

EVALUATION OF ADULT WINTER STEELHEAD OUTPLANTING ABOVE FOSTER DAM ON THE S. SANTIAM RIVER USING GENETIC PARENTAGE ANALYSIS

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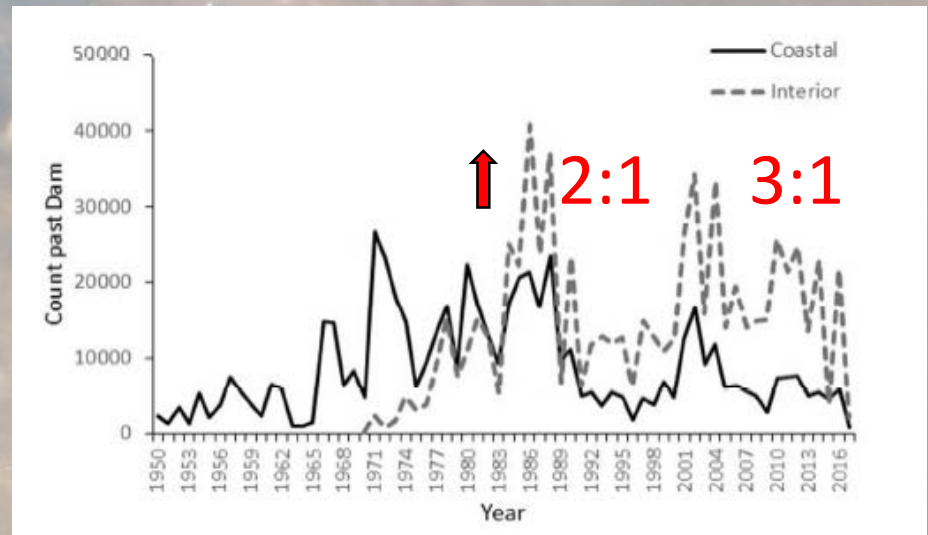


Background

- UWB WSH listed under ESA as threatened
- FOS outplanting started in 2006
- Numbers outplanted range from 122-426 indiv.
 - Avg 269 indiv/yr 2006-2016
 - Avg 1.5 female:male
- Goal is to increase production of WSH by utilizing higher quality, upper basin habitat

Background

- Concerns of the outplanting program
 - Does outplanting deplete the ESA-listed popn downstream from FOS?
 - Does outplanting introduce non-native, Summer SH upstream FOS?
 - Is the outplanting program effective to boost the native winter SH population?



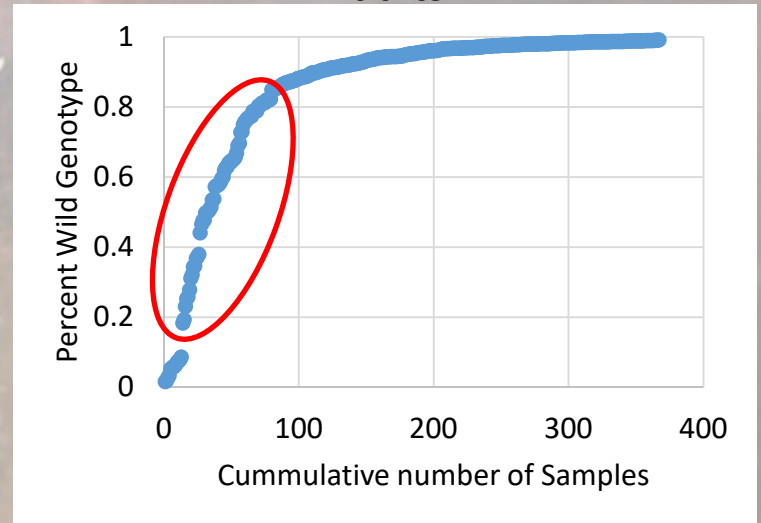
The Adult Fish Facility at Foster Dam may capture:
NOS originating above or below dam in S Santiam
Strays from other basins



NOS in the S Santiam may be:

- Wild Winter Steelhead
- Hybrids (wild x hatchery; S x W)
- O. mykiss* life history crosses (WSH x RBT)
- Summer SH
- Other hybrids (WSH x CCT)

Adults WFD



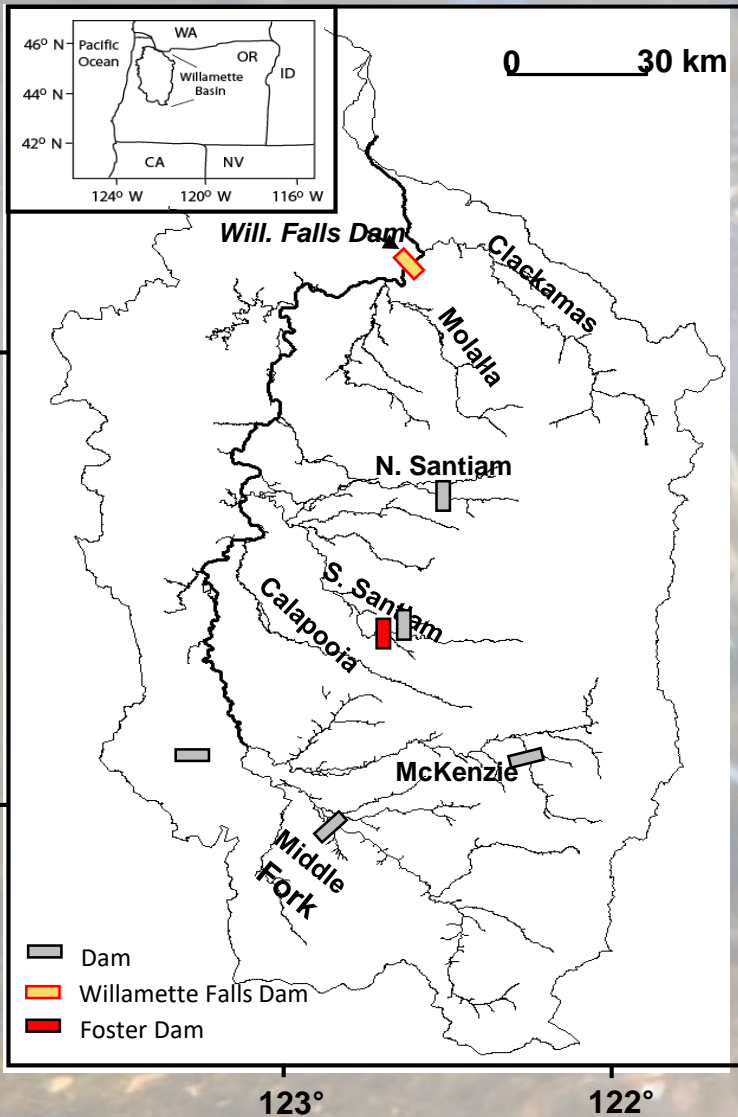
Objectives

- 1) Describe the genetic composition (HxW admixture) in unmarked Steelhead outplanted above Foster Dam
- 2) Determine if outplanted Steelhead produce offspring
 - a. adult to juvenile
 - b. adult to adult
 - c. test factors related to reproductive success
- 3) Estimate the proportion of outplanted Steelhead reared upstream Foster Dam returning to the AFF
- 4) Examine phenotypes from *O.m.* PIT tagged in FOS reservoir to identify characteristics to predict migration (preliminary data)

