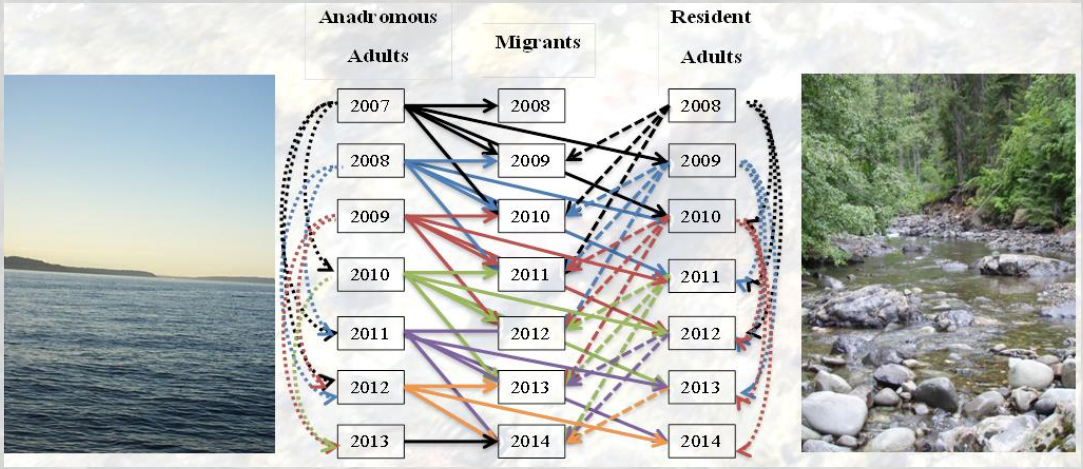
Yakima Steelhead VSP Project: Resident/Anadromous *O. mykiss* Monitoring

Gabriel M. Temple, Chris Frederiksen, Zack Mays, Ryan Fifield, Todd Seamons
Tim Webster, Cade Lillquist, Alex Hedrick

Yakima Basin Science and Management Conference
Central Washington University, Ellensburg WA
June 2019

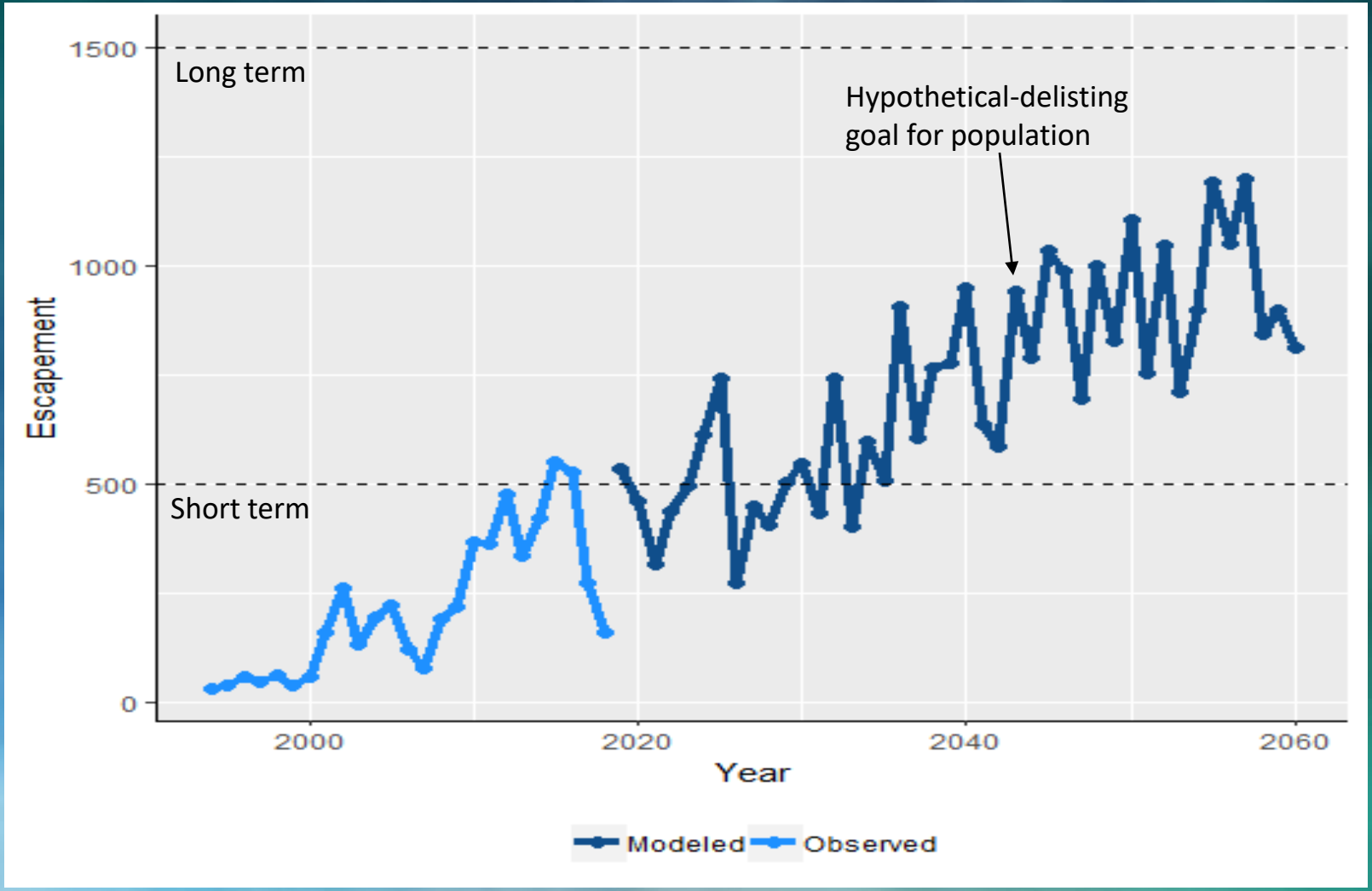
Describe our observations of VSP metrics for Upper Yakima *O. mykiss*

- *O. mykiss* = Rainbow Trout = Steelhead Trout
- VSP = Abundance, Productivity, Spatial Structure, Diversity
- Important because our Steelhead population is depressed and listed as threatened in the Yakima Basin yet our sympatric Rainbow Trout population is robust
- Steelhead recovery objectives under ESA, but large uncertainty surrounding interactions between life-histories that may affect recovery

