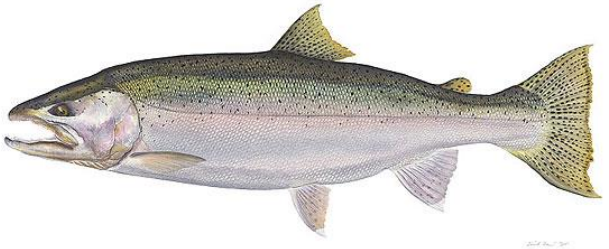


Life-cycle models for Yakima River *O. mykiss*: Breeding interactions and life history production

Chris Frederiksen[§] Neala Kendall[*] Gabe Temple[*] Todd Seamons[*] and Zack Mays [§]

[§]Yakama Nation Fisheries

[*]Washington Department of Fish and Wildlife

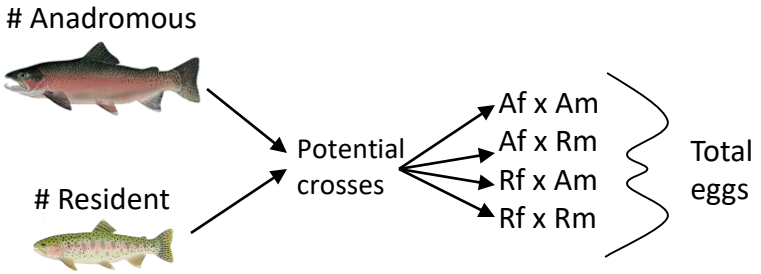
FISHERIES YKFP YAKAMA NATION

BONNEVILLE POWER ADMINISTRATION

Washington Department of FISH and WILDLIFE

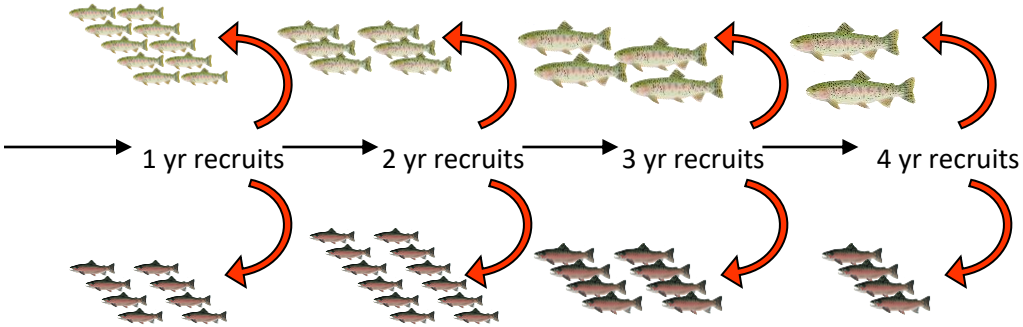
O. mykiss life-cycle model synopsis

1) Breeding Interactions & relative ecotype production:



