PC: John McMillan

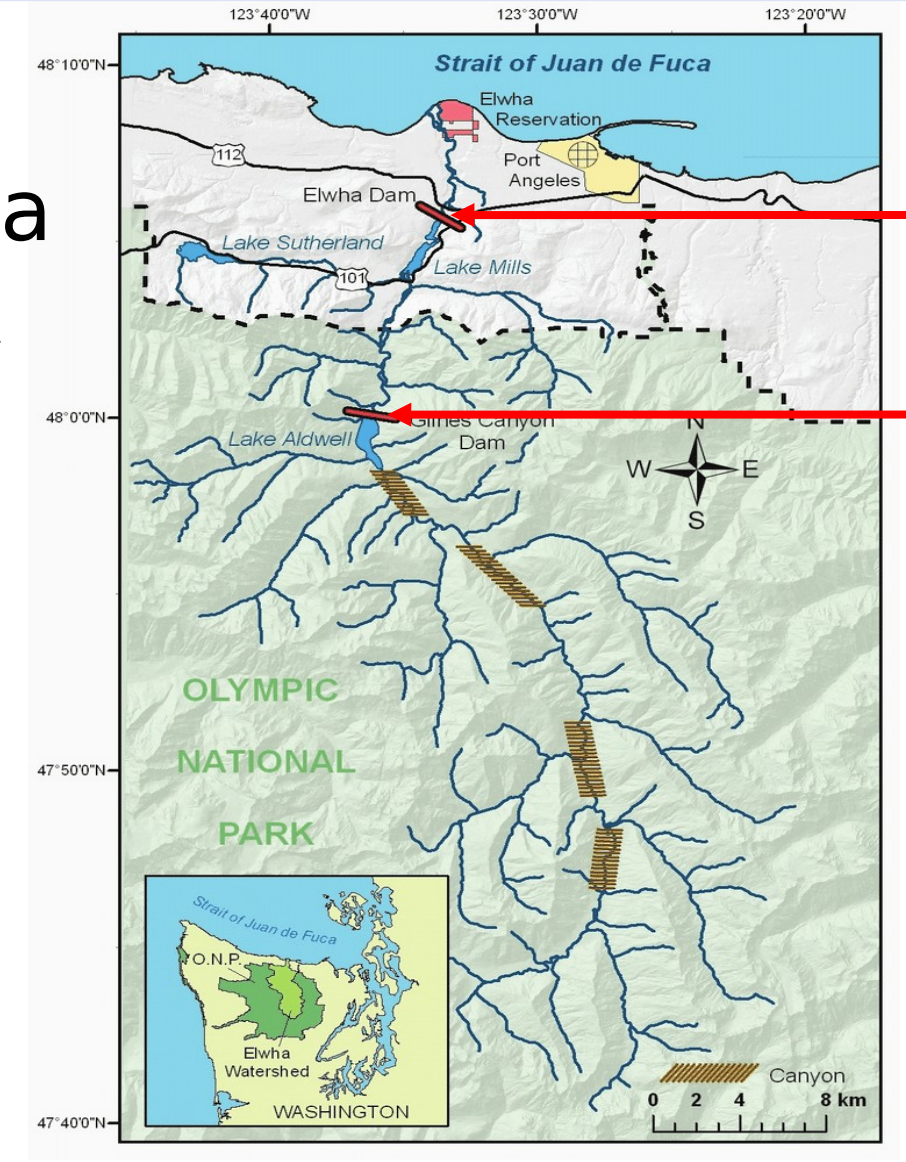
Genetic diversity following dam removal and recolonization of Steelhead in the Elwha River

Krista Nichols
George Pess
Todd Bennett
Abigail Wells
Garrett McKinney
Gary Winans
Alexandra Fraik
Joanna Kelley
John McMillan
Mike McHenry

Two dams constructed restricted water flow and movement

Elwha River

Olympic Peninsula
Washington, USA

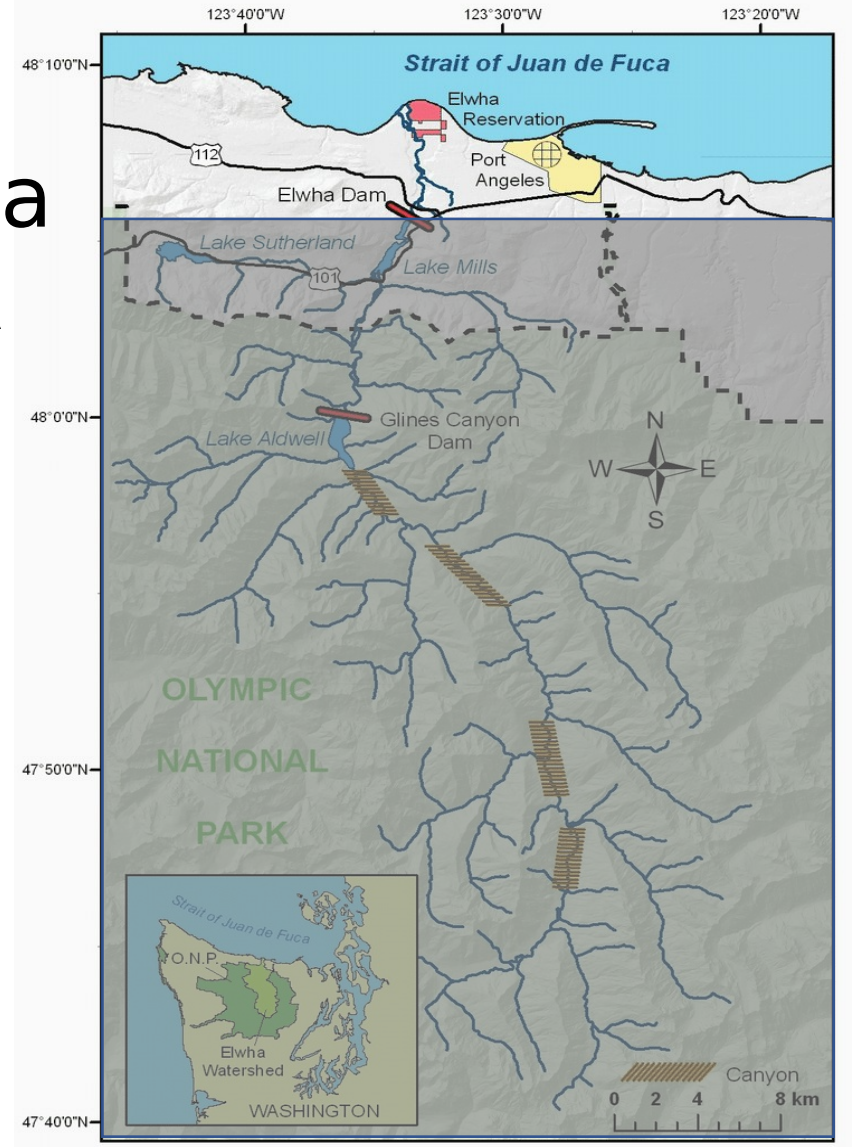


Elwha River Dam (1915)

Glines Canyon Dam (1924)

Construction of the Glines Canyon and Elwha River Dams

Elwha River
Olympic Peninsula
Washington, USA



> 90% habitat inaccessible to Steelhead

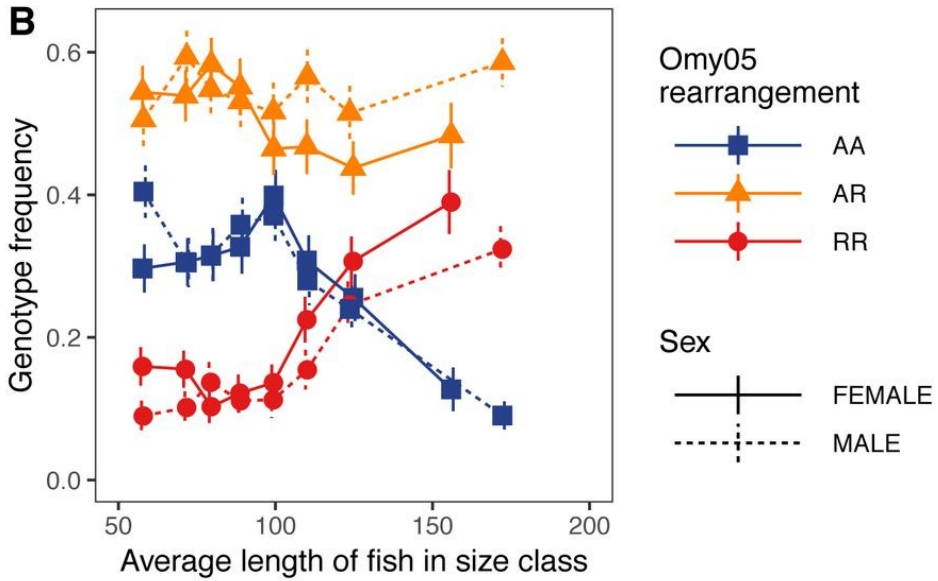
Dam removal drastically changed the landscape

Glines Canyon Dam 20011

Glines Canyon Dam 2019

Candidate loci for phenotypic variation in migration

Omy5
Candidate for Anadromy



Adapted from Pearse et al (2019) Nature
see also Pearse et al. (2018), Pearse et al. (2014)

