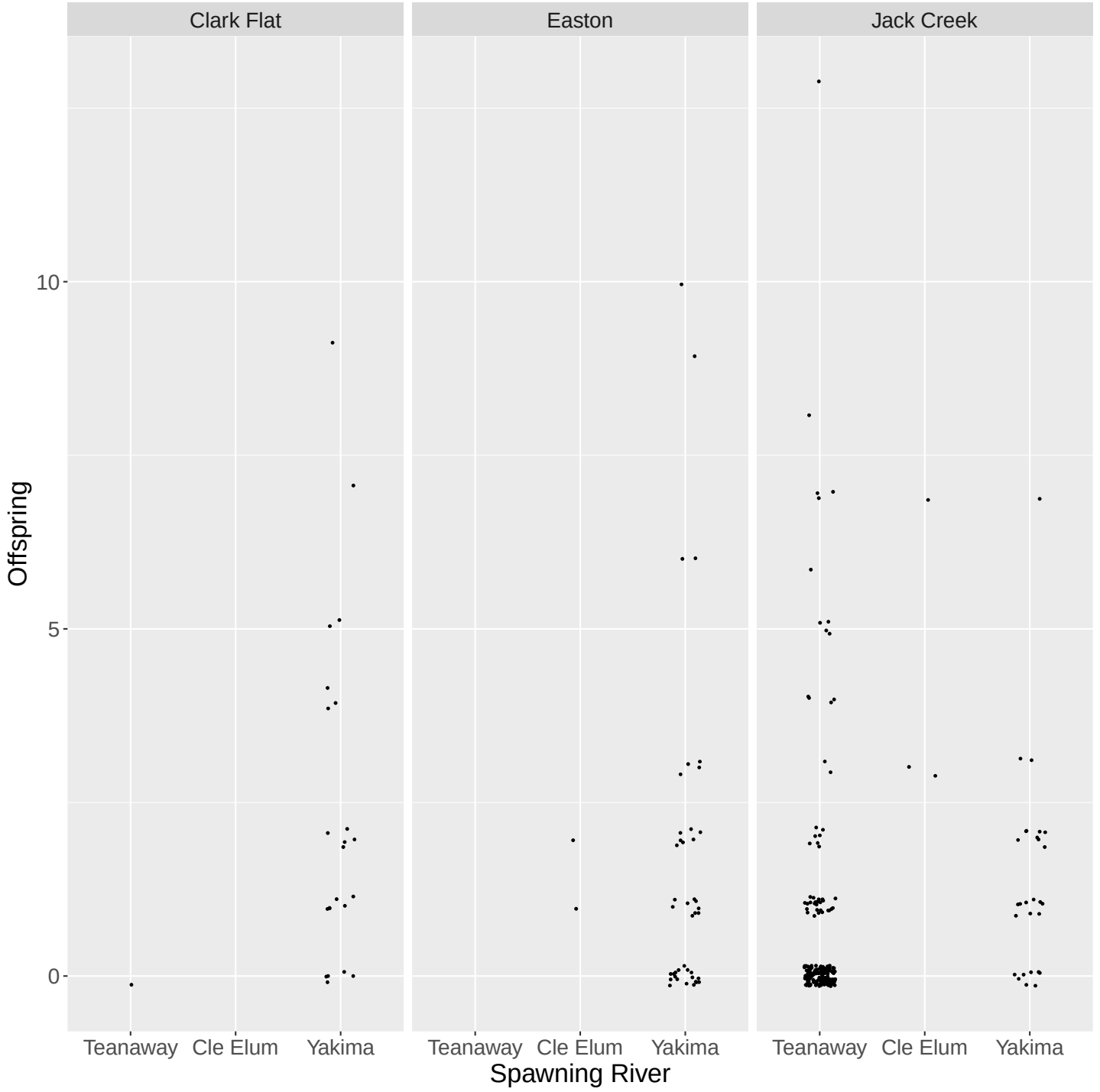


Figure 3, Dittman et al., 2010



Did Teanaway spawners affect the RS of hatchery-origin fish?

