Apr 6th, 8:45 AM - 9:00 AM

Evaluating common trends in Chinook density and the influence of temperature and salinity patterns among distributary channels in a large river estuary to aid evaluation, planning, and prioritization of restoration activities

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How landscape patterns in Chinook distribution can inform restoration effectiveness and prioritization in a large river delta.

Joshua Chamberlin[1], Jason Hall[2], Todd Zackey[3], Frank Leonetti[4], Michael Rustay[4], and Casimir Rice[1]

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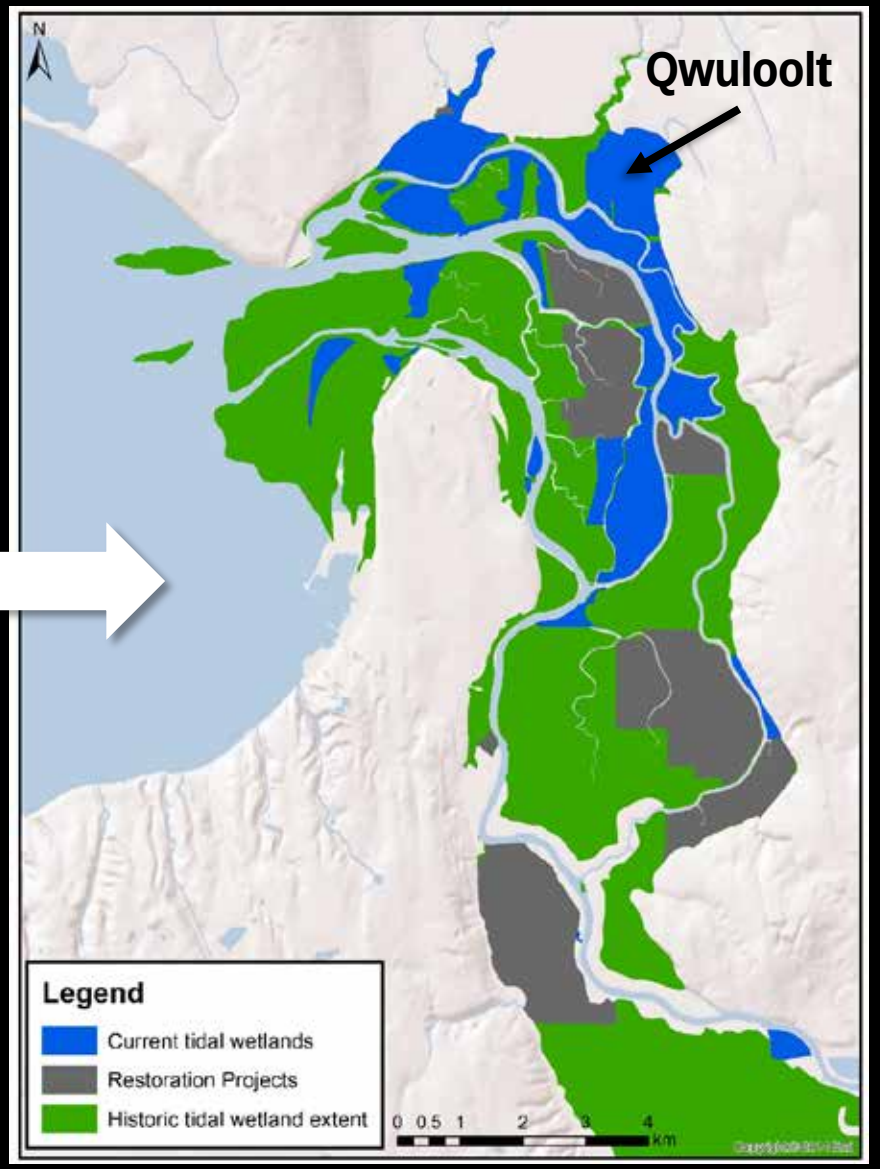
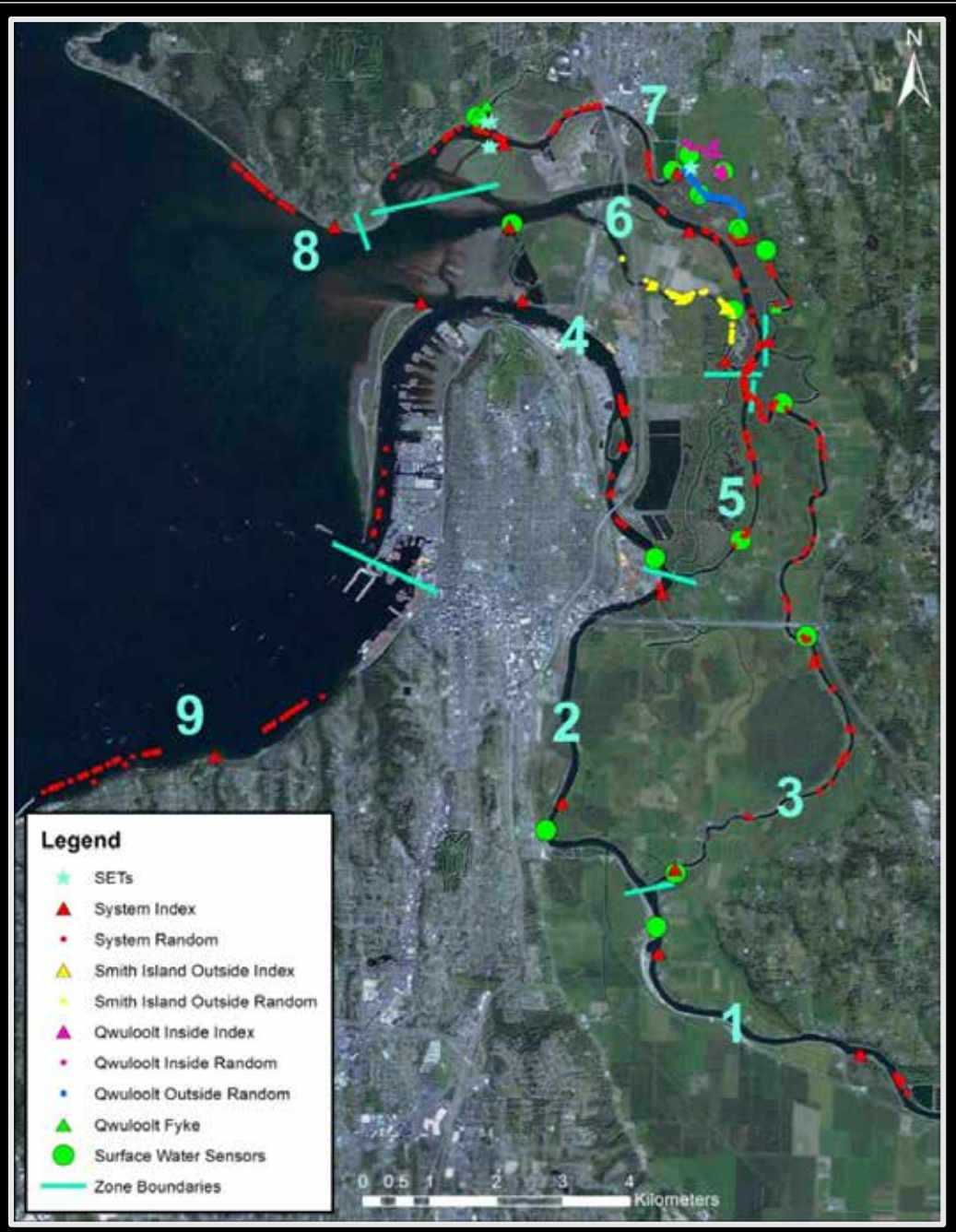
[3] Tulalip Tribes, Natural Resources Division
[4] Snohomish County, Surface Water Management

