Genetic Evaluation of Fall Chinook Salmon Carcasses from the White Salmon River, 2013-2021

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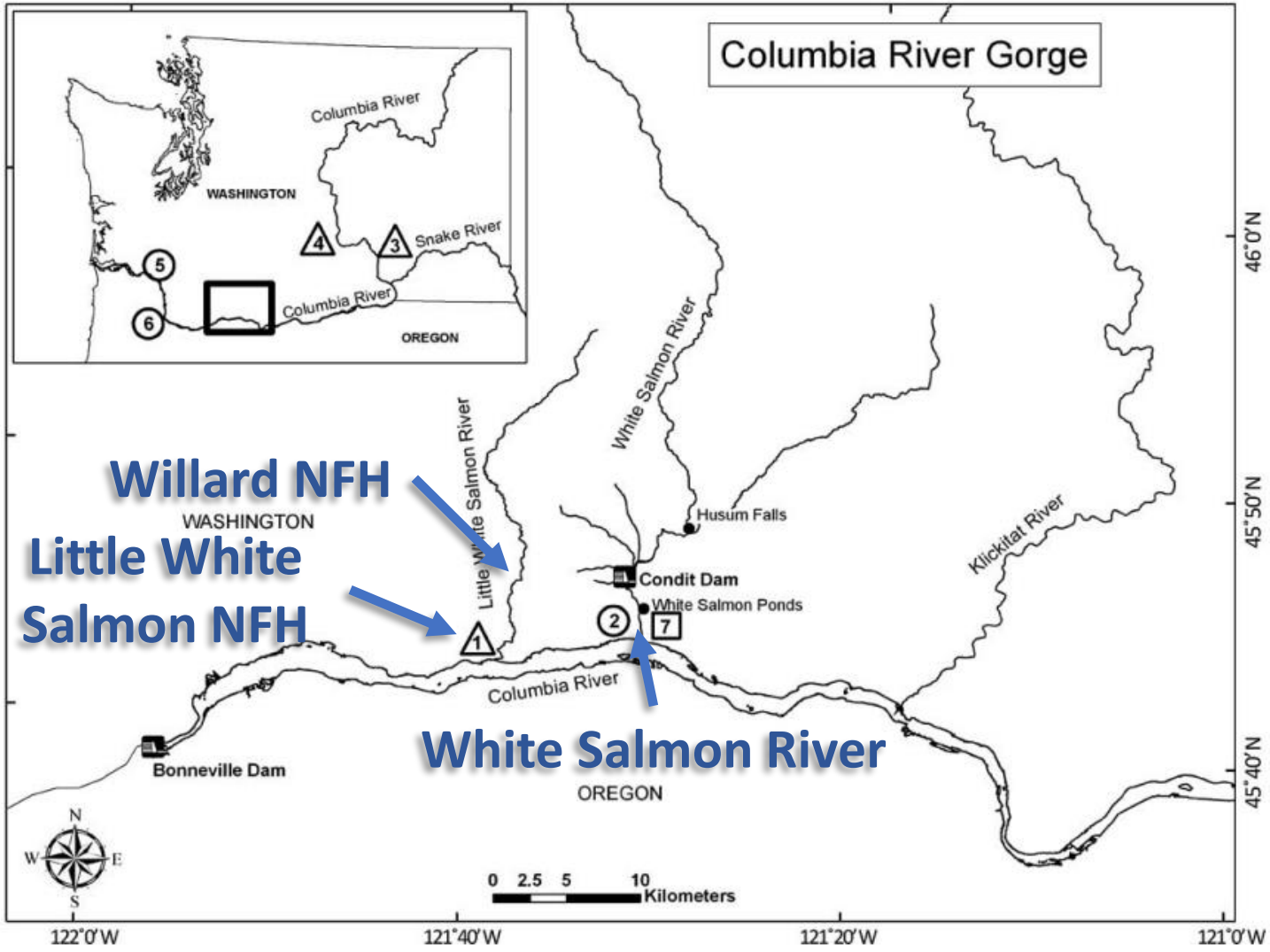
Background

- ESA-listed tule fall Chinook salmon population in the White Salmon River
- Upriver bright (URB) Chinook salmon straying into White Salmon River
- Spawn timing
  - Tule = Sept-Oct
  - URB = late Oct-Nov