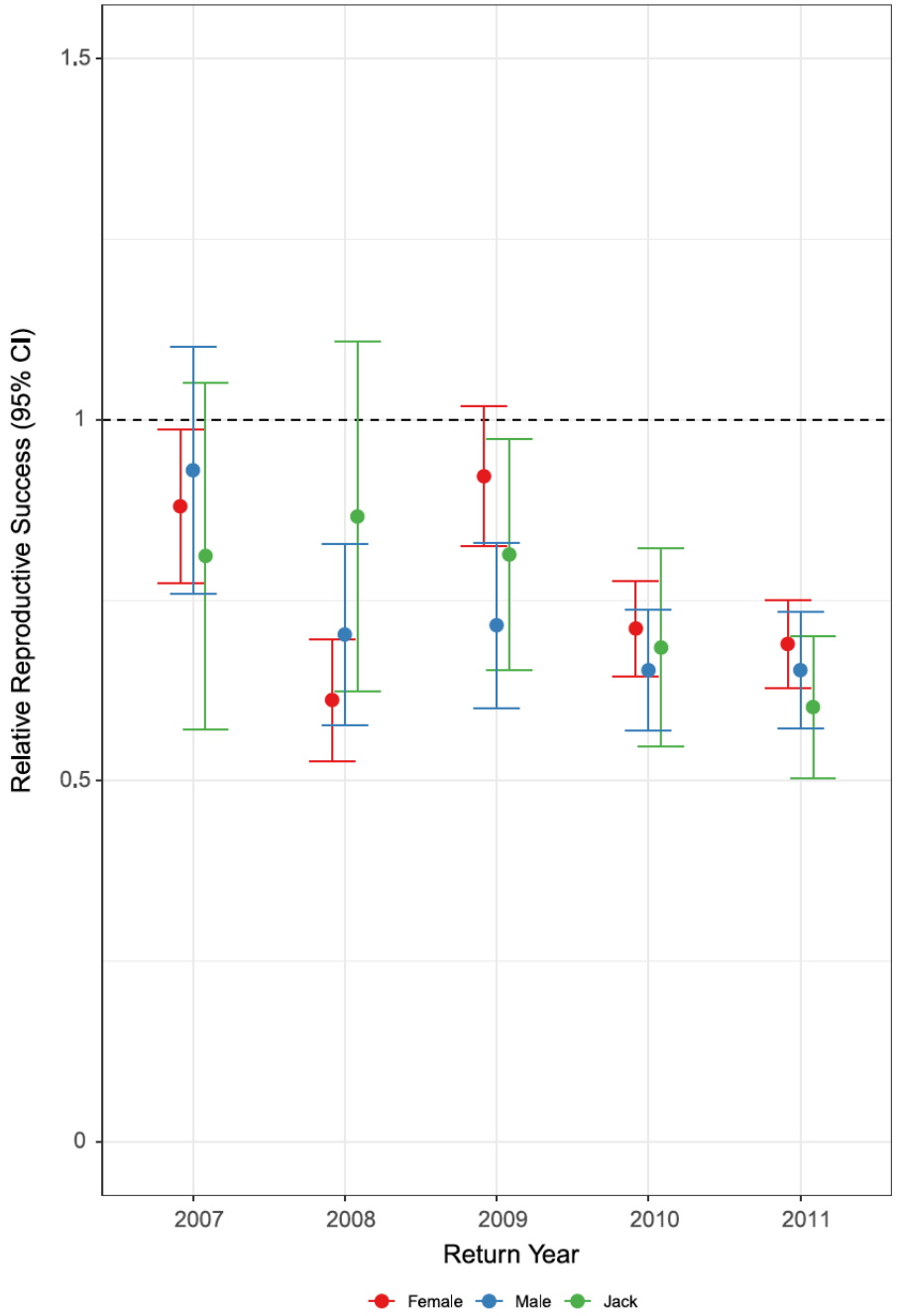