Candidate loci for phenotypic variation in migration

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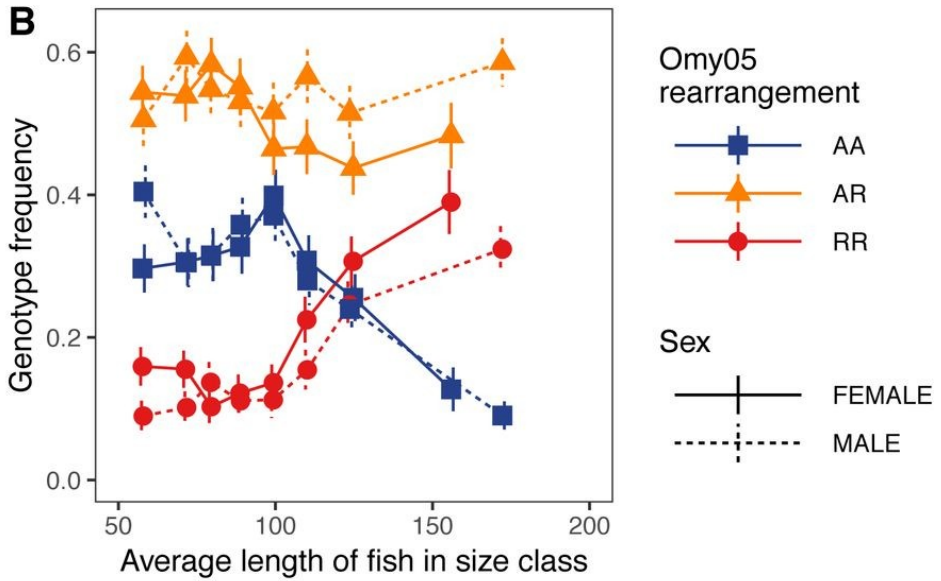
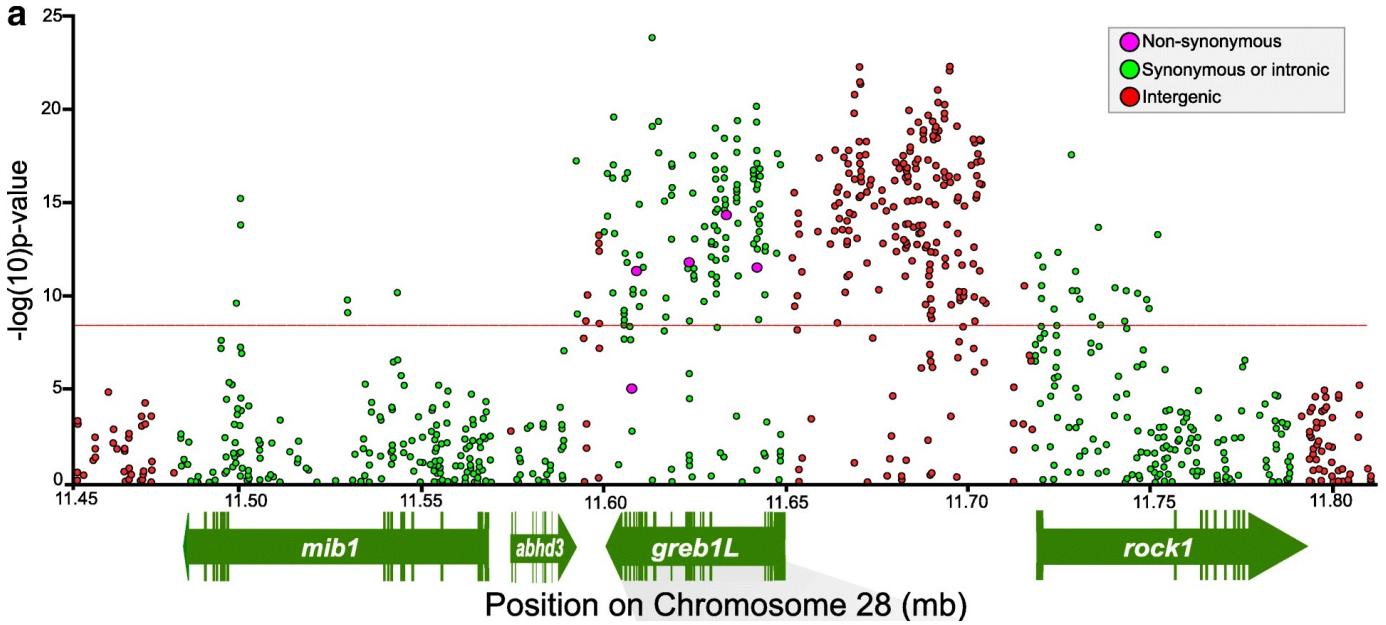


Adapted from Pearse et al (2019) Nature
see also Pearse et al. (2018), Pearse et al. (2014)

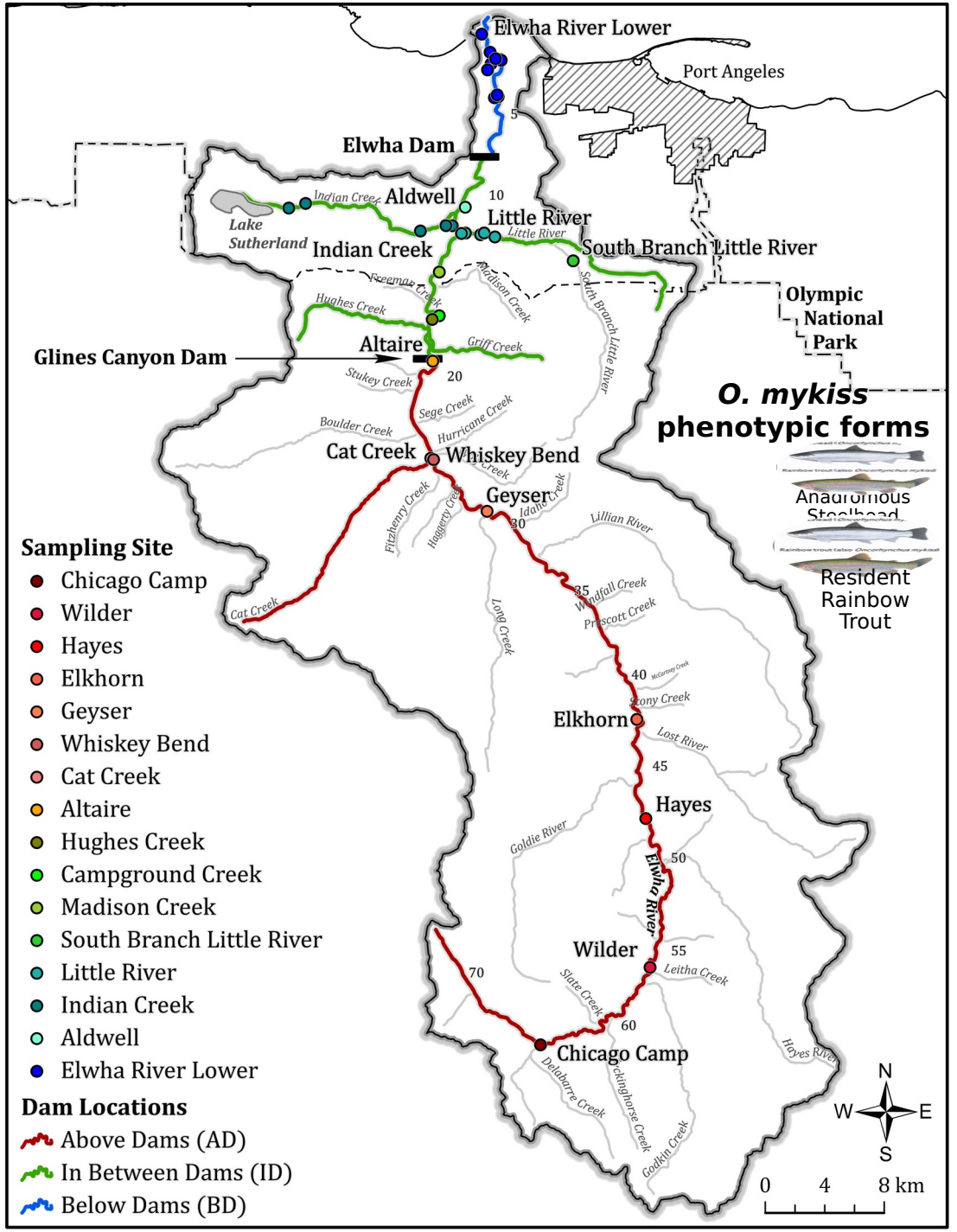
Omy28
Candidate for Run-Timing



Adapted from Michelletti et al (2018
see also Prince et al. (2017), Hess et al (201