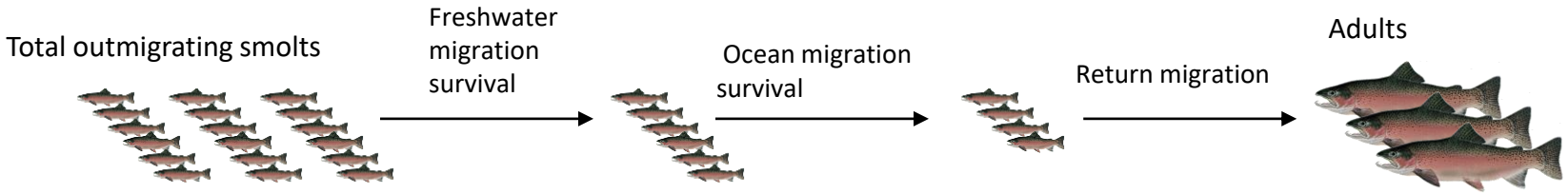
2) Freshwater growth & recruitment

2a) Resident age classes & proportions maturing



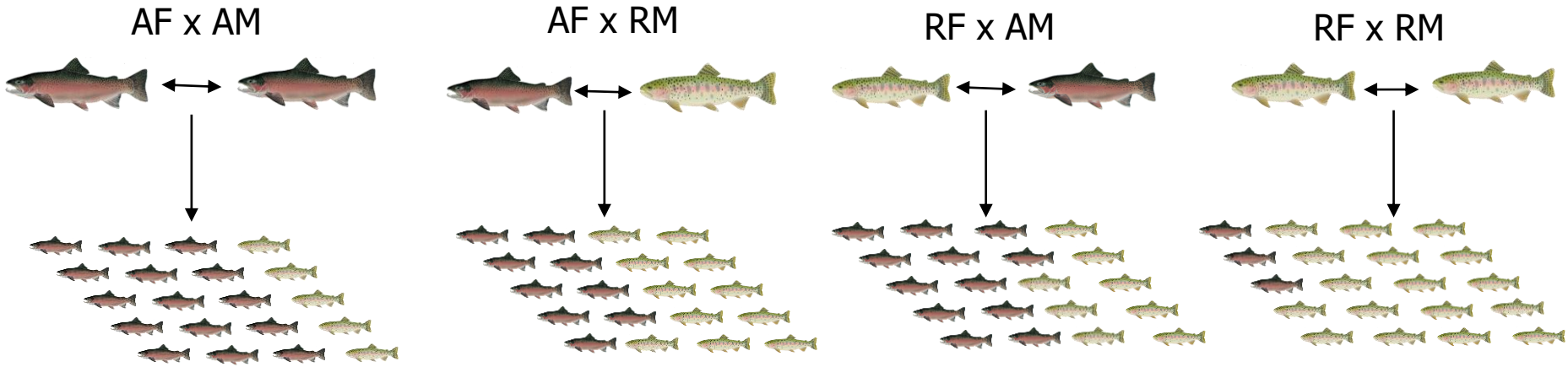
2b) Anadromous recruitment & smolt age

3) Migration survival & adult returns



O.mykiss Breeding Interactions

- Breeding Interactions & relative life history production
  - Degree of sympatry
  - Sex ratios
  - Population viability effects?

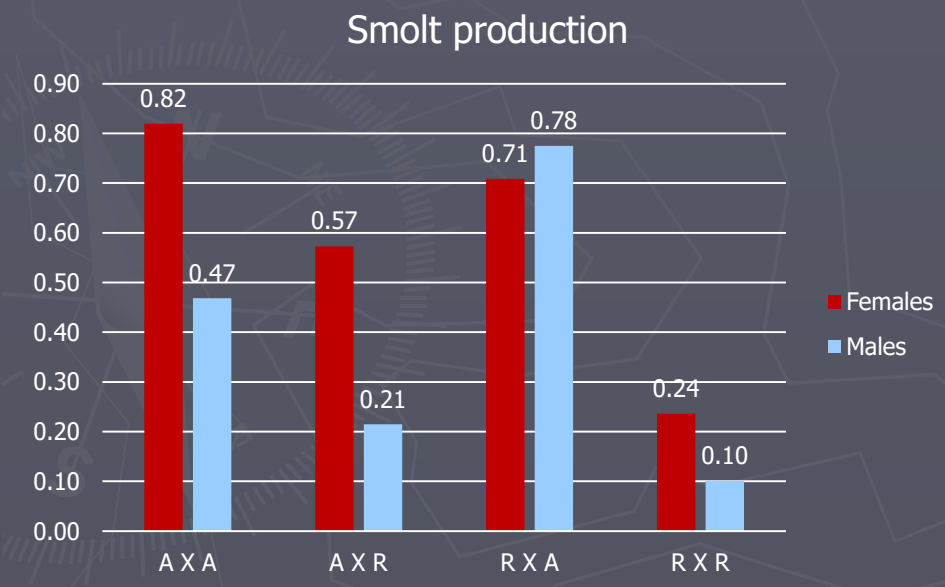


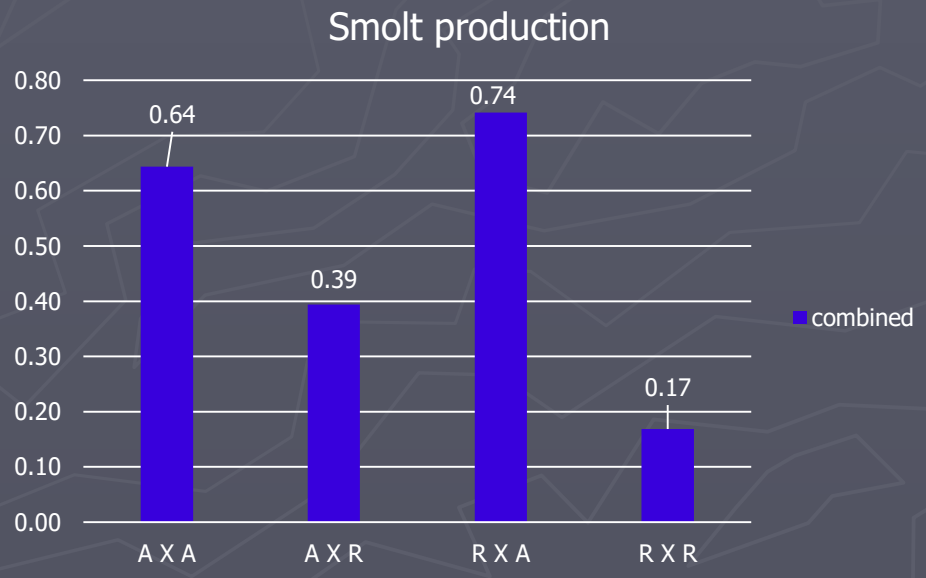
O.Mykiss Breeding Interactions: Evidence for Relative Differences in Anadromous Production

Genetic architecture of growth and early life-history transitions in anadromous and derived freshwater populations of steelhead