High Restoration Potential

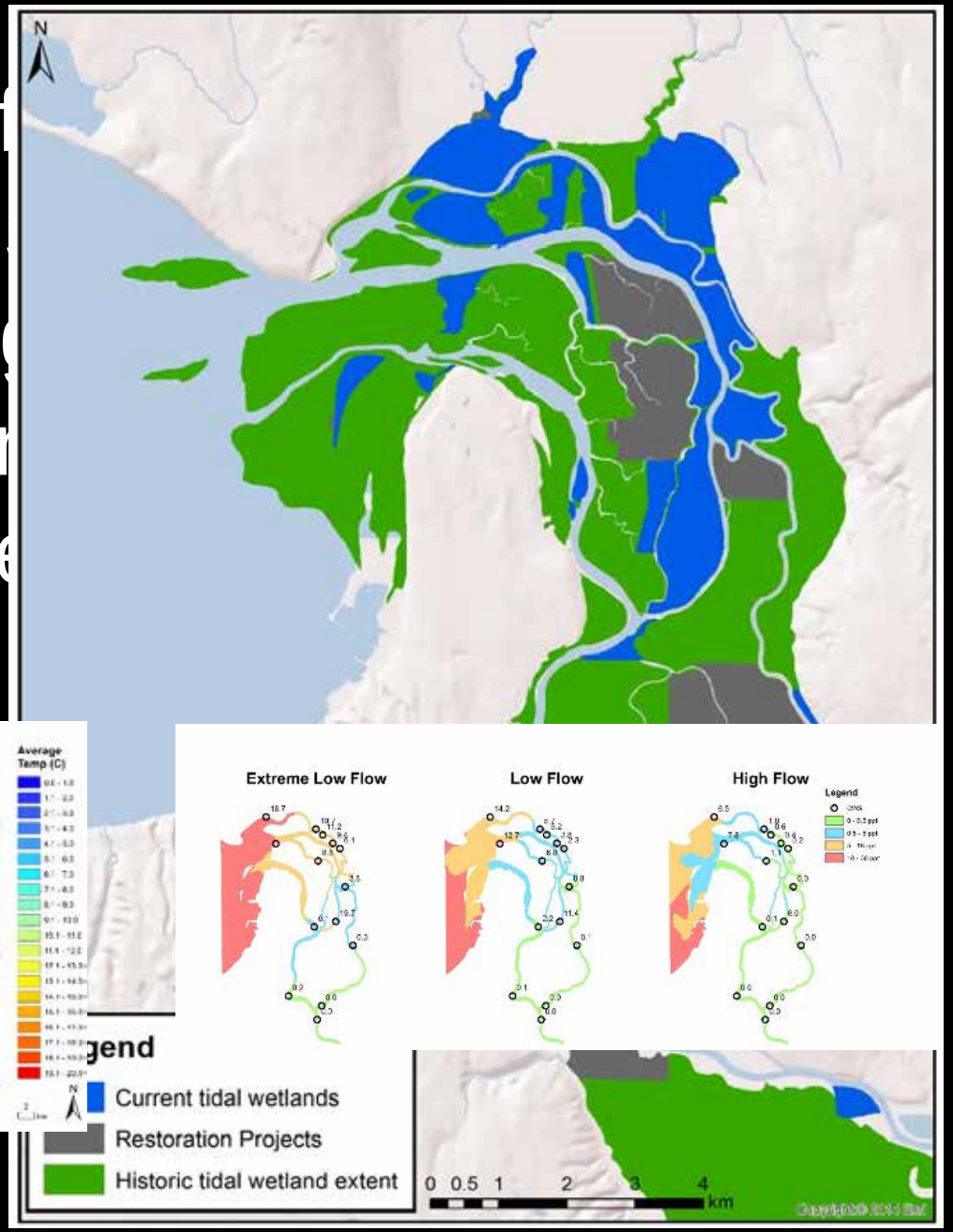
≈50% of Historic Habitat Extent

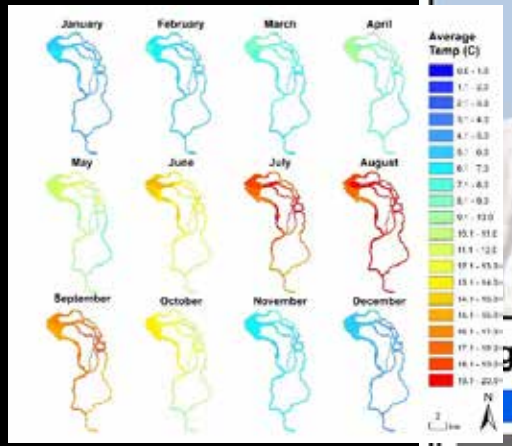