Population genetics char
Steelhead recolonization

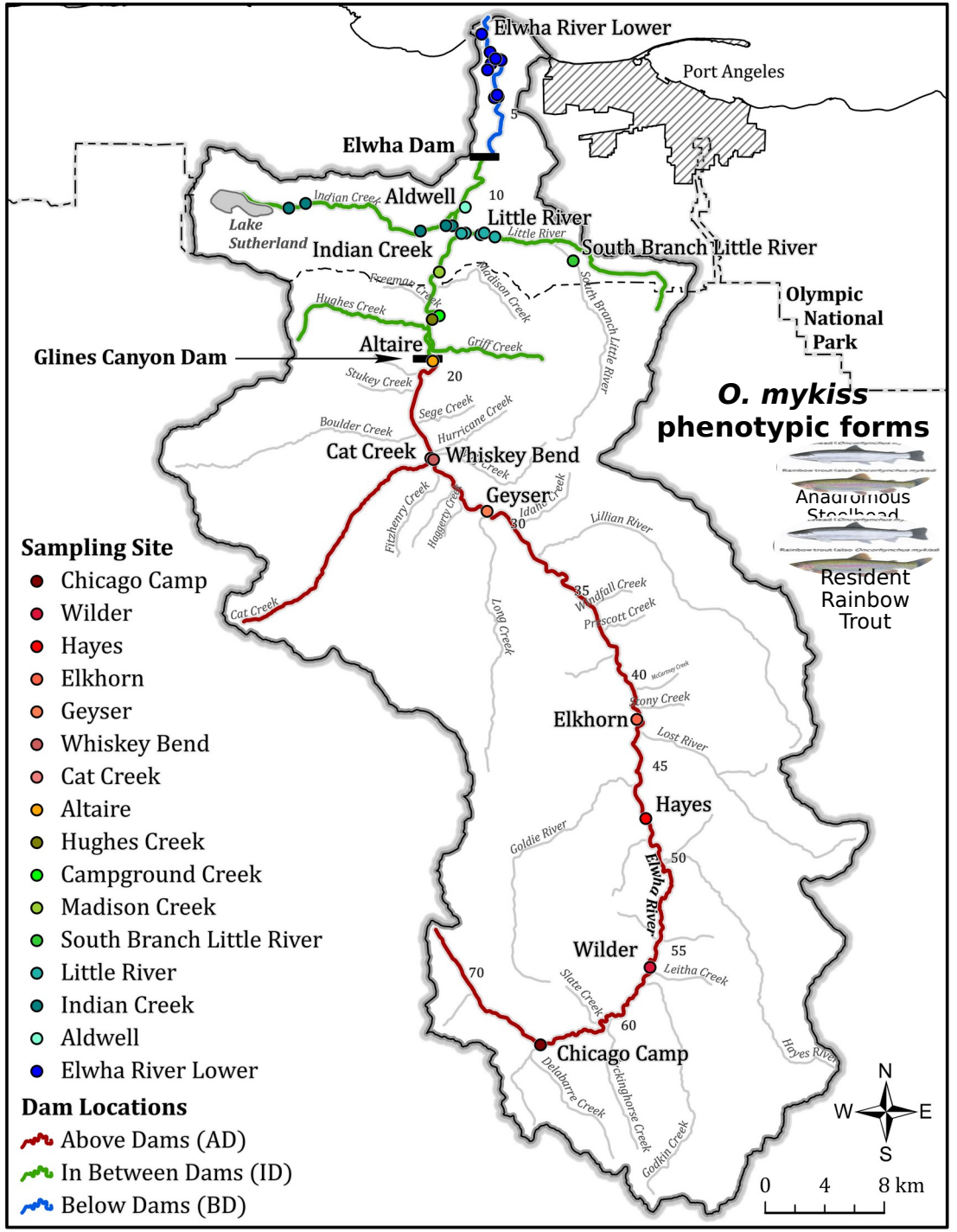
1. How does genetic population structure and diversity change through time following dam removal?



Cartoon Credit: Dr. Katie O' Reilly

Population genetics char
Steelhead recolonization

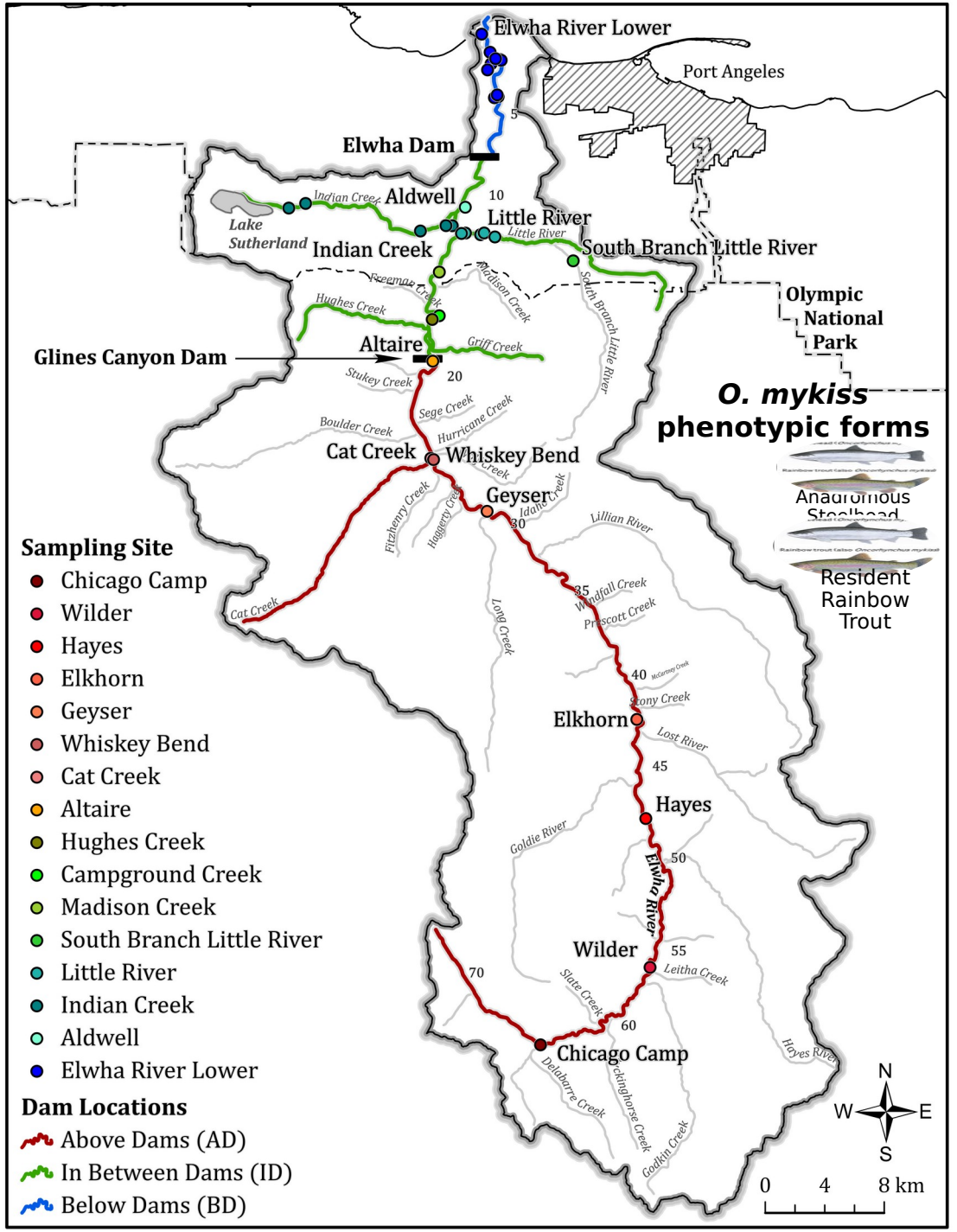
1. How does genetic population structure and diversity change through time following dam removal?
2. What is the source for alleles previously associated with run-timing and anadromy post-dam removal?



Cartoon Credit: Dr. Katie O' Reilly

Population genetics char
Steelhead recolonization

1. How does genetic population structure and diversity change through time following dam removal?
2. What is the source for alleles previously associated with run-timing and anadromy post-dam removal?
3. What patterns do these loci tell us about how Steelhead are recolonizing the Elwha River watershed?

