



The Progression of Naturalization: Using Parentage-Based Tagging to monitor the reintroduction of spring Chinook salmon to Lookingglass Creek, OR

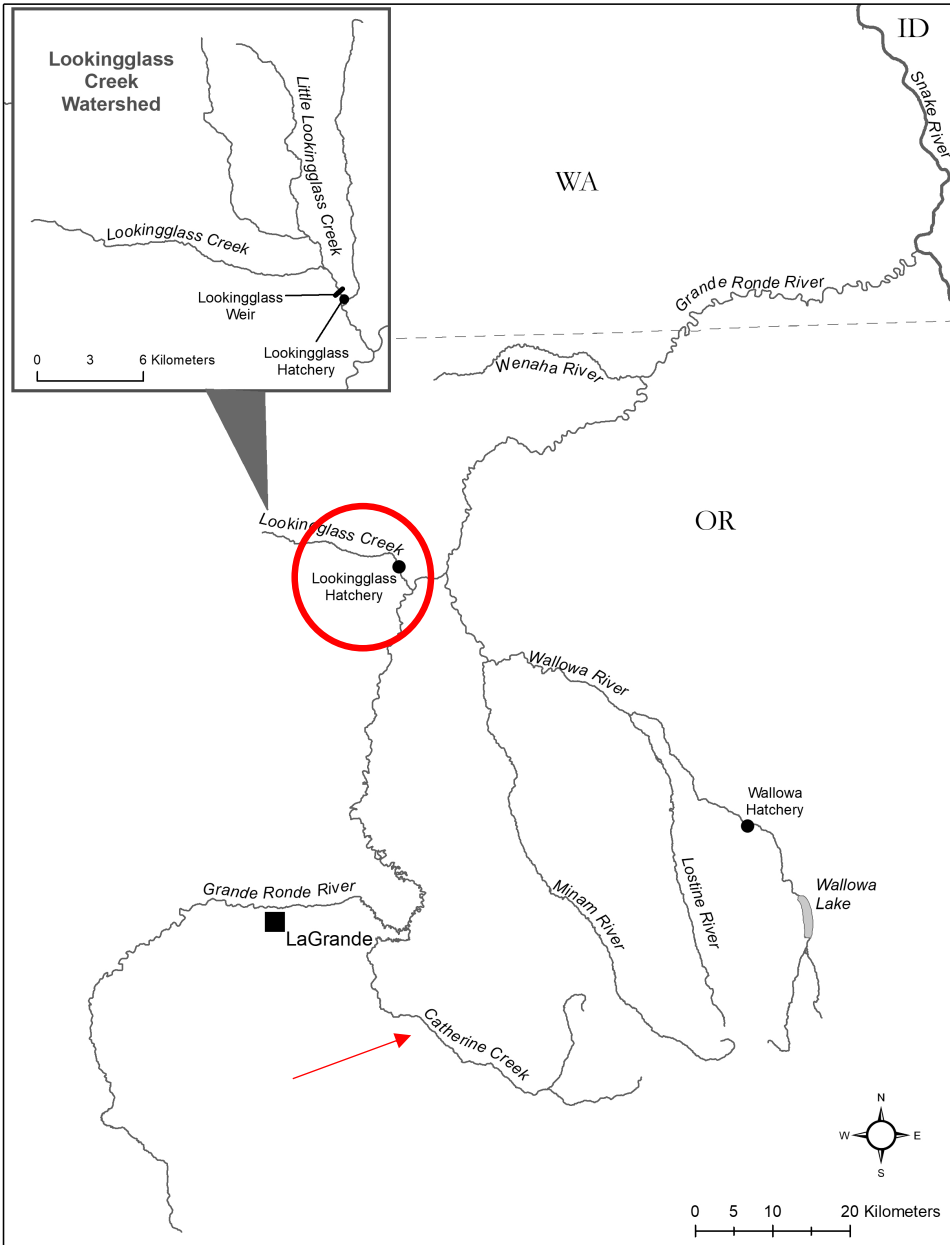
H.M. Nuetzel¹, P. Galbreath¹, B. Staton¹, C.A. Crump², L. Naylor², G.E. Shippentower²

