Can’t beat em’? Make em’!: Genomic investigation reveals basis for trait selection of reintroduced Coho Salmon in the Wenatchee River Basin

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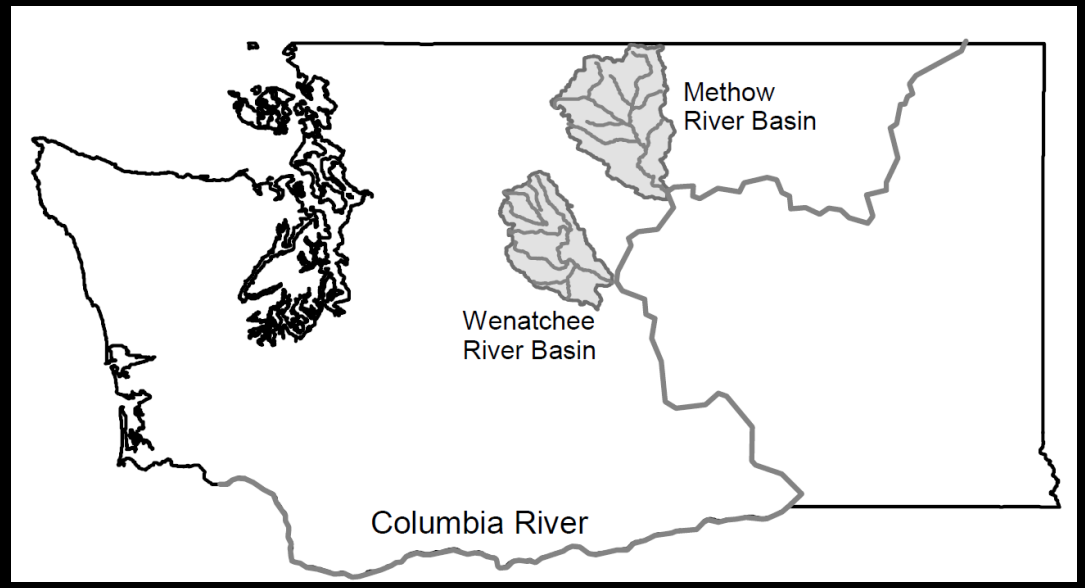
Mid-Columbia Coho

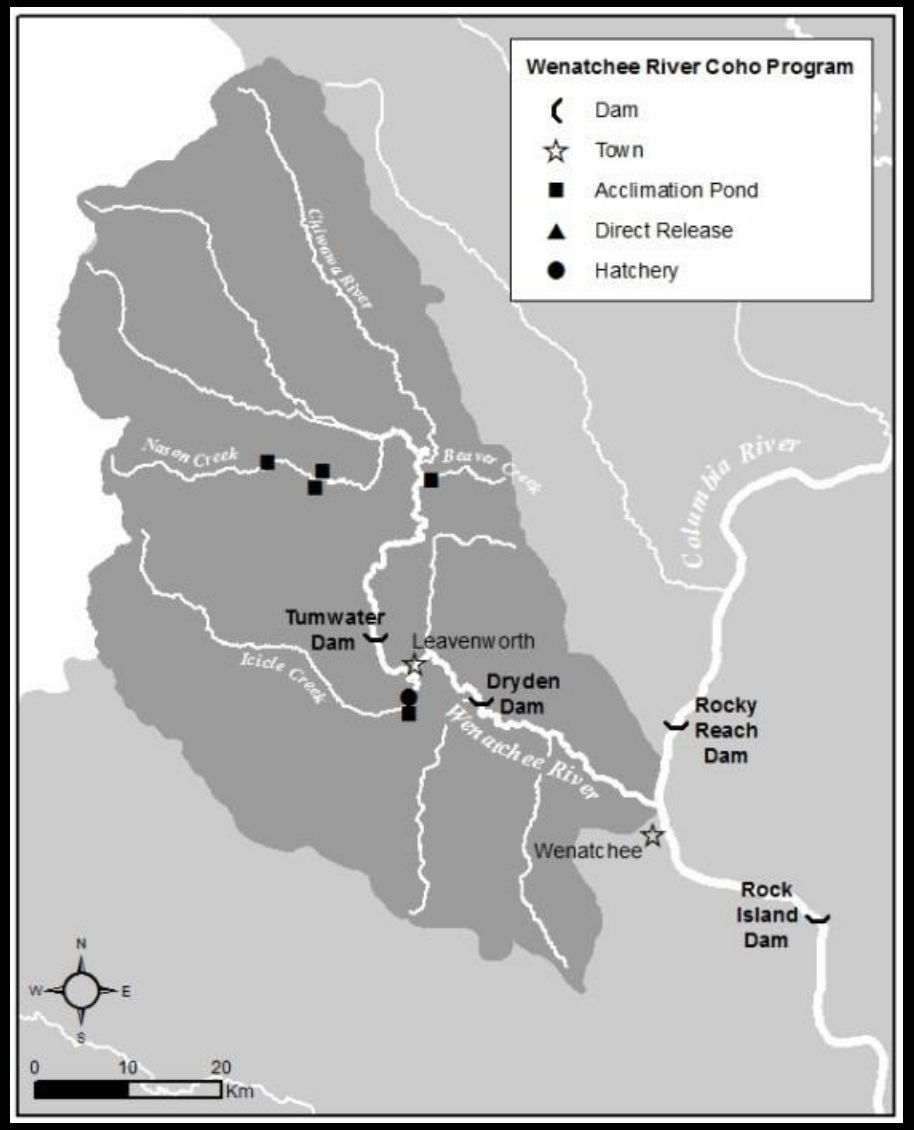
- Historical coho abundance (Mulan 1983)
  - Entiat: 9,000-13,000
  - Methow: 23,000-31,000
  - **Wenatchee: 6,000-7,000**
- Coho decimated in early 1900's, functionally extirpated by early 1990's
- **Goal: Re-establish naturally spawning population of coho with opportunities for tribal harvest**