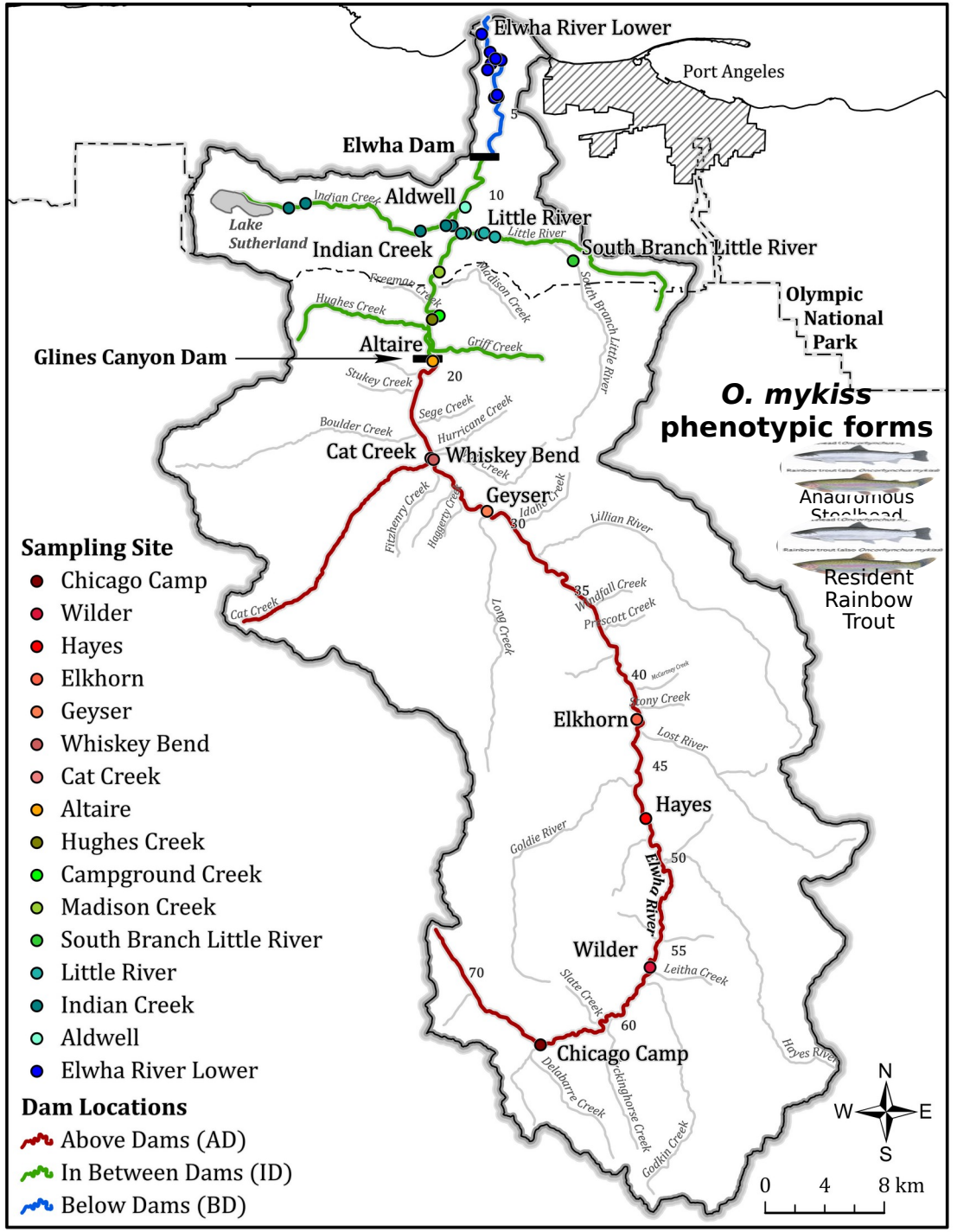


Cartoon Credit: Dr. Katie O' Reilly

Population genetics char
Steelhead recolonization

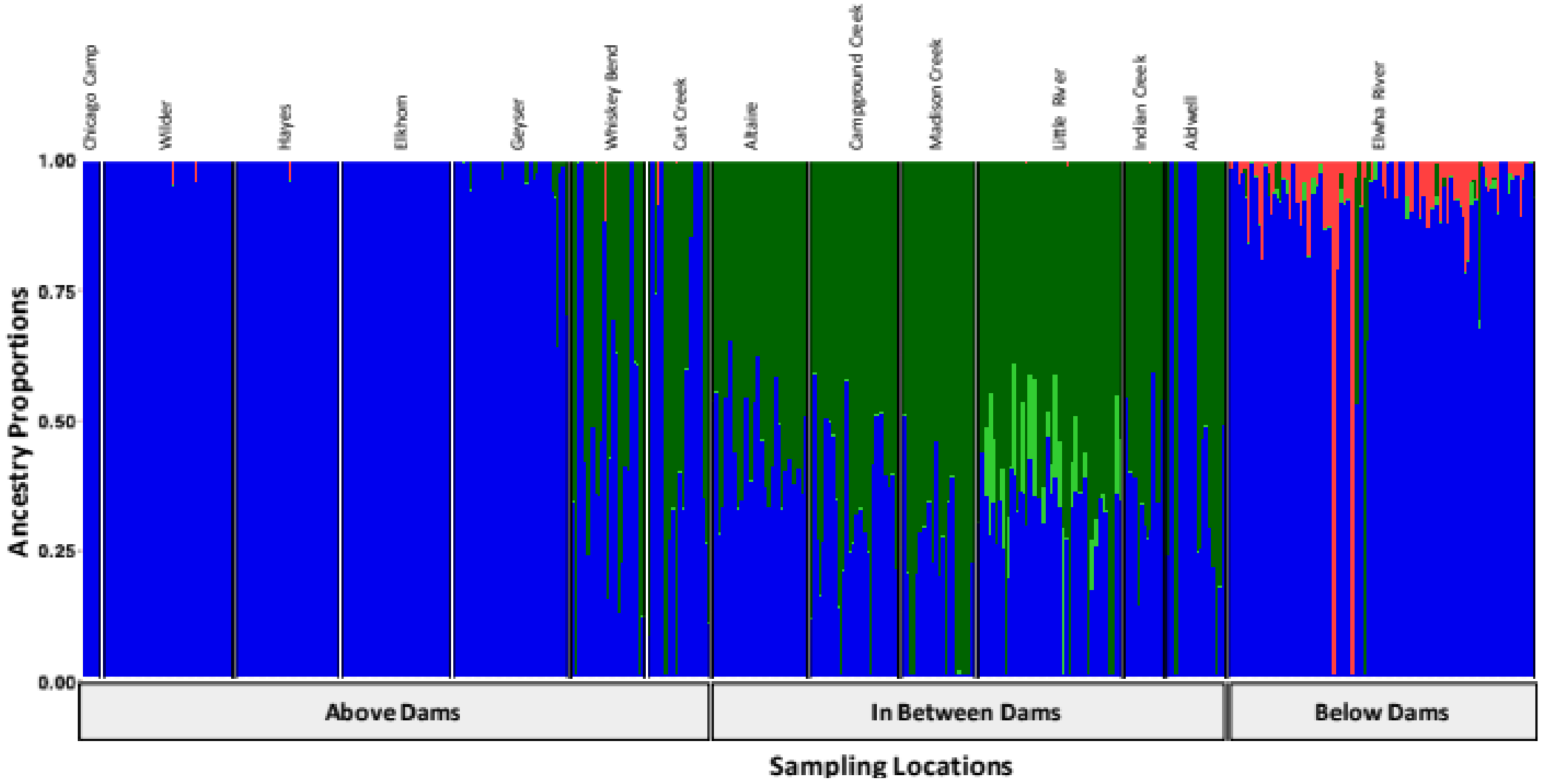
1,125 individuals genetically sequenced

- 567 rainbow trout and steelhead pre-dam removal
- 558 Steelhead post-dam removal
  - Adult steelhead and juvenile smolts
- Collected 2004-2017
- 71,320 genetic variants or single nucleotide polymorphisms (SNPs) throughout the genome

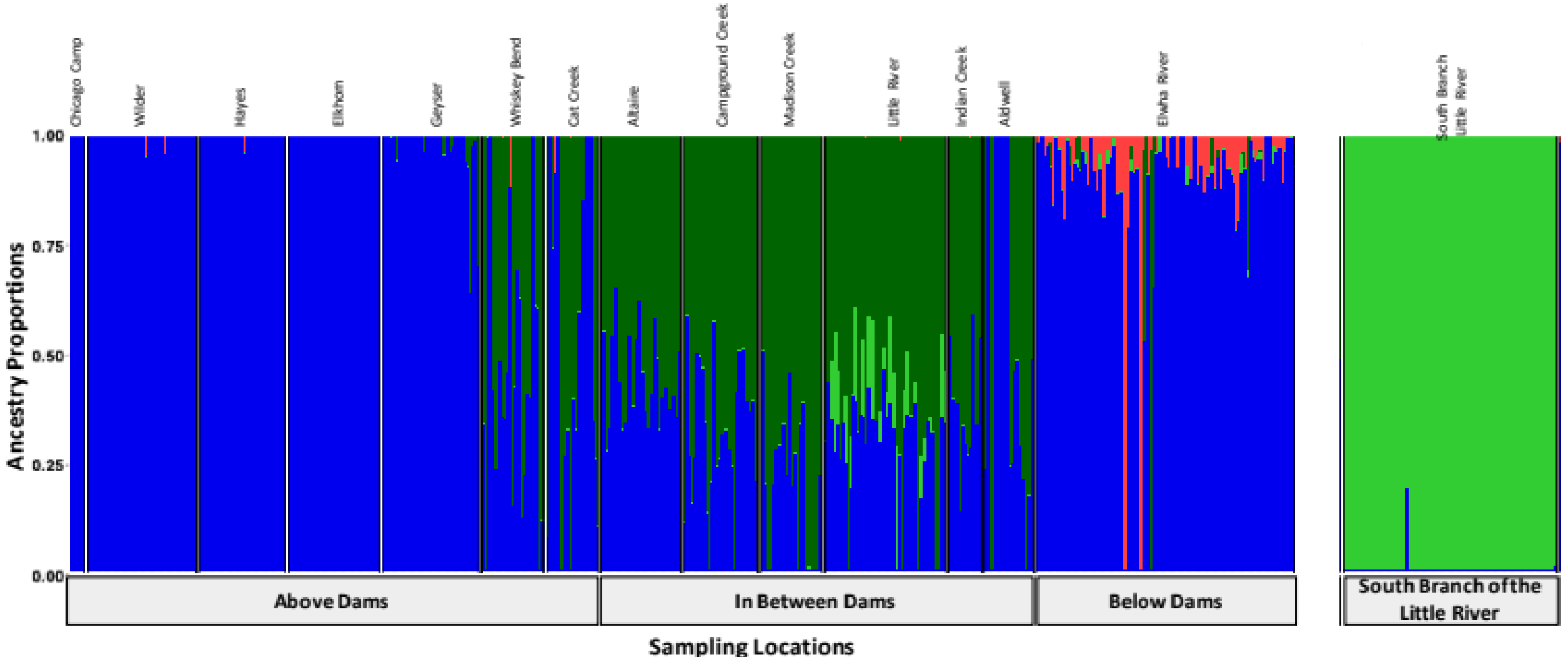


Cartoon Credit: Dr. Katie O' Reilly

Before the dams were removed, we detected 3 distinct genetic clusters primarily generated by anadromous barriers



We also looked at a population pre-dam removal that was separated by a natural barrier (South Branch of the Little River)