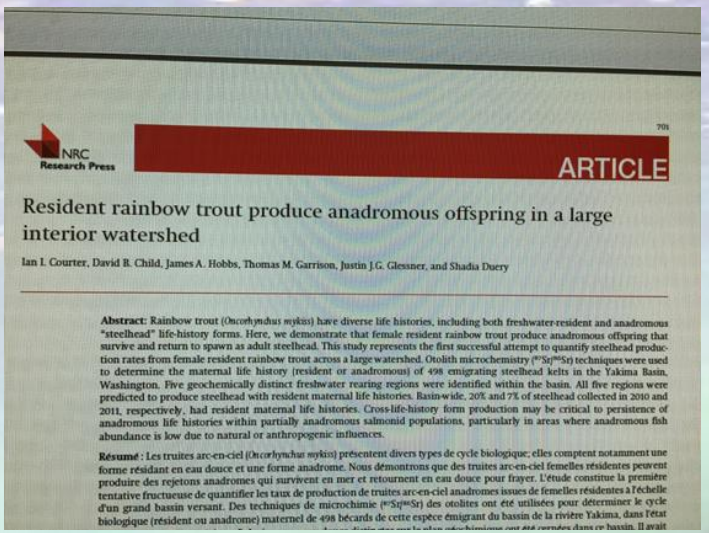
F. P. Thrower*†,J.J.Hard‡ and J. E. Joyce*

*National Marine Fisheries Service, Alaska Fisheries Science Center, Auke Bay Laboratory, 11305 Glacier Highway, Juneau, Alaska 99801, U.S.A. and ‡National Marine Fisheries Service, Northwest Fisheries Science Center, Conservation Biology Division, 2725 Montlake Boulevard East, Seattle, Washington, U.S.A.





O.Mykiss Breeding Interactions



NRC Research Press

ARTICLE

Resident rainbow trout produce anadromous offspring in a large interior watershed

Ian I. Courter, David B. Child, James A. Hobbs, Thomas M. Garrison, Justin J.G. Glessner, and Shadia Duery

Abstract: Rainbow trout (*Oncorhynchus mykiss*) have diverse life histories, including both freshwater-resident and anadromous "steelhead" life-history forms. Here, we demonstrate that female resident rainbow trout produce anadromous offspring that survive and return to spawn as adult steelhead. This study represents the first successful attempt to quantify steelhead production rates from female resident rainbow trout across a large watershed. Otolith microchemistry ($^{87}Sr/^{86}Sr$) techniques were used to determine the maternal life history (resident or anadromous) of 498 emigrating steelhead kelts in the Yakima Basin, Washington. Five geochemically distinct freshwater rearing regions were identified within the basin. All five regions were predicted to produce steelhead with resident maternal life histories. Basin-wide, 20% and 7% of steelhead collected in 2010 and 2011, respectively, had resident maternal life histories. Cross-life-history form production may be critical to persistence of anadromous life histories within partially anadromous salmonid populations, particularly in areas where anadromous fish abundance is low due to natural or anthropogenic influences.

Résumé : Les truites arc-en-ciel (*Oncorhynchus mykiss*) présentent divers types de cycle biologique; elles comptent notamment une forme résidant en eau douce et une forme anadrome. Nous démontrons que des truites arc-en-ciel femelles résidentes peuvent produire des rejetons anadromes qui survivent en mer et retournent en eau douce pour frayer. L'étude constitue la première tentative fructueuse de quantifier les taux de production de truites arc-en-ciel anadromes issues de femelles résidentes à l'échelle d'un grand bassin versant. Des techniques de microchimie ($^{87}Sr/^{86}Sr$) des otolites ont été utilisées pour déterminer le cycle biologique (résident ou anadrome) maternel de 498 bécards de cette espèce émigrant du bassin de la rivière Yakima, dans l'état

- Courter et al 2013
  - Yakima River (Basin-wide) Resident Maternal Origin
    - 2010- 20% sampled kelts
    - 2011- 7% sampled kelts

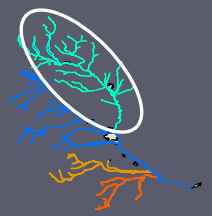
O.Mykiss Breeding Interactions

Breeding Structure of Steelhead Inferred from Patterns of Genetic Relatedness among Nests