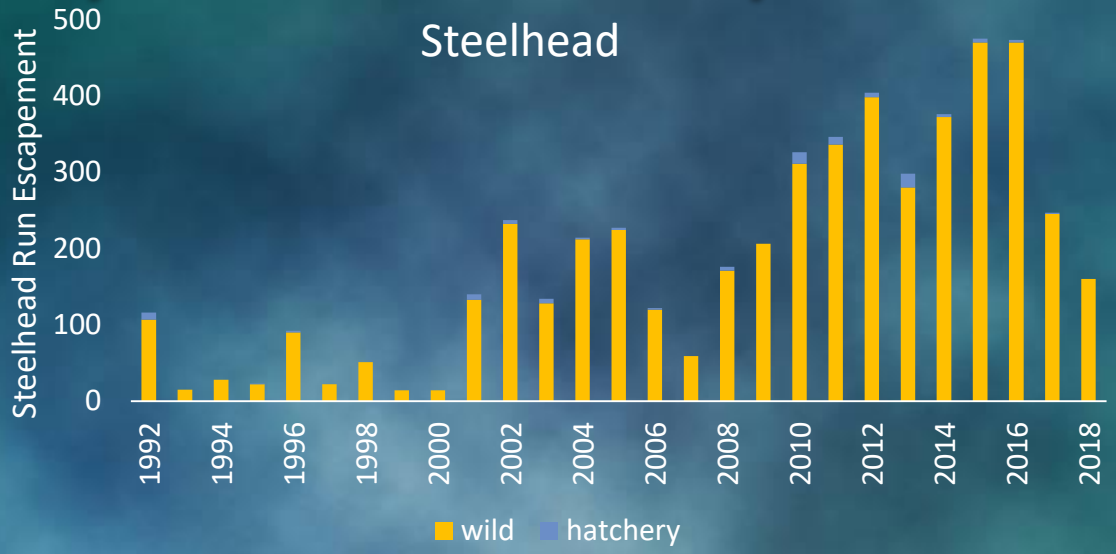


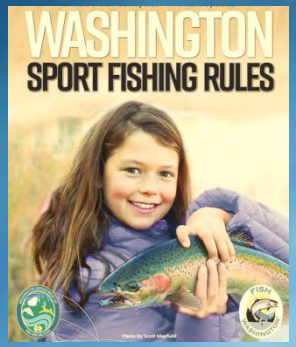
McElhany et al. 2000, NMFS-NWFSC-42; Crawford and Rumsey 2011; Guidance Document

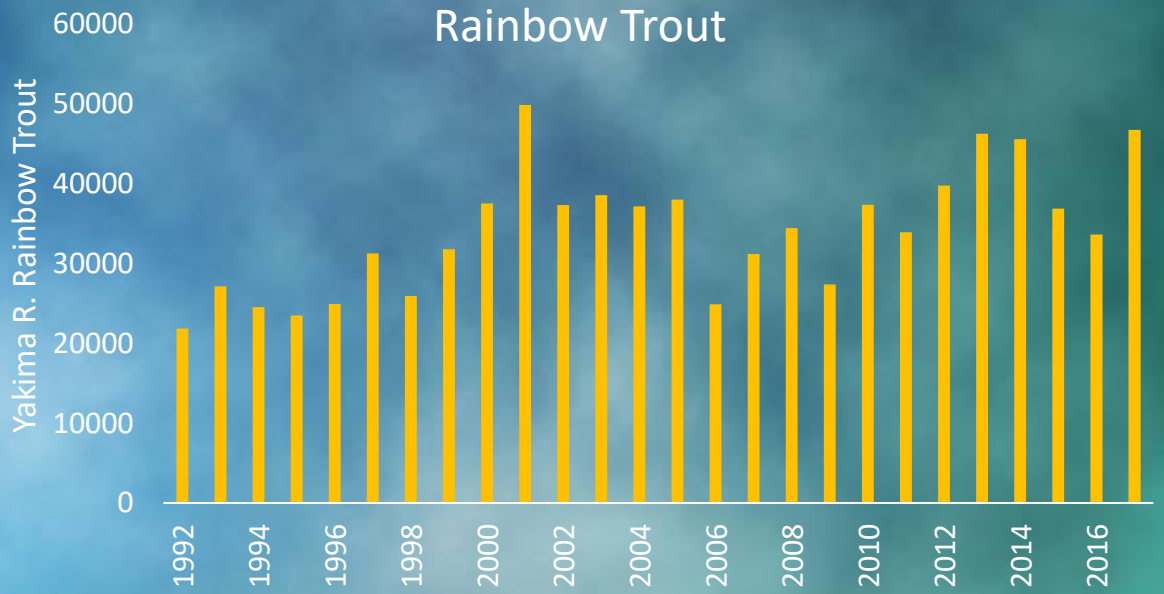
Upper Yakima Steelhead Population Trajectory and Recovery Goals