¹Columbia River Inter-Tribal Fish Commission

²Confederated Tribes of the Umatilla Indian Reservation

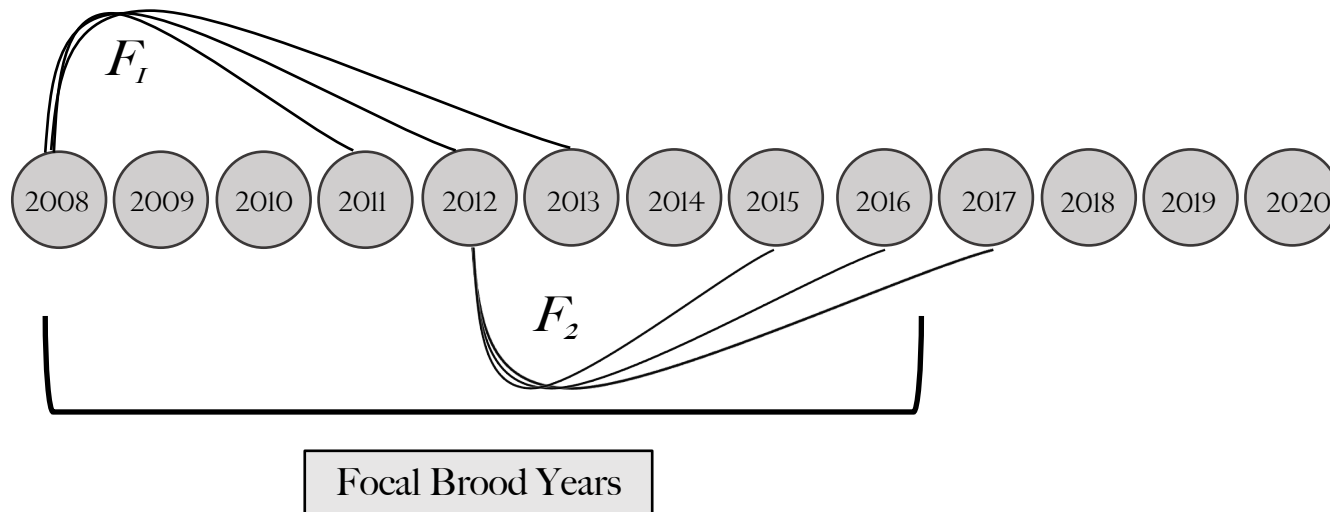
HISTORY

- 1956] Construction of Lower Snake River Dams
- 1975] Lower Snake River Compensation Plan
- 1976]
- 1982 Lookingglass Hatchery
- 1992 ESA – Snake River spring/summer Chinook salmon
- 2000 Local broodstock management
- 2001 First Catherine Creek captive brood released
- 2004 First local, adult return
- 2008 First natural origin adults return since BY2000
- 2022 Relative Reproductive Success (RRS) study



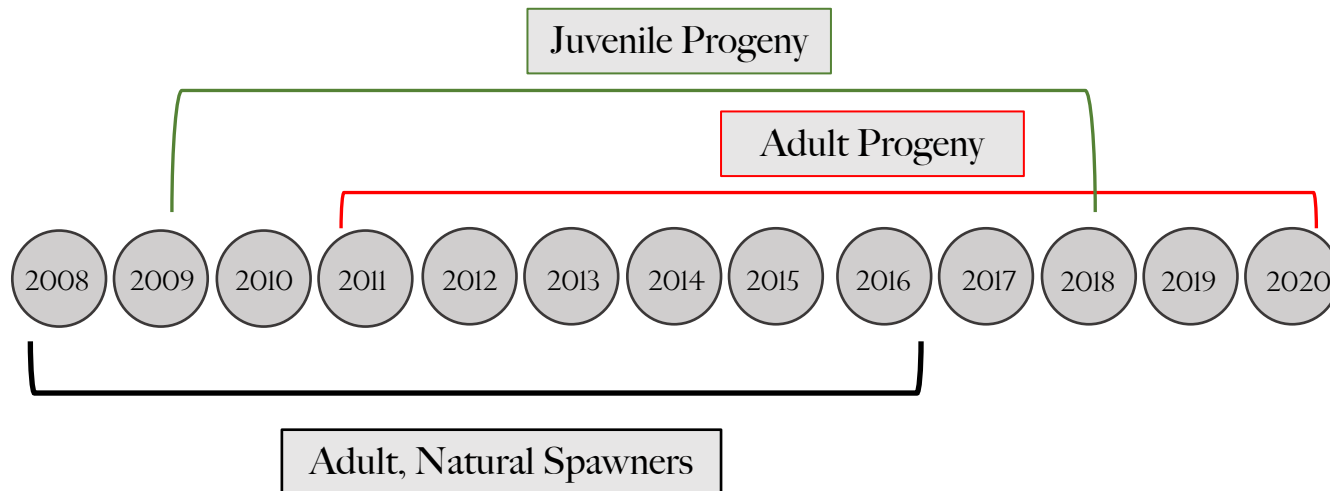
STUDY DESIGN

Question: Do natural-origin (NOR) spring Chinook salmon experience greater reproductive success than their hatchery-origin counterparts when spawning naturally in Lookingglass Creek?



STUDY DESIGN

Question: Do natural-origin (NOR) spring Chinook salmon experience greater reproductive success than their hatchery-origin counterparts when spawning naturally in Lookingglass Creek?