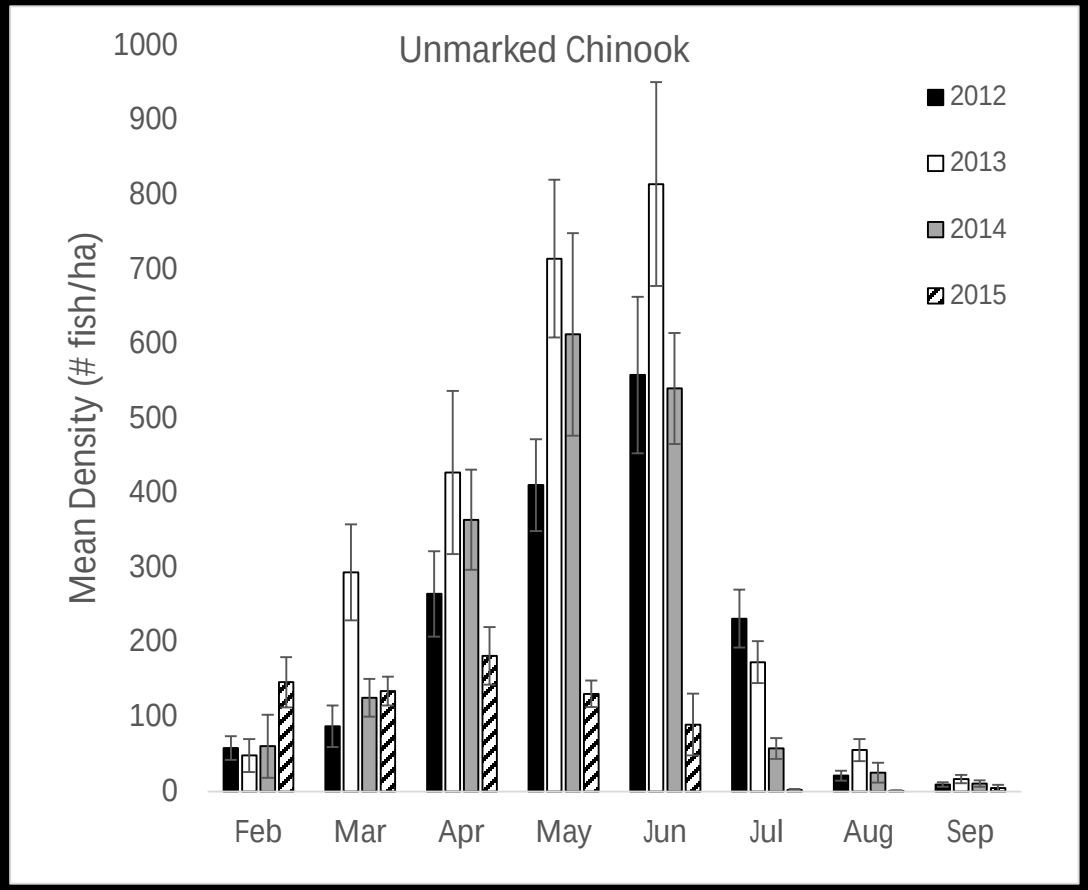


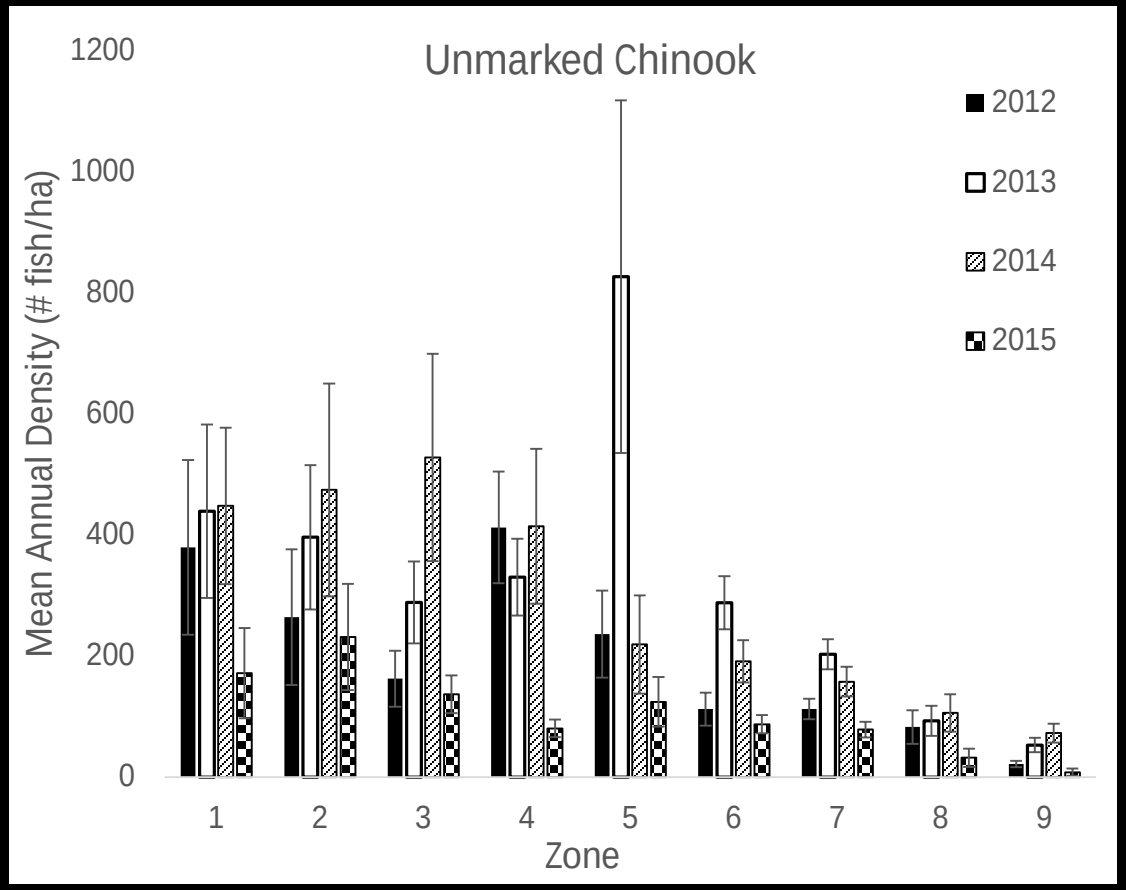
- Stratif
- Exten
  fishin
- Contin

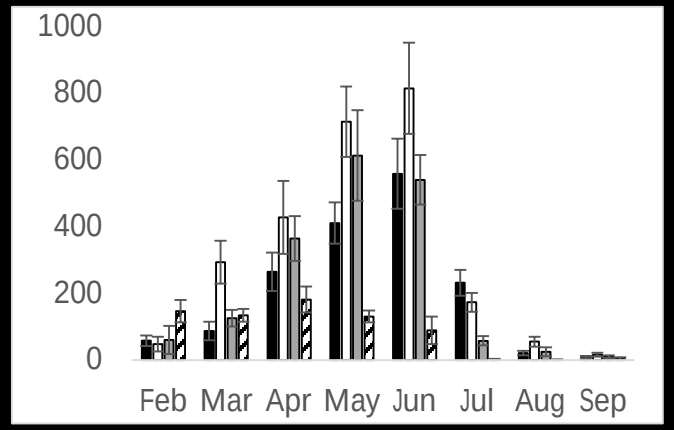
?