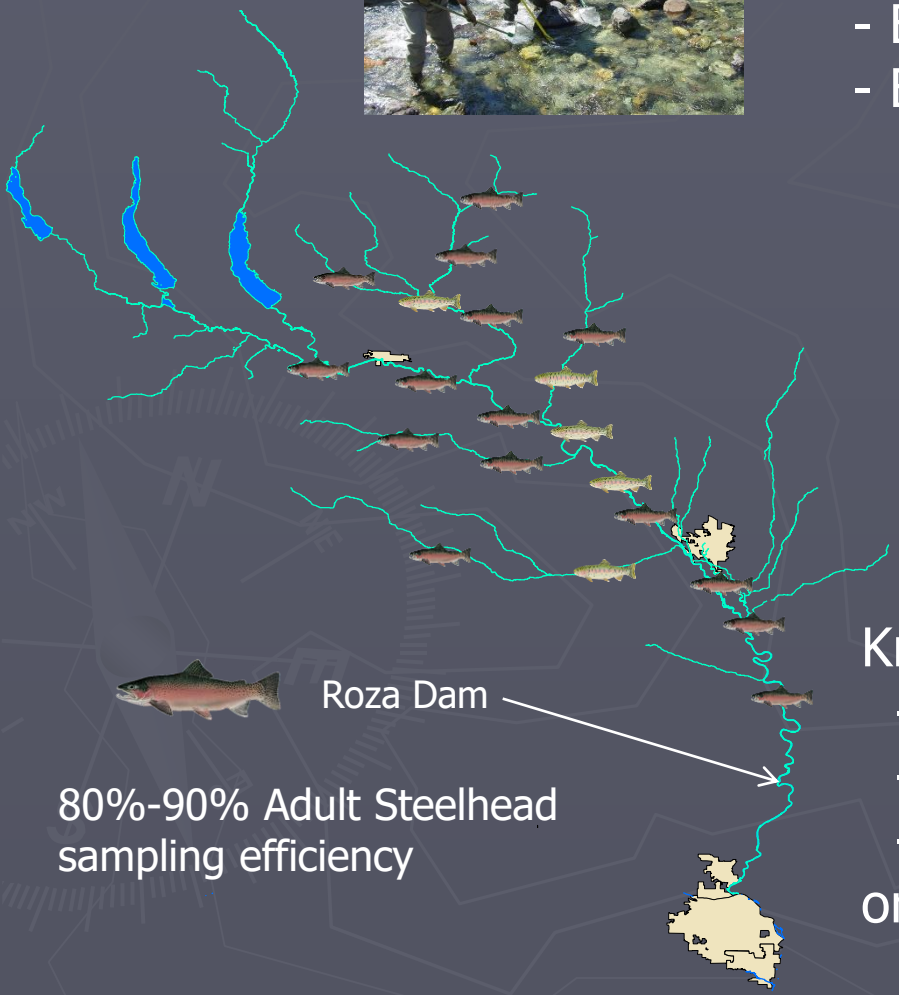
DAVID R. KULIGOWSKI*
National Marine Fisheries Service, Northwest Fisheries Science Center, Conservation Biology Division, Manchester Research Station, Post Office Box 130, Manchester, Washington 98353, USA
MICHAEL J. FORD
National Marine Fisheries Service, Northwest Fisheries Science Center, Conservation Biology Division, 2725 Montlake Boulevard East, Seattle, Washington 98112-2097, USA
BARRY A. BEREJIKIAN
National Marine Fisheries Service, Northwest Fisheries Science Center, Resource Enhancement and Utilization Technology Division, Manchester Research Station, Post Office Box 130, Manchester, Washington 98353, USA

- 8 Redds created by minimum 21 parents
  - 5 females
  - 16 males

Upper Yakima River Parent Progeny Analysis (2010-2015)



Tributary and Mainstem Juvenile Sampling:
- -Electroshocking
- - Biodata collected, fish PIT-tagged
- - Both life histories sampled and tagged



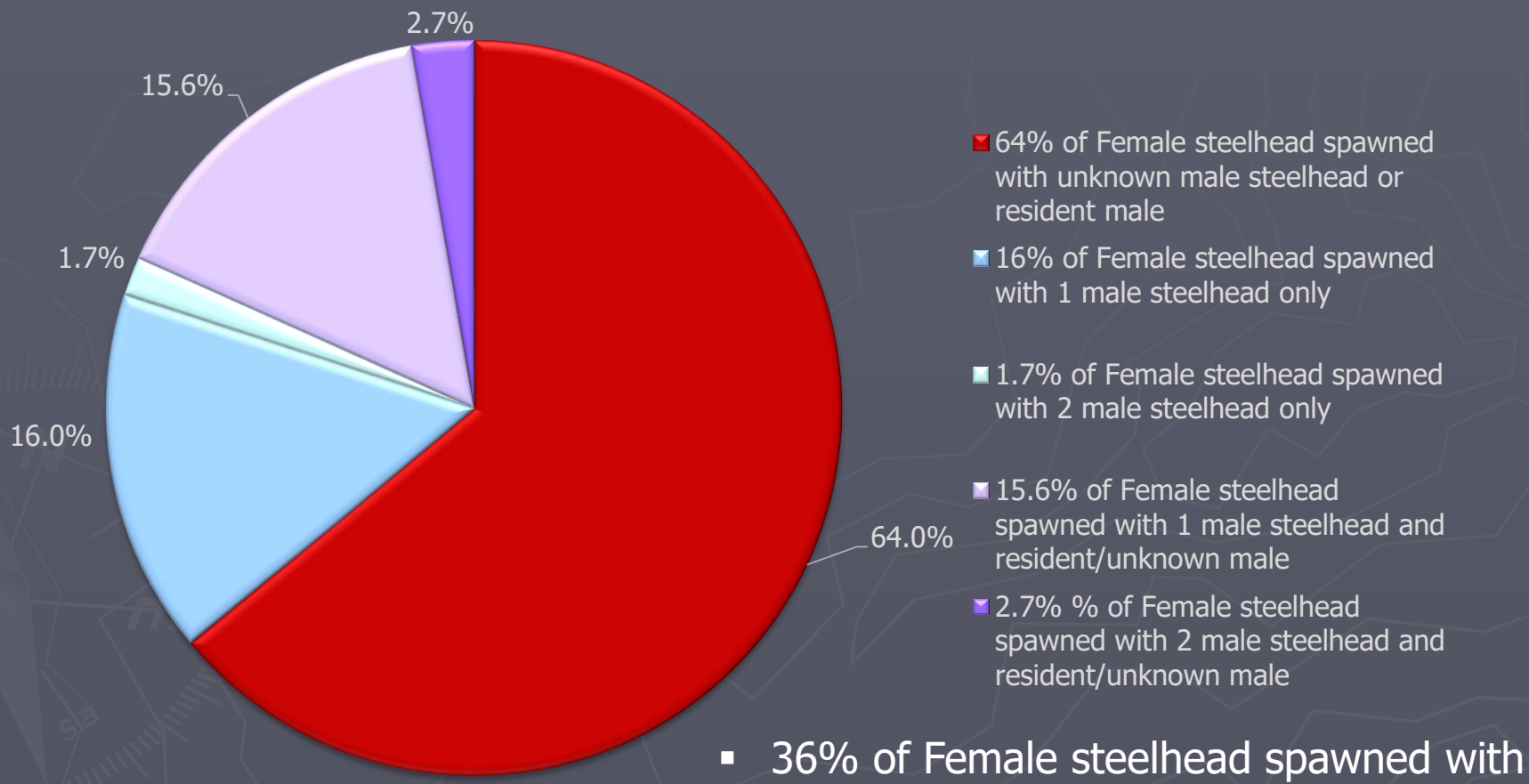
80%-90% Adult Steelhead sampling efficiency