Background

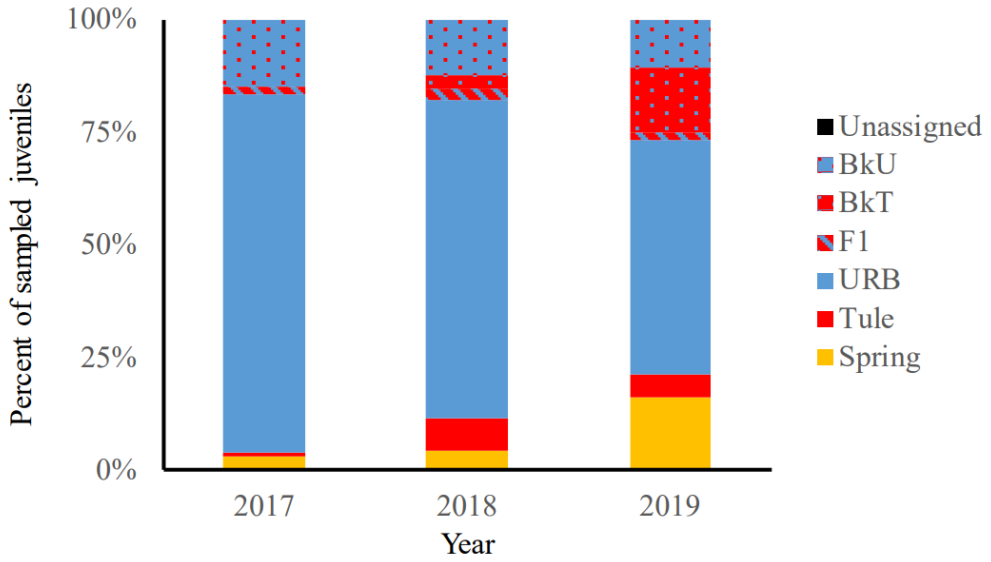
- URB production began at Little White Salmon National Fish Hatchery (LWS NFH) in 1982
  - Production goals increased in 2009
- 4.4 million URB juveniles released annually 2012 to 2021 from LWS and Willard (WI) NFHs
- Past genetic studies have quantified hybridization with ESA-listed tule population

Background: Previous Studies

- Mostly focused on outmigrating juveniles

- **Smith & Engle 2011**
  - 4.3%-15% = Tule *x* URB hybrids in 2006-2008

- **Smith *et al*. 2021**
  - 17%-32% fall run juveniles = hybrids in 2017-2019
  - 8.4% of broodstock at LWS NFH = hybrids in 2015-2018



Study Goals

- Evaluate the potential impact of hybrids used as broodstock at LWS and WI NFHs on the incidence of hatchery-origin strays.
- Estimate the proportion of hybrids among spawners for the URB and native tule fall Chinook populations in the White Salmon River.
- Use parentage-based tagging to determine the percent of carcasses that are misclassified as wild-origin spawners due to the non-detection of hatchery markings.
- Quantify proportion of misidentified fish used as broodstock at LWS and Spring Creek (SC) NFHs.

Sampling: Carcasses

- 967 individuals
  - Surveys by WDFW
- GTseq Panel
  - 340 loci after filtering
- Sample size variable by year
  - URB not targeted 2014-2017

Year	Tule	URB
2013	140	141
2014	190	1
2015	127	-
2016	23	-
2017	40	-
2018	13	70
2019	24	52
2020	24	31
2021	41	50
Total	**622**	**345**

Sampling: Broodstock

Little White Salmon NFH

Year	N
2015	8,048
2016	7,313
2017	5,364
2018	1,730
2019	6,209
2020	4,310
2021	8,262

Spring Creek NFH

Year	N
2015	5,553
2016	4,651
2017	4,063
2018	6,252
2019	4,927
2020	5,450
2021	6,048