Anadromy vs. Residency







Interesting Facts – Yakima *O. mykiss*

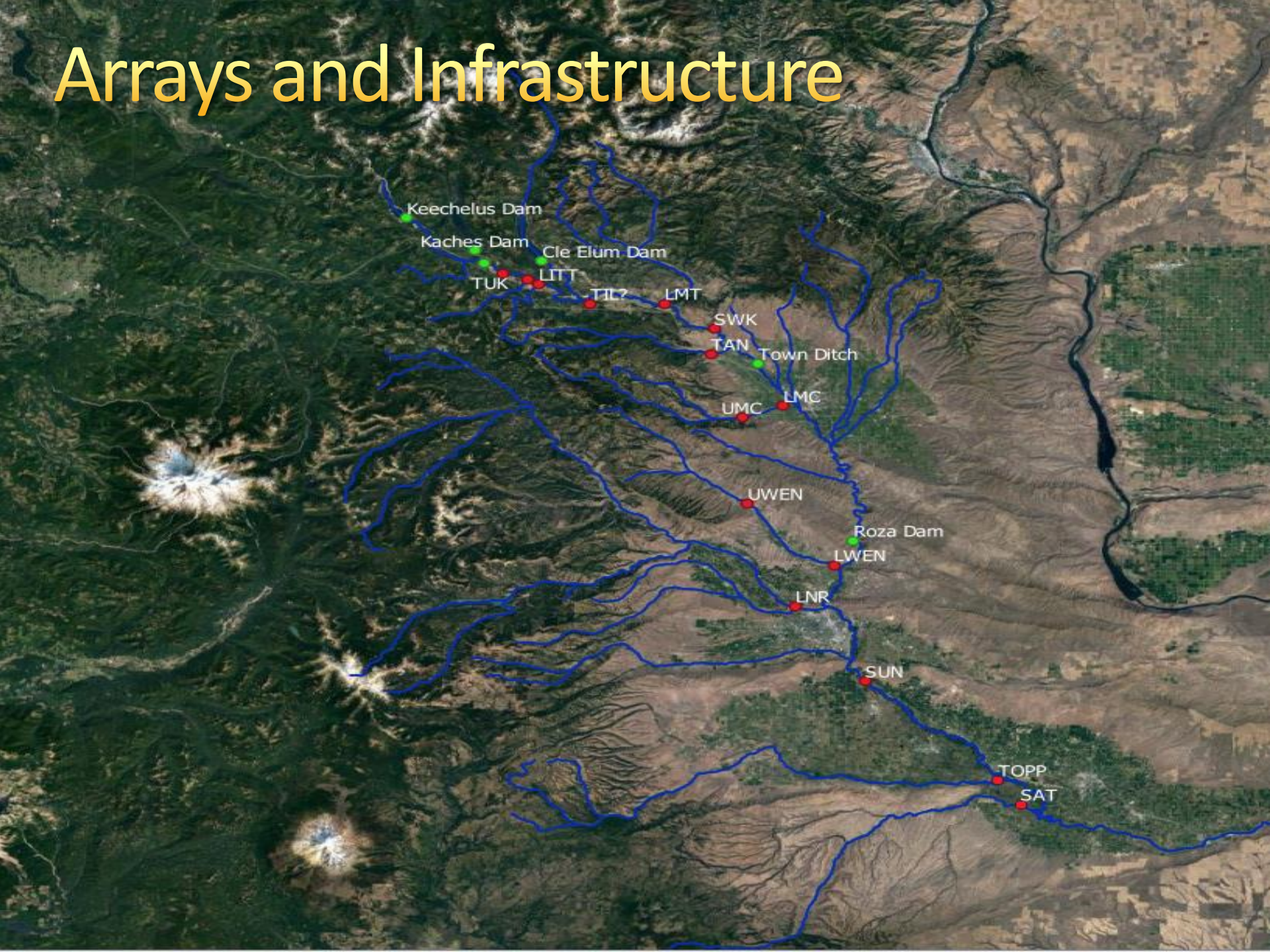
- 1) Very Little Hatchery Steelhead Influence
- 2) Extensive Hatchery Trout Stocking
  - Goldendale Hatchery, South Tacoma
- 3) Genetic Admixture of Hatchery and Wild trout (Campton and Johnston 1985)
- 4) Overlap in Spawn Timing and Distribution of both Resident and Anadromous *O. mykiss* (Pearsons et al. 2007)
- 5) Rainbow Trout and Steelhead Genetically More Similar in Individual Streams than the Same Life History Forms are Between Streams (Blankenship et al. 2009)
- 6) Courter et al. 2013 report up to 20% of Steelhead kelts originated from resident mothers

Evidence of Interbreeding – Yakima

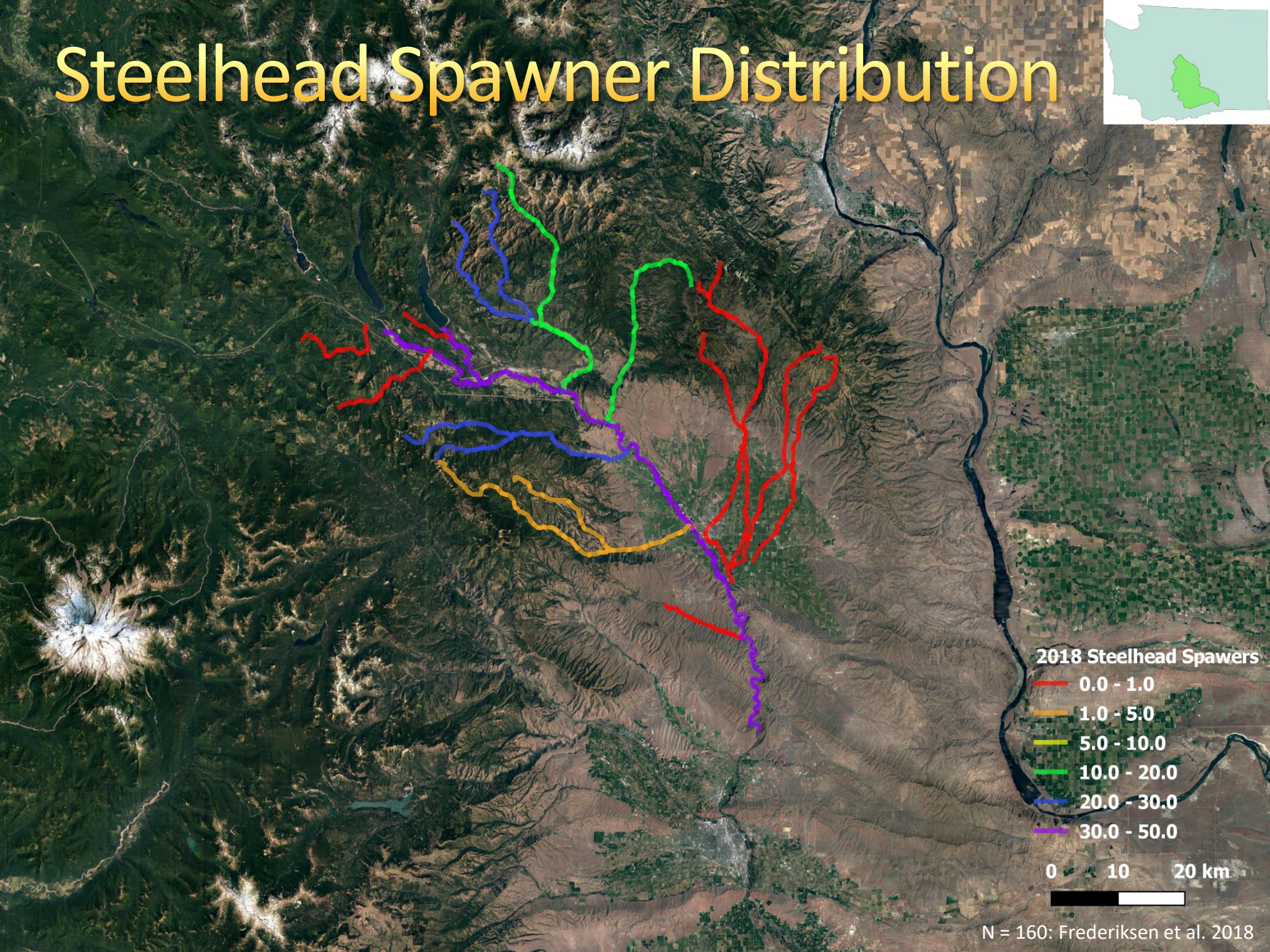
Objectives

- Determine influence a large resident trout population has on recovery of steelhead
- Employ large scale PIT tagging project
- Couple with a basin scale genetic parentage assessment
- Get a handle on how many smolts are produced from where
- And who their parents are
- Explore factors influencing anadromy
  - Genetics vs Environment