Coho Reintroduction

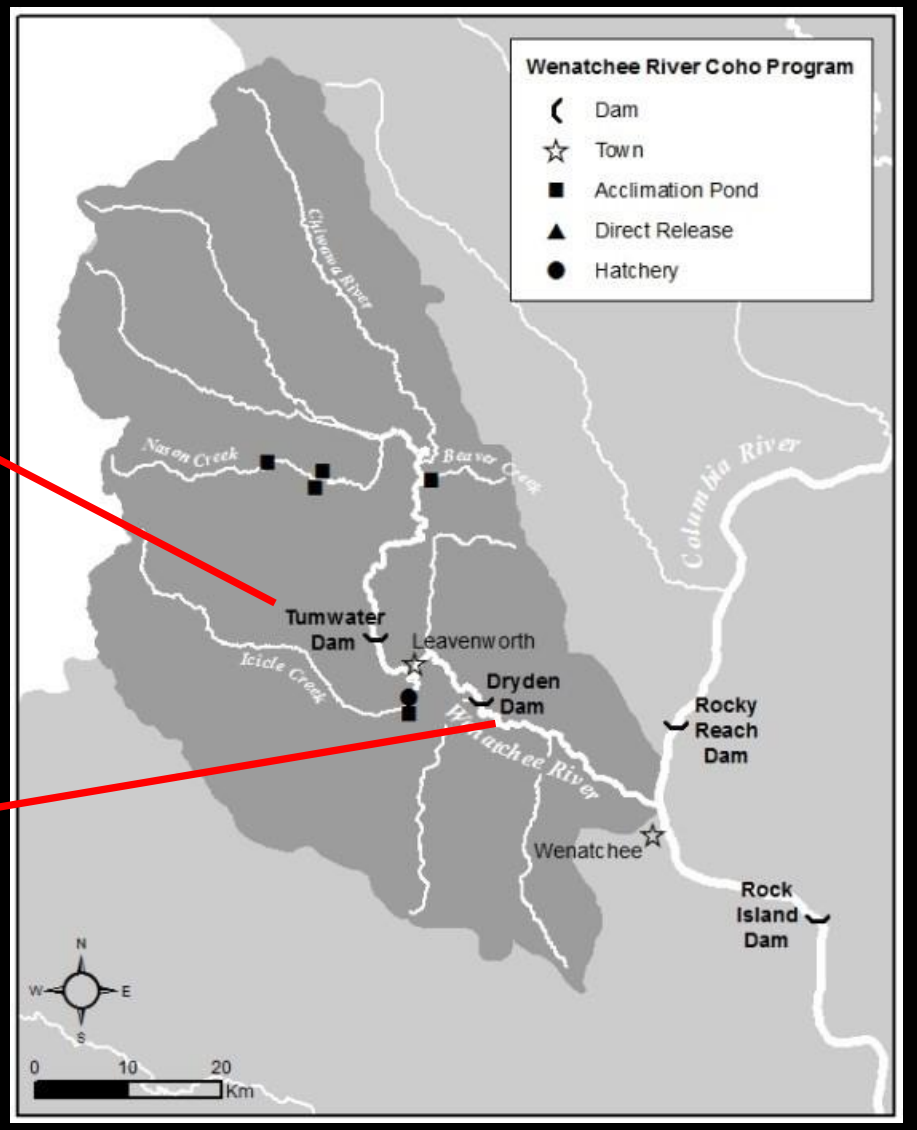
- Feasibility study launched in 1996
- Using Lower-Columbia donor stock to develop locally-adapted population
- **Objective: Develop a locally-adapted, natural spawning coho stock**