Known Anadromous Expression:
- -Migrants detected at downstream Dams
- -Parent analysis run with genetic sample
- - Presence/absence of maternal/paternal origin determined

*Breeding Cross Inferred

Roza Adult Steelhead Parentage/Progeny Analysis: 2010-2015

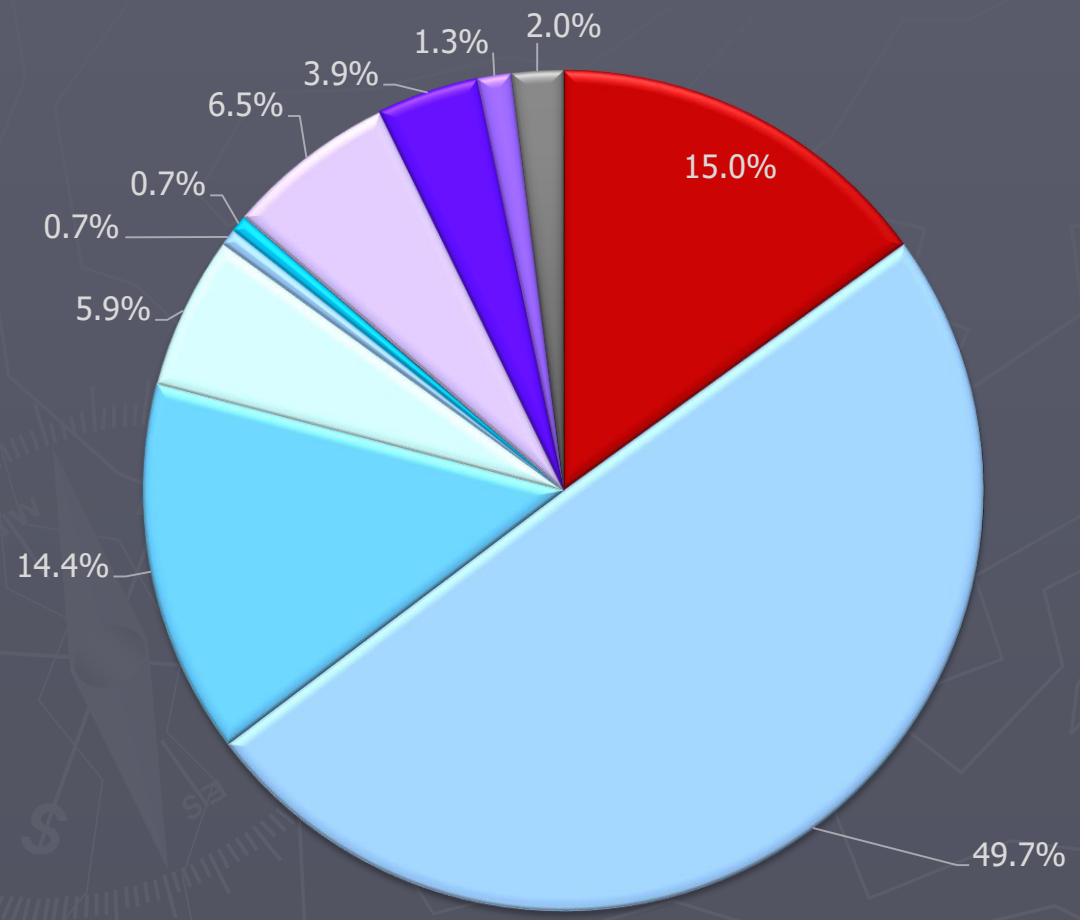
Female Steelhead:



- 36% of Female steelhead spawned with Male steelhead
  - Could be as high as 50%

Roza Adult Steelhead Parentage/Progeny Analysis: 2010-2015

Male Steelhead:



Roza Adult Steelhead Parentage/Progeny Analysis: 2010-2015

		Males	Females
sex ratios		25.4%	74.6%
	1000	254	746

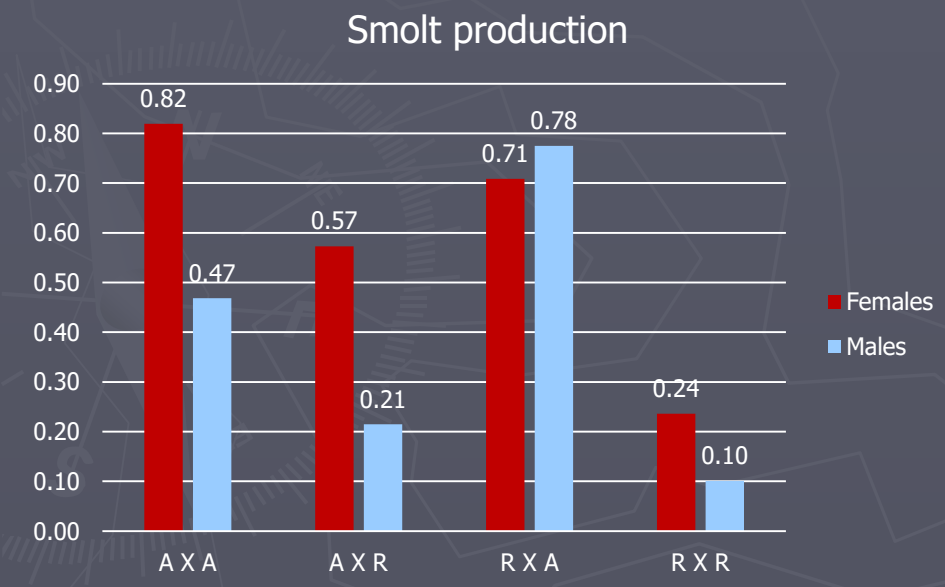
	Male allocation	Female allocation
15% M steelhead spawned with unknown female or resident female	38	0
49.7% M steelhead spawned with 1 female steelhead	126	126
14.4% M steelhead spawned with 2 female steelhead	37	74
5.9% M steelhead spawned with 3 female steelhead	15	45
0.7% M steelhead spawned with 4 female steelhead	2	8
0.7% M steelhead spawned with 5 female steelhead	2	10
6.5% M steelhead spawned with 1 female steelhead and another unknown	17	17
3.9% M steelhead spawned with 2 female steelhead and another unknown	10	20
1.3% M steelhead spawned with 3 female steelhead and another unknown	3	9
2.0% M steelhead spawned with 4 female steelhead and another unknown	5	20
Total	254	329

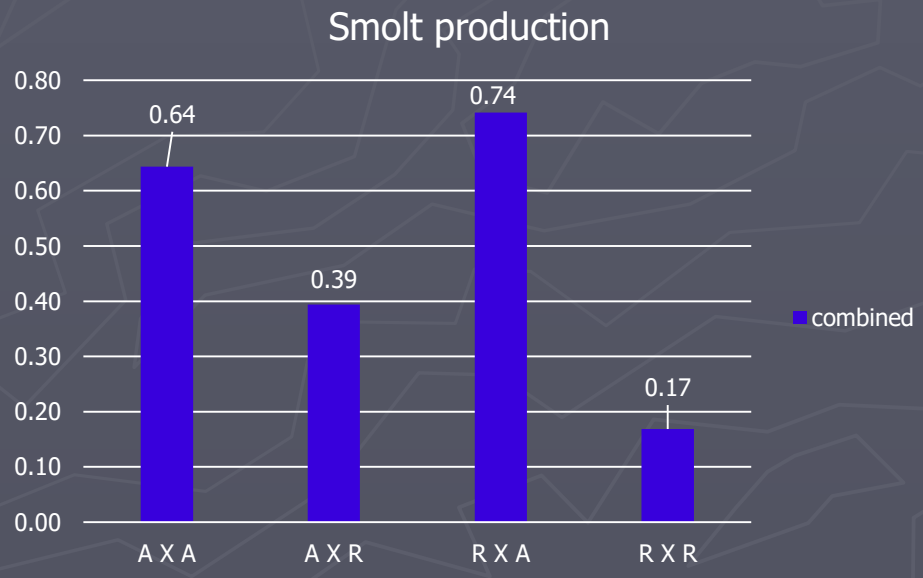
Minimum % females that spawned with male steelhead 44.1%

* Possible or more likely estimate 49.2%

O.Mykiss Breeding Interactions

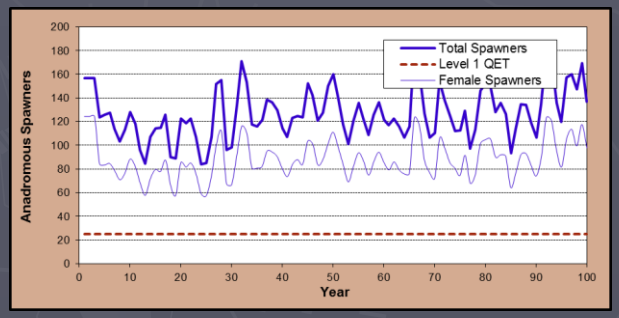
- But does it really matter??
  - Total net smolt production
    - AFxAM + AFxRM