Arrays and Infrastructure



Steelhead Spawner Distribution

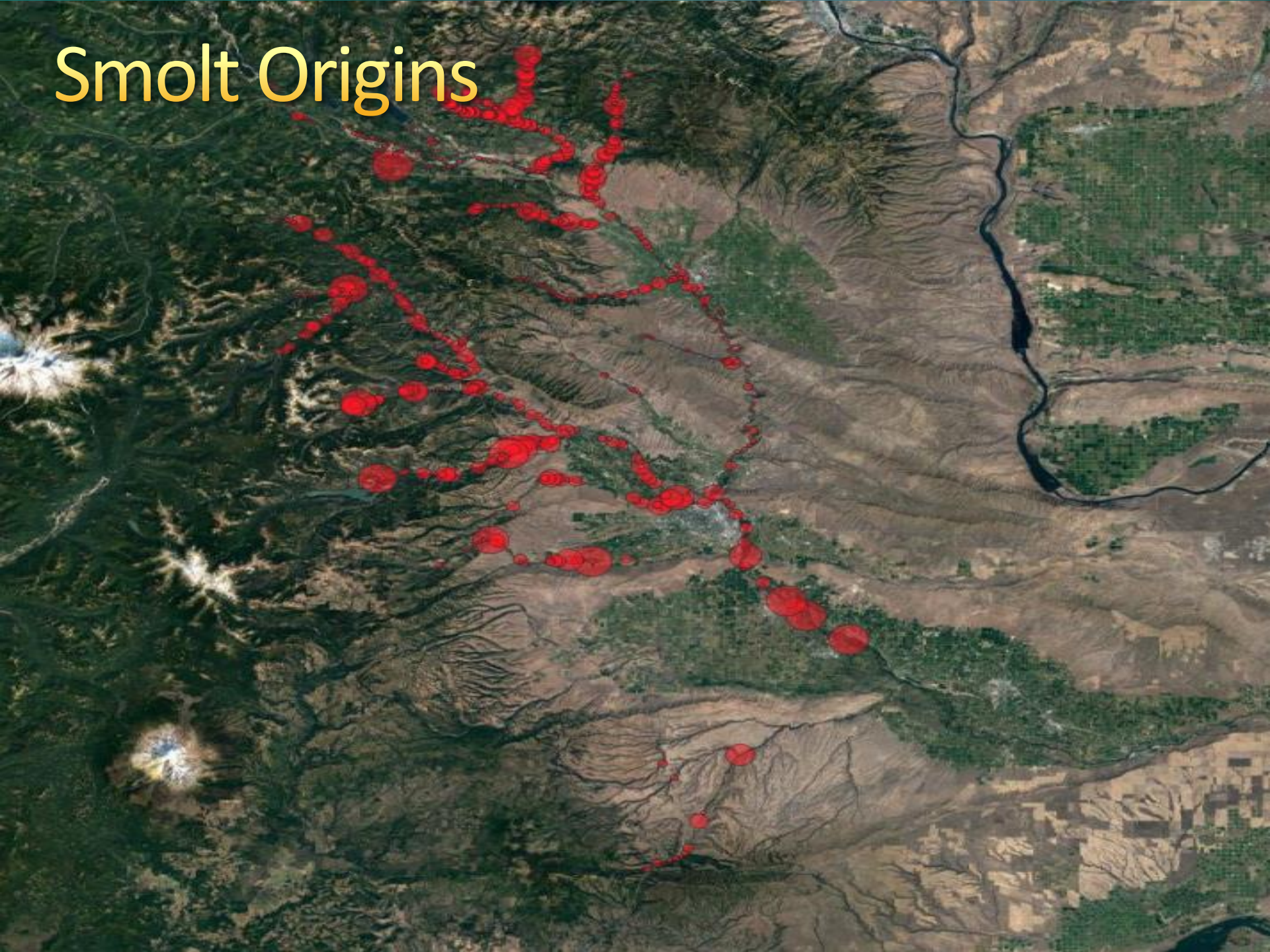


N = 160: Frederiksen et al. 2018

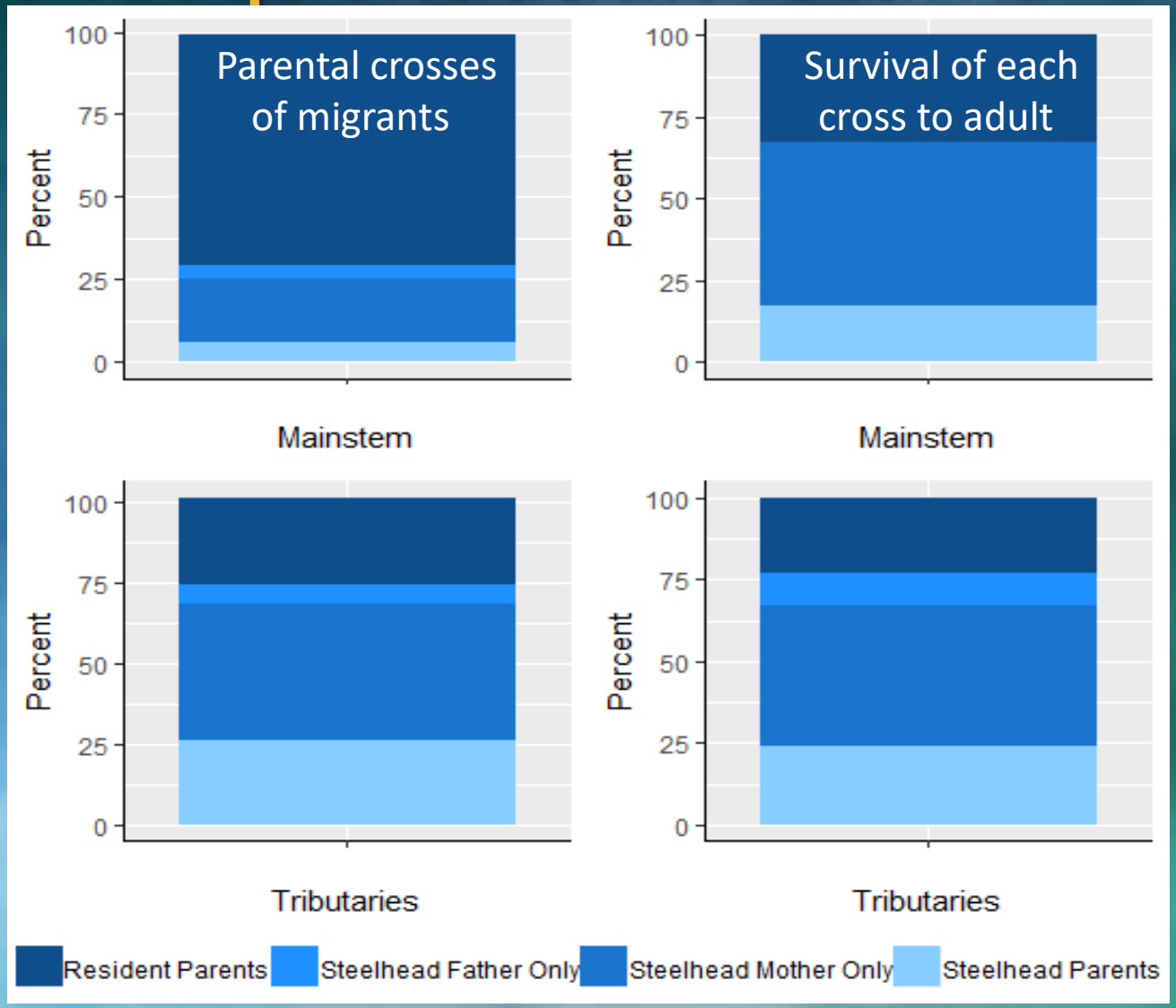
Juvenile Sampling

monitoringresources.org
Protocols: 2165,3297,3300
Methods:115,116,117,118,
119,120,121,2165
Sample Designs:3578,3579,
3582,4205,4209,6662,
15625,15626