DATA ANALYSIS

1. Generate genotype data

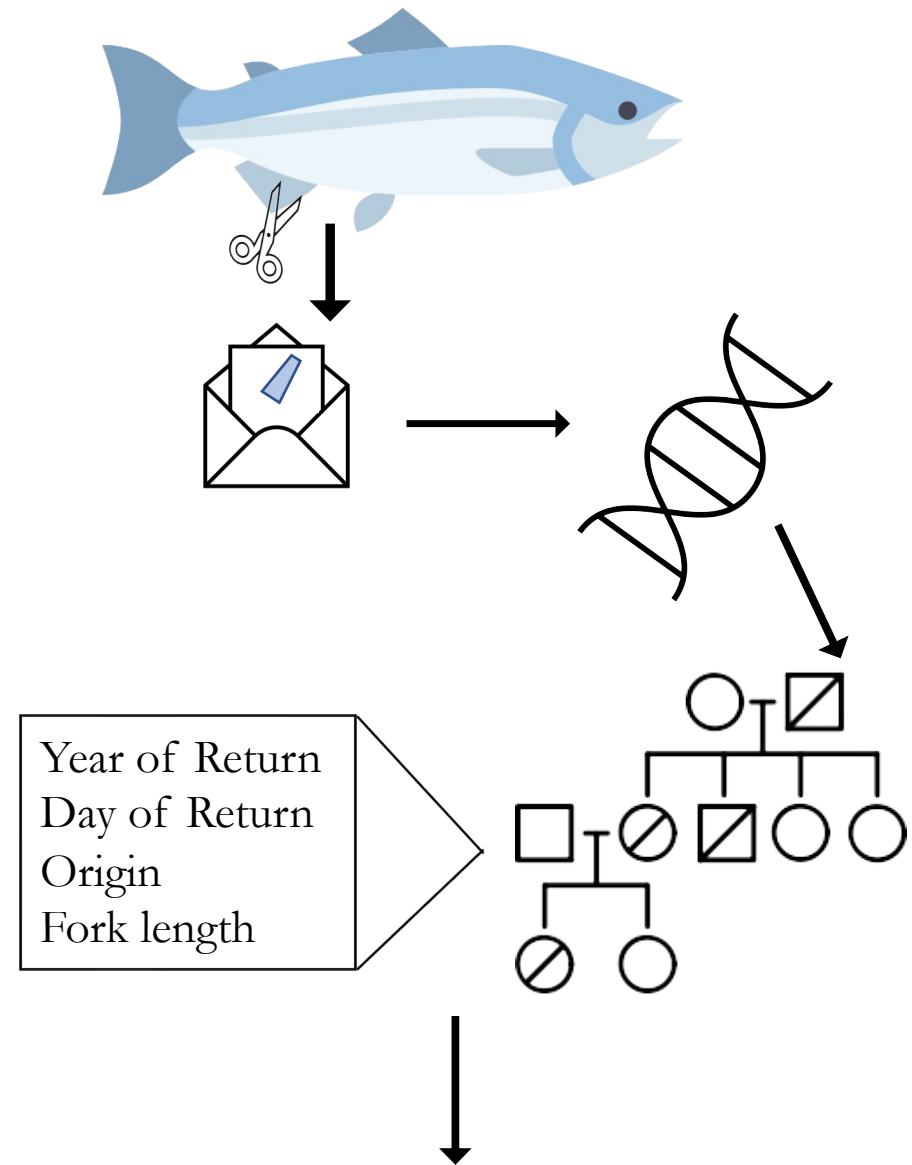
- DNA extraction by Qiagen & Chelex
- Amplification of 93 SNP markers by GTseq

2. Parentage-Based Tagging

- Reconstruct parent-offspring trios (SNPPIT & COLONY) & single parent-offspring pairs (COLONY)

3. Generalized Linear Modelling

- Use parentage assignments & phenotypic data to predict reproductive success



```
glmmTMB::glmmTMB(formula = y_var ~ origin * sex * year + day * origin + I(day^2) + length * origin,  
  ziformula = ~origin * sex * year,  
  dispformula = ~1,  
  family = glmmTMB::truncated_nbinom2)
```

DEFINITIONS

Reproductive Success (RS): The number of progeny attributed to any one individual; a corollary for fitness. A successful spawner is one that is attributed >0 progeny

Relative Reproductive Success (RRS): A comparison of reproductive success (RS) conditioned upon a demographic/phenotypic characteristic (i.e., origin, age).