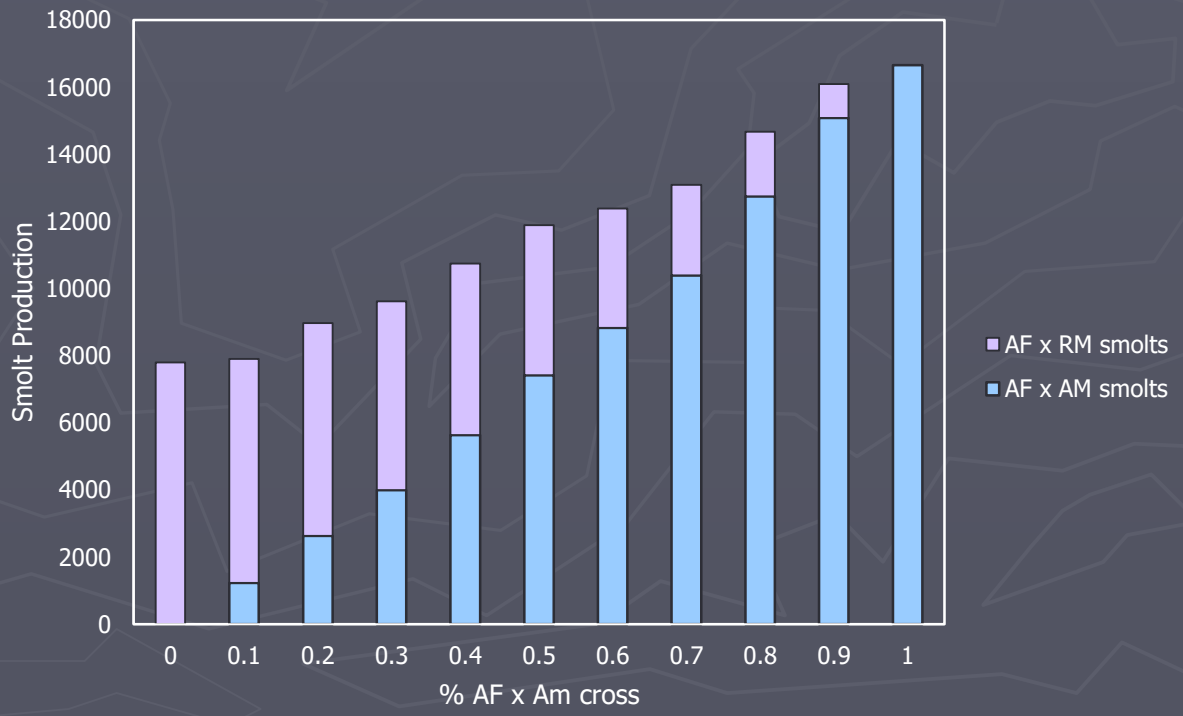




O.Mykiss Breeding Interactions

- Model Simulation
  - Breeding interaction scenarios
    - % AF x AM crosses (10% increments)
    - Average of 50 simulations (100 generations)





O.Mykiss Breeding Interactions

- Initial Conclusions:
  - Breeding interactions are complex and highly variable
  - Degree of fidelity or hybrid breeding crosses have potential to:
    - Influence smolt production
    - Influence mature sex ratios between anadromous and resident life histories
  - Degree of anadromous fidelity breeding crosses may be a function of male abundance (Anadromous males)