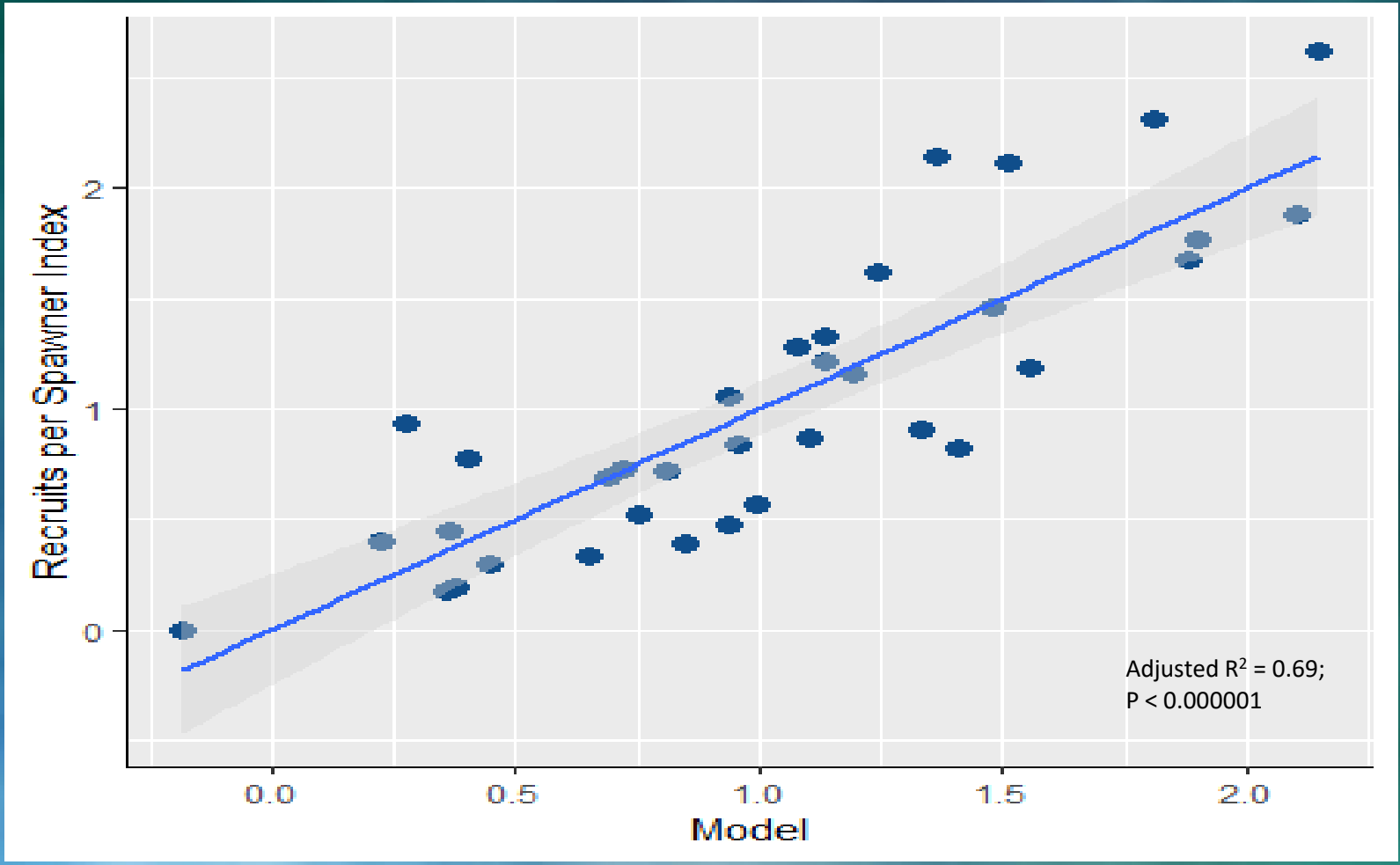
Smolt Origins



Parent assignments of migrants and the subsequent adult returns

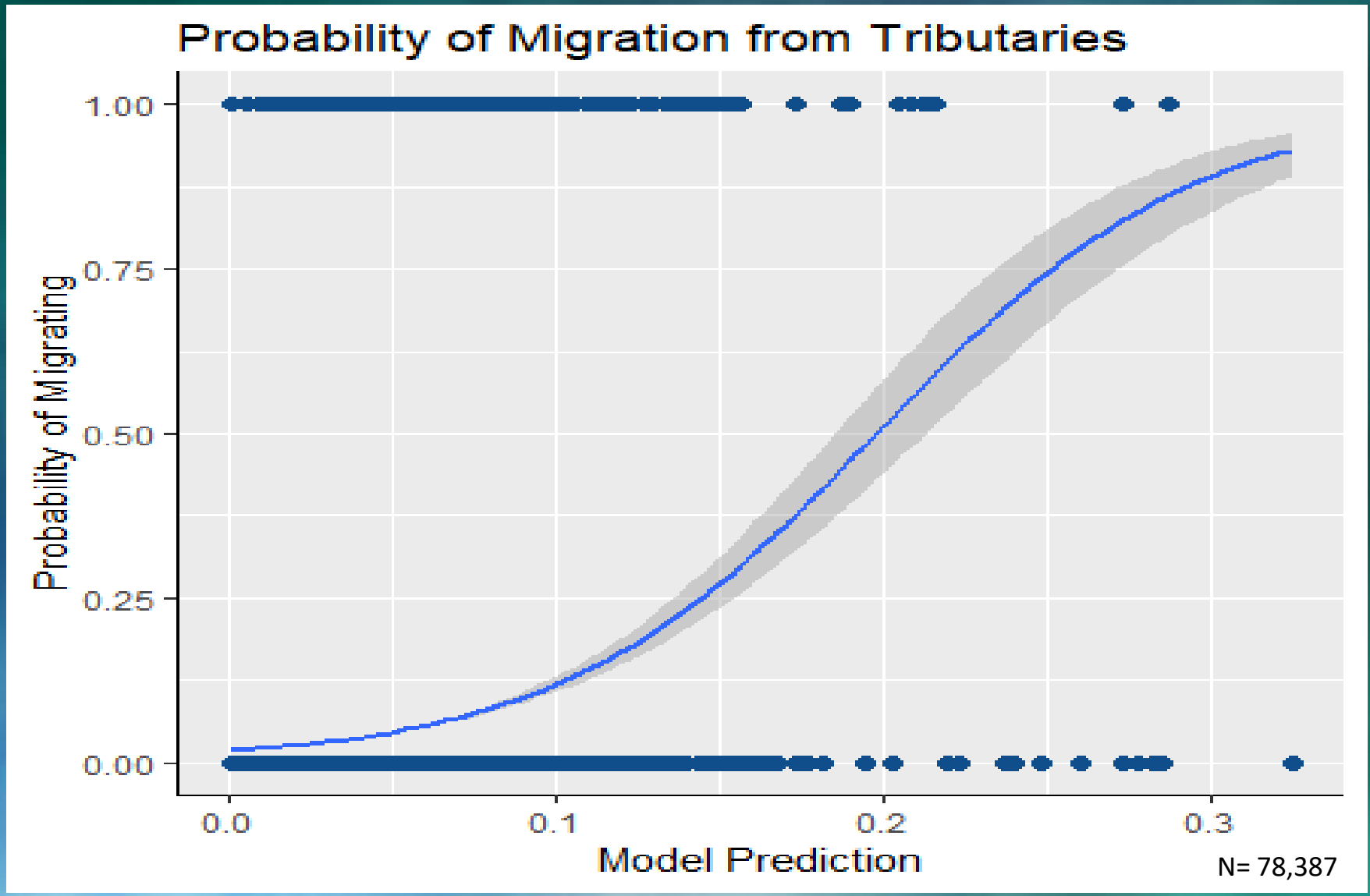


Tribs- Potential Explanatory Variables