Genotyped by CRITFC - 257 GTseq loci

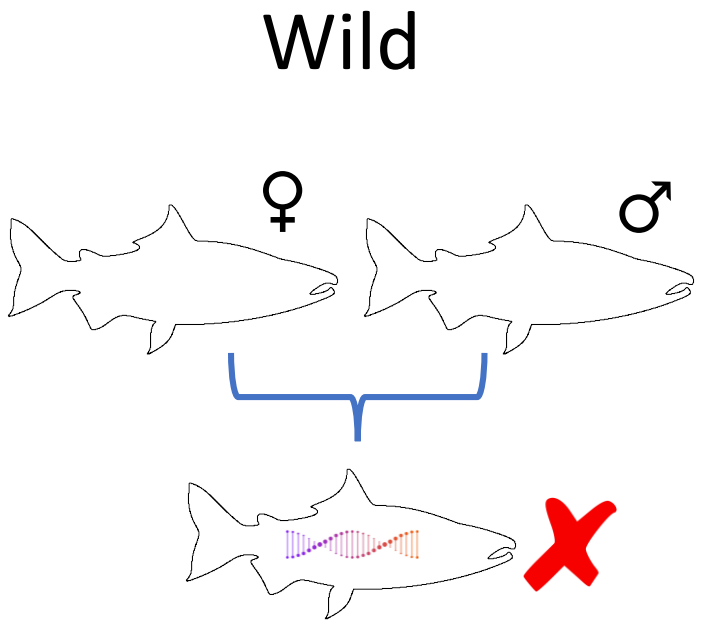
Genetic Methods

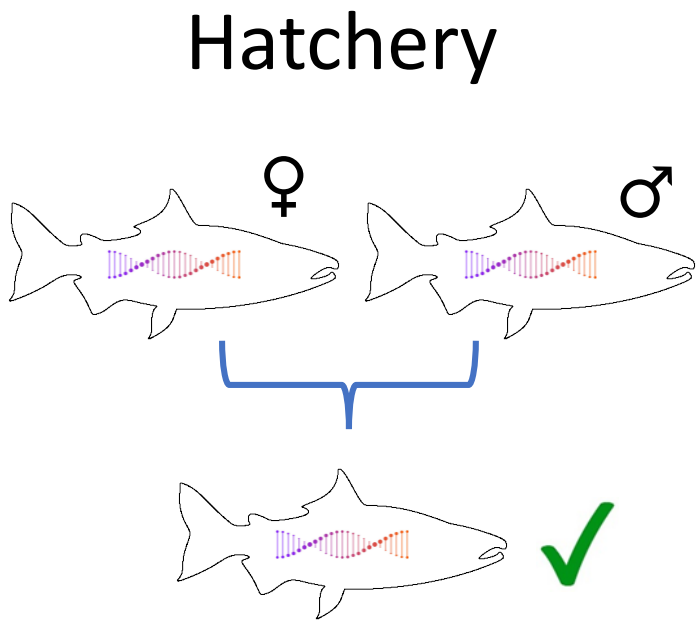
- Identify hybrids in **NewHybrids** (carcasses) or **Snapclust** (broodstock)
  - All sample years
  - Hybrid classes:
    - F1
    - F2
    - Tule backcross
    - URB backcross

- Parental assignment for carcasses using **SNPPIT**
  - Sample years 2018 to 2021
  - Identify hatchery-origin spawners

Parentage-based Tagging

- Genotype all hatchery broodstock
- Genotype returning fish (carcasses)
- Compare genotypes to identify hatchery-origin individuals