Wenatchee Basin

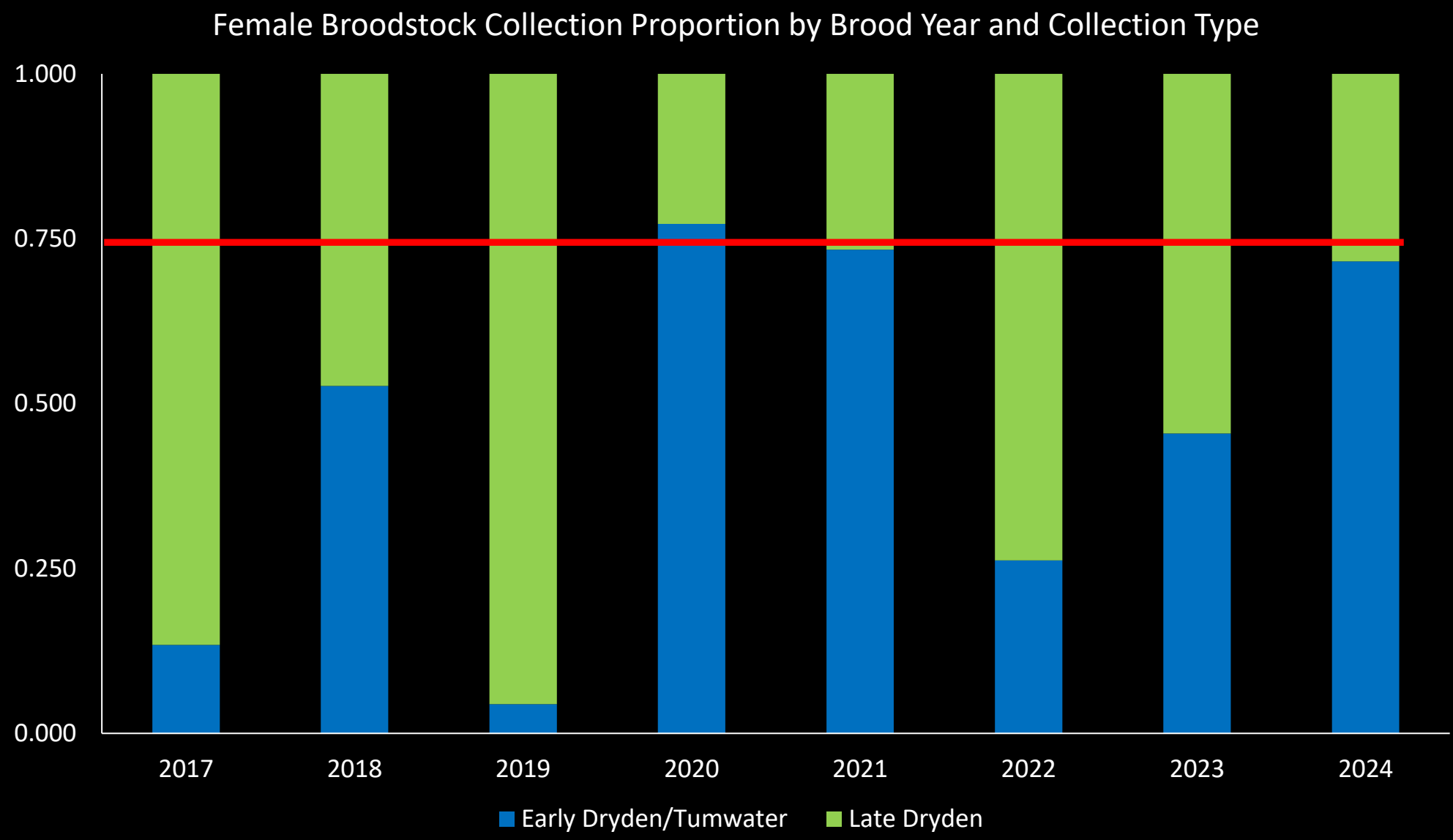




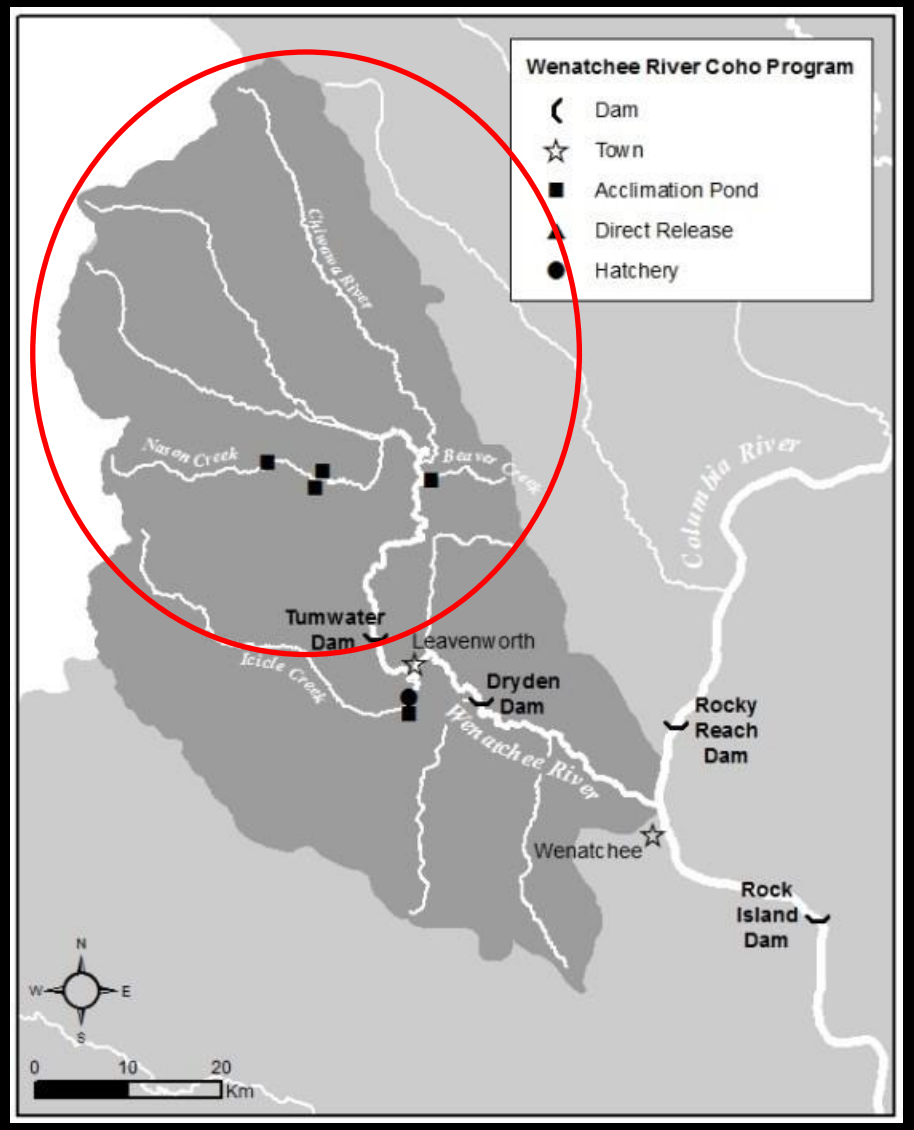
Broodstock Collection Points



Yakama Nation Fisheries

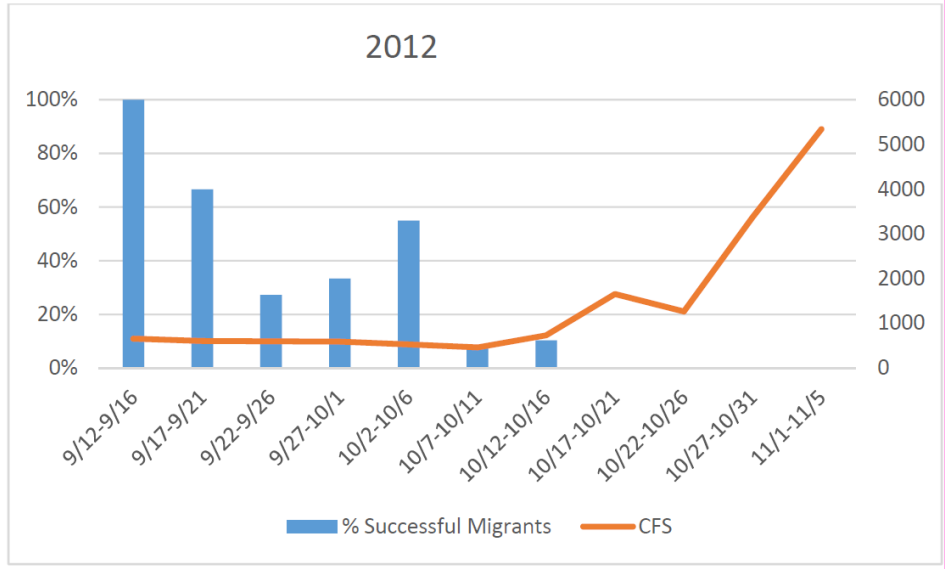