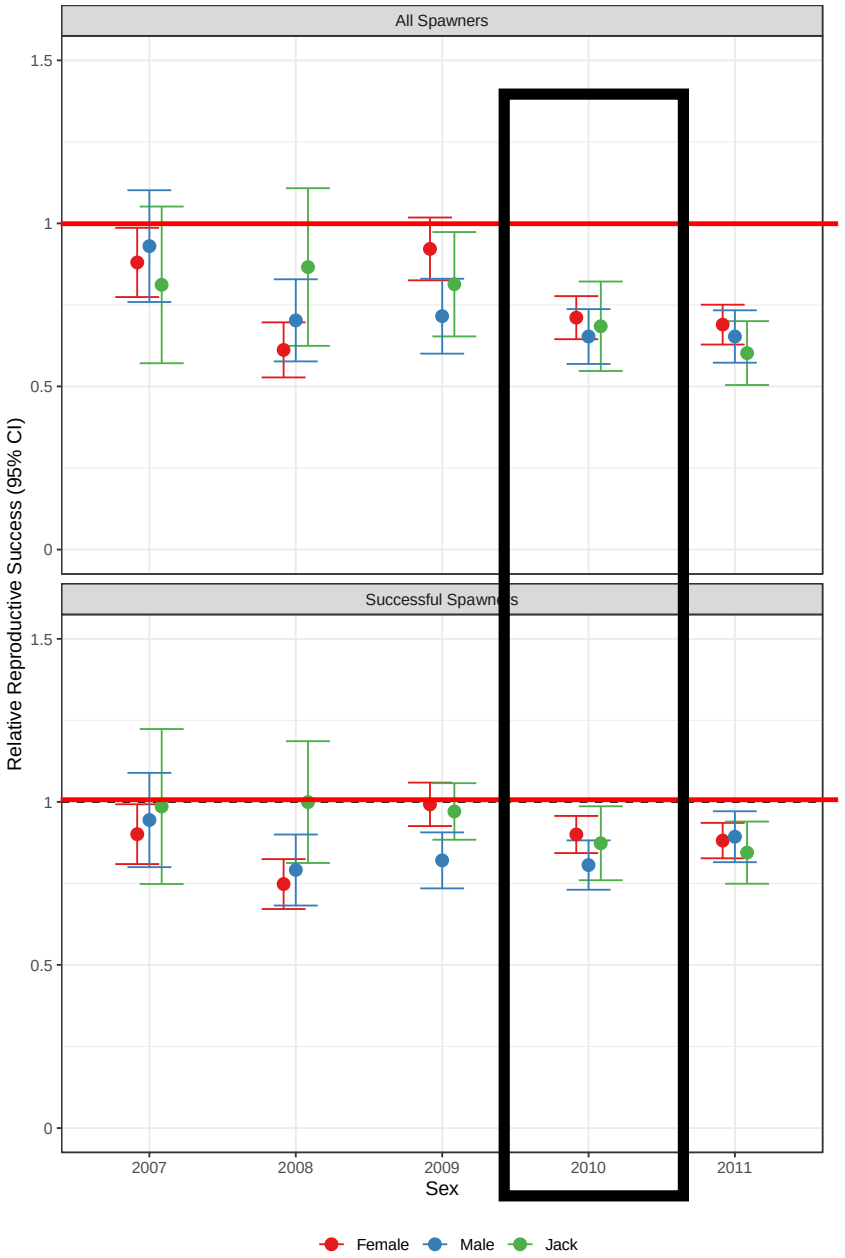