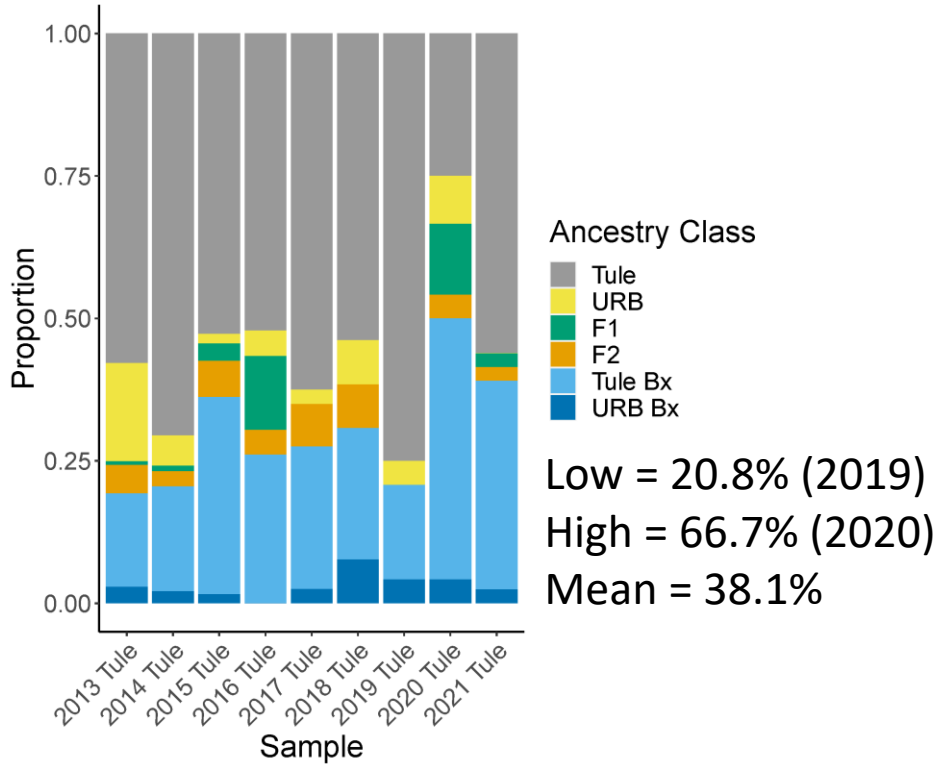


Results: Hybrid Proportion by Year (Carcasses)

- Lowest proportion of hybrids:
  - 18.1% in 2018
- Highest proportion of hybrids:
  - 45.7% in 2015
- Overall: 31.1% per year

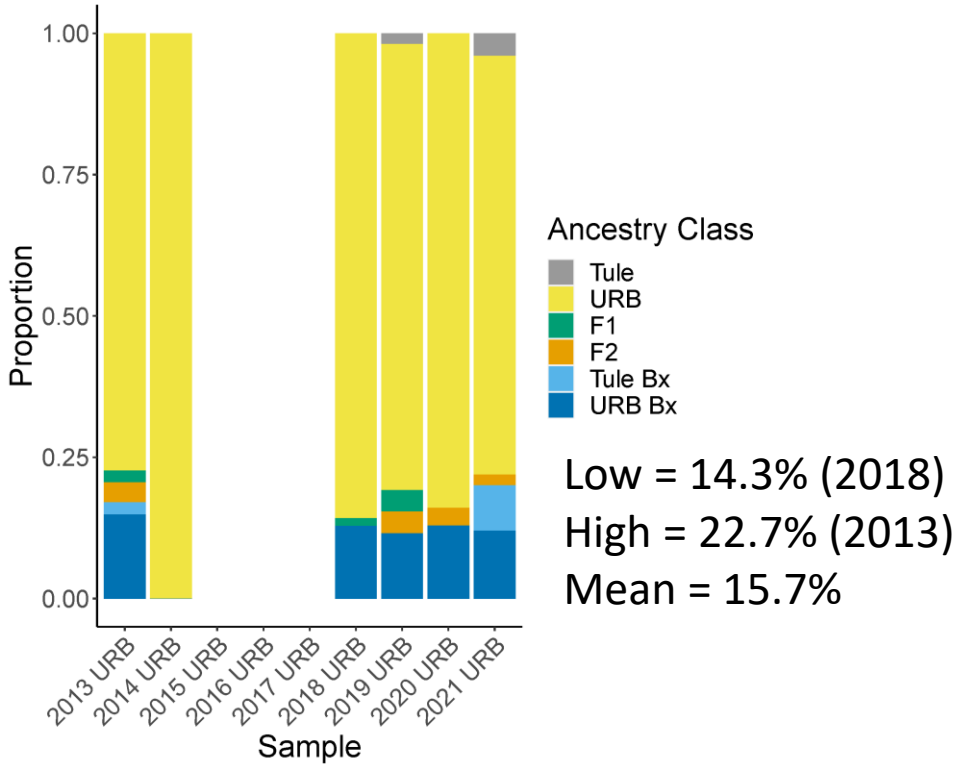
Results: Hybrid Proportion by Year (Carcasses)