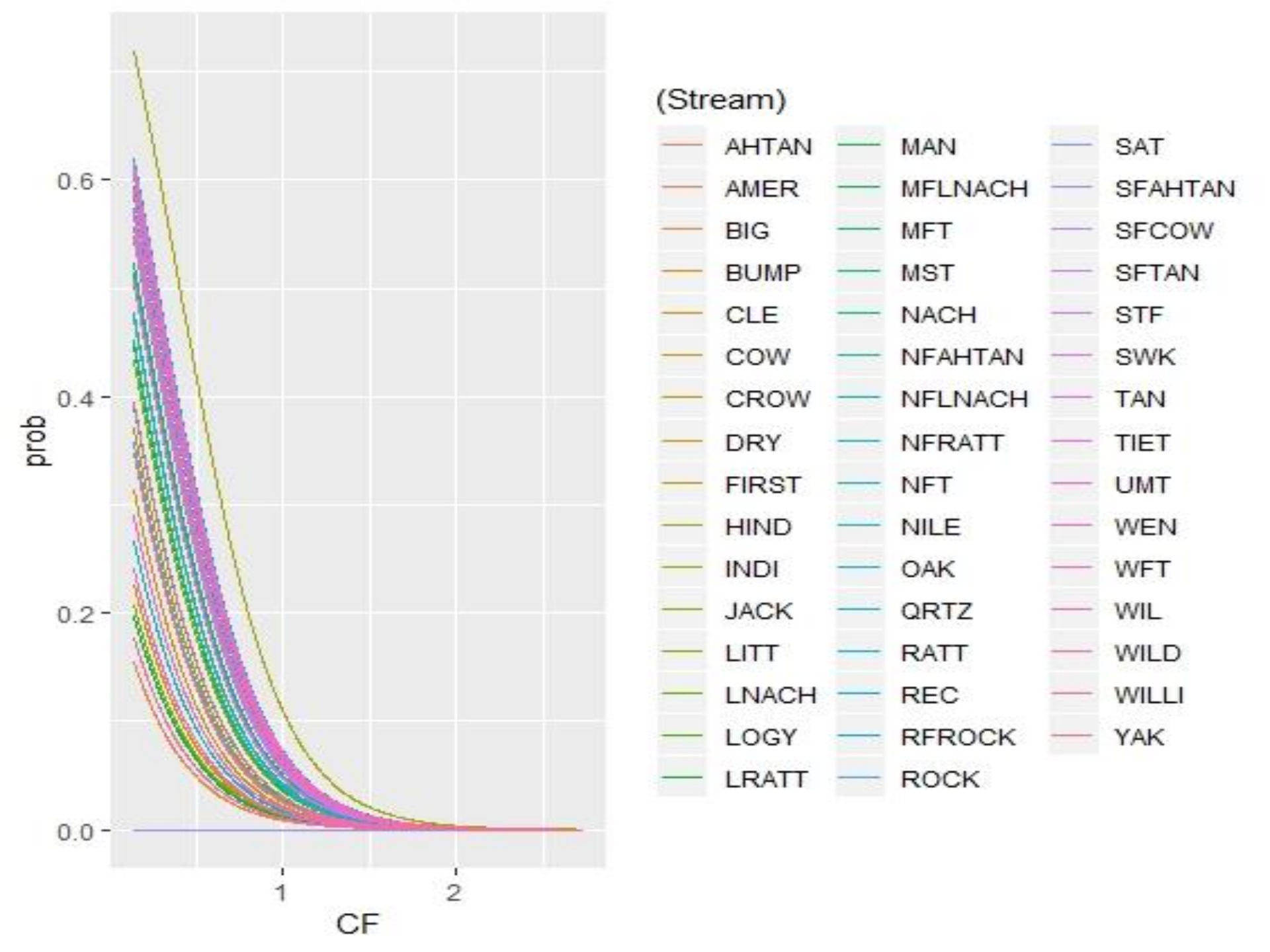


Model Form: Productivity = a + (β_1*v_1) + (β_2* v_2) + (β_x* v_x) where v include summer stream widths, mid-day water temps, discharge, and *O. mykiss* density