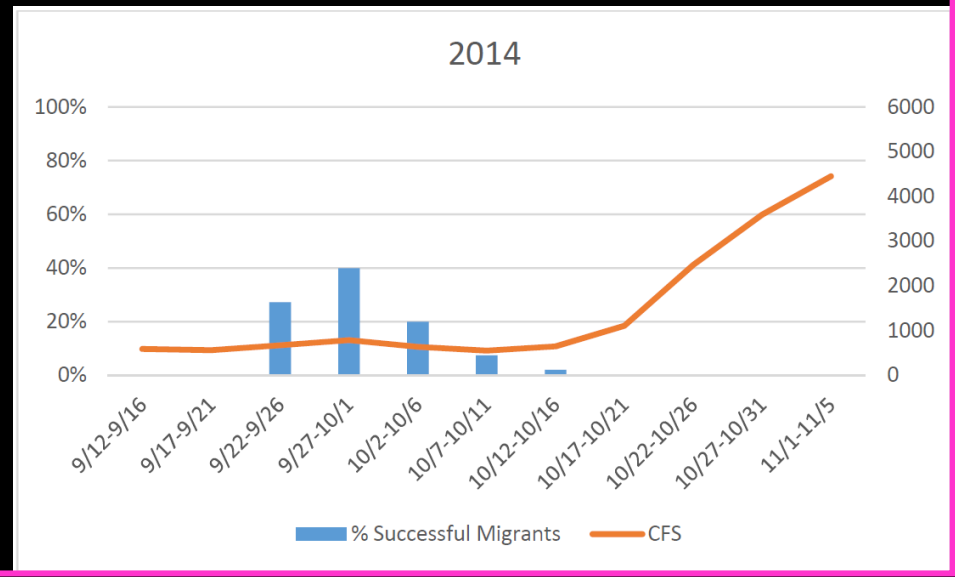
Expanding In-Basin Coho Distribution

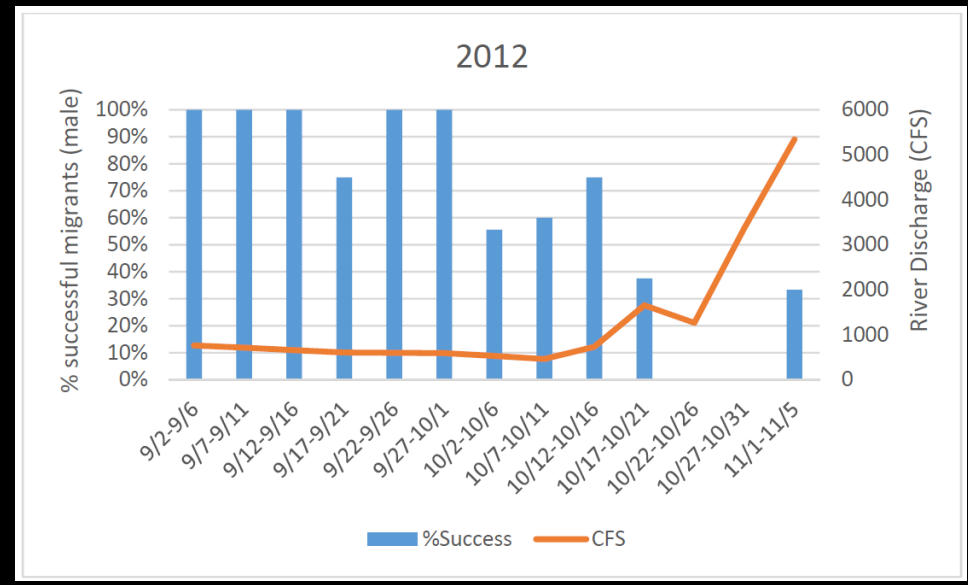


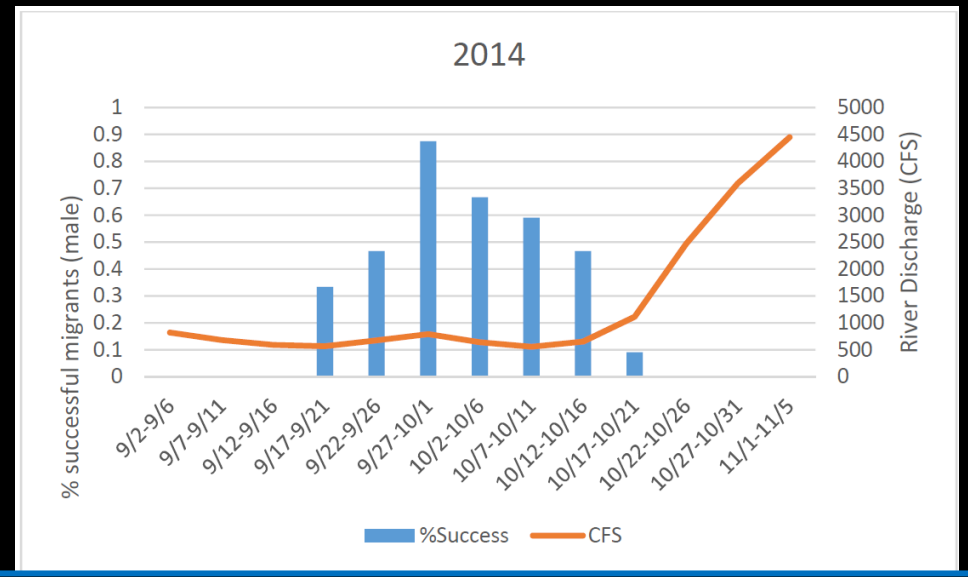
“Exit Drop”

“Exit Drop”