Tule



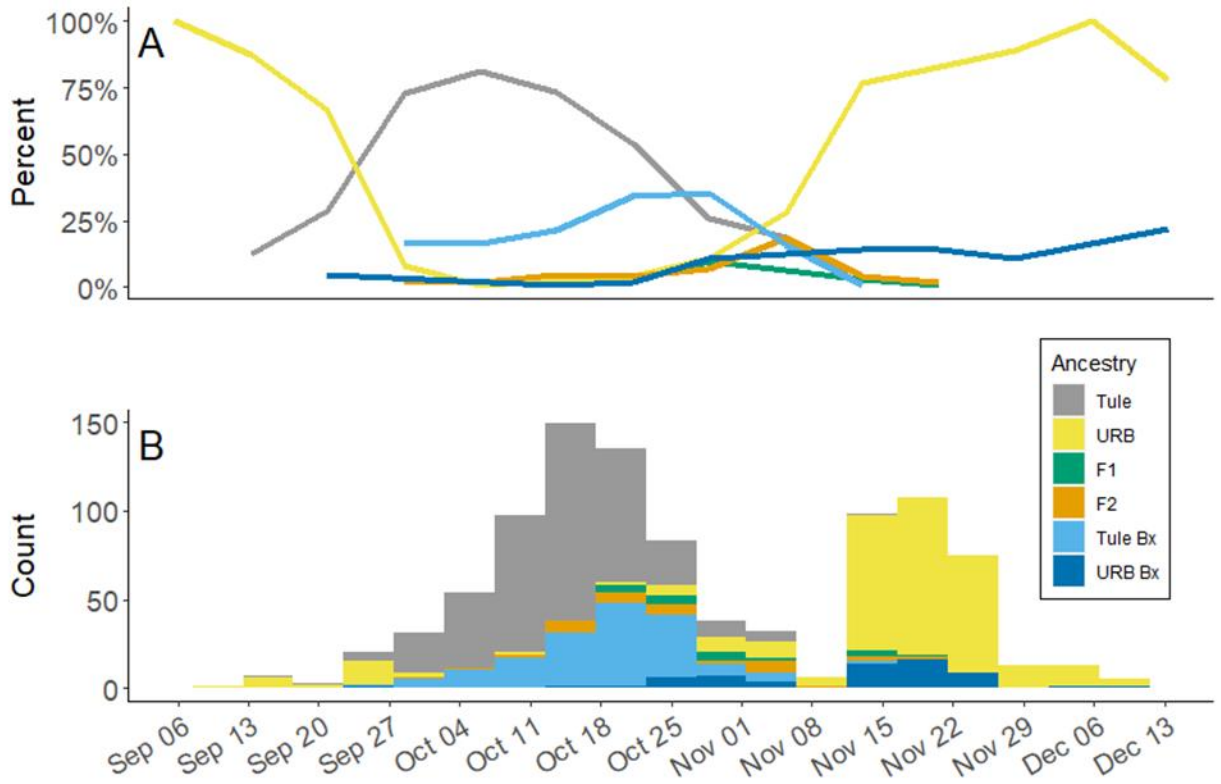
Low = 20.8% (2019)
High = 66.7% (2020)
Mean = 38.1%

Upriver Bright



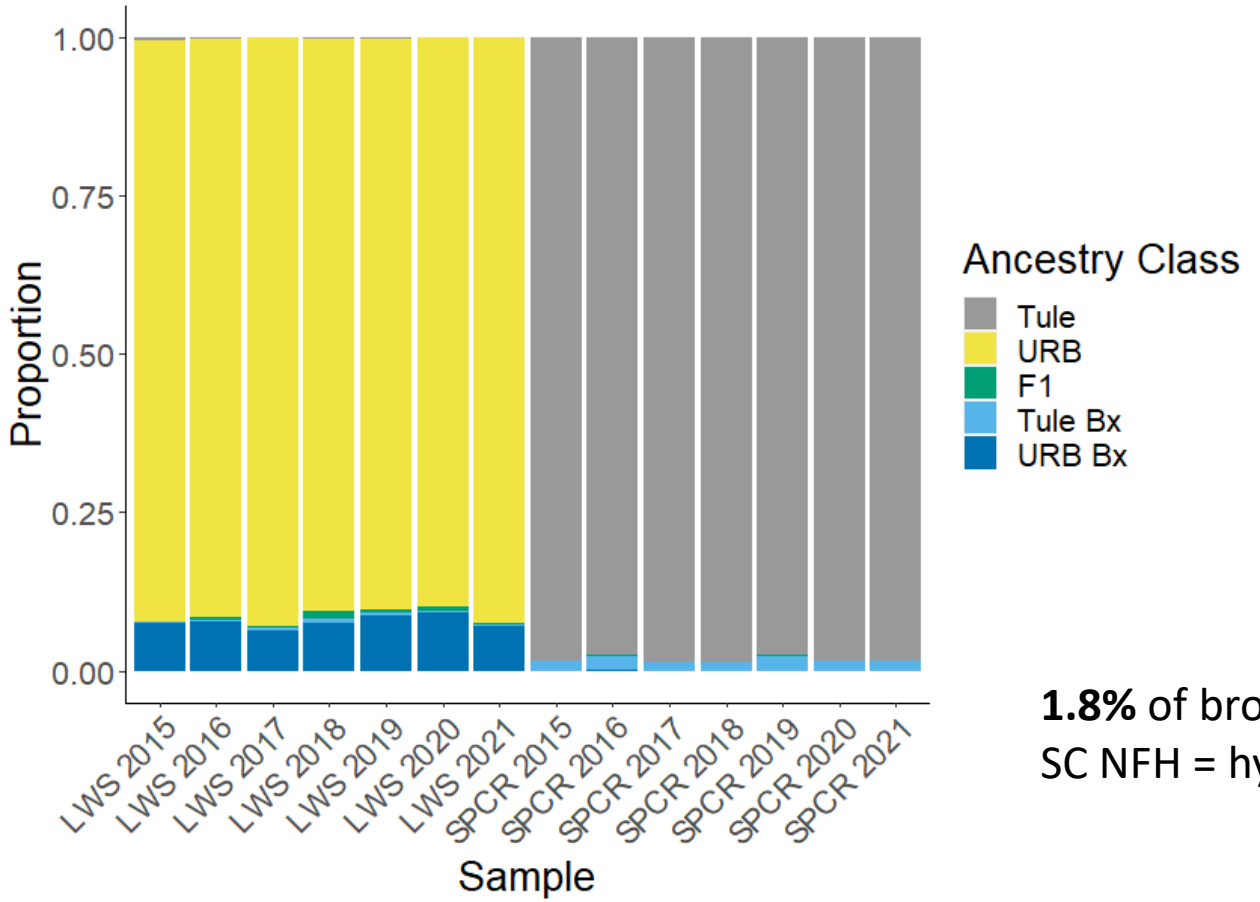
Low = 14.3% (2018)
High = 22.7% (2013)
Mean = 15.7%

Results: Ancestry Class by Collection Date



Results: Ancestry of Hatchery Broodstock

8.7% of broodstock at LWS NFH = hybrids



1.8% of broodstock at SC NFH = hybrids

Results: Hatchery Parental Assignment

- 64 total hatchery-origin fish
  - 25 marked (39.1%)
  - 39 unmarked (60.9%)
- Hatchery markings
  - Adipose clip
  - Coded wire tag (CWT)
- ‘Hatchery’ or ‘Wild’ assignment = current generation only

Genetic ID

Field ID	Hatchery Assigned	Unassigned
Hatchery Origin	20	5
Wild Origin	39	241

Results: Hatchery Parental Assignment for LWS NFH

Year	Samples	%Marked	%Unmarked	%Hatchery
2018	70	11.4%	11.4%	22.9%
2019	52	5.8%	30.8%	36.5%
2020	31	3.2%	19.4%	22.6%
2021	50	24.0%	14.0%	38.0%
Overall	203	11.8%	18.2%	30.1%

- Most hatchery strays were unmarked
  - Implications for URB spawner estimates in the White Salmon River?

Results: Ancestry of Hatchery-origin Carcasses

Field ID \ Genetic ID	Tule	URB	F1	F2	Tule Bx	URB Bx	Total
Tule	1	-	-	-	1	1	3
URB	-	56	1	-	-	4	61
Total	1	56	1	0	1	5	64

- 10.9% of all returning hatchery fish were hybrids

- Seven total F1 hybrids detected 2018-2021; just one originated from a hatchery

Results: Hatchery vs. Wild-origin Hybrids

Run	Wild Origin			Hatchery Origin		
	Samples	Hybrids	%Hybrid	Samples	Hybrids	%Hybrid
Tule	99	42	42.4%	3	2	66.7%
URB	142	31	21.8%	61	5	8.2%

- More wild-origin hybrids than hatchery-origin

- Hatchery-origin hybrids not showing elevated stray rate
  - URB Strays = 8.2% hybrids
  - URB Broodstock = 8.4% hybrids (Smith et al. 2021)

Conclusions

- Hatchery-origin hybrids are not straying to the White Salmon River at a greater rate than non-hybrids.

- More wild-origin hybrid spawners than hatchery-origin.
  - Expected to yield continued reproduction of wild-origin hybrids.

- More hatchery fish are straying to the White Salmon River than previously detected.

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The findings and conclusions in this presentation are those of the authors and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

Questions?

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