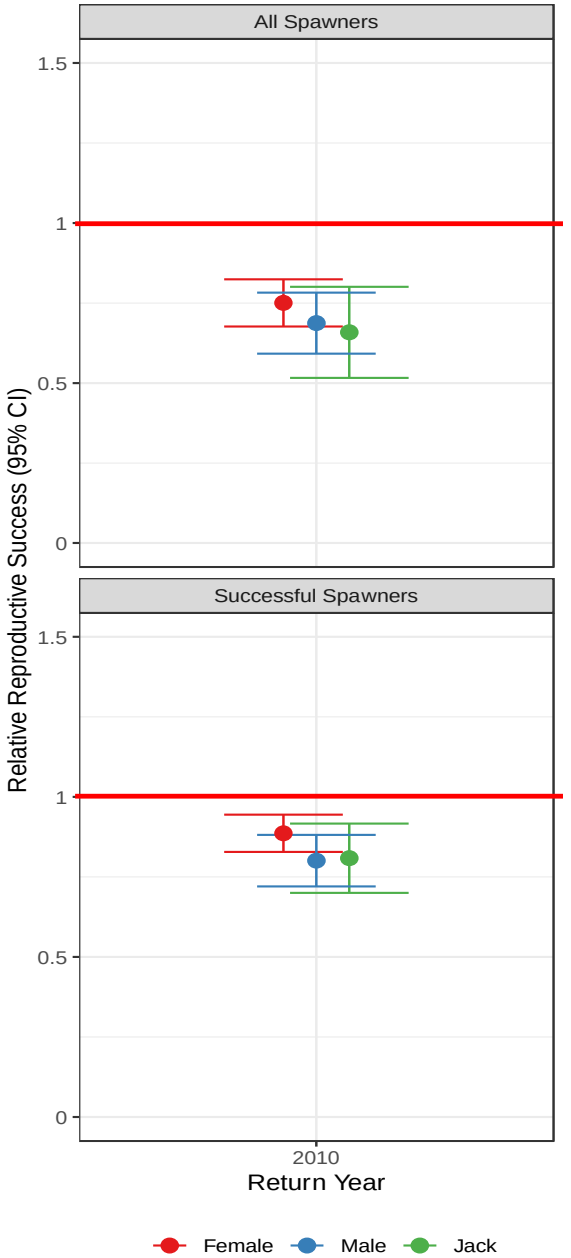
Figure 3, Koch et al., 2022

2022 Publication



$$RRS = \frac{HOR\ RS}{NOR\ RS}$$

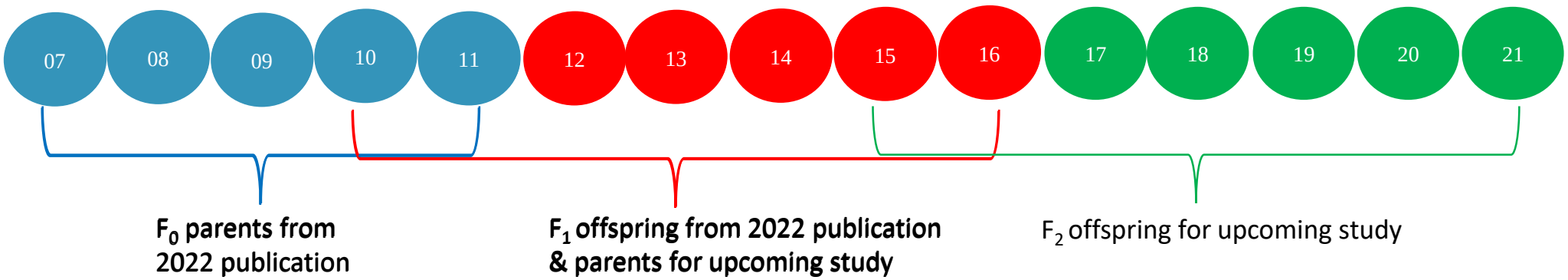
After removing Jack Creek Fish



Conclusions

- Fish spawning in the Teanaway demonstrate lower reproductive success.
  - However, sample sizes were small and unbalanced.
- Removal of Jack Creek fish in SY2010 did not affect RRS inference.
- Additional mechanisms and/or interactions may be important
  - Spawn site x spawn year
  - Length
  - Return day
- Patterns post restoration?