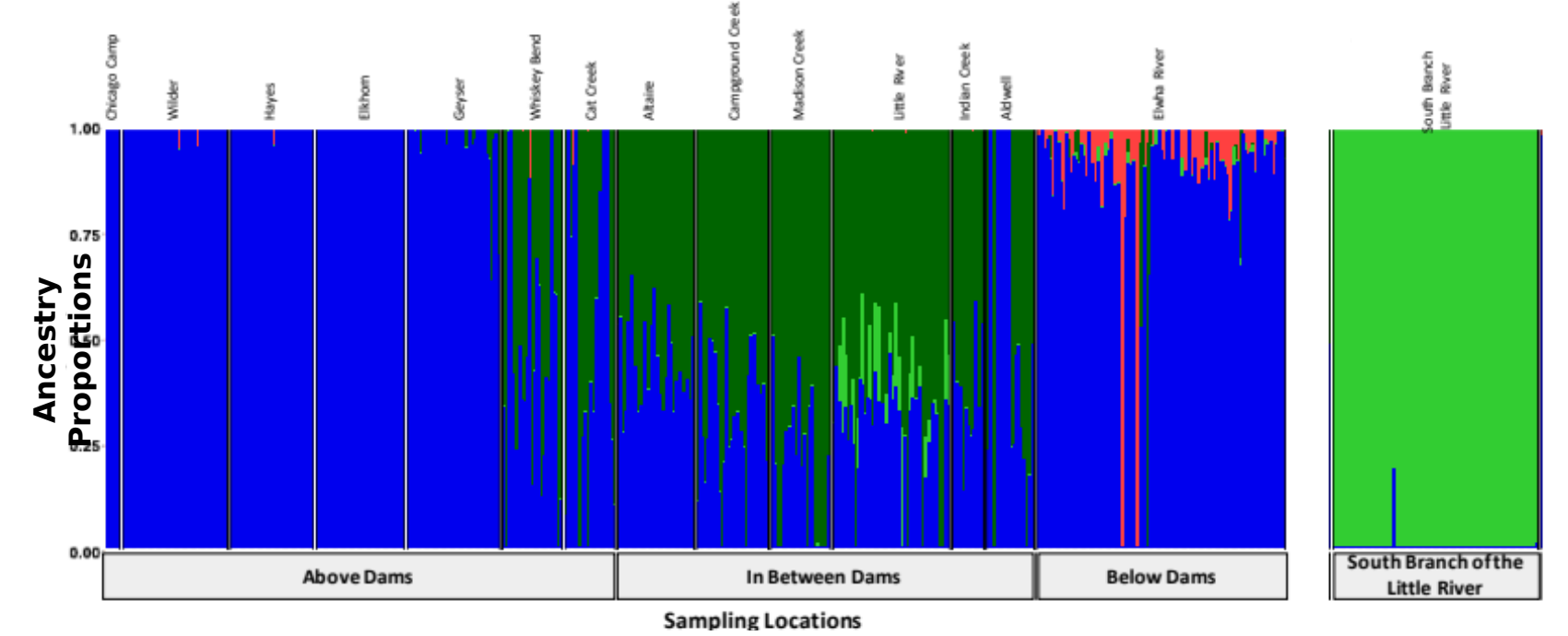


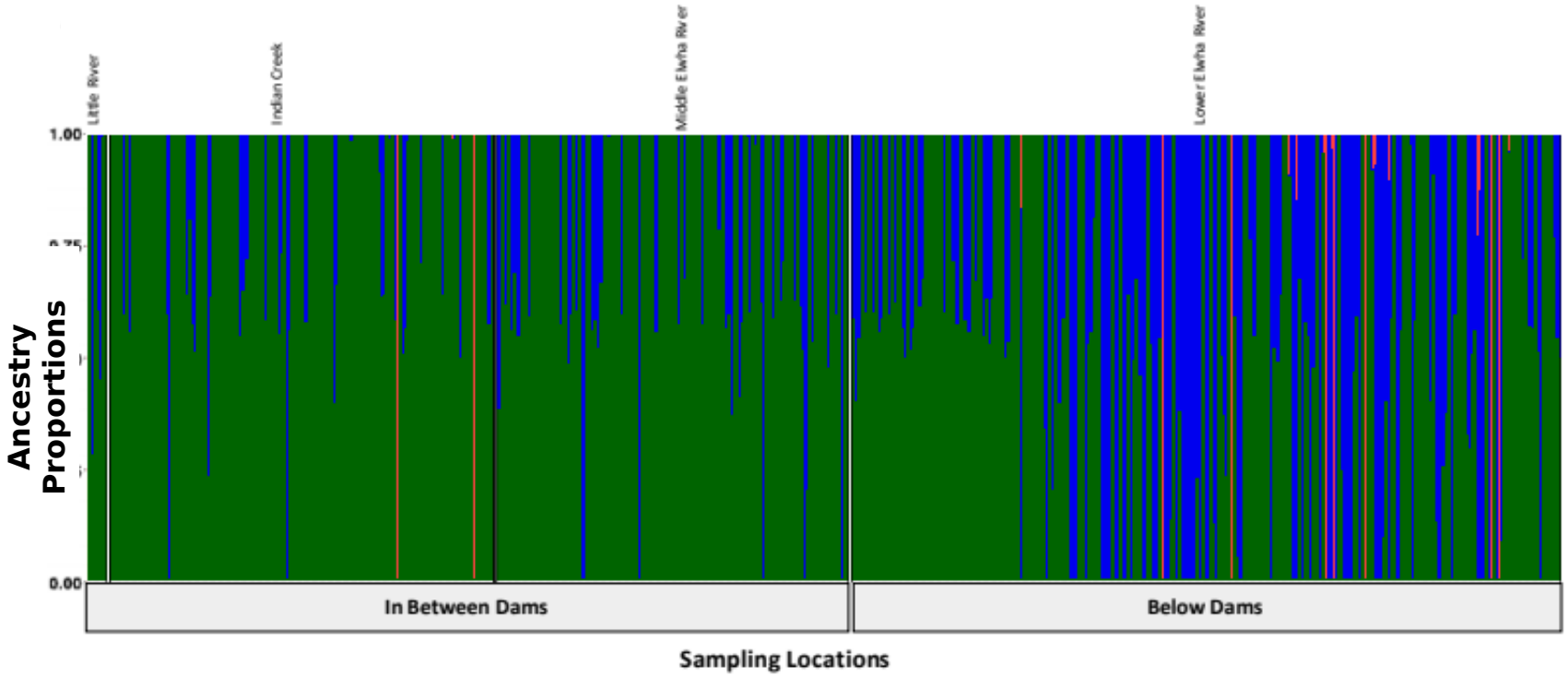
Pre-dam Removal

Following dam removal we detected 3 genetic clusters that weren't very distinct

Genetic differences decreased and fish interbred river wide

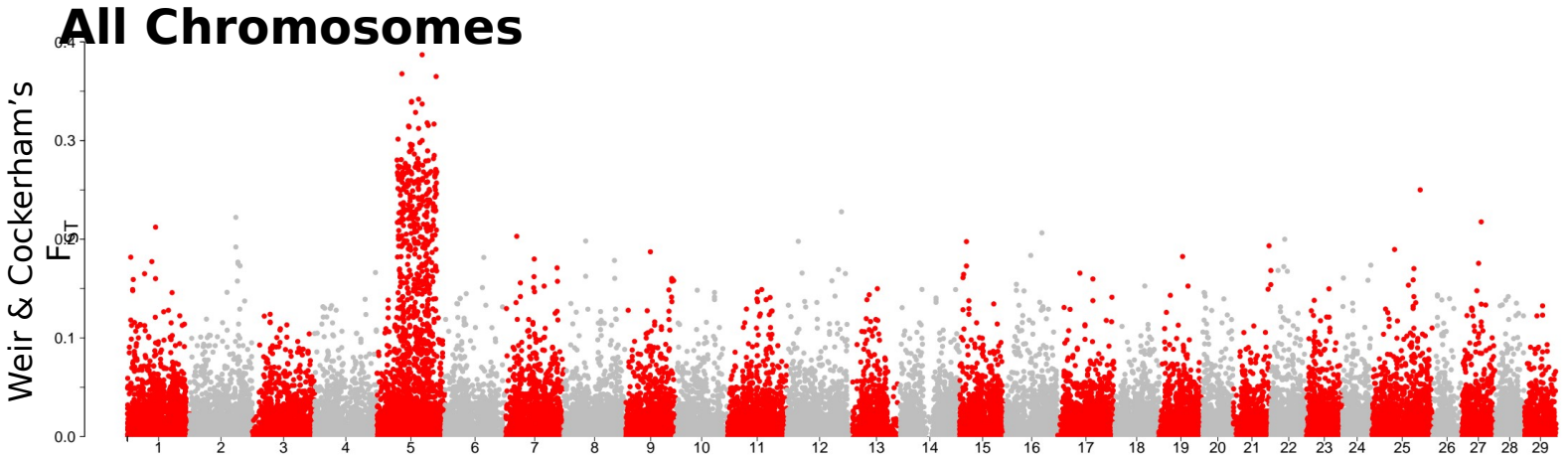
Post-dam Removal



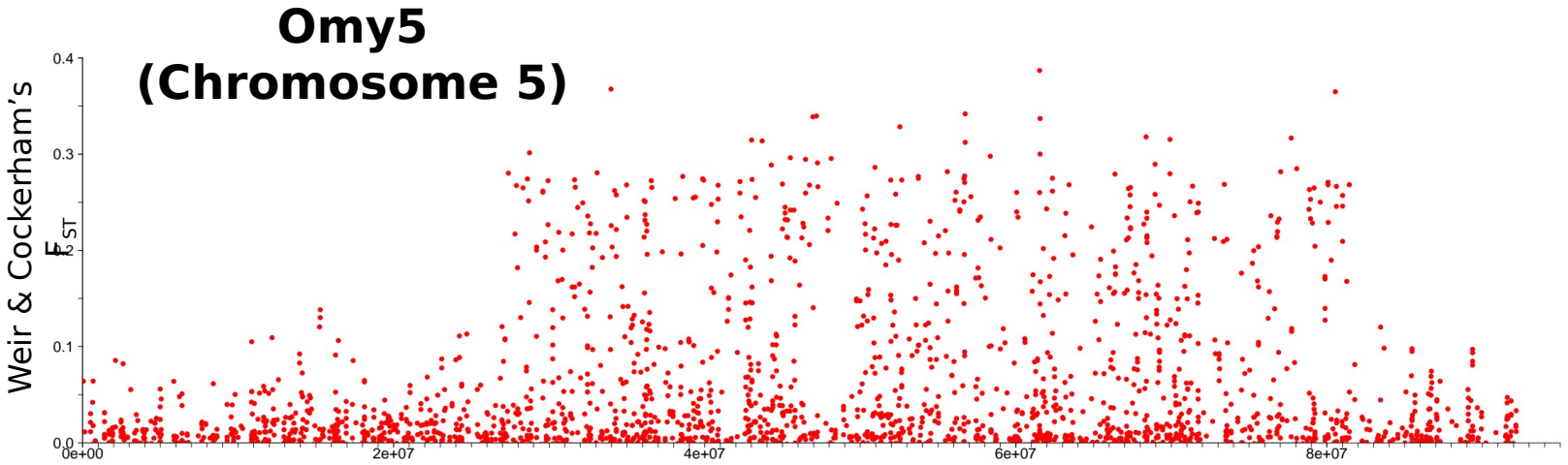