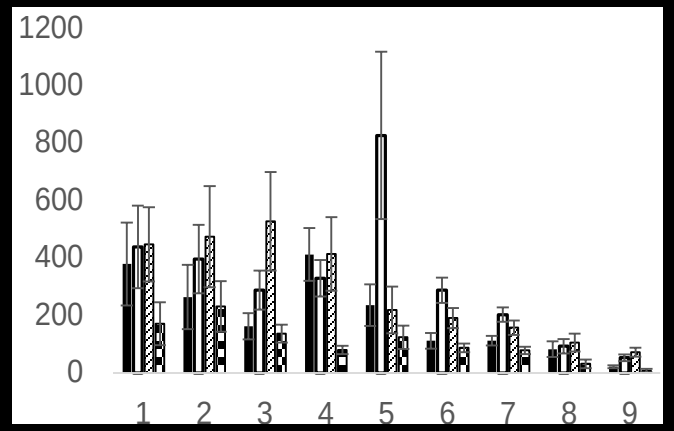


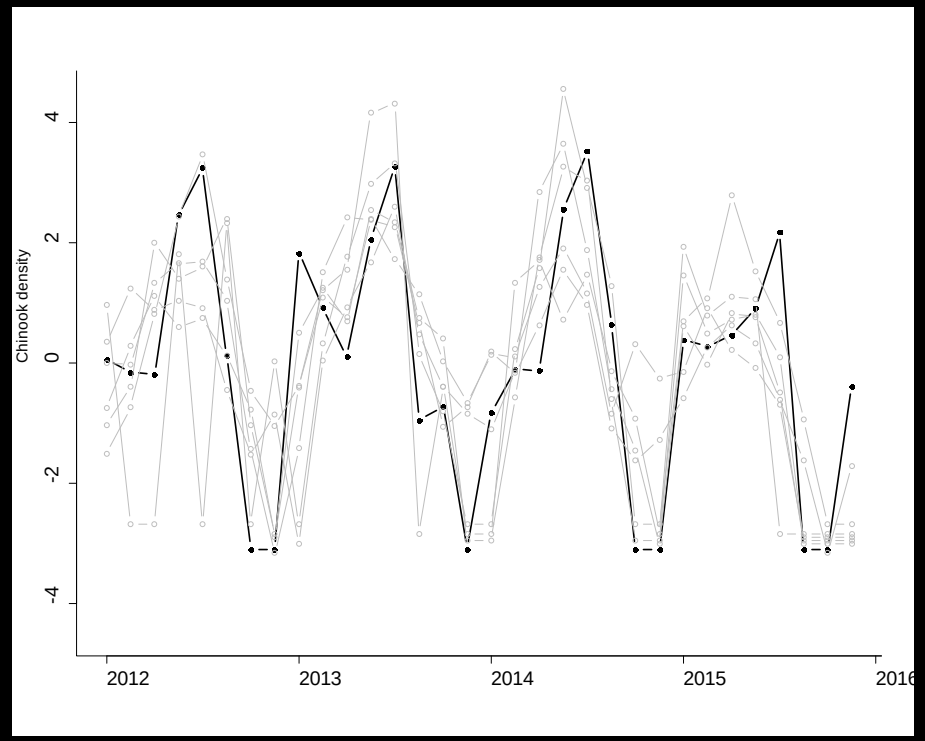


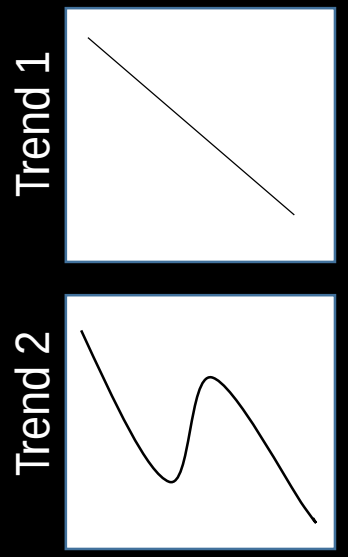

Unmarked Chinook
Mean Density (# fish/ha)
1000
900
800
700
600
500
400
300
200
100
0
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
2012
2013
2014
2015

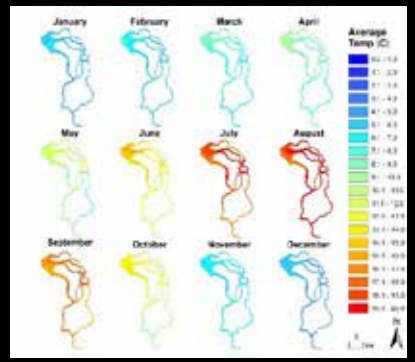

Unmarked Chinook
Mean Annual Density (# fish/ha)
1200
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
9
Zone
2012
2013
2014
2015

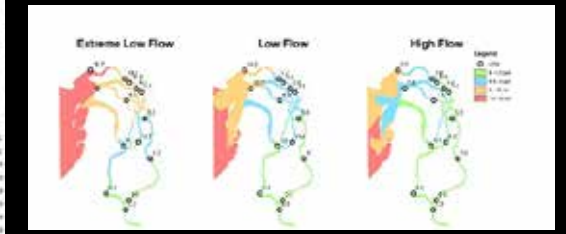

1000
800
600
400
200
0
Feb Mar Apr May Jun Jul Aug Sep


1200
1000
800
600
400
200
0
1 2 3 4 5 6 7 8 9

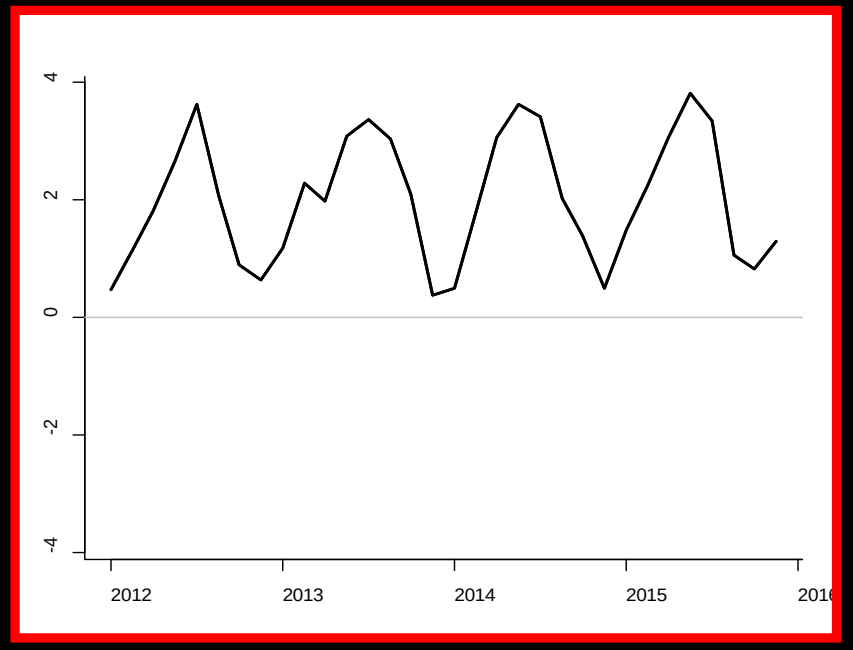

Chinook density
4
2
0
-2
-4
2012
2013
2014
2015
2016

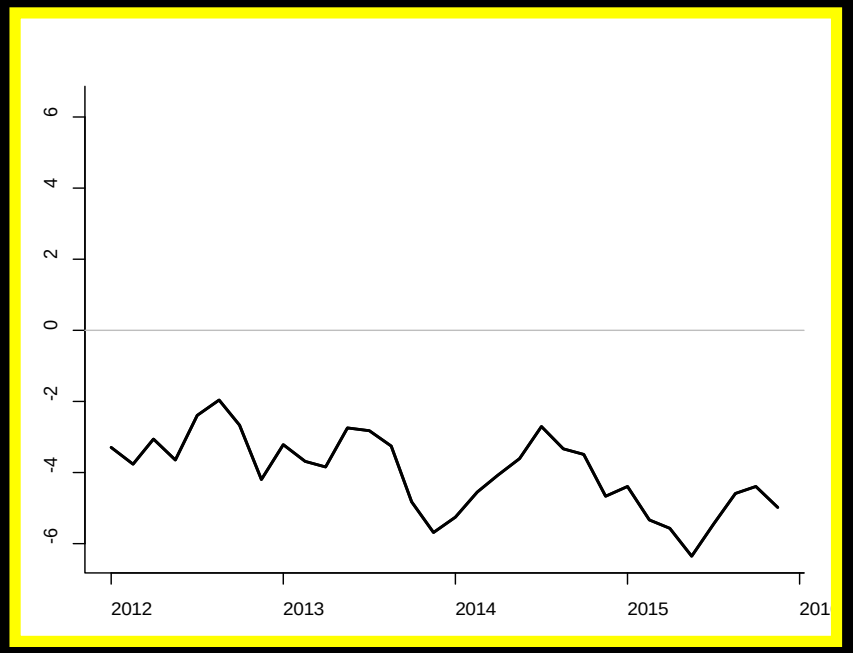

Trend 1
Trend 2
Time

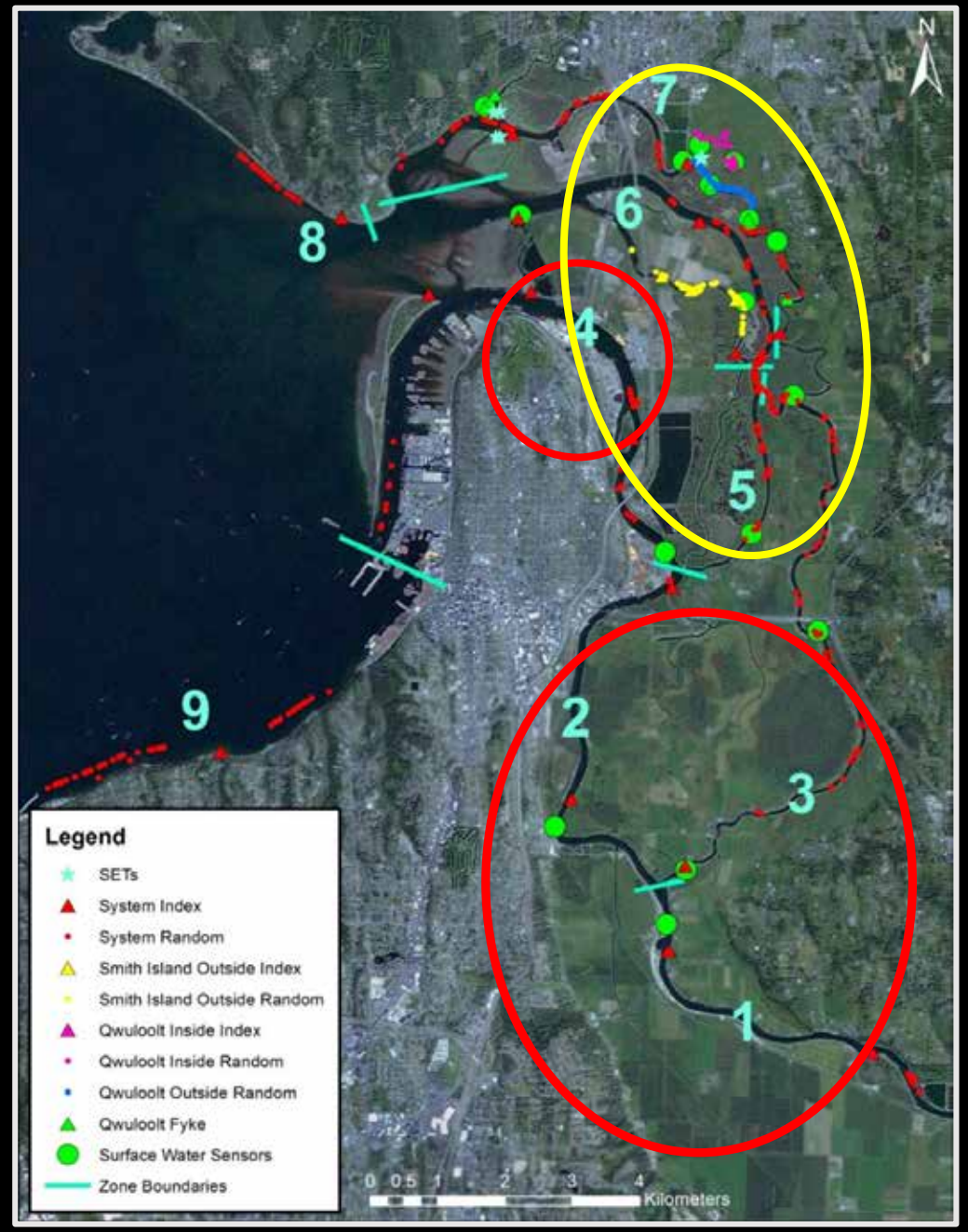

January
February
March
April
May
June
July
August
September
October
November
December

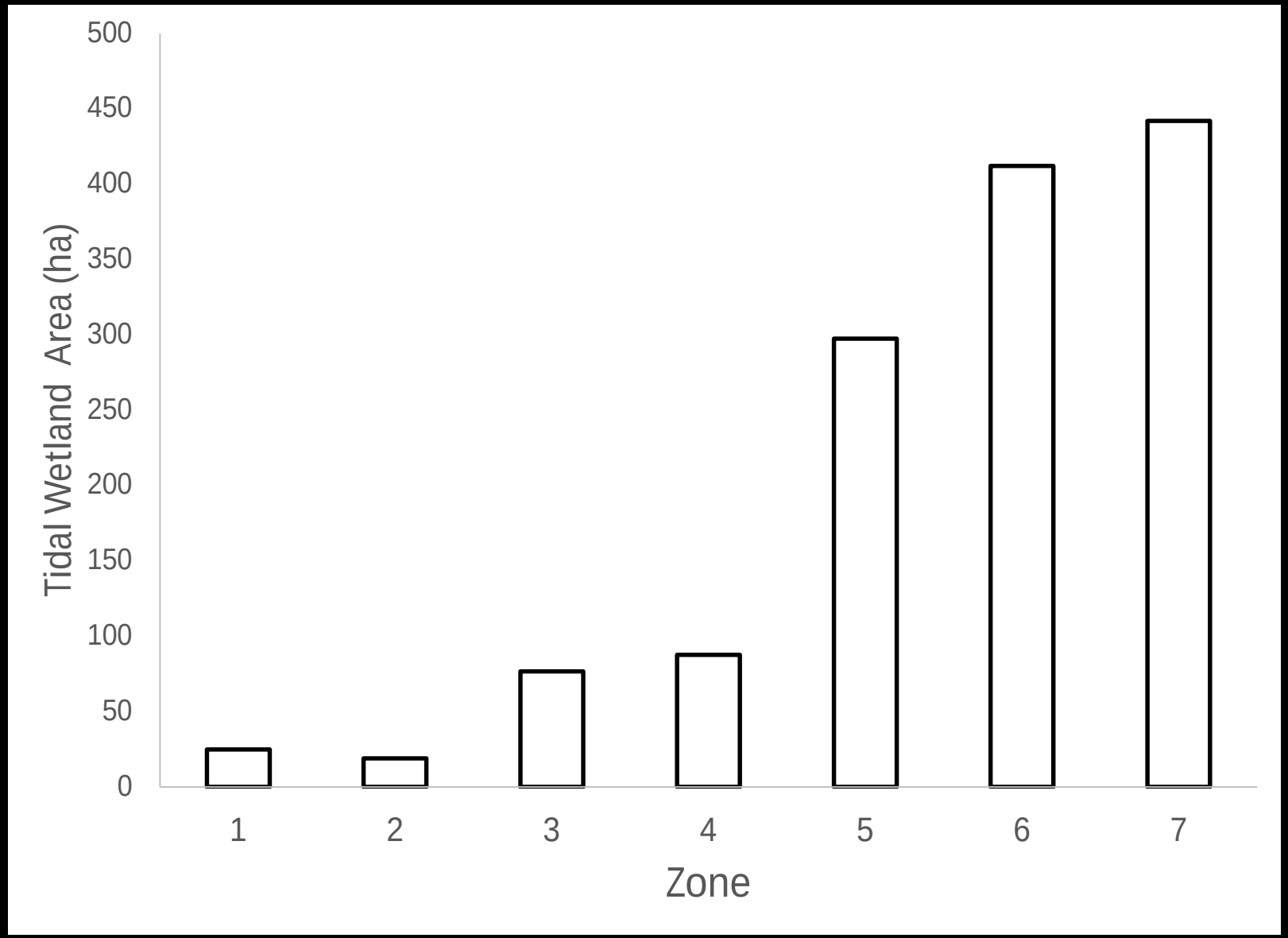

Extreme Low Flow
Low Flow
High Flow

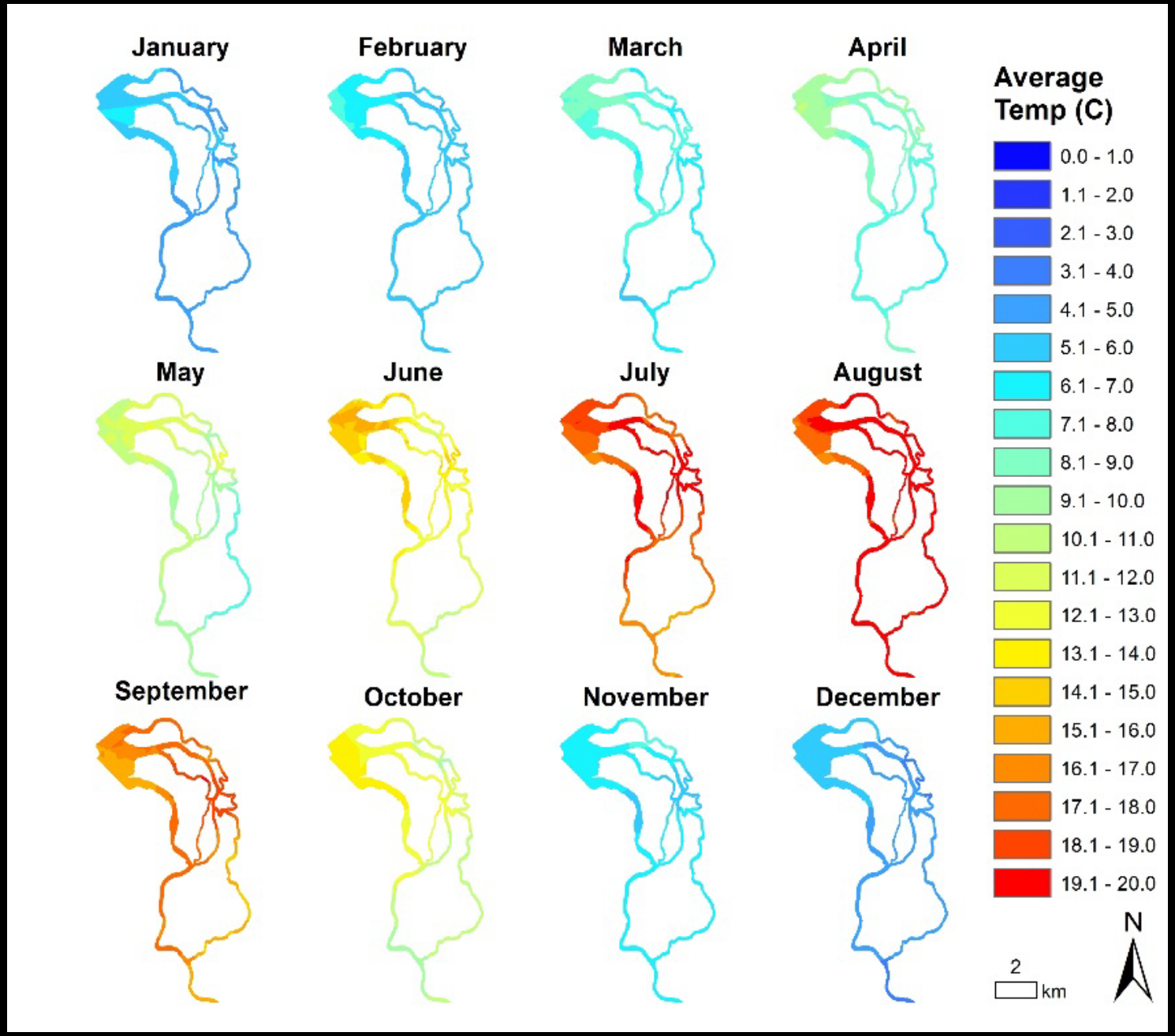
Normalized Mean Chinook Density (#fish/ha)

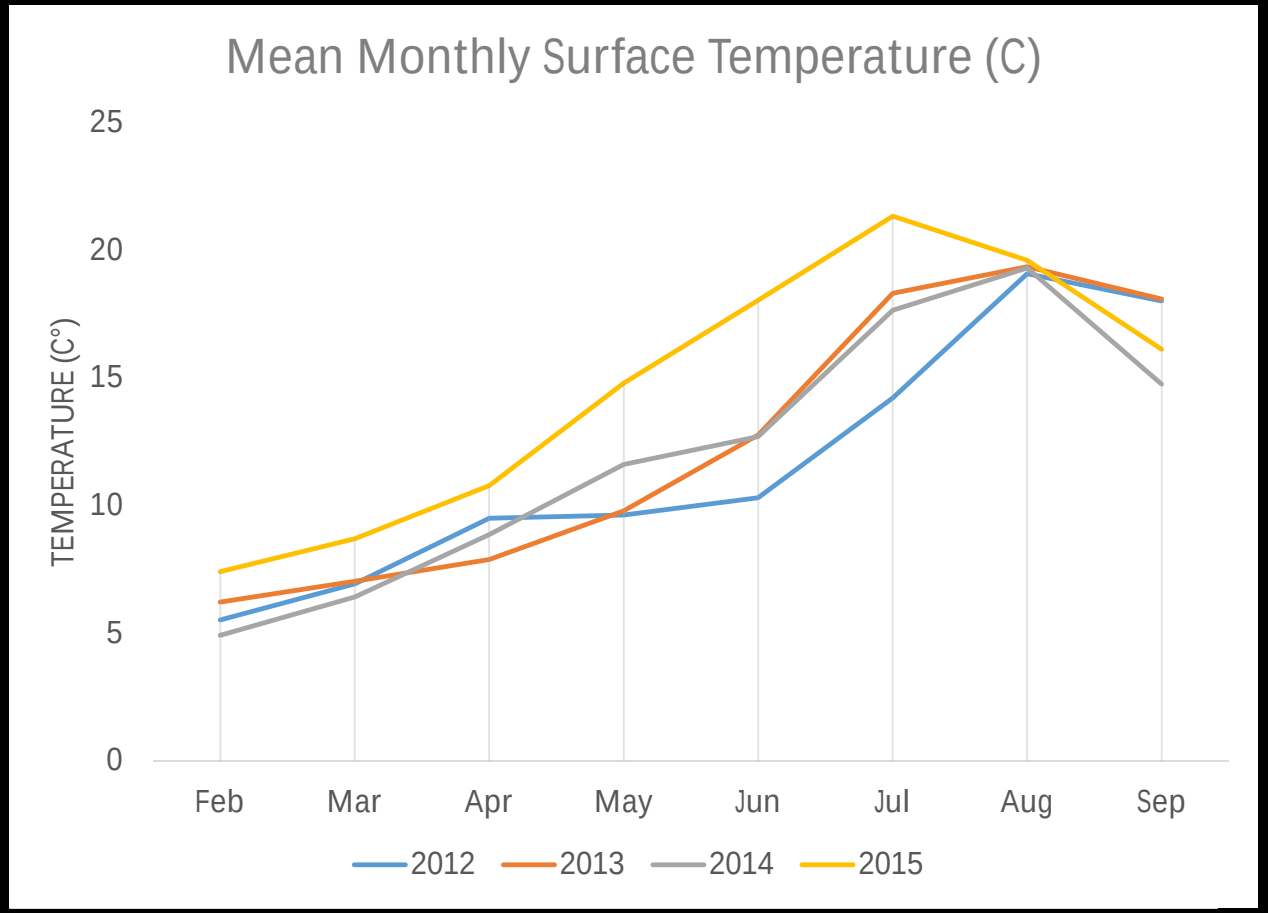