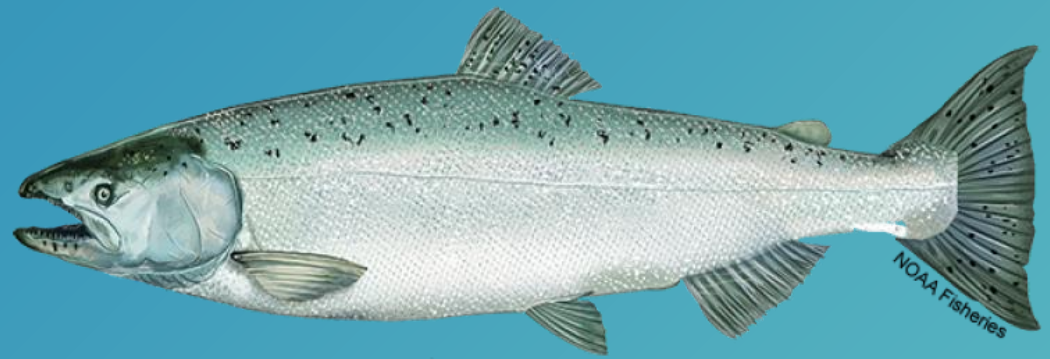
Roza Pedigree Study Updates



- **Primary questions for upcoming study:**
  - Results suggest that RS decreases in the first generation (F_0) for NOR fish when mating with HOR fish in nature.
    - *When their offspring return to spawn (F_1), do they continue to show decreases in RS (F_2)?*
    - *How many grandoffspring will 2007-2011 HOR fish produce compared to NOR fish?*
  - Results also showed that supplementation increased overall abundance of fish spawning naturally on the spawning grounds.
    - *Does the demographic boost from supplementation, even after accounting for the lower RS of HOR fish, continue to show increases in natural production as supplementation proceeds across multiple generations?*

Roza Pedigree Study Updates

- New approach using both SNPPIT and CKMRsim
- Reran *ALL* of the Yakima data so that we could compare concordance between our published results and this current analysis (N~52k assignments)
  - Preliminary results showed over 95% concordance (99% when comparing whether at least one parent matched across both analyses).
- For now, assignments have only been trimmed based on analysis parameters, such as LOD, mismatches, and FDR.
- Plan to produce RRS estimates using statistical models (negative binomial hurdle model; Nuetzel et al., 2022)



Questions?

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River Gauge Info

Name	Lat	Long	WA DOE Station	BOR Station	Source	Water Temp Years
Yakima River near Horlick Siphon	47.124	-120.74	39A073	YRWW	BOR & WA DOE	9/19/11 - 4/1/16
Yakima River near Easton	47.2401	-121.18	39A095	EASW	BOR & WA DOE	4/1/07 - 4/1/16
Teanaway at Forks near Cle Elum	47.2456	-120.86	*NA*	TNAW	BOR	*NA*
Teanaway at Red Bridge Road	47.2007	-120.78	39D110	*NA*	WA DOE	7/14/14 - 10/5/14, 2/25/15 - 12/31/15, 2016, 1/1/17 - 10/1/17
Cle Elum Reservoir, River & Weather Station	47.2456	-121.07	*NA*	CLE	BOR	4/1/07 - 4/1/16

VIE Tagging Scheme

Year	Jack Creek	Easton	Clark Flat
2002	Green	Orange	Red
2003	Orange	Green	Red
2004	Green	Orange	Red
2005	Orange	Green	Red
2006	Orange	Green	Red
2007	Orange	Green	Red
2008	Green	Orange	Red
2009	Orange	Green	Red
2010	Orange	Green	Red
2011	Orange	Green	Red
2012	Orange	Green	Red
2013	Orange	Green	Red
2014	Orange	Green	Red
2015	Orange	Green	Red
2016	Orange	Green	Red