Pairwise F_{ST} BD VS ID

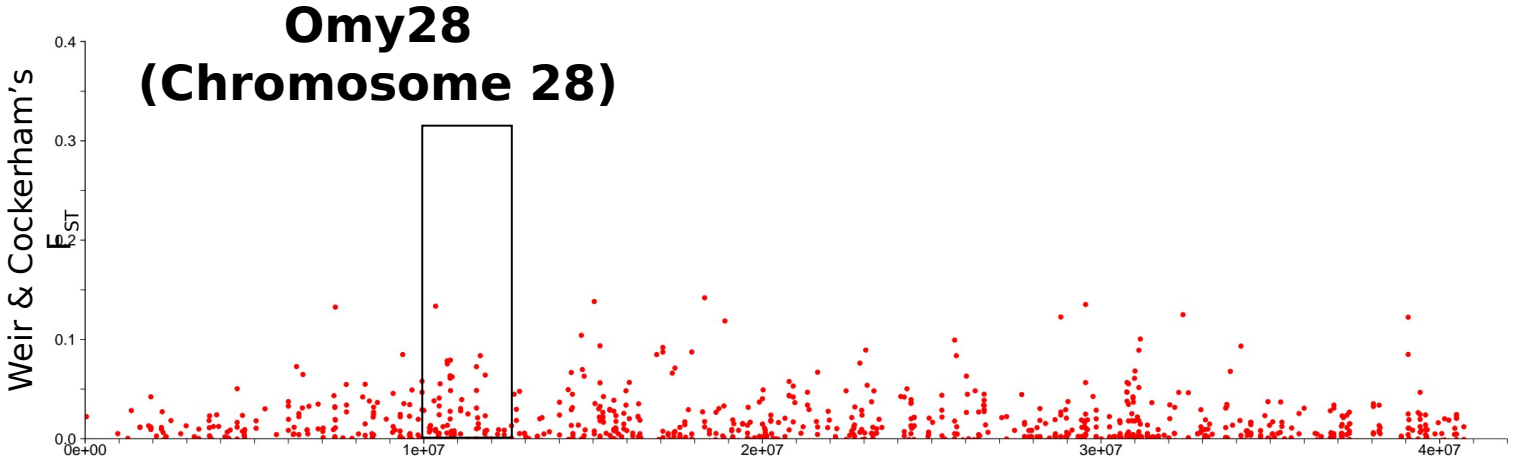
Pre-Dam Removal



Genome-wide patterns of genetic differentiation



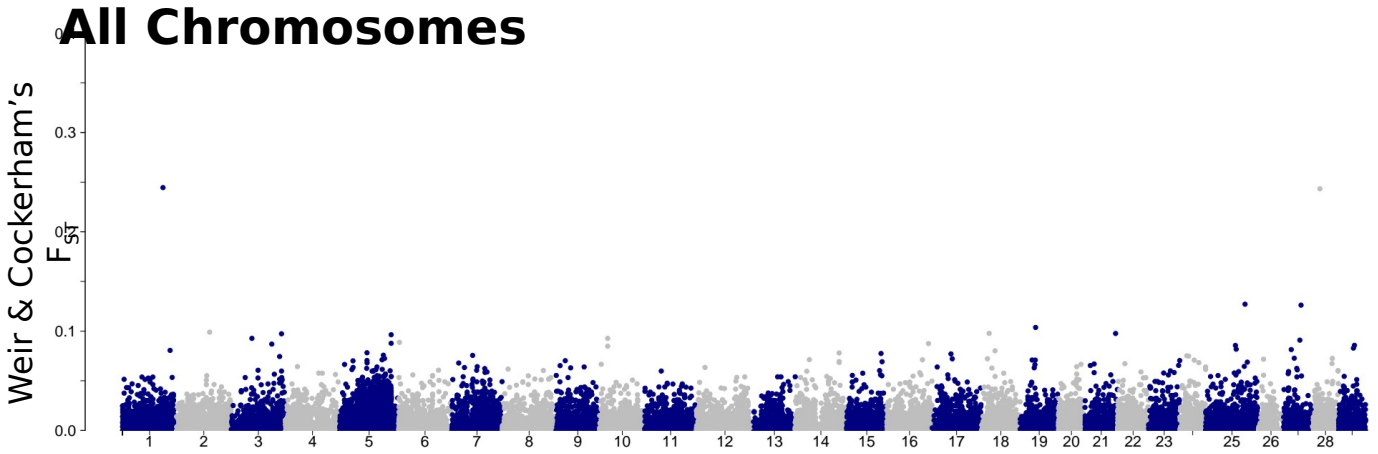
Loci associated with anadromy



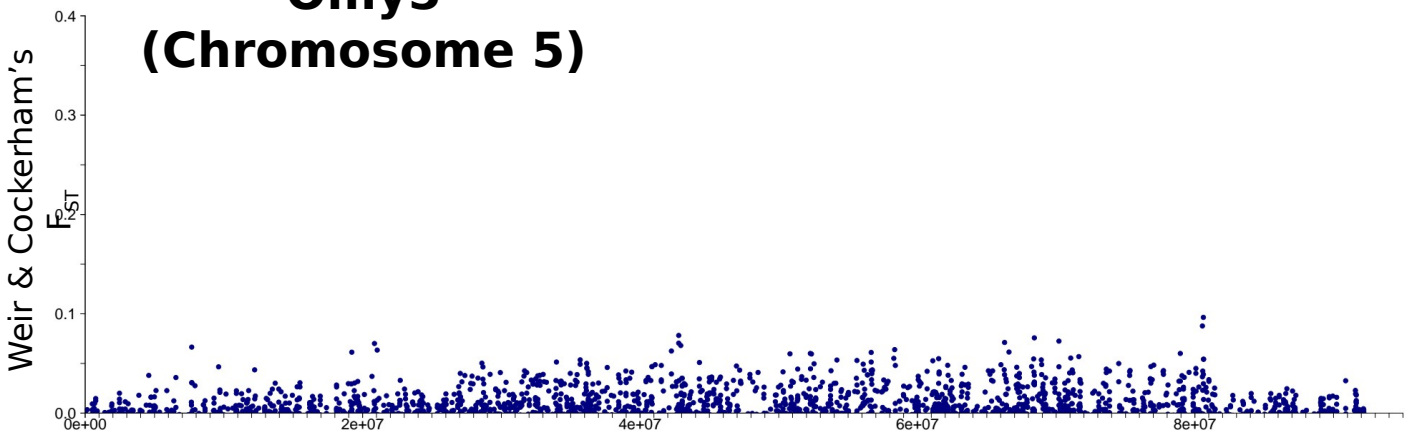
Loci associated with run-timing

Pairwise F_{ST} BD VS ID

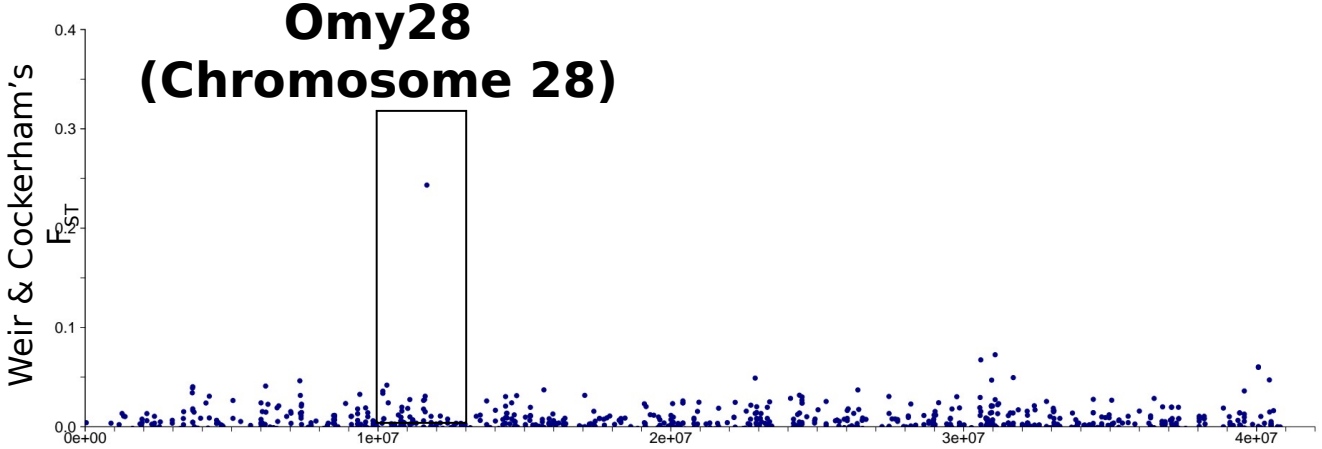