Methods

- Fish collections – adults at FOS AFF (2012-2016)
 - Juvs from smolt trap upstream from reservoir (2013, 2014, 2015, 2017)
 - Juvs from FOS forebay (2017)
 - PIT tagging and photos in 2017 at FOS reservoir to identify characteristics associated with smolt migration

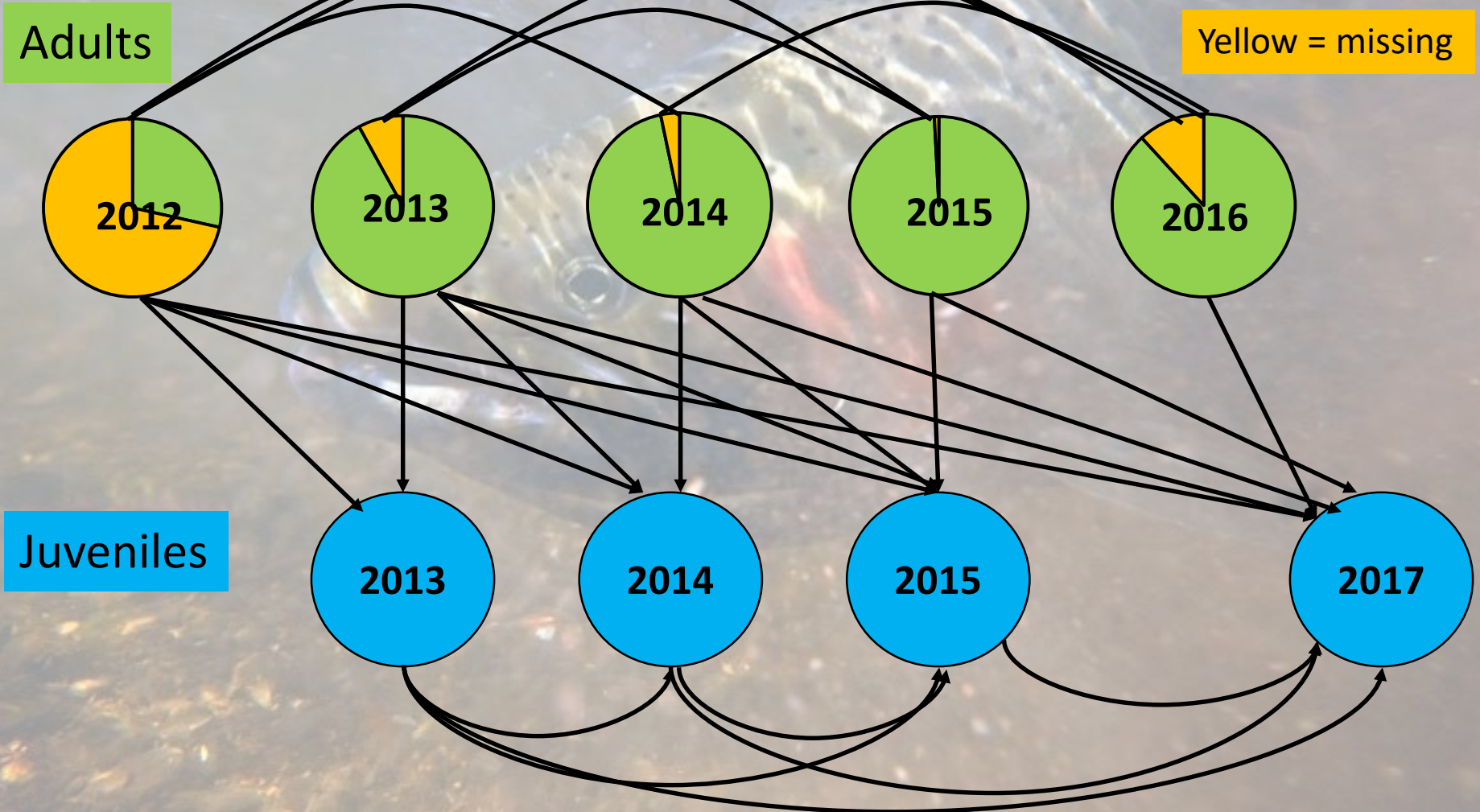




| | Location | Year | n | n outplant | % candidate parents in sample |
|---------------|---------------------------------|---------|------|---------------|--|
| Adults | Foster AFF | 2012 | 93 | 326 | 28.5 |
| | | 2013 | 264 | 286 | 92.3 |
| | | 2014 | 207 | 214 | 96.7 |
| | | 2015 | 128 | 129 | 99.2 |
| | | 2016 | 195 | 221 | 88.2 |
| Juvs | Smolt trap, u/s reservoir | 2013 | 632 | | |
| | | 2014 | 290 | | |
| | | 2015 | 34 | | |
| | | 2017 | 53 | | |
| | | Forebay | 2017 | 354 | |

After removed duplicates and failed samples (12-14%, <90% loci)

Methods



Lab Methods

- *O.m.* SNP panel – 267 loci, identified sex and screens CT hybrids
 - 2 diagnostic loci associated with run timing – count of number of winter alleles out of the 4 alleles measured
- Parentage Test - Exclusion analysis allow 2 mismatch alleles using CERVUS