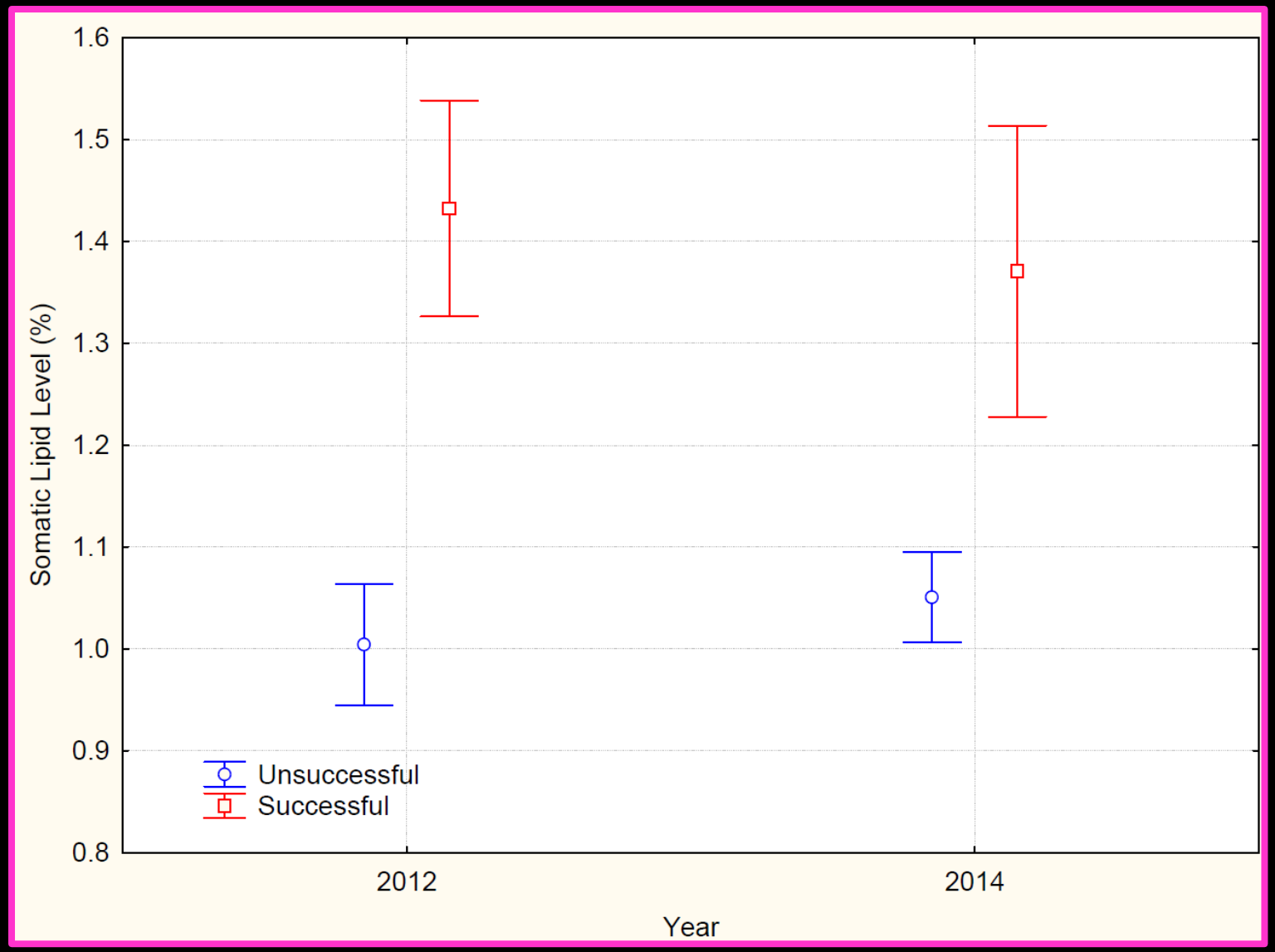

2012
100%
80%
60%
40%
20%
0%
6000
5000
4000
3000
2000
1000
0
9/12-9/16
9/17-9/21
9/22-9/26
9/27-10/1
10/2-10/6
10/7-10/11
10/12-10/16
10/17-10/21
10/22-10/26
10/27-10/31
11/1-11/5
% Successful Migrants
CFS


2014
100%
80%
60%
40%
20%
0%
6000
5000
4000
3000
2000
1000
0
9/12-9/16
9/17-9/21
9/22-9/26
9/27-10/1
10/2-10/6
10/7-10/11
10/12-10/16
10/17-10/21
10/22-10/26
10/27-10/31
11/1-11/5
% Successful Migrants
CFS


2012
% successful migrants (male)
River Discharge (CFS)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
6000
5000
4000
3000
2000
1000
0
9/2-9/6
9/7-9/11
9/12-9/16
9/17-9/21
9/22-9/26
9/27-10/1
10/2-10/6
10/7-10/11
10/12-10/16
10/17-10/21
10/22-10/26
10/27-10/31
11/1-11/5
%Success
CFS


2014
% successful migrants (male)
River Discharge (CFS)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
9/2-9/6
9/7-9/11
9/12-9/16
9/17-9/21
9/22-9/26
9/27-10/1
10/2-10/6
10/7-10/11
10/12-10/16
10/17-10/21
10/22-10/26
10/27-10/31
11/1-11/5
%Success
CFS

“Exit Drop”


1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
Somatic Lipid Level (%)
Unsuccessful
Successful
2012
2014
Year

“Exit Drop”

- Female Coho have difficulty ascending Tumwater Canyon, especially later in fall as flows increase
- But there’s a lot of good habitat up there!
- We can’t change the environment, but maybe we can “make” coho better able to ascend Tumwater canyon through selective spawning…
- Are there genetic markers underlying phenotypic characteristics associated with ascending Tumwater Canyon?

Transactions of the American Fisheries Society, 2025, 154, 414–423

dictate return timing and location? (NO!)

Methods

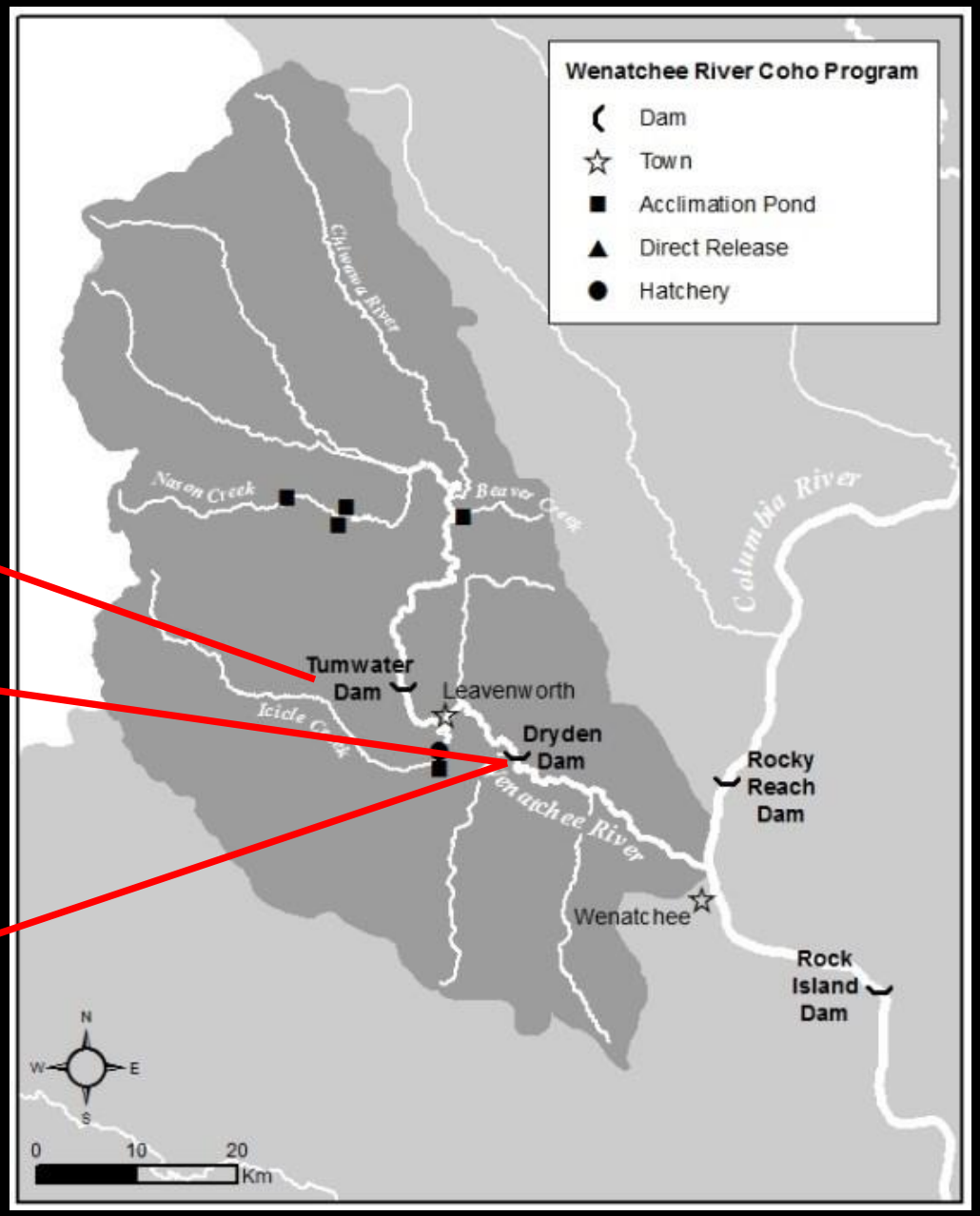
- 987 total samples collected from 2017-2022, representing 3 genetically distinct broodlines
  - Broodline A: 2018, 2021
  - Broodline B: 2019, 2022
  - Broodline C: 2017, 2020
- Genomic DNA extraction and low-coverage whole-genome resequencing
- 3 collection groups:
  1. Tumwater
  2. Dryden Early
  3. Dryden Late

Collection Groups

1) Tumwater
   n=266

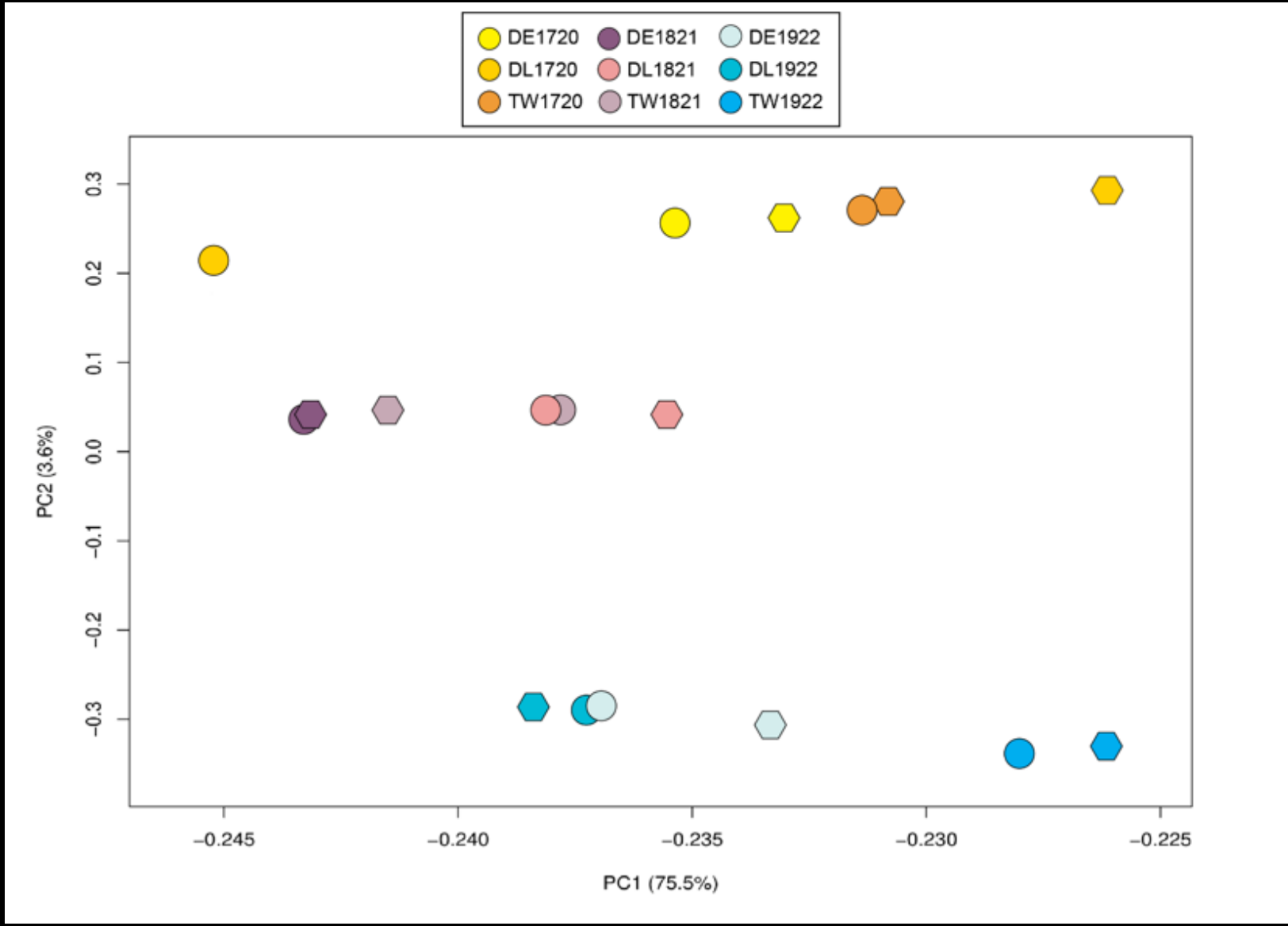
2) Early Dryden (before 10/7)
   n=408

3) Late Dryden (after 10/7)
   n=313

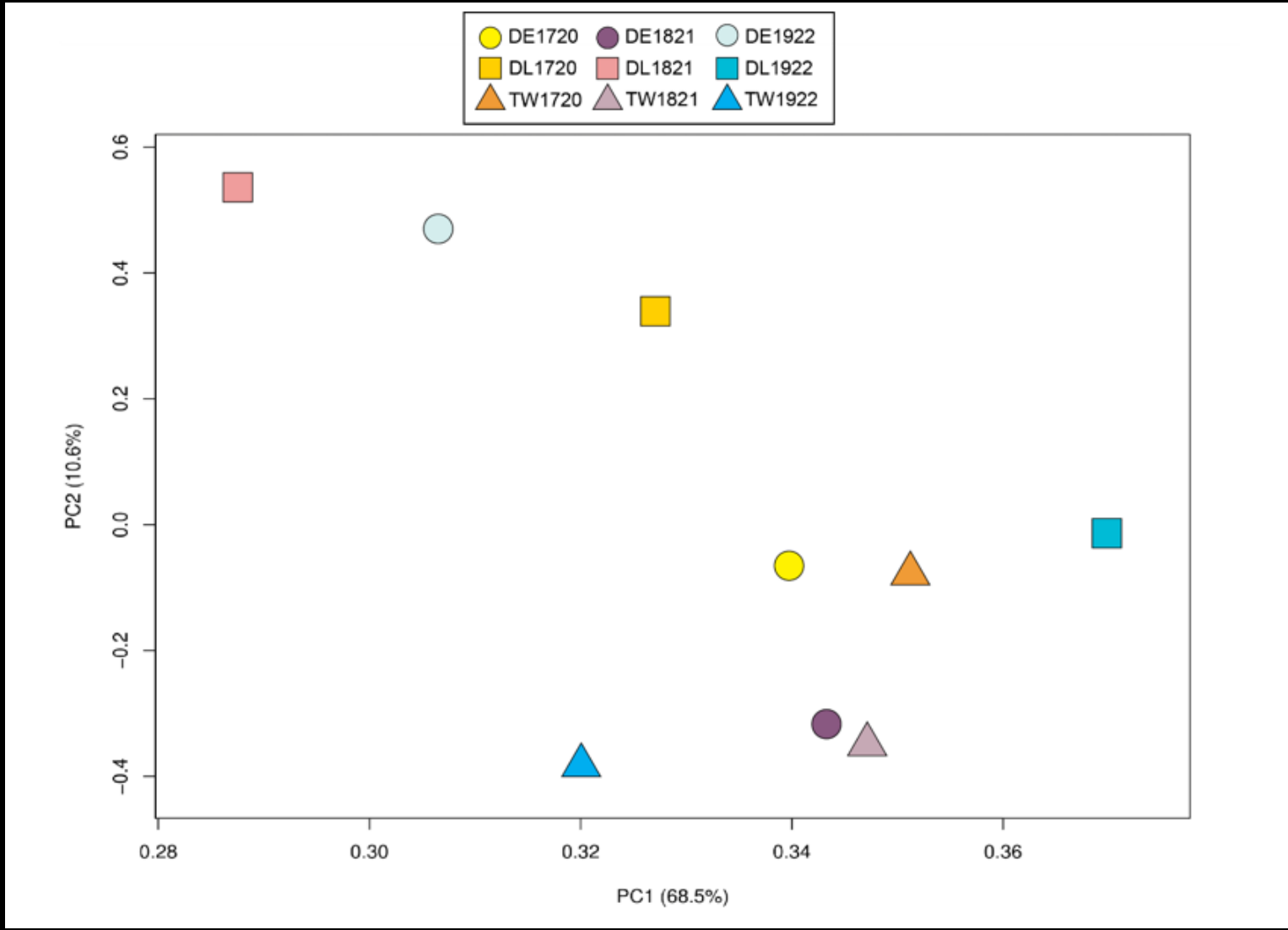


Yakama Nation Fisheries

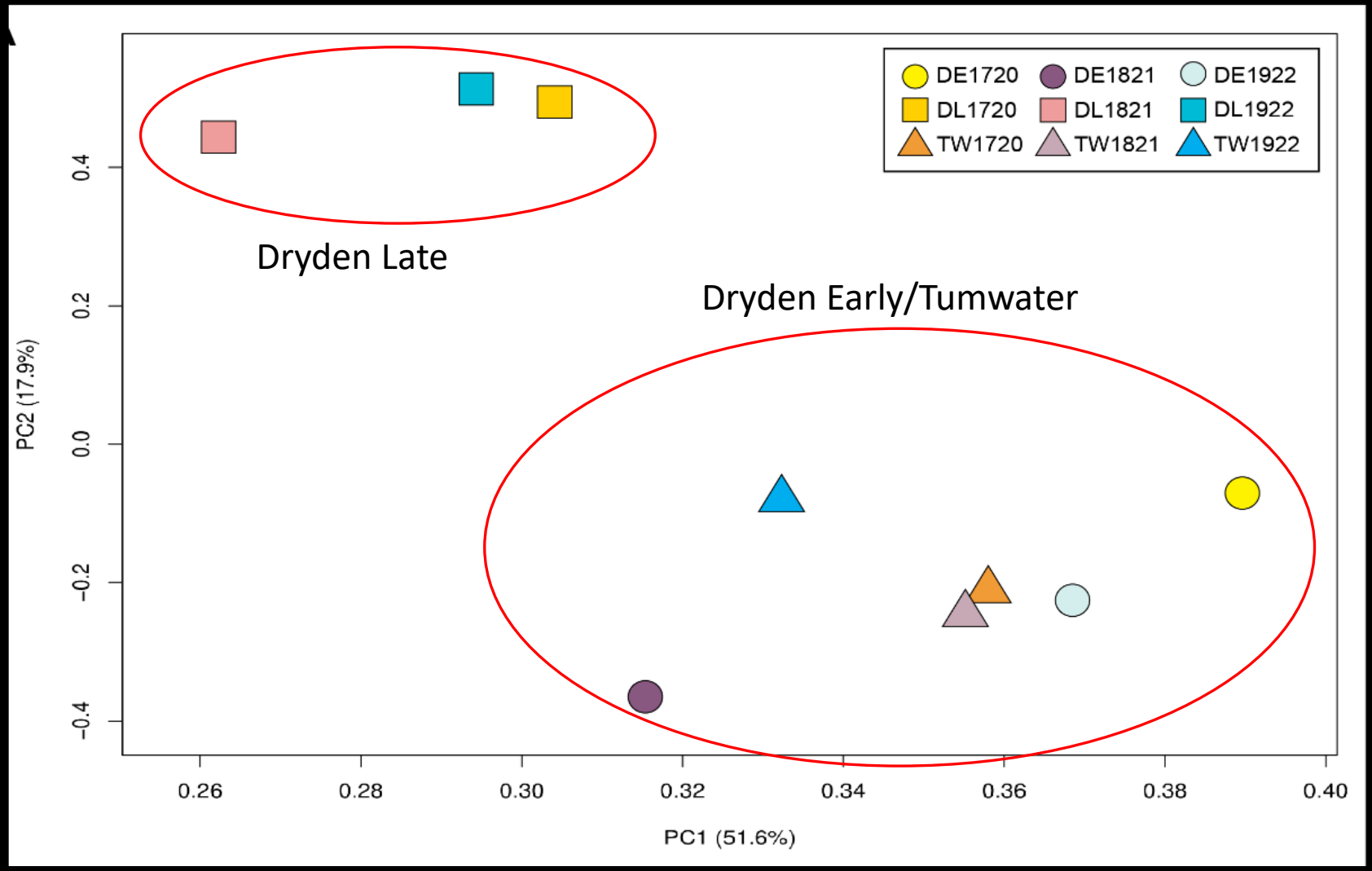
Results


DE1720
DE1821
DE1922
DL1720
DL1821
DL1922
TW1720
TW1821
TW1922
PC2 (3.6%)
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.245
−0.240
−0.235
−0.230
−0.225
PC1 (75.5%)

Results-Males



Results-Females



Conclusions

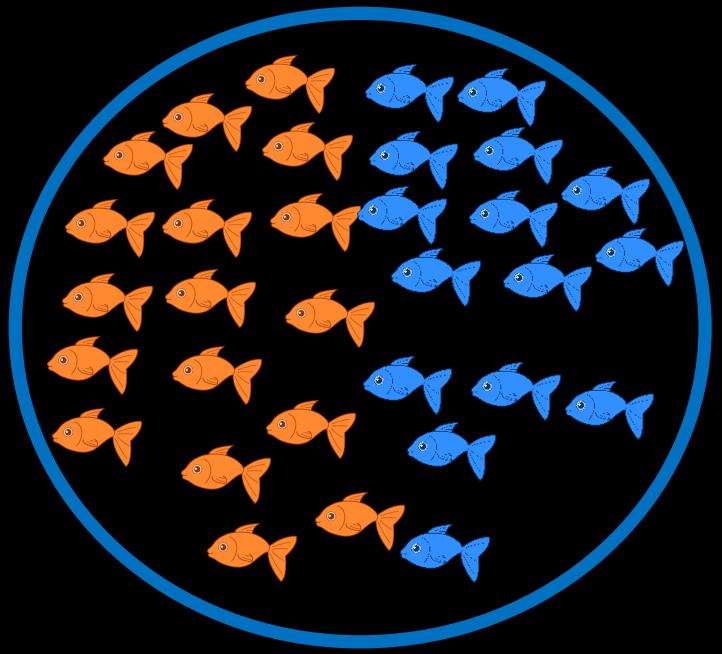
- There is a genetic association with return timing/ability to ascend Tumwater Canyon (females only)
- Continued selection of Dryden Early/Tumwater females for broodstock should increase number of returning females able to ascend Tumwater Canyon in future generations
- Can we “make” fish capable of ascending Tumwater Canyon and utilizing upstream habitat? **(MAYBE!)**

Comparison Groups

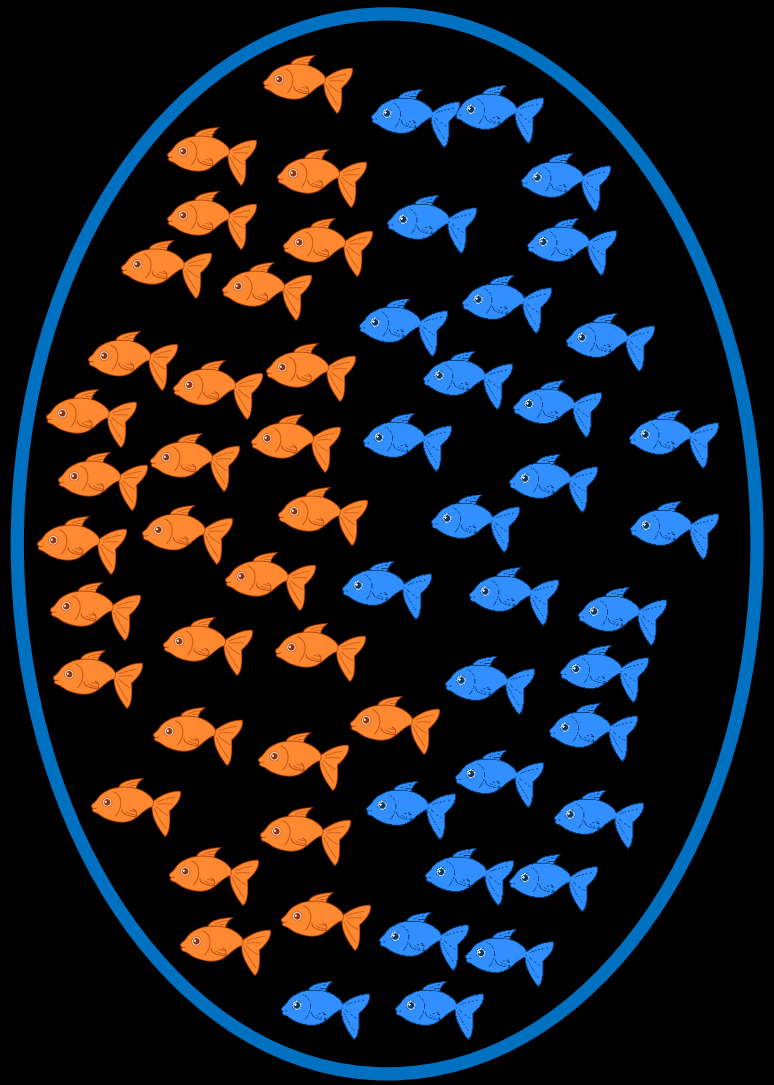
Early Dryden/Tumwater

Late Dryden

Pond A: 17x17 mothers



Pond B: 30x30 mothers



- Side-by-side rearing of juveniles from two collection groups
- 2 ponds x 3 years (BY 2022-2024)
- Groups differentiated via PBT and PIT tags
- Monitor reproductive success, run timing, Tumwater ascension

Conclusions

- Can we “make” fish capable of ascending Tumwater Canyon and utilizing upstream habitat? **(I THINK SO!)**
- Continue to preferentially spawn Tumwater and Dryden Early females and monitor comparison groups
- Increased utilization of habitat above Tumwater should help goal of establishing locally-adapted, self-sustaining population of coho

Acknowledgements

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Read the paper!