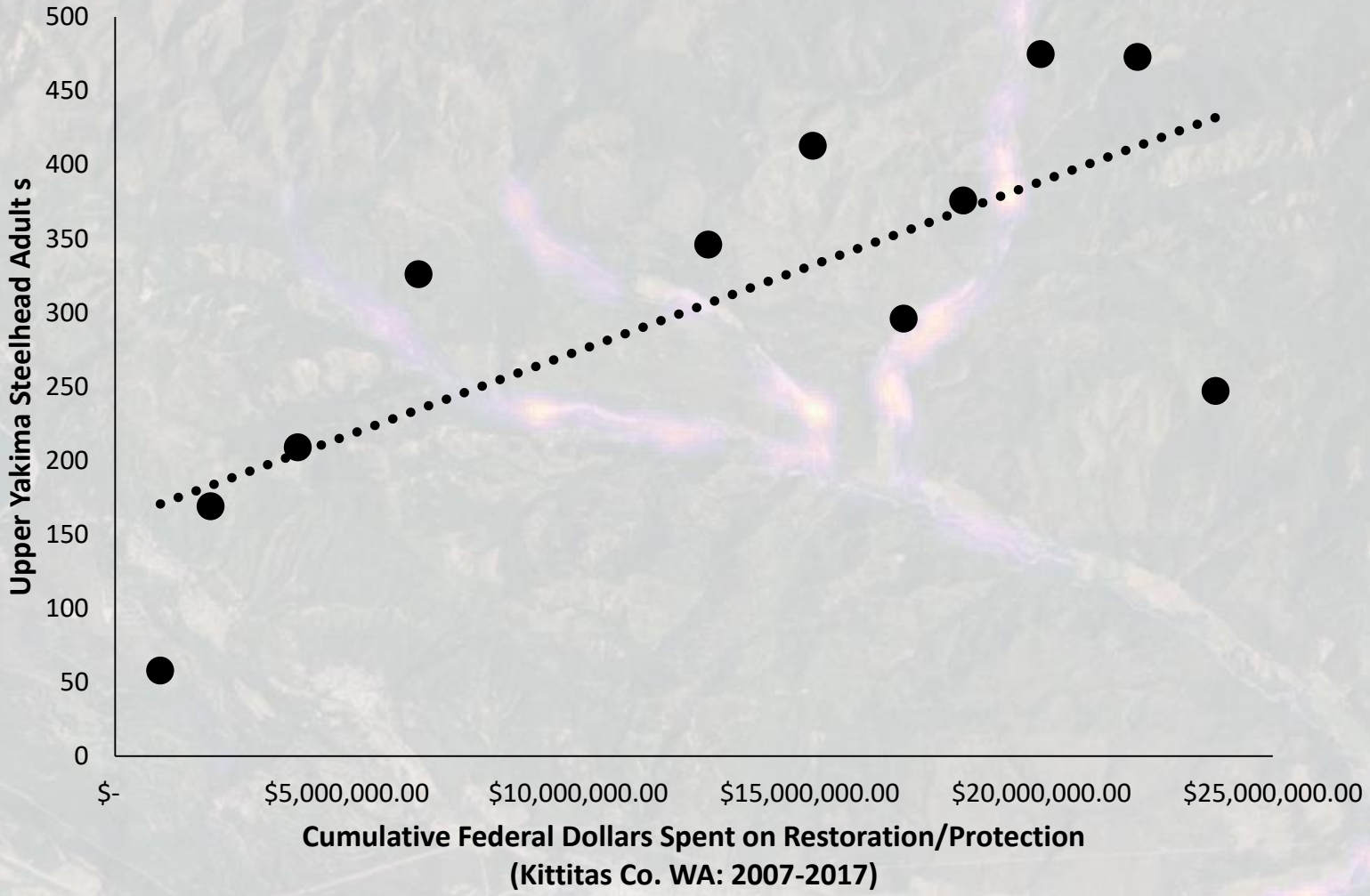
Appears Consistent with McMillan et al. 2011 and Sloat and Reeves 2014



Model Form: Probability of Migration = $\ln[Y/(1-Y)] = \alpha + (\beta_1 * v_1) + (\beta_2 * v_2) + (\beta_X * v_X)$
Where v = fish condition, summer stream wetted widths, mid-day water temperatures and summer base flow


prob
0.0
0.2
0.4
0.6
1
2
CF
(Stream)
AHTAN
AMER
BIG
BUMP
CLE
COW
CROW
DRY
FIRST
HIND
INDI
JACK
LITT
LNACH
LOGY
LRATT
MAN
MFLNACH
MFT
MST
NACH
NFAHTAN
NFLNACH
NFRATT
NFT
NILE
OAK
QRTZ
RATT
REC
RFROCK
ROCK
SAT
SFAHTAN
SFCOW
SFTAN
STF
SWK
TAN
TIET
UMT
WEN
WFT
WIL
WILD
WILLI
YAK

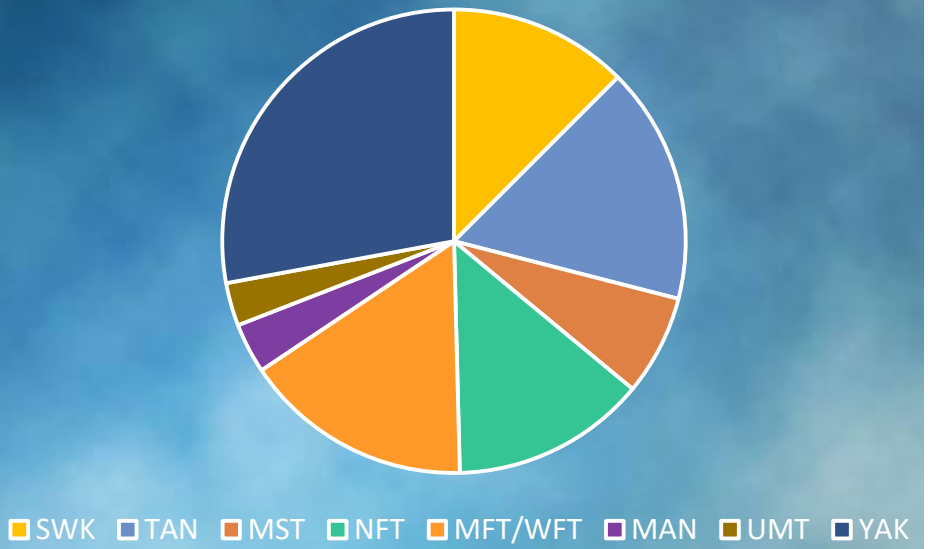
Restoration vs. Steelhead

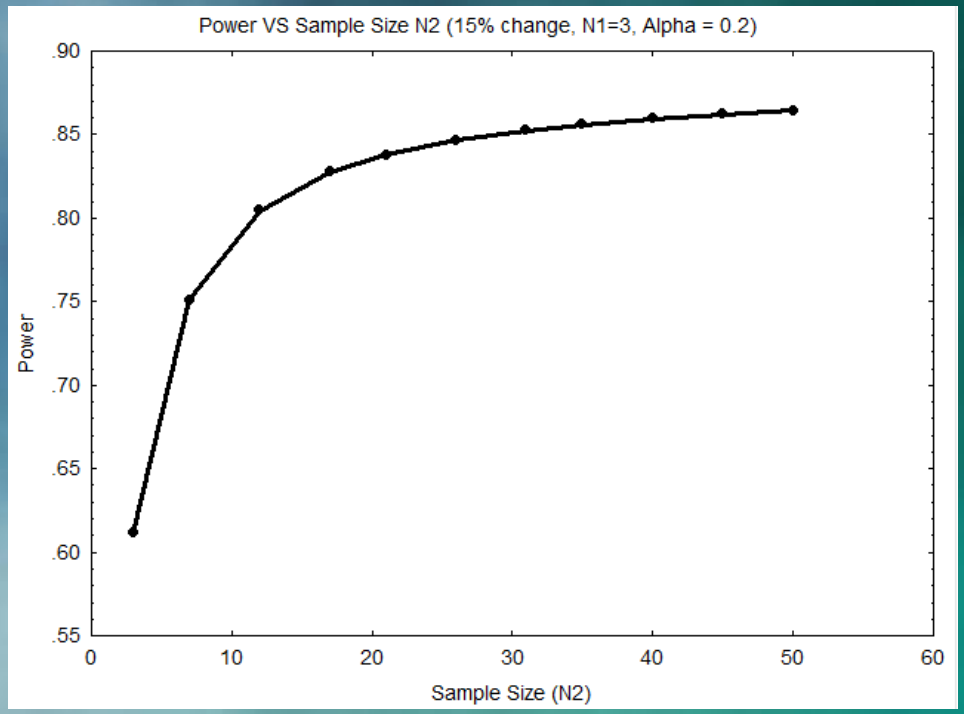


Spatial Structure

- NMFS Recommendation-Determine spatial distribution with the ability to detect a change in distribution of ± 15% with 80% certainty.

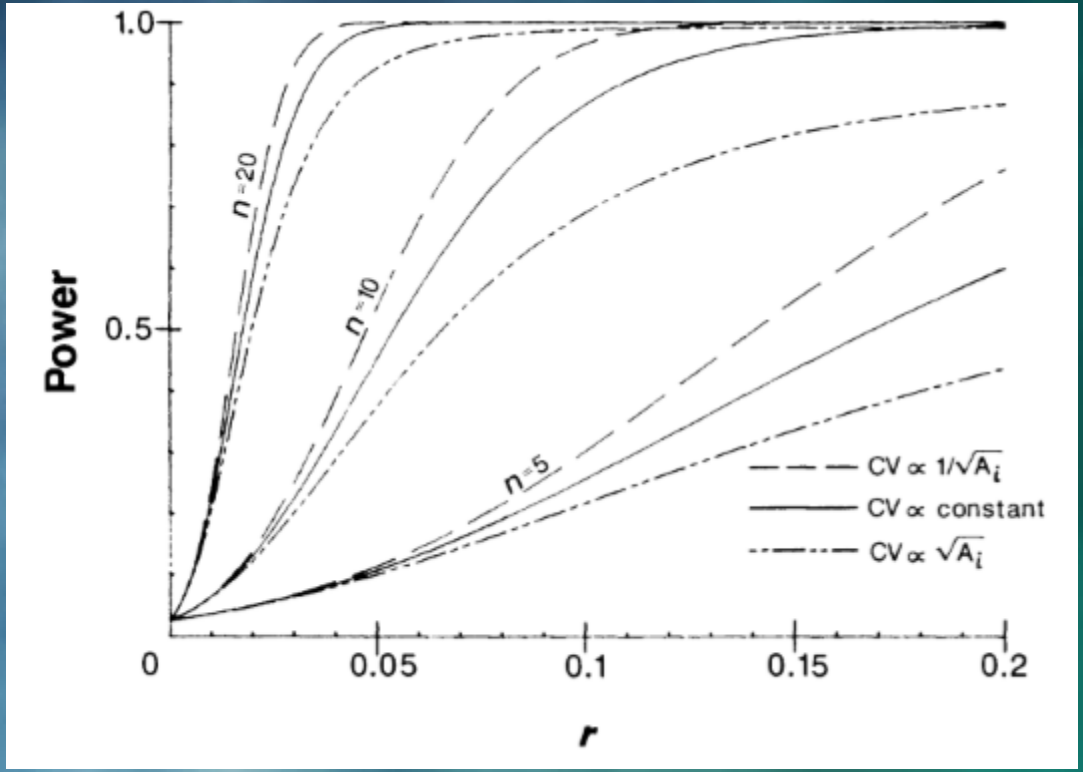
Steelhead Spawner Distribution





Diversity

- Run timing
- Sex ratio's
- Age at maturity
- Spawn timing
- Age distribution
- Size structure
- Genetic sampling
- Life history expression



Gerrodette, T. 1987.
Power Analysis for Detecting Trends.
Ecology 68:1364-1372.

Summary

- Upper Yakima *O. mykiss* may be genetically predisposed to a resident life history and current conditions likely favor that life-history pathway
- Likely different drivers of life-history expression in different geographical areas of the basin
- Interdependency of life-histories and their interaction with the environment suggest restoring habitat features that promote expression of life-history diversity will be more effective than managing adult spawning (McPhee et al. 2007)
- *O. mykiss* life history interaction stuff is complicated