Statistical Analysis



- **Parentage**

- Logistic Regression

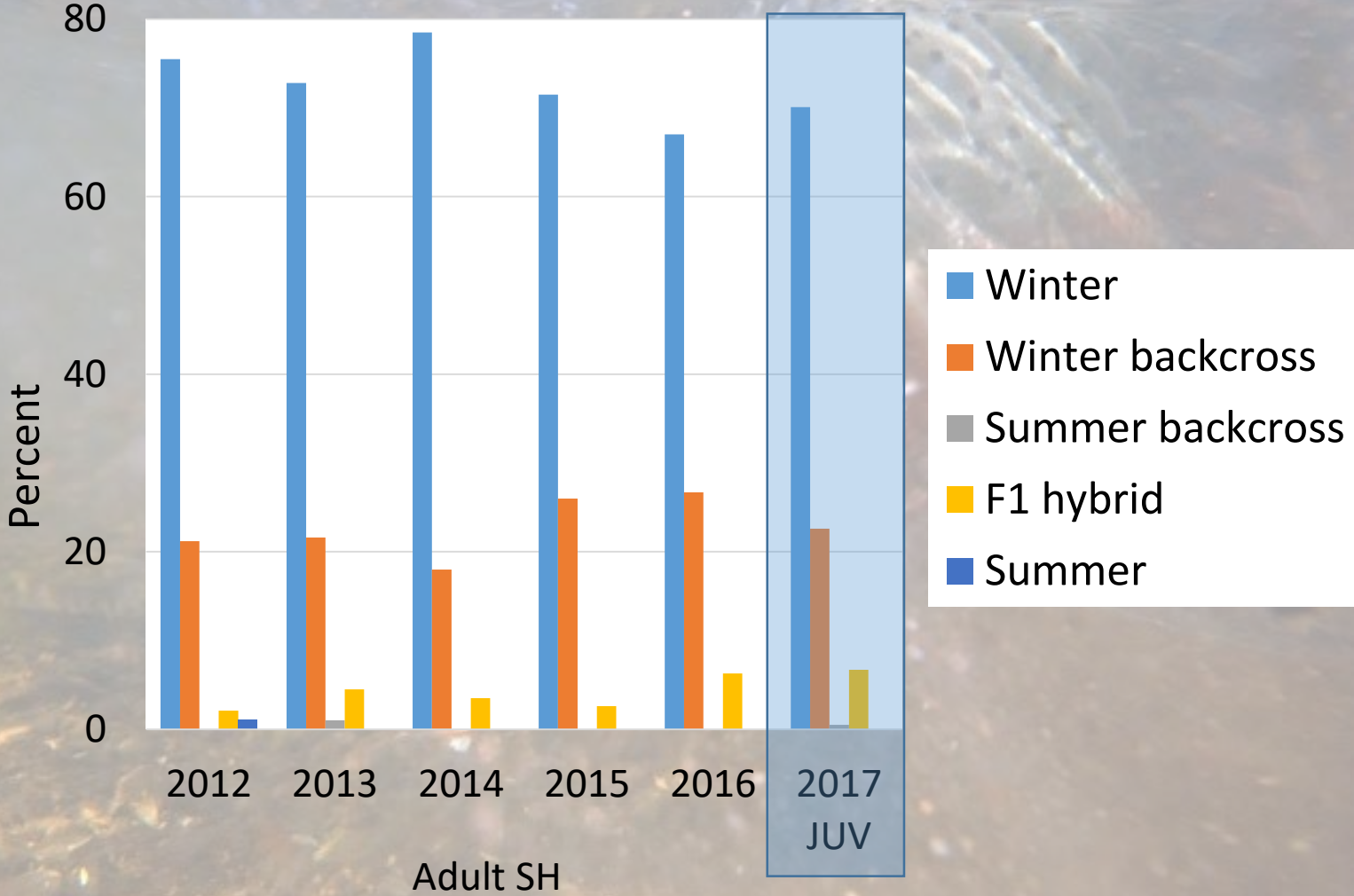
- Offsp (y, n)

- Day, sex, length, wild.alleles, interactions

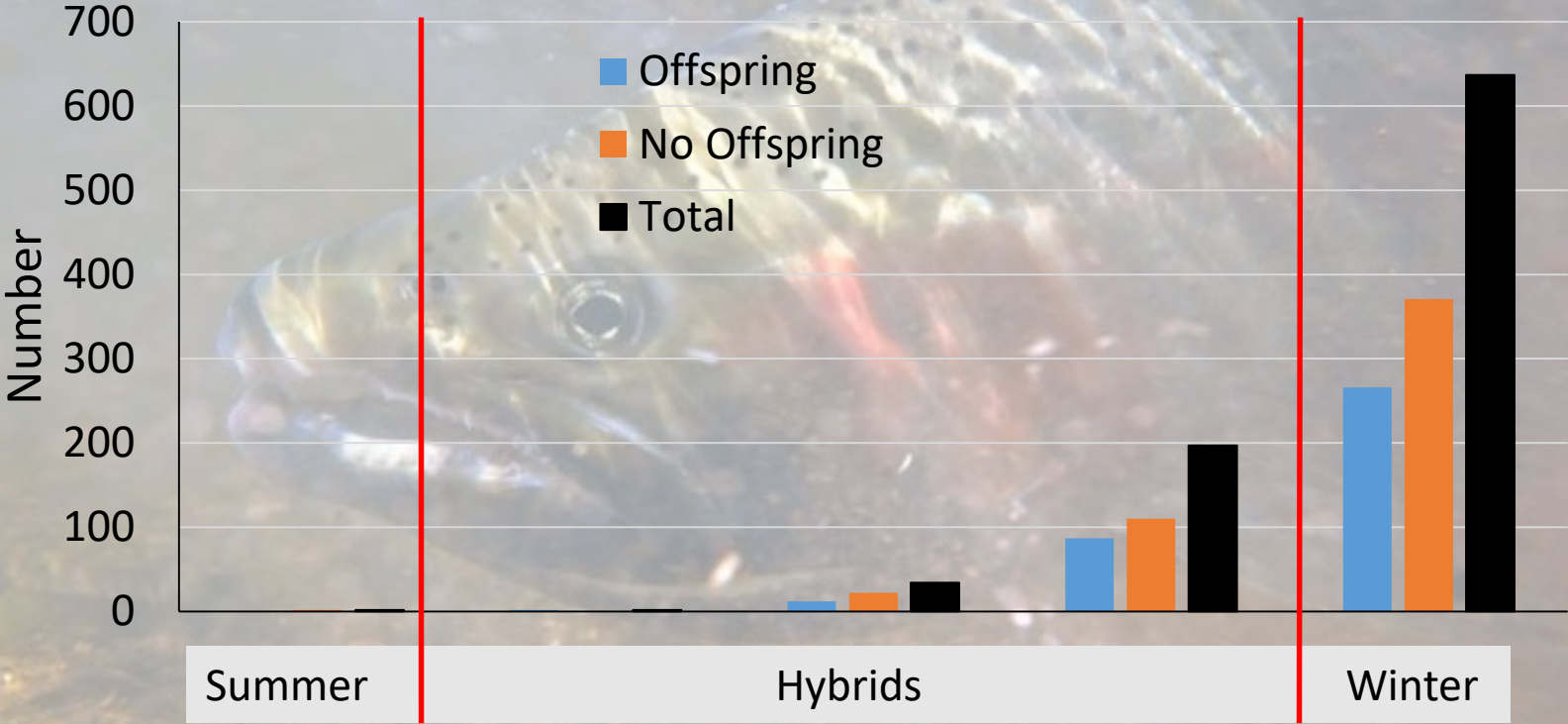
- **Smolt phenotypes**

- ANOVA by length

Objective 1: Describe the genetic composition (HxW admixture) in unmarked Steelhead outplanted above Foster Dam