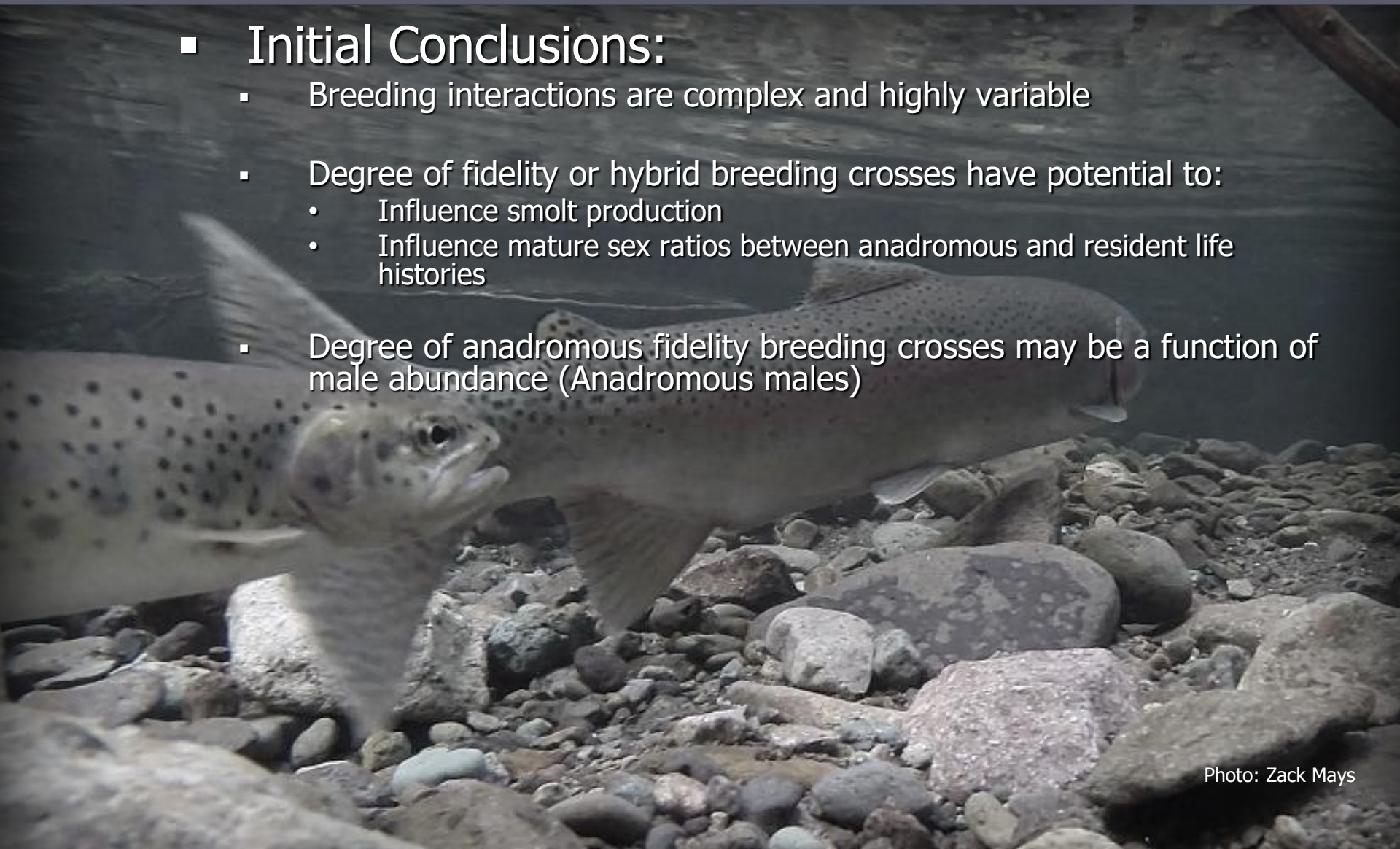


Photo: Zack Mays

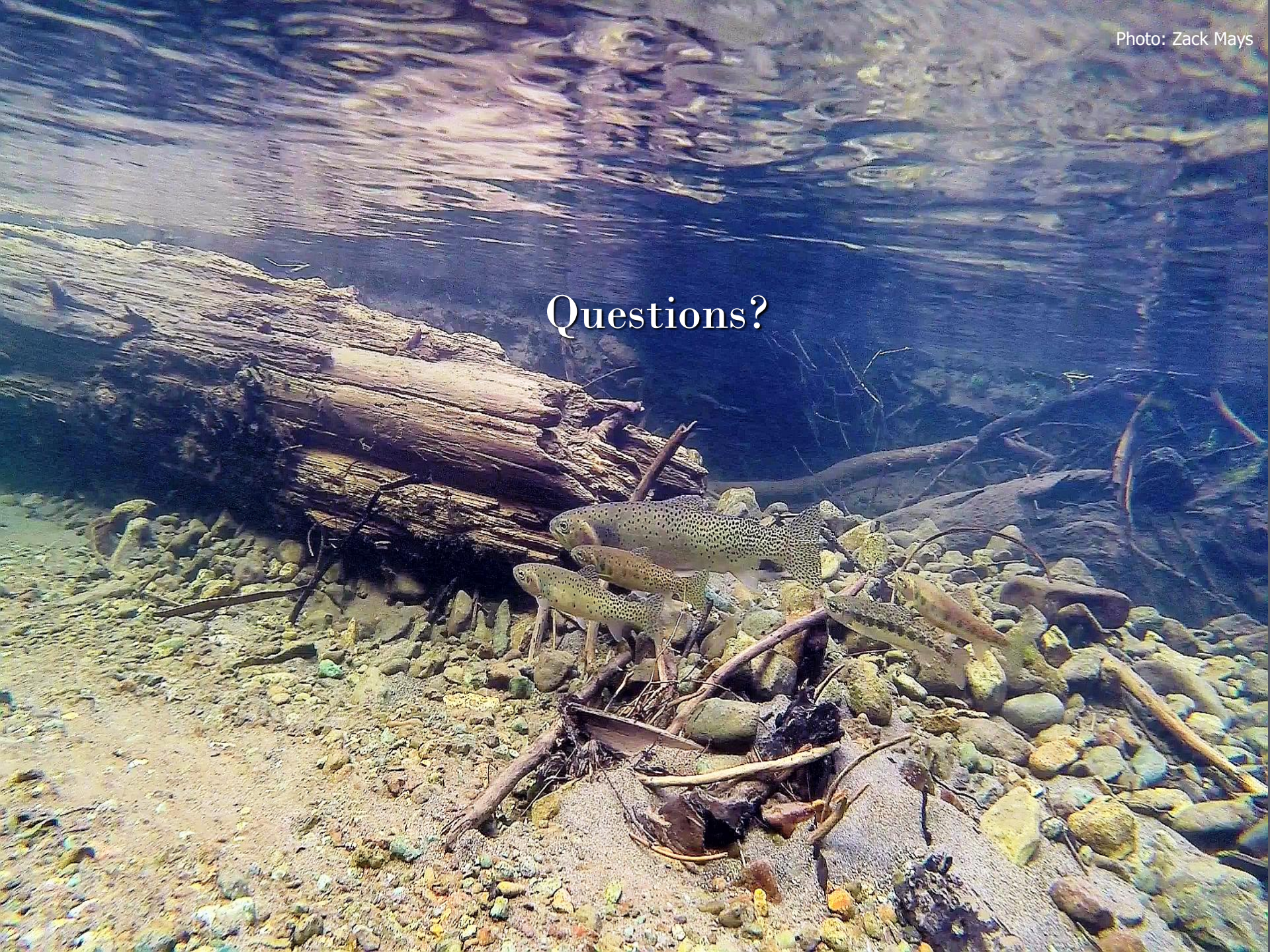


Photo: Zack Mays
Questions?