Post-Dam Removal



Genome-wide patterns of genetic differentiation

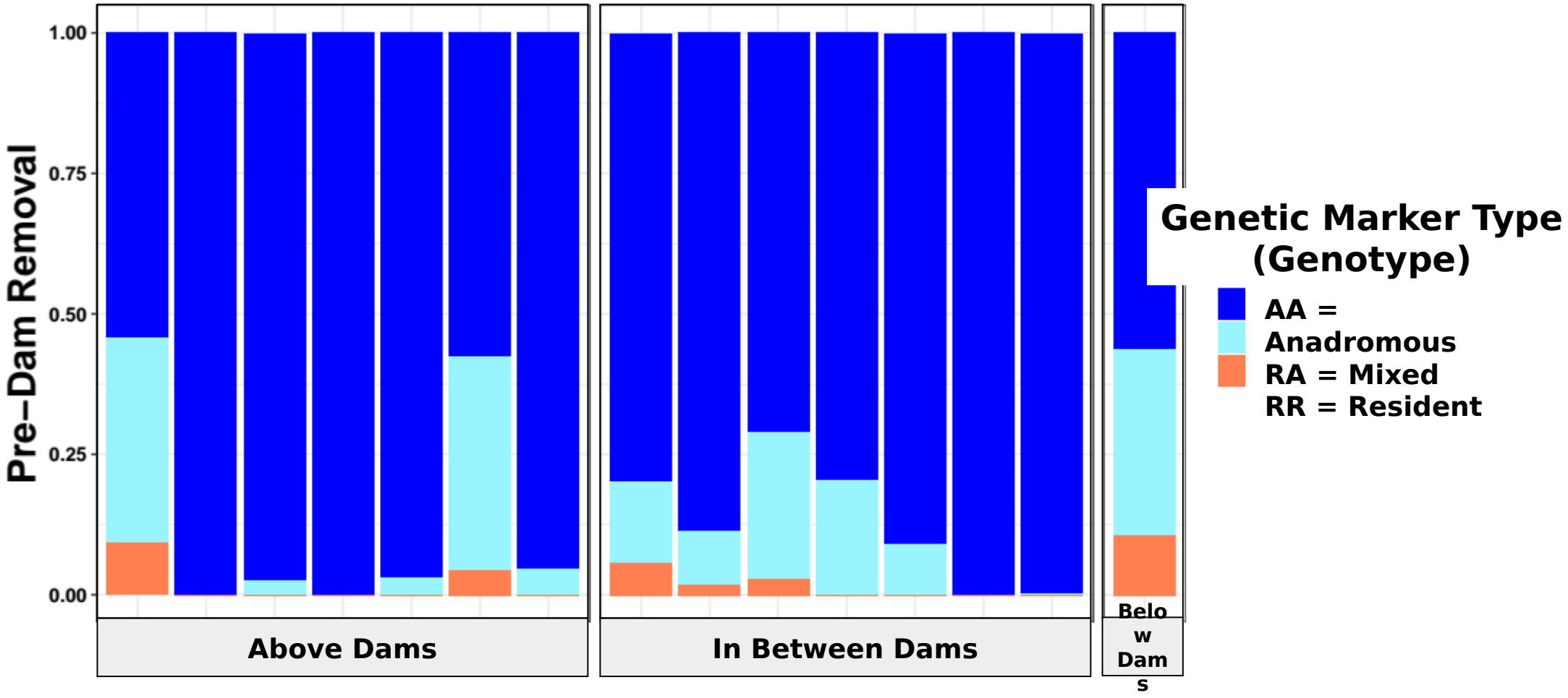


Loci associated with anadromy

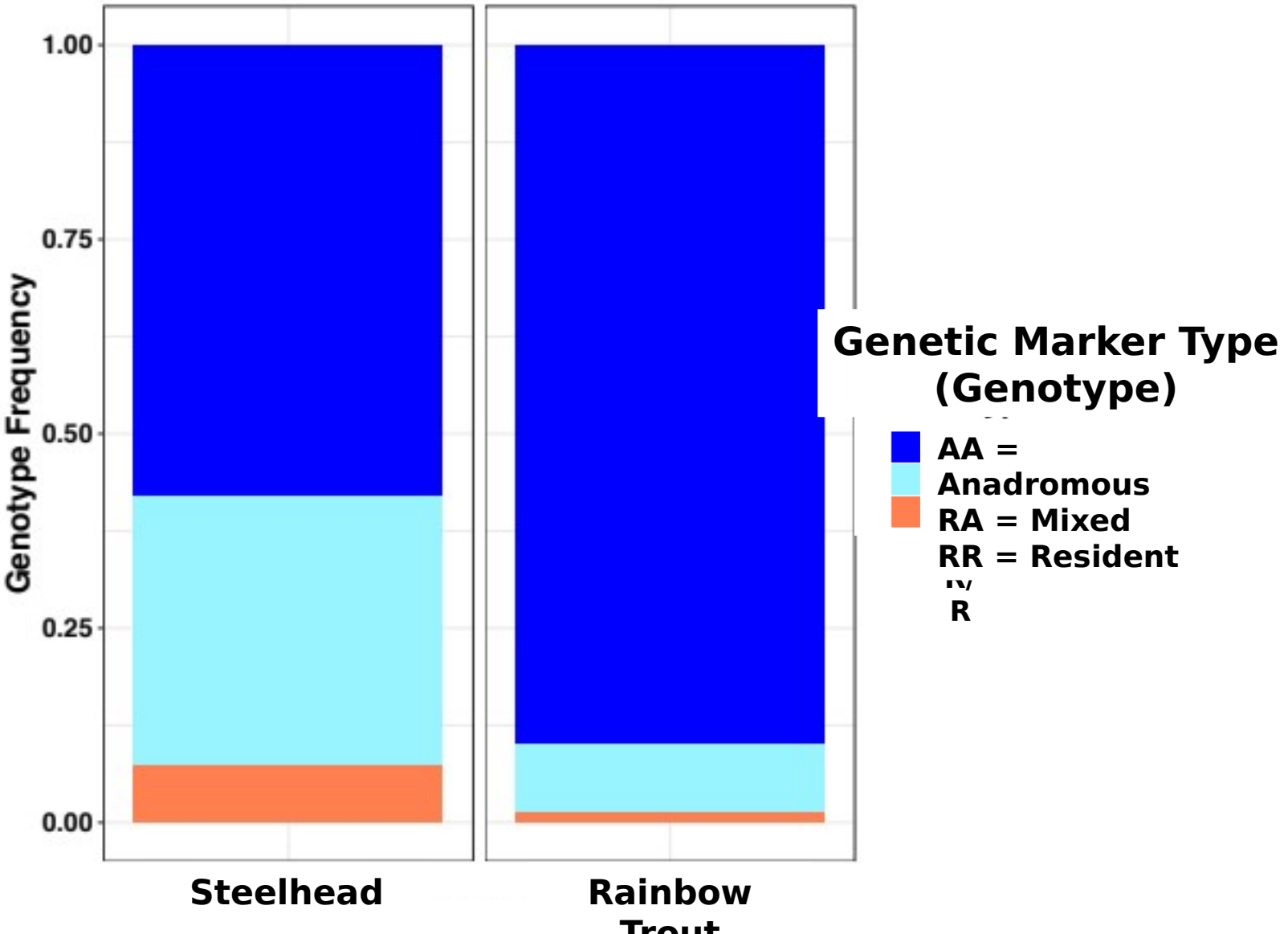


Loci associated with run-timing

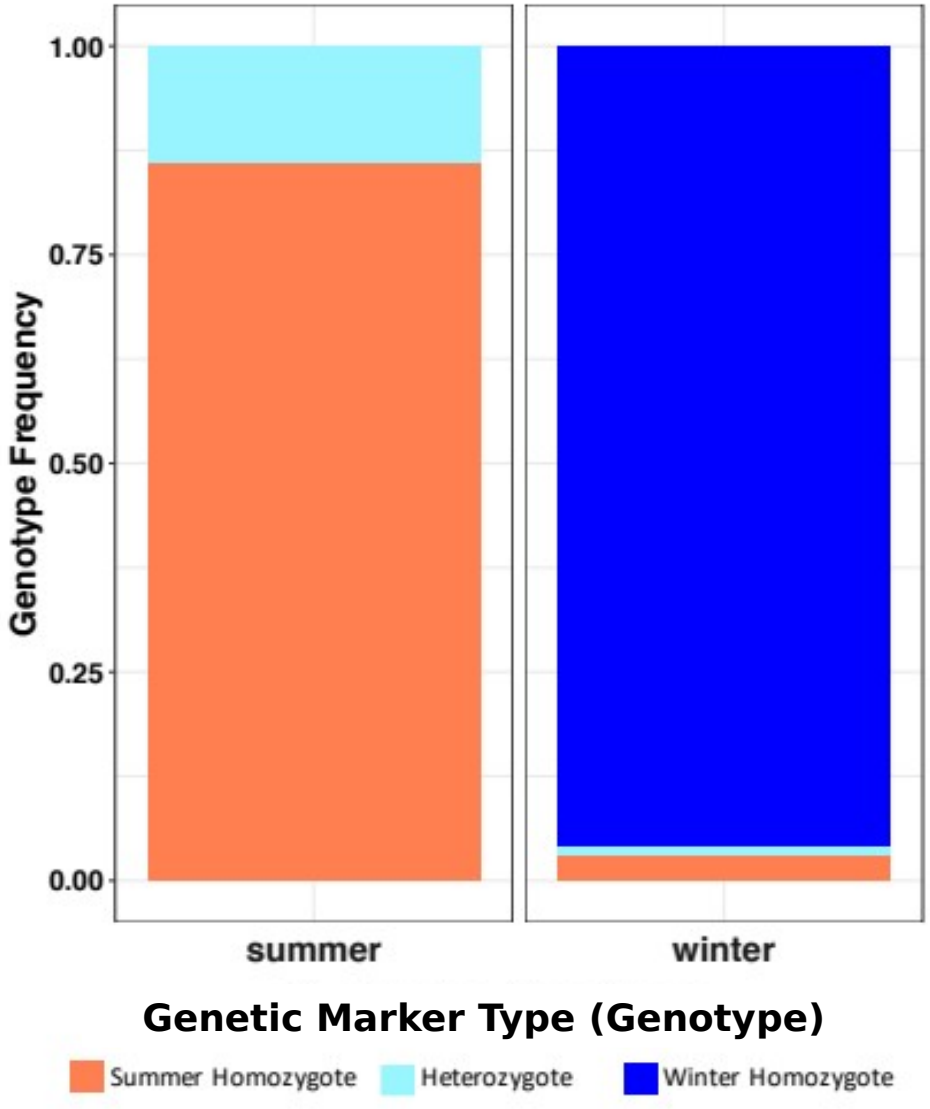
Steelhead and rainbow trout Omy5 genotype lacked significant diversity prior to dam removal