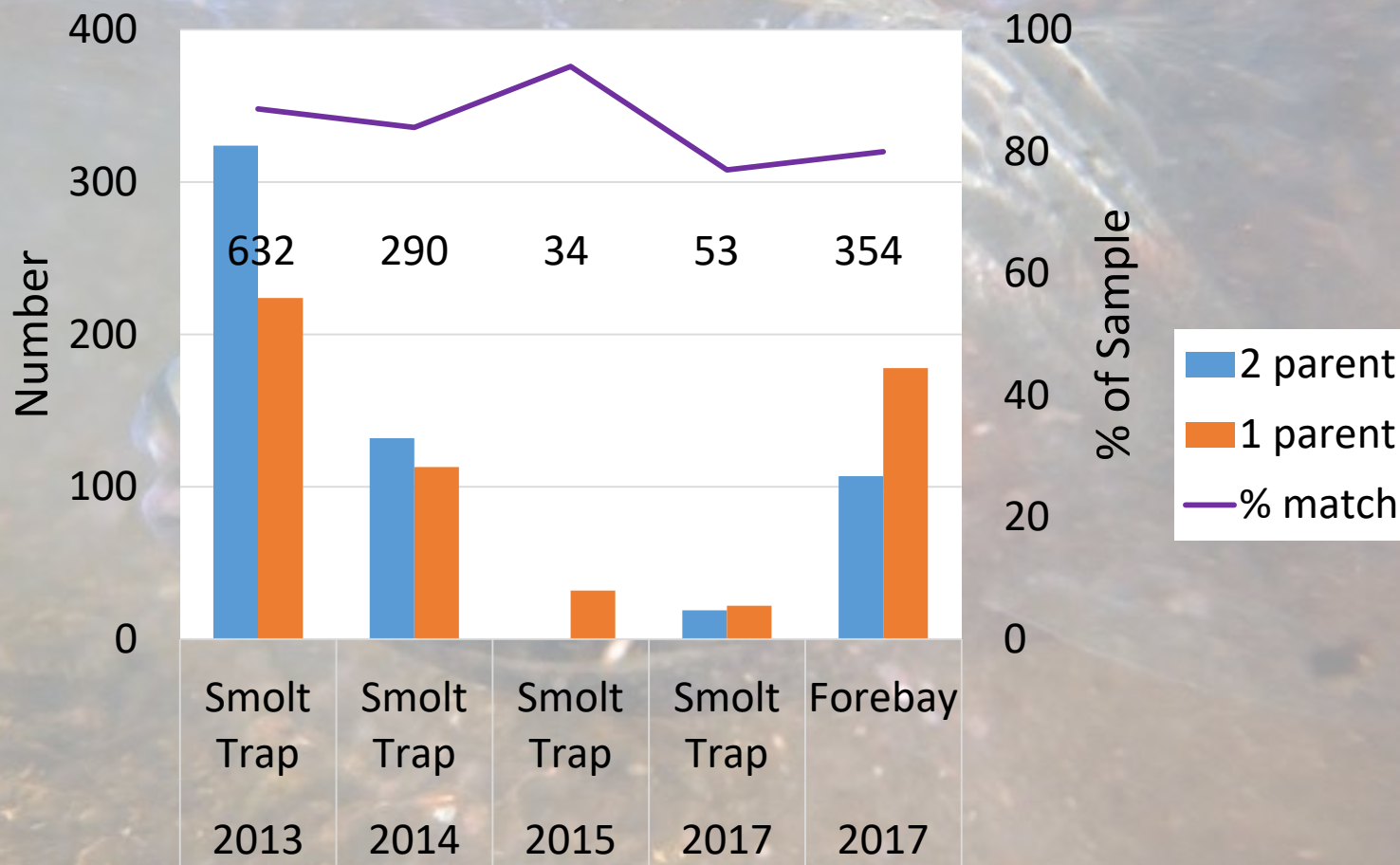


Objective 1: Describe the genetic composition (HxW admixture) in unmarked Steelhead outplanted above Foster Dam



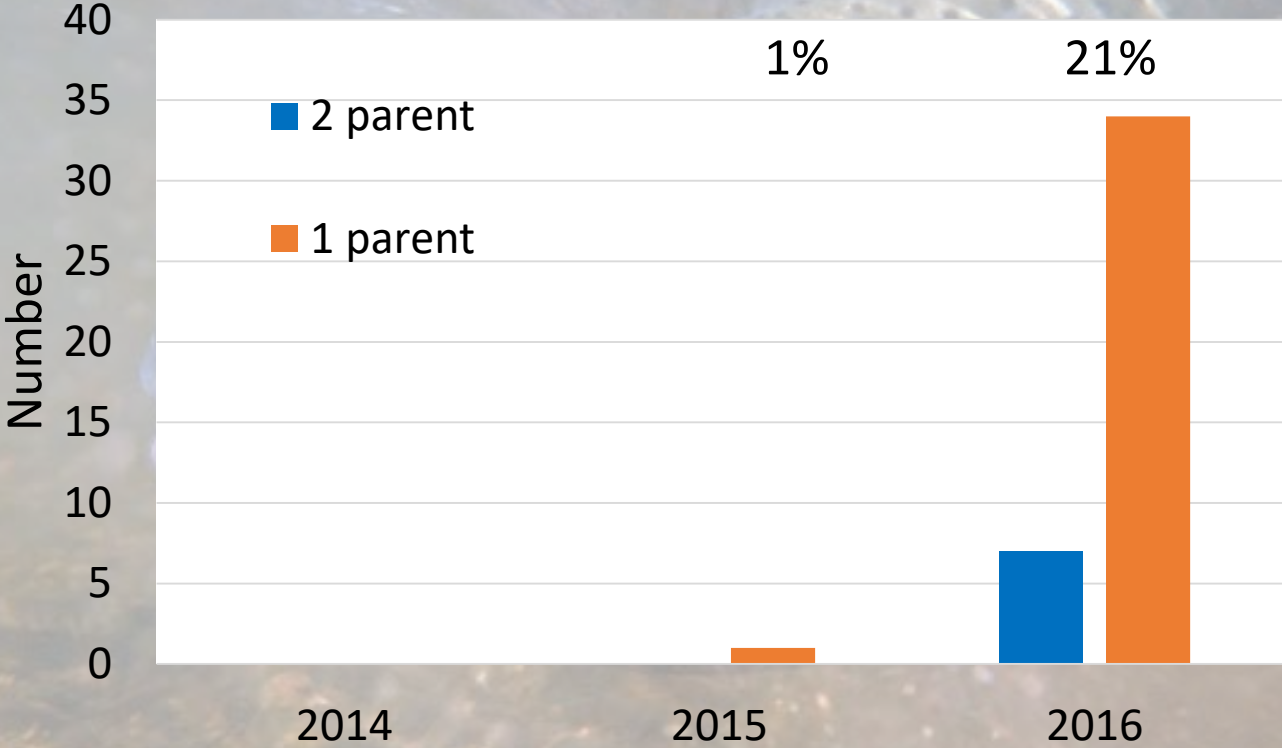
Number of Winter Alleles (4 total)

Objective 2.a: Determine if outplanted Steelhead produce offspring (adult to juvenile)