Hatchery-origin (HOR): An individual hatched in a hatchery

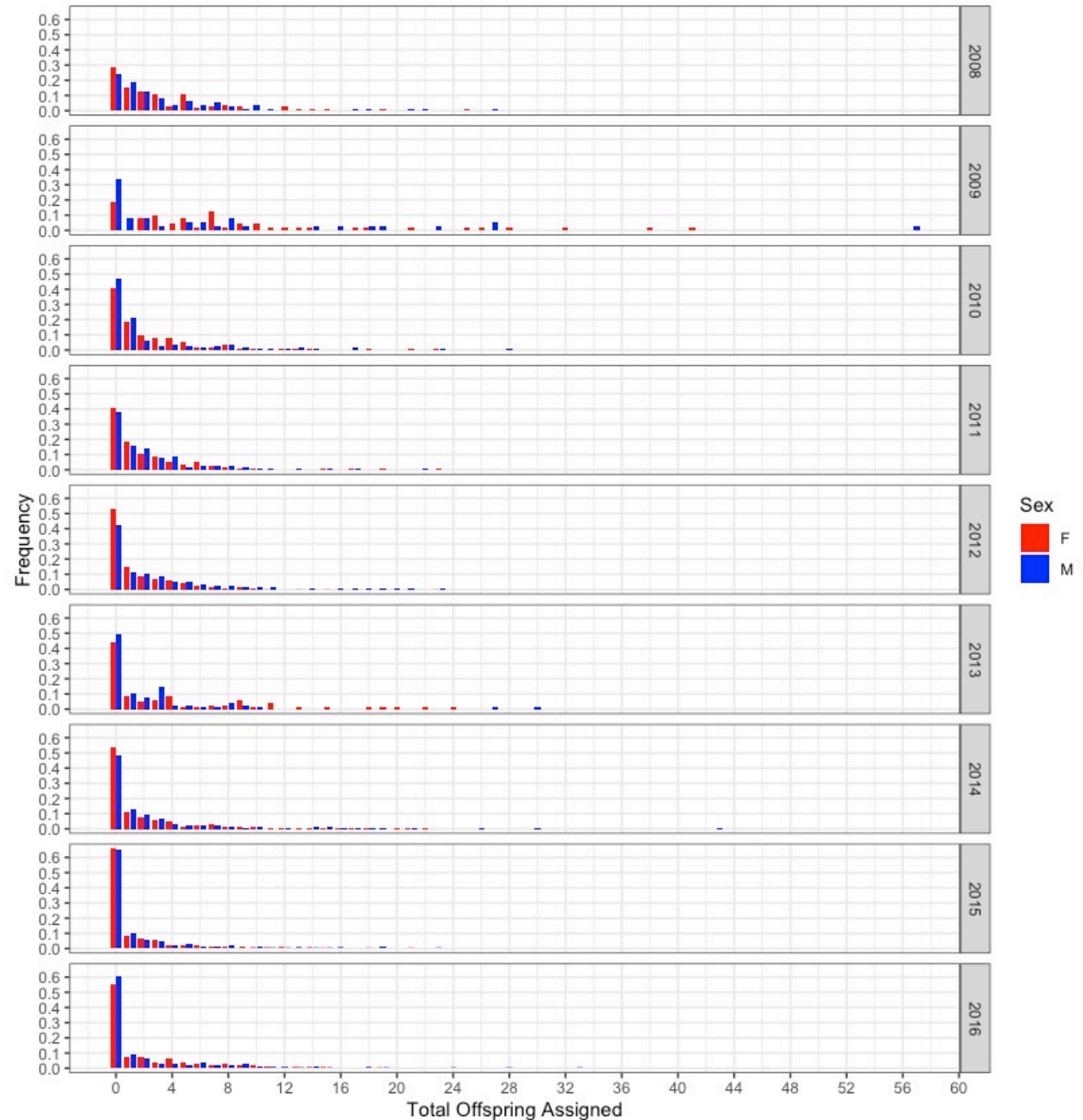
Natural-origin (NOR): An individual hatched in nature

- Parentage-Based Tagging

- 65.6% adult progeny (2012-2020) and 83.6% of juvenile progeny (2009-2018) assigned to ≥ 1 parent

Avg. Proportion Natural Spawners Assigned ≥ 1 offspring

	HOR	NOR
Male	54.37%	64.05%
Female	56.58%	64.21%



RESULTS

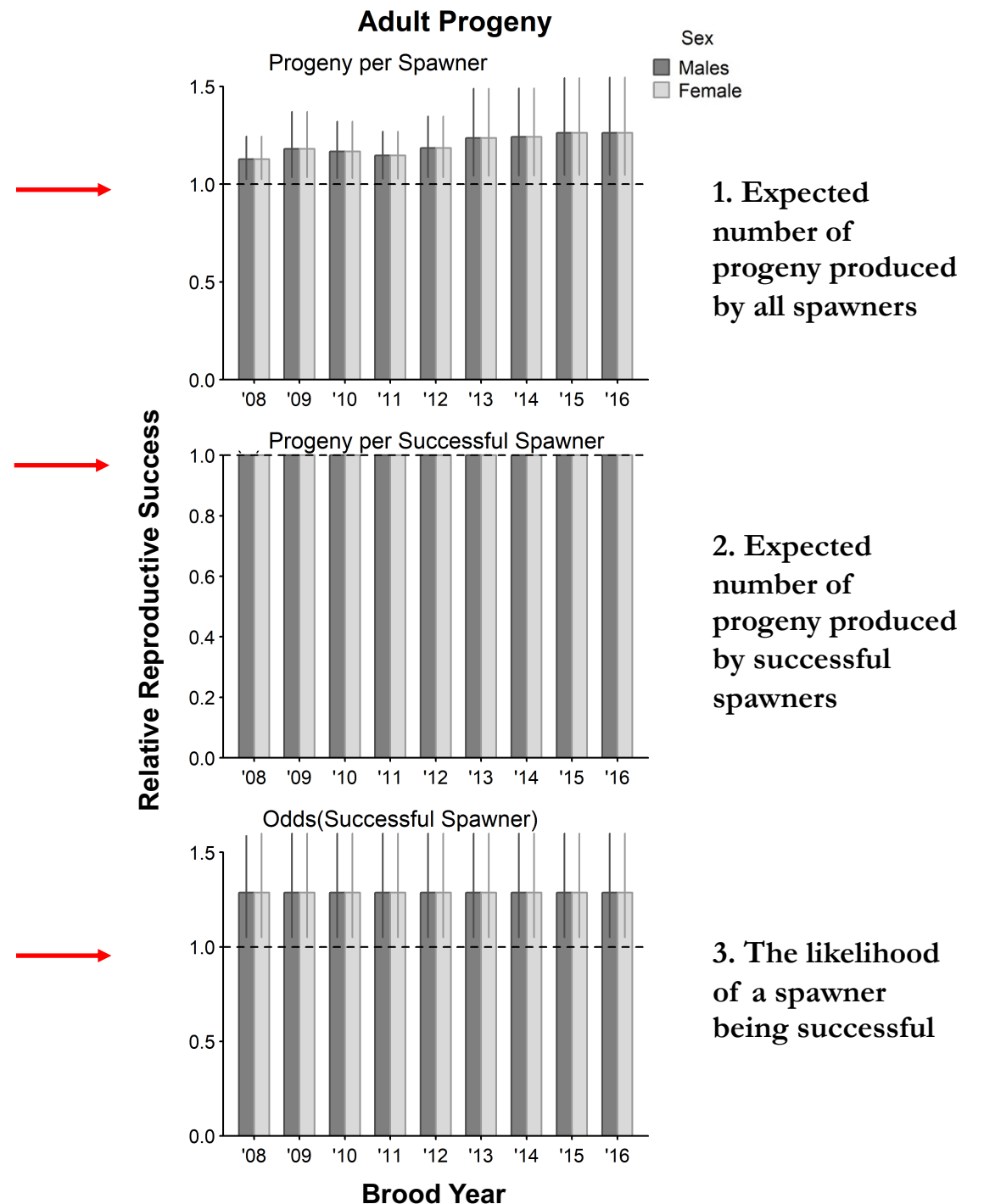
- GLM – RRS by Individual Origin

- Relative Reproductive Success (RRS) expectations by origin given **adult** progeny

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

- Top Model identified following covariates as important to predictions:

- Origin
- Sex
- Year



RESULTS

- GLM – RRS by Individual Origin

- Relative Reproductive Success (RRS) expectations by origin given **juvenile** progeny

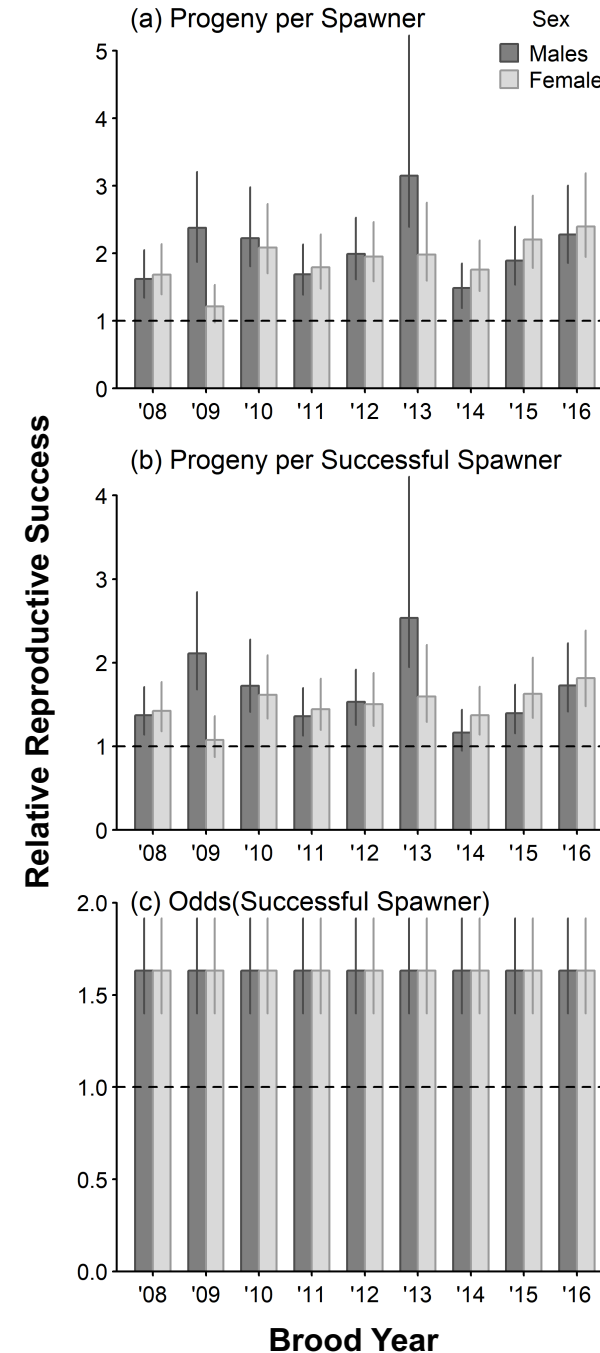
$$RRS = \frac{NOR\ RS}{HOR\ RS}$$

- Top Model identified following covariates as important to predictions:

- Day
- Length
- Origin
- Sex
- Year



Juvenile Progeny



1. Expected number of progeny produced by all spawners

2. Expected number of progeny produced by successful spawners

3. The likelihood of a spawner being successful

RESULTS

- GLM – RRS by Cross Type
 - RRS expectations by Parental Cross Type

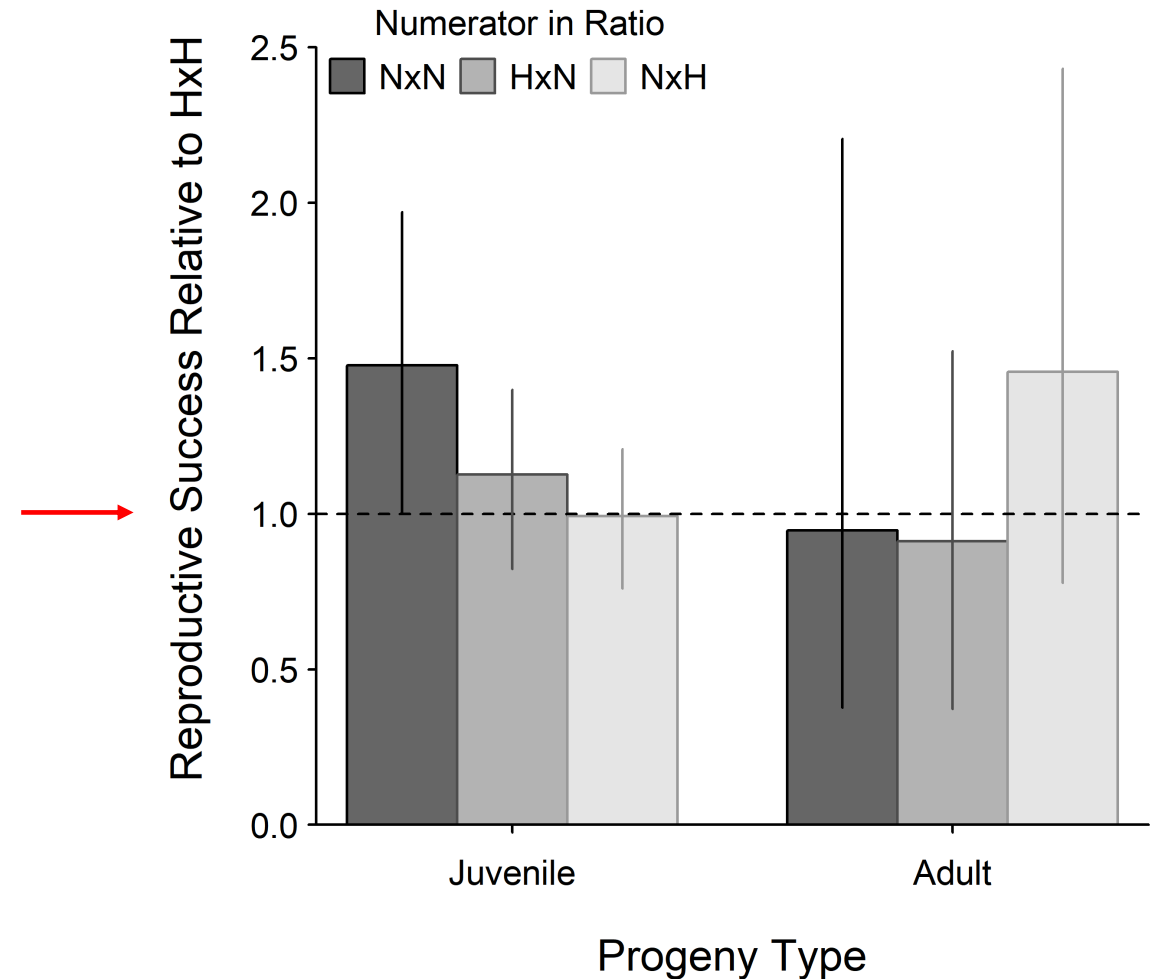
NxN = NOR male x NOR female

HxN = HOR male x NOR female

NxH = NOR male x HOR female

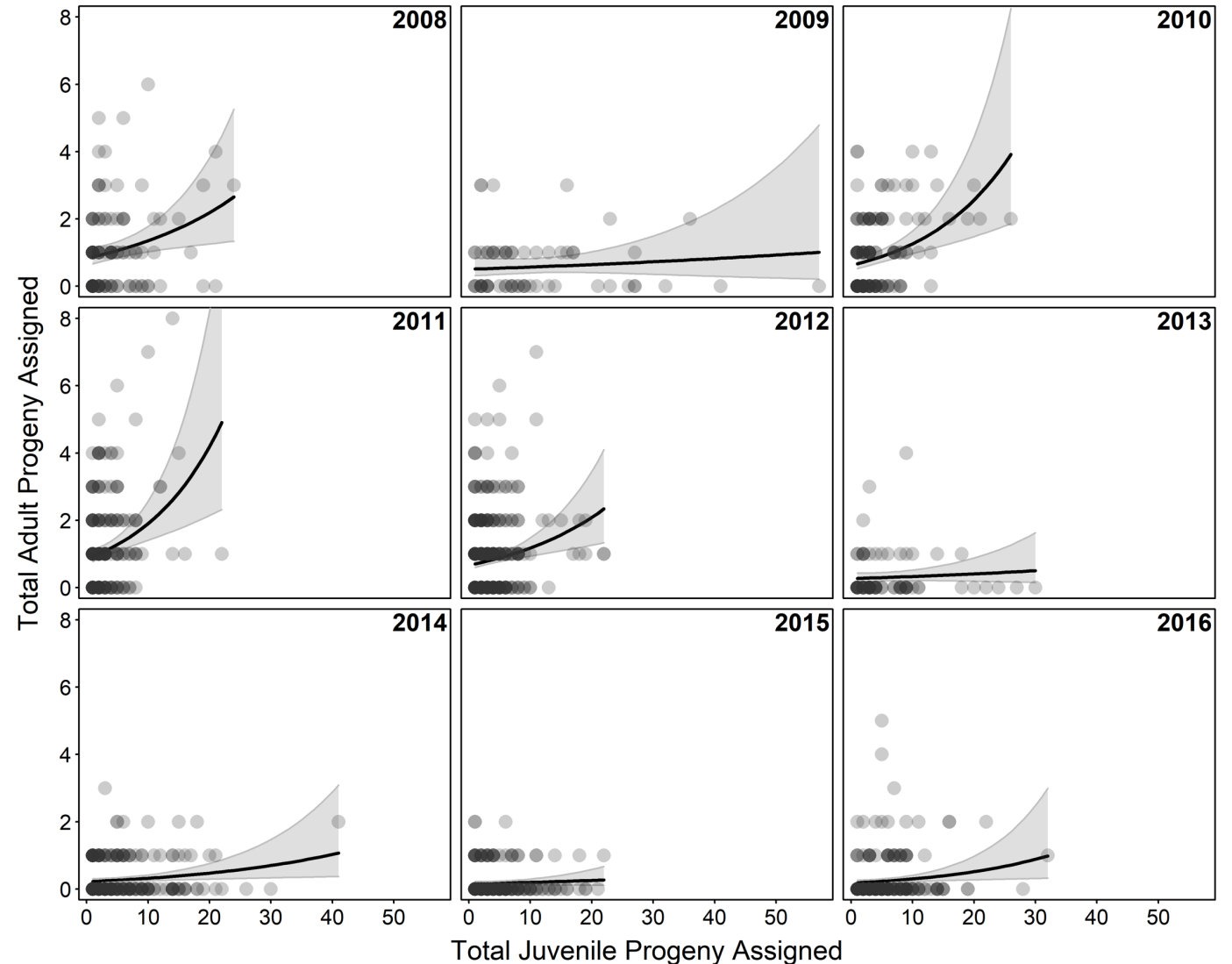
HxH = HOR male x HOR female

$$\text{RRS} = \frac{N_{xN} \text{ RS}}{H_{xH} \text{ RS}} \text{ or } \frac{H_{xN} \text{ RS}}{H_{xH} \text{ RS}} \text{ or } \frac{N_{xH} \text{ RS}}{H_{xH} \text{ RS}}$$



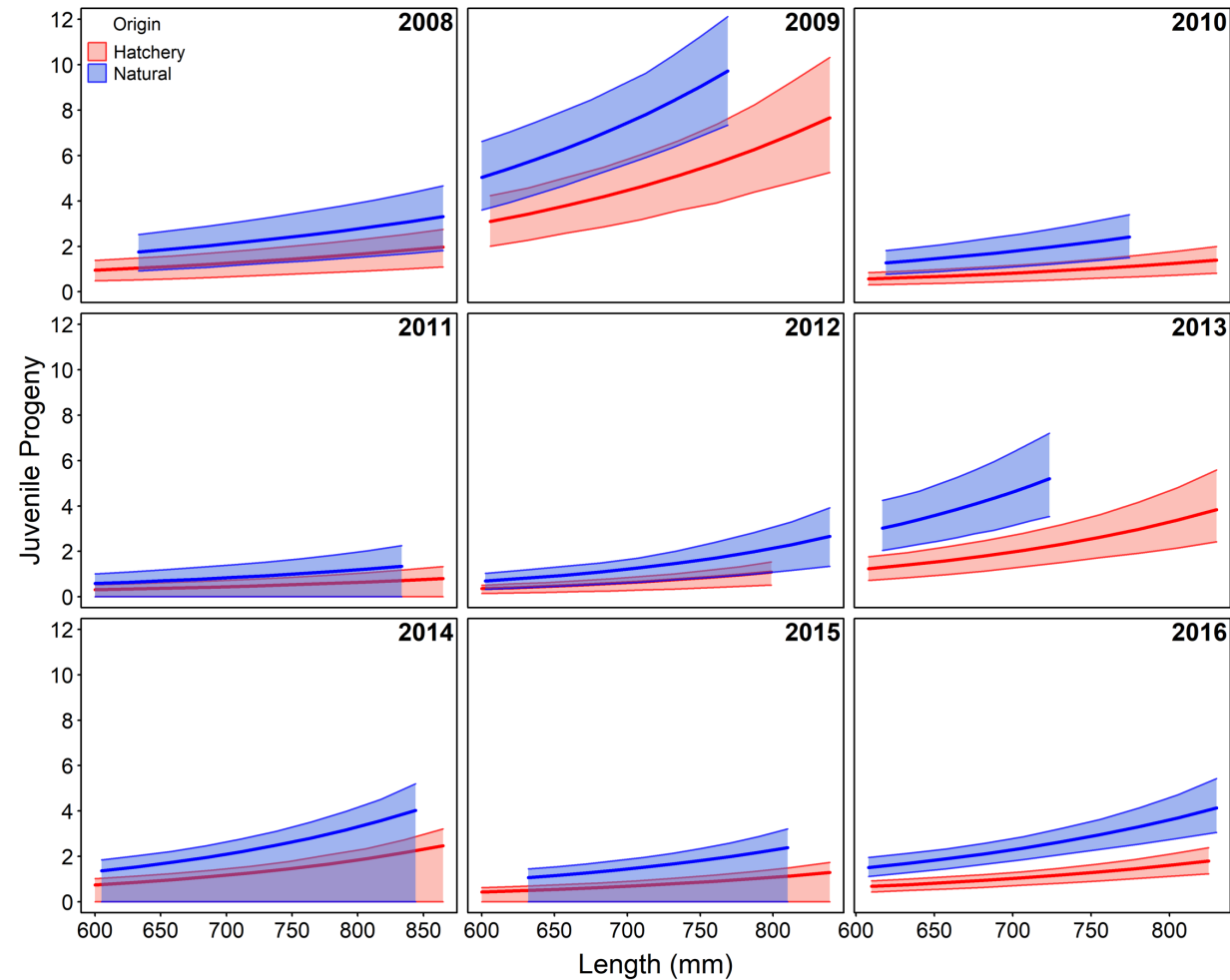
RESULTS

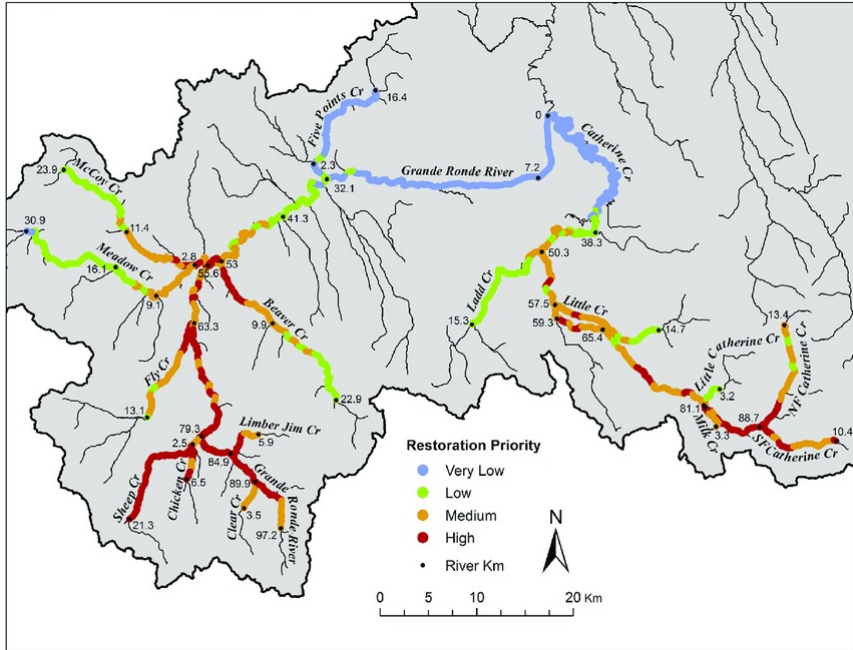
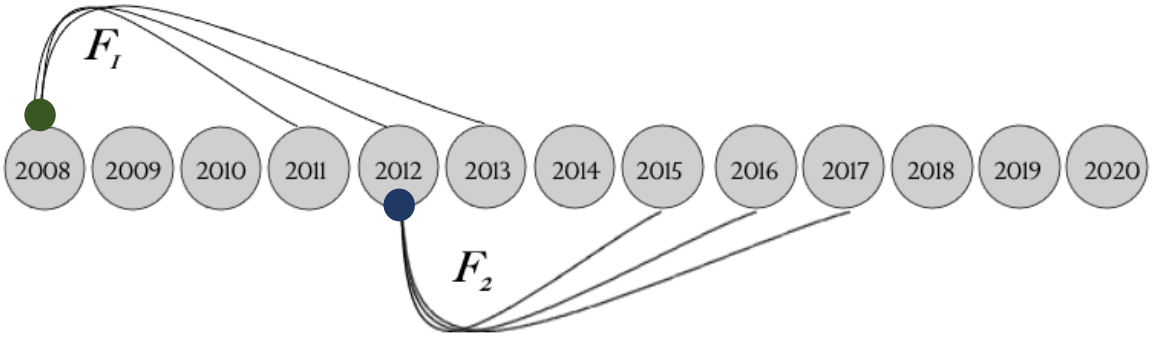
- GLM – Juvenile to Adult Progeny
 - Is RS inferred from juvenile progeny relational to RS inferred from adult progeny?
- Some relationship but significant variability



SYNTHESIS & INTERPRETATION

- Individual NOR fish demonstrate higher RS than HOR
- Reproductive advantages by cross type are not as clear
- RS given juvenile progeny is not necessarily predictive of adult progeny produced
- RRS comparisons by adult v. juvenile progeny may provide unique insights





From Justice et al., 2016

ACKNOWLEDGEMENTS

The Bonneville Power Administration for providing funding under agreements reached within the Columbia Basin Fish Accords (Project 2009-009-00).

The Lower Snake River Compensation Plan for providing funding for work associated with the evaluation of the reintroduction of spring Chinook to Lookingglass Creek.

Bureau of Reclamation Internship program for supporting summer field technicians over the last five years.

Columbia River Inter-Tribal Fish Commission

Zachary Penney, Doug Hatch and Shawn Narum for administrative and scientific support. All the lab technicians at the Hagerman Fish Culture Experiment Station for generating genetic data.

Confederated Tribes of the Umatilla Indian Reservation

Mike McClean (Project Biologist) for his assistance reviewing and interpreting years of metadata logs. All the field technicians that have collected innumerable tissue samples throughout the years.

Oregon Department of Fish & Wildlife

Diane Deal (Lookingglass Hatchery Manager), Andrew Gibbs (East Region Hatchery Coordinator) & Joseph Feldhaus (RME Project Lead)

Contact: hnuetzel@critfc.org