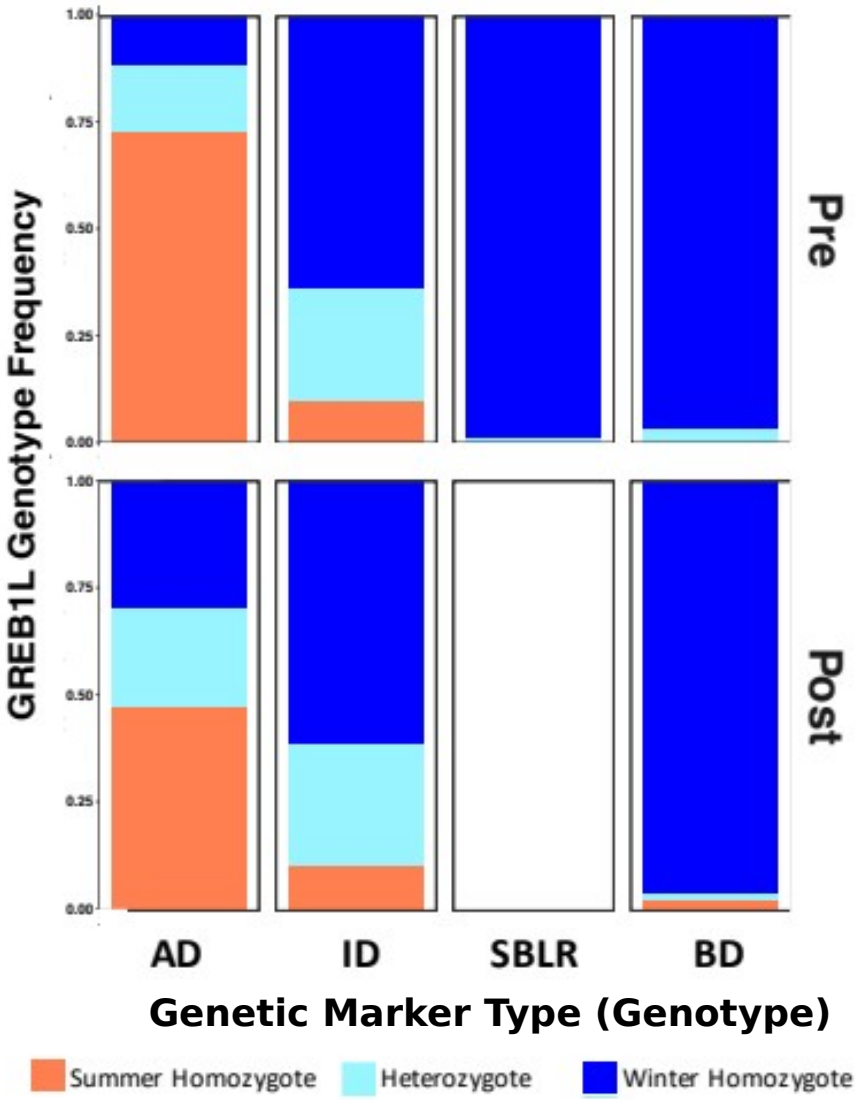


Migration genetic marker was not associated with migratory phenotype

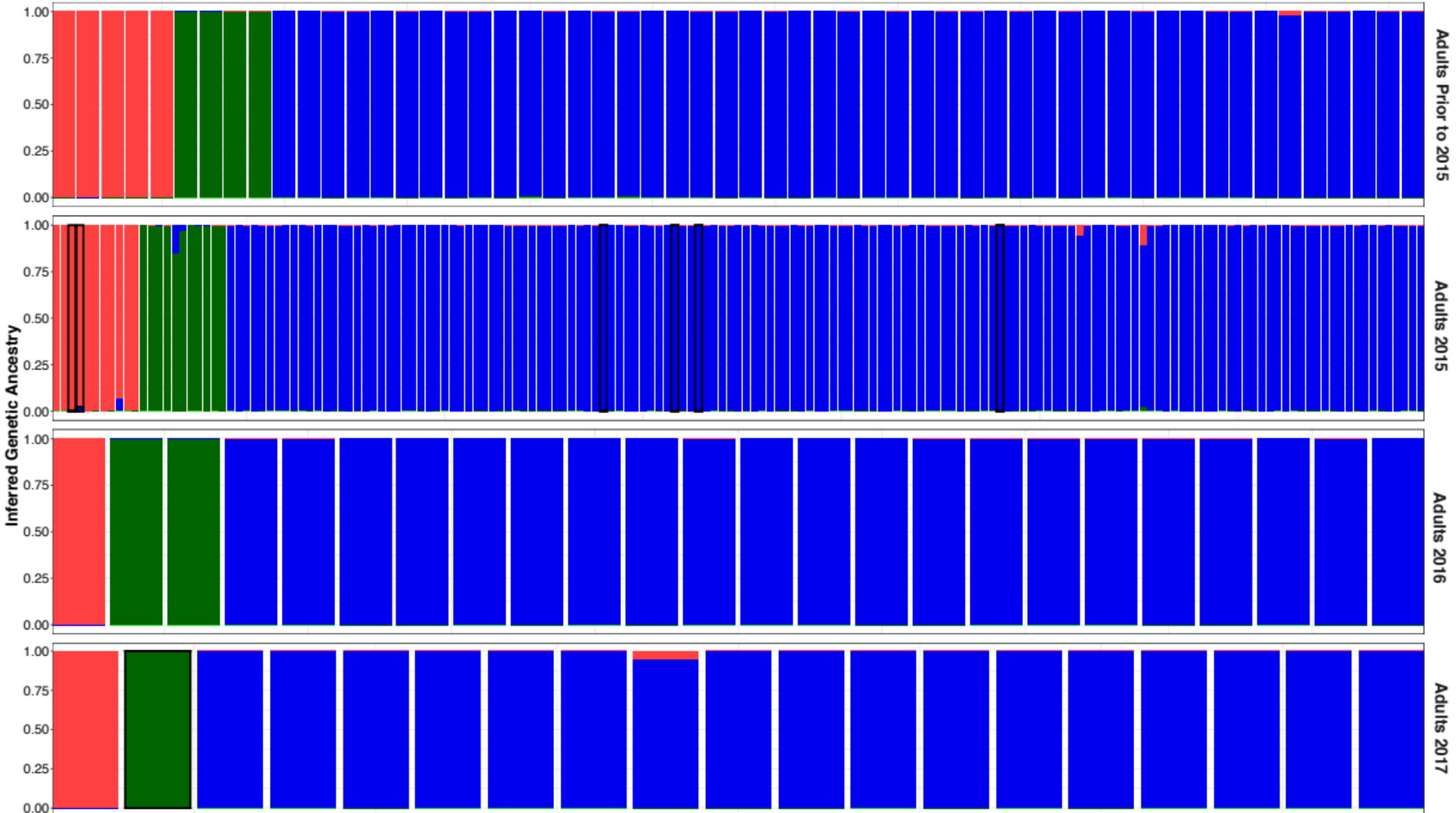


Frequency of the “summer” allele in the GREB1L gene was highest in formerly AD populations pre and post-dam removal

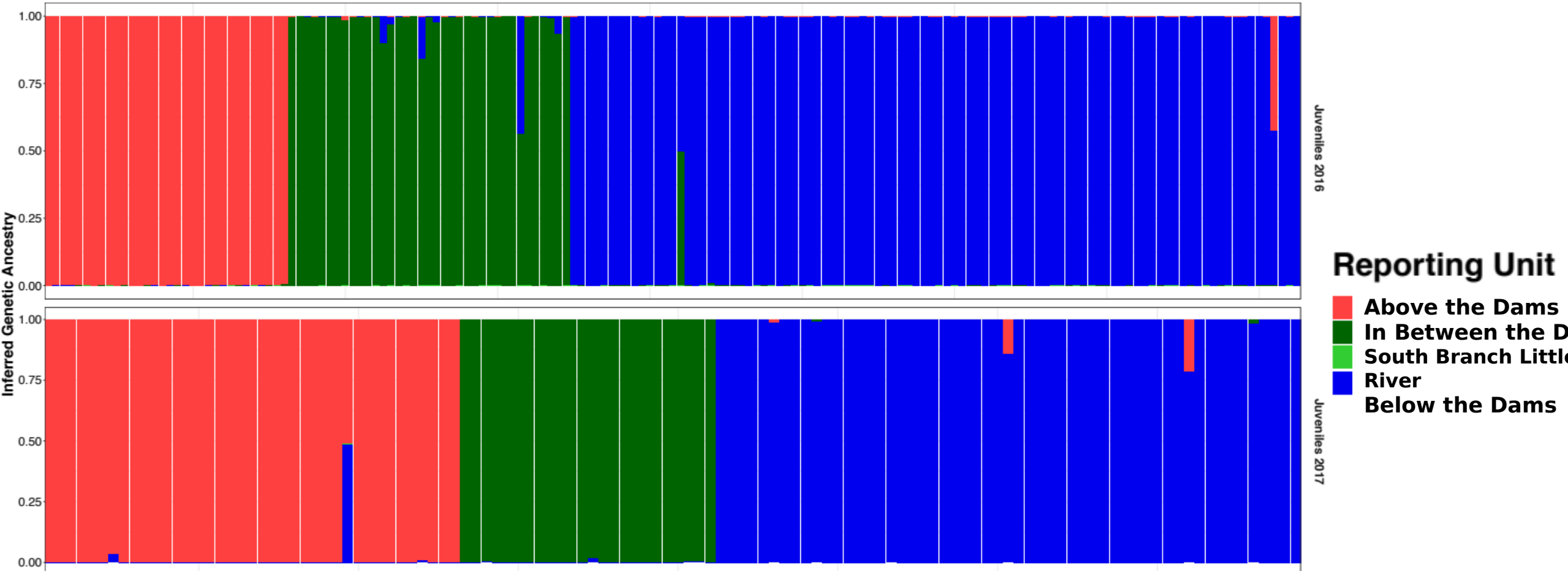




Returning adult steelhead primarily descended from BD populations



Juveniles out-migrating smolts had a higher proportion of descendants from AD and ID populations



What have we learned from the Elwha River *O. mykiss*?

We detected 3 genetic clusters explained by anadromous barriers prior to dam removal that diminished

Post-dam removal, genetic structure decreased and admixture increased

Recolonizing Steelhead were descended from all the mainstem populations

There were no significant associations between Omy5 genotype and migratory phenotype

There has been a “re-awakening” of summer Steelhead, likely as a result of GREB1L summer run-timing alleles being maintained by natural selection in up-river populations

Acknowledgements

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Questions?