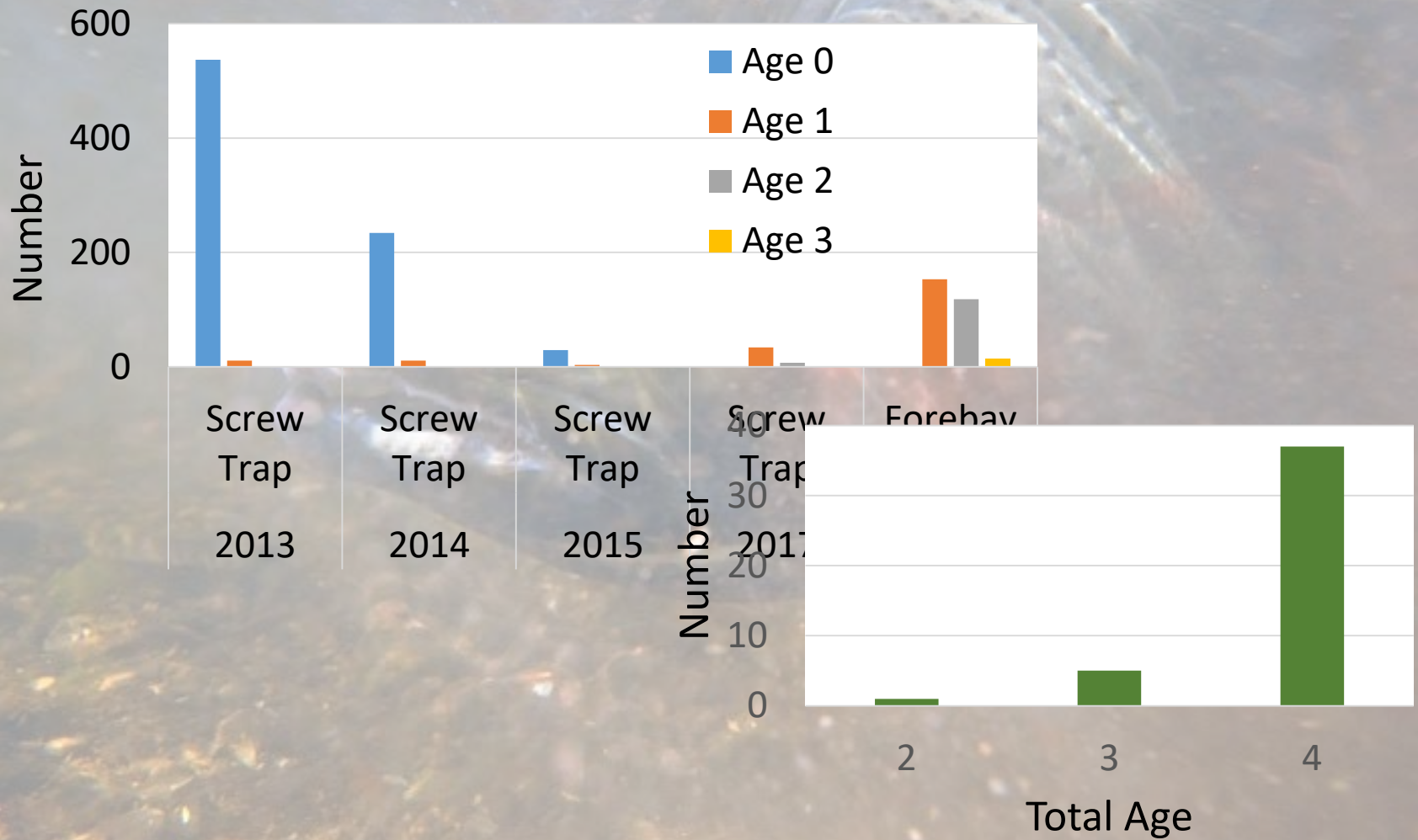


High proportion (>80%) of sample matches to outplanted adult
High proportion of 2 parent matches

Objective 2.b: Determine if outplanted Steelhead produce adult returns (adult to adult)

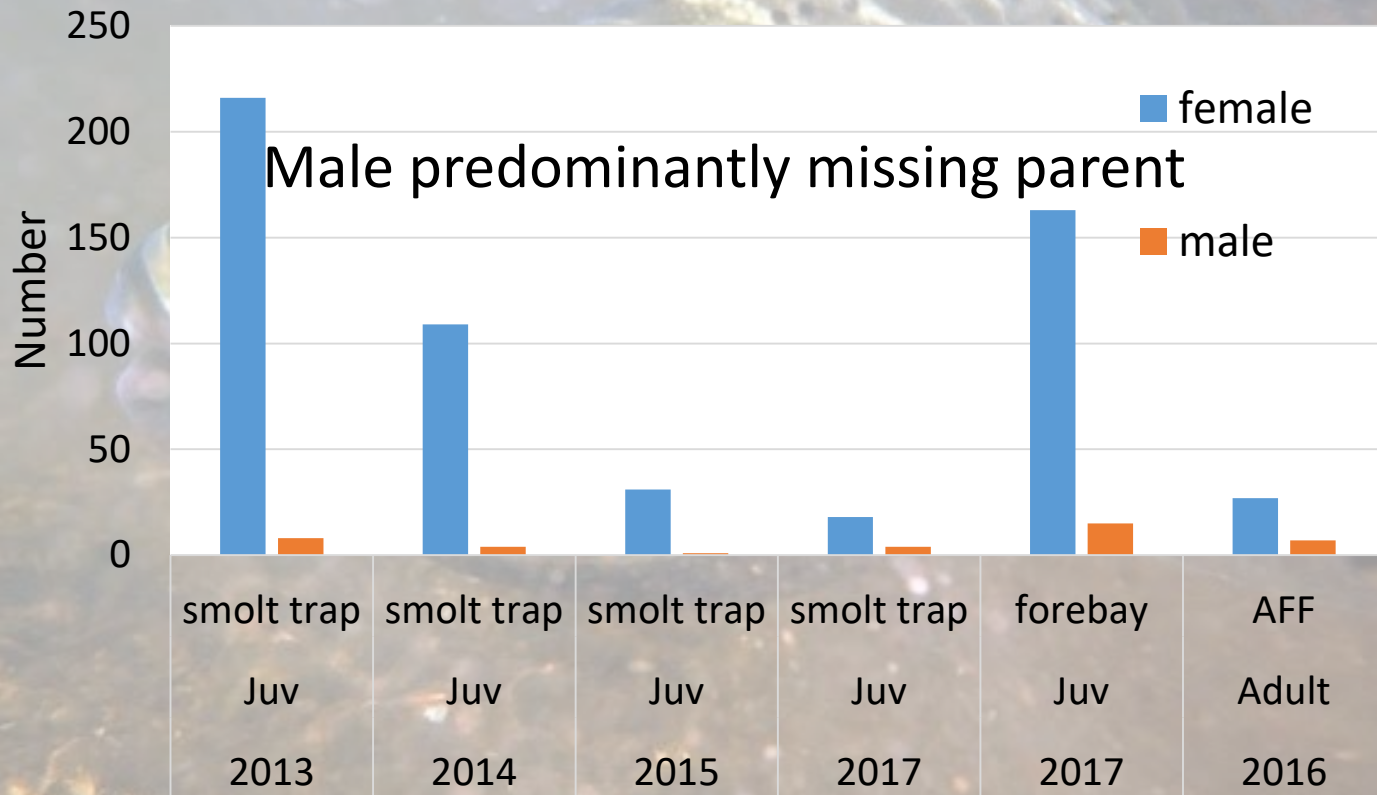


Age of collections



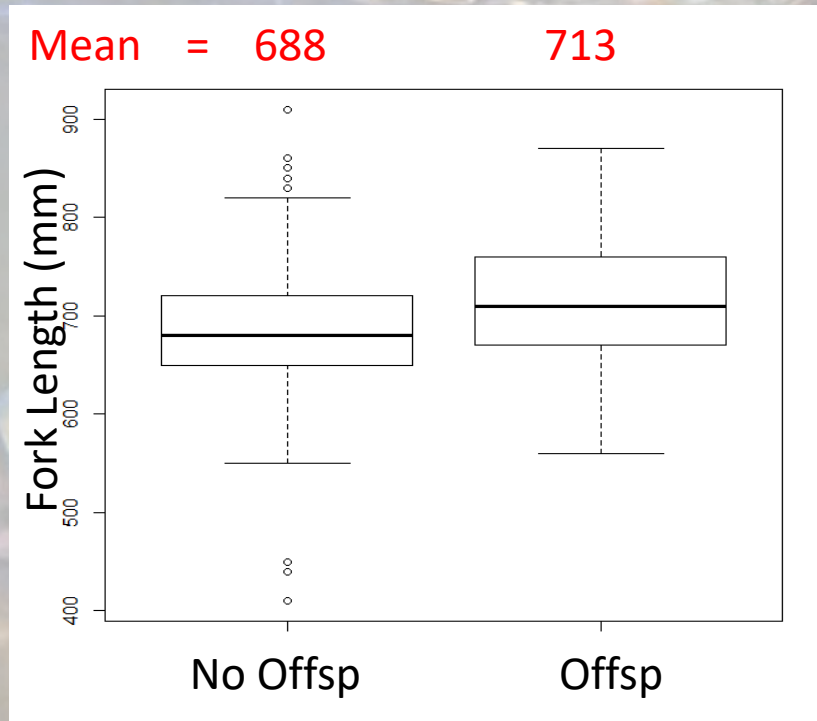
Objective 2.a, b. Determine if outplanted Steelhead produce offspring

Composition of 1 parent matches by sex



Objective 2.c. Test factors related to reproductive success

$p < 0.001$



Logistic Regression

Lowest AIC length only

Odds Ratio increase odds produce offspring 1.0

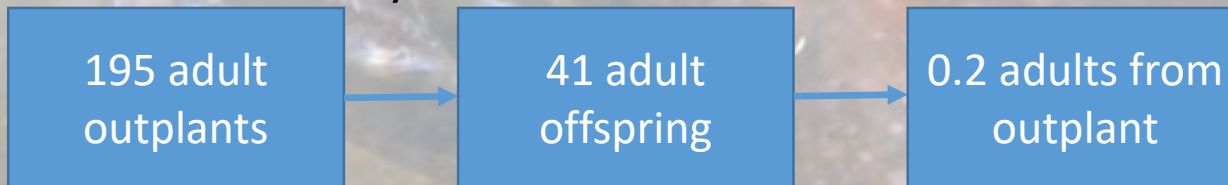
Objective 3. Estimate the proportion of adult Steelhead returns reared upstream Foster Dam

Can outplanting become a source population for Steelhead?

All Years



2016 returns only



2016 adult returns -> mostly BY 2012

Which was sampled at **28%** adults

Possible that **72%** of adult returns are from outplants,
But we don't really know.....

Objective 3. Estimate the proportion of outplanted Steelhead reared upstream Foster Dam

Non-representative (?) sample – 21% is outplant offspring
But,maybe 71%?

- ? Outplant offspring stray elsewhere
- ? Outplant offspring don't enter AFF

Can we address these unknowns?

- 1) Continue adult parentage
- 2) Sample downstream population

? Resid. RBT

Wild + Hatchery

? Repro Success

Wild Fish 😊

~1480
S San + outplant offsp
+ Imm. non-S San

-221
(15%)



2016 Estimates

Objective 4: Examine phenotypes from *O.m.* PIT tagged in FOS reservoir to identify characteristics to predict migration (preliminary data)

Silvering

0= none

1= partial

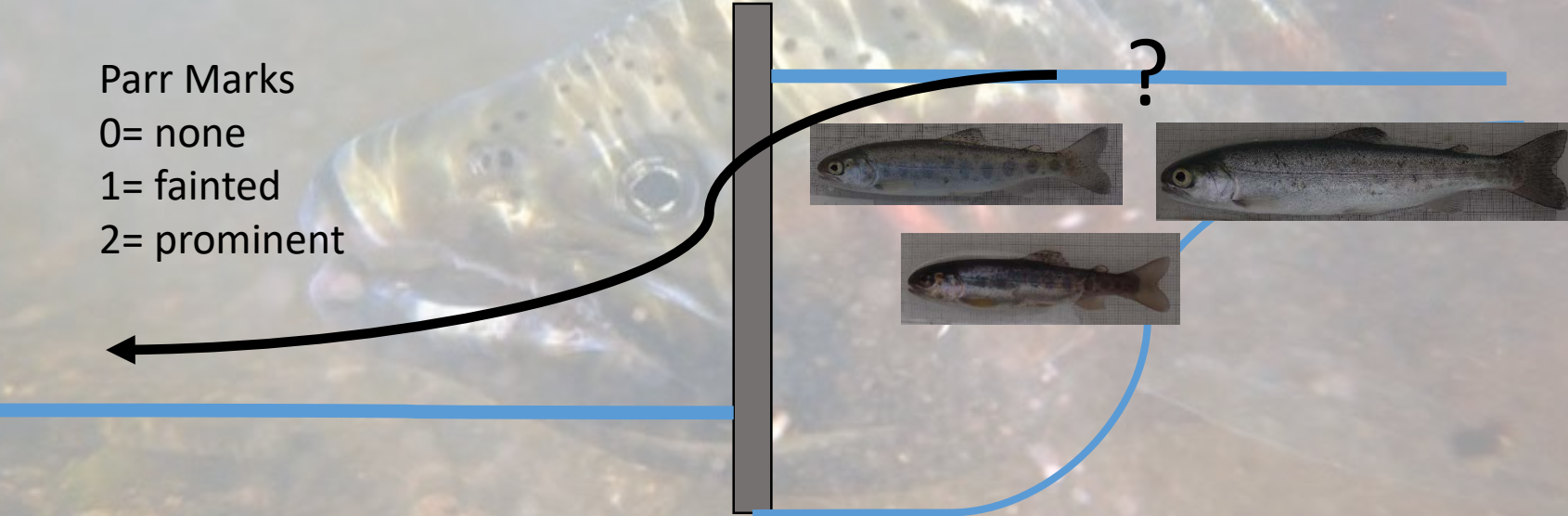
2= all

Parr Marks

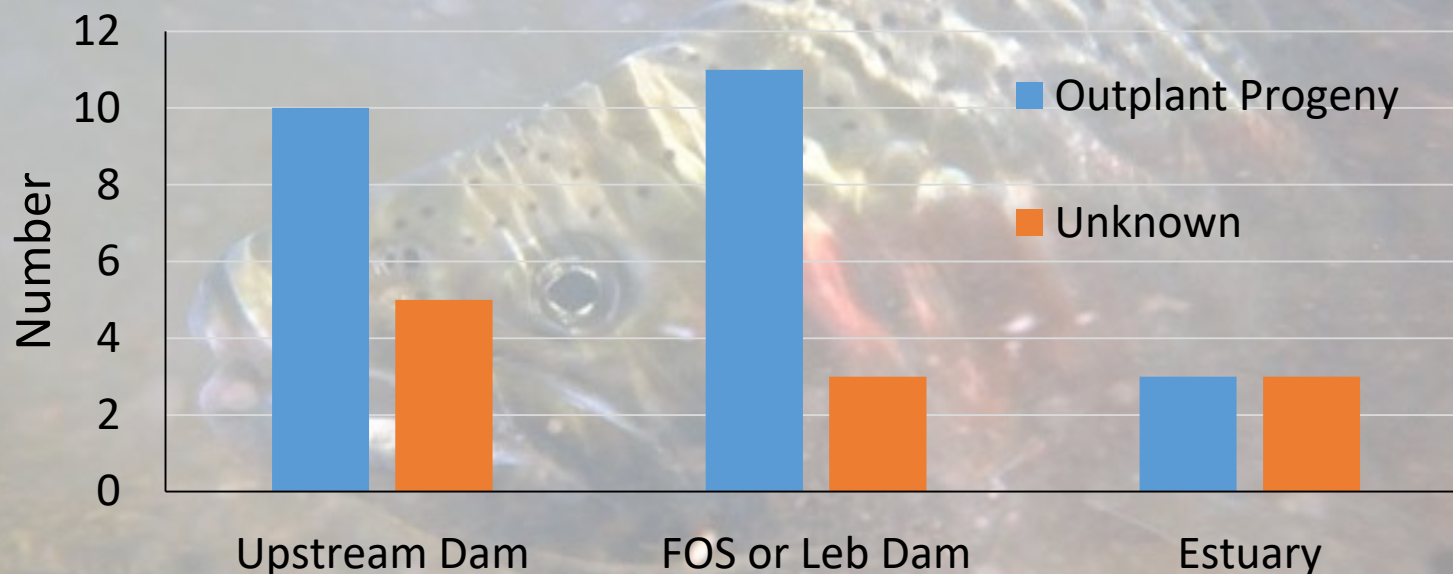
0= none

1= faded

2= prominent



Objective 4: Examine phenotypes from *O.m.* PIT tagged in FOS reservoir to identify characteristics to predict migration (preliminary data)

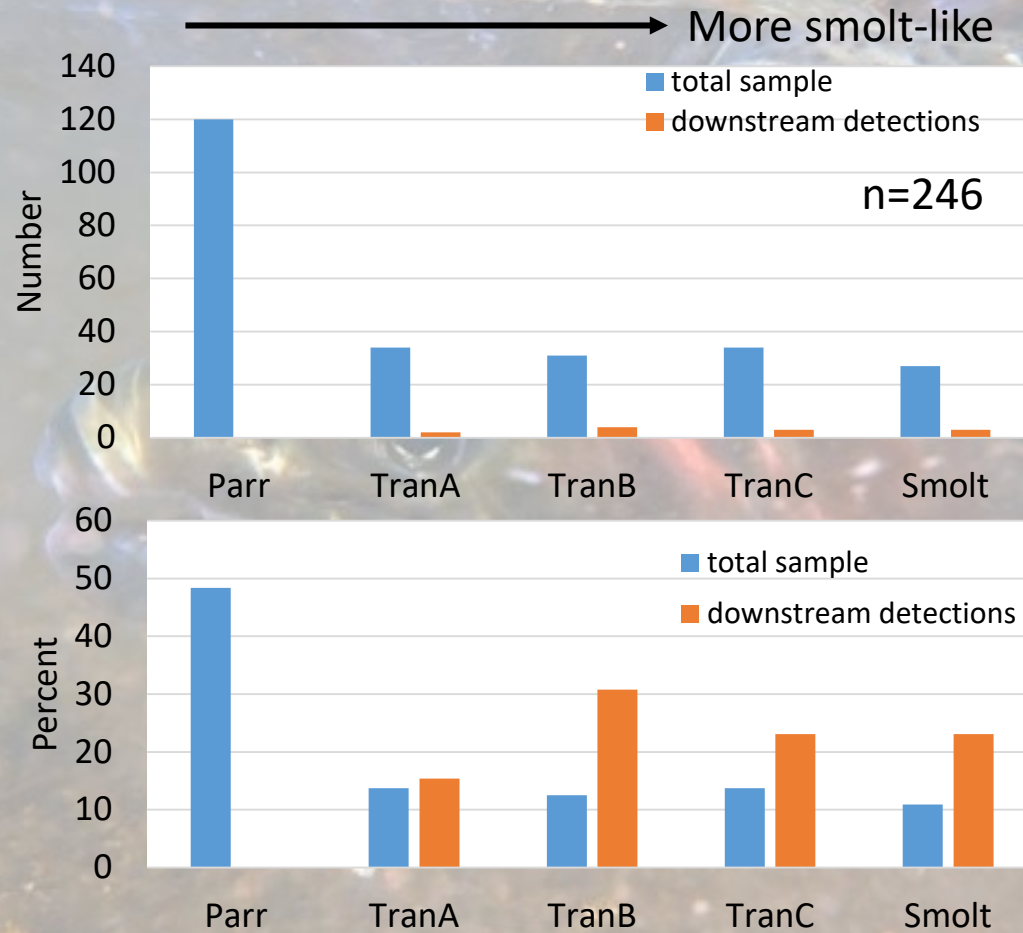


Maximum Detected Movement

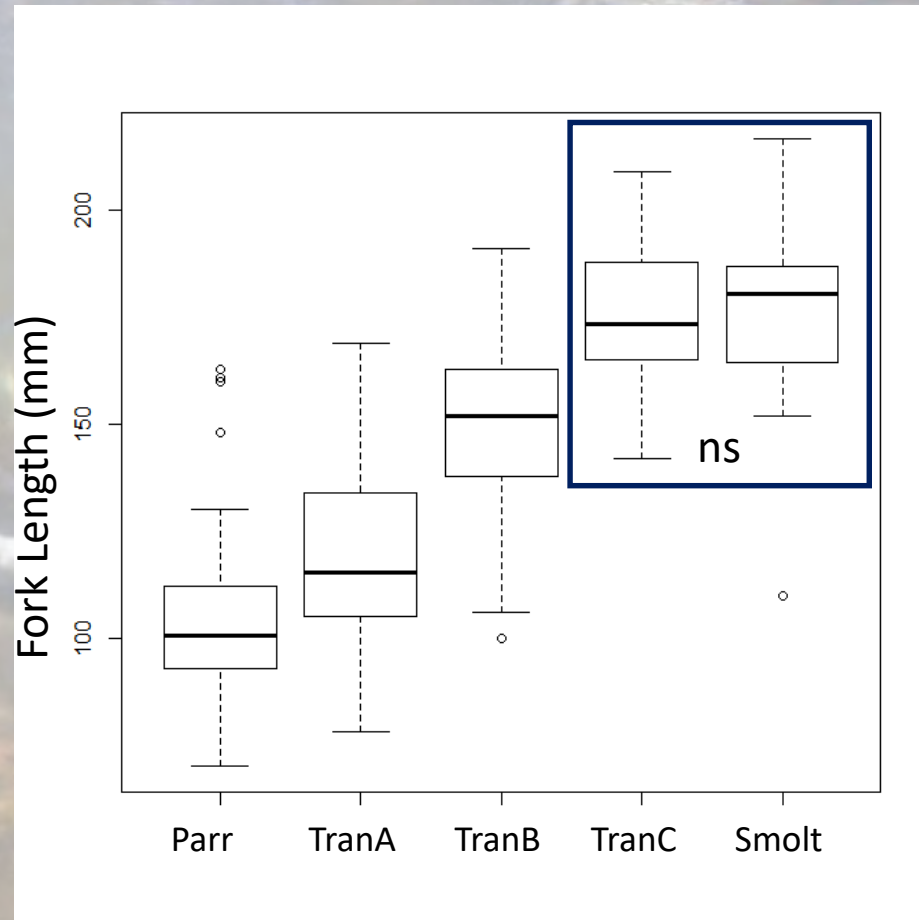
7.3% of PIT tags detected, n=453

Tag reports up to Jan 10, 2017

Objective 4. Examine phenotypes from *O.m.* PIT tagged in FOS reservoir to identify characteristics to predict migration (preliminary data)



Objective 4. Examine phenotypes from *O.m.* PIT tagged in FOS reservoir to identify characteristics to predict migration (preliminary data)



ANOVA pairwise comparisons $p < 0.001$ except TranC-Smolt (ns)

Conclusions

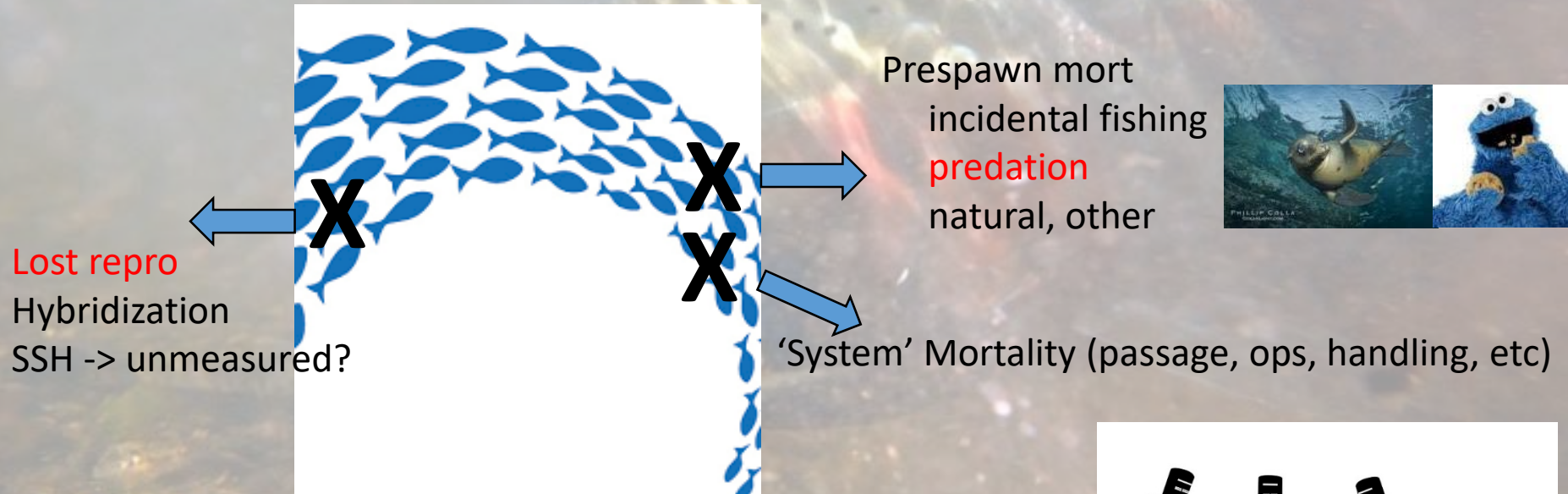
- Genetic composition of outplanted adults
 - 25% hatchery introgression
 - 6% F₁ hybrids
- Outplants were successful reproducing u/s FOS
 - 80% of parr assign to outplanted SH
 - Avg 1.7 juv/ad 2013-2016
 - Avg 0.5 ad/ad 2012
- Proportion return est remove 15% adults @FOS, return >21% from outplanting
 - Outplanting increasing adult SH population, but lots of missing information to estimate effectiveness
- Silvering and parr marks were sig related to smolting
 - indivs without visual smolt indicator did not migrate
 - length also sig. with phenotype group
 - Phenotype can be used as a covariate in migration studies to account for migration potential

Data Gaps or future analyses

- Genetic composition of outplanted adults
 - Demographic and fitness effects of hybridization in the UWB
 - Genotype WSH prior to outplanting to prevent release of hybridized adults us FOS
- Reproductive success of outplant program
 - Adult sampling for additional years (2017, 2018, 2019) will improve the estimate of fitness and program effectiveness
 - Role and genetic composition of resident *O.m.* that may be crossing with outplanted SH
- Proportion of adult returns from outplant program
 - Improved sampling below FOS to provide paired estimates of fitness
 - Genetic sampling below FOS to identify proportion of missed outplanted offspring
- Phenotypes and smolt outmigration
 - Allow more time for detection of PIT tags
 - Additional analyses of existing data

Data Gaps or future analyses

- Demographic effects to listed WSH



? Long term persistence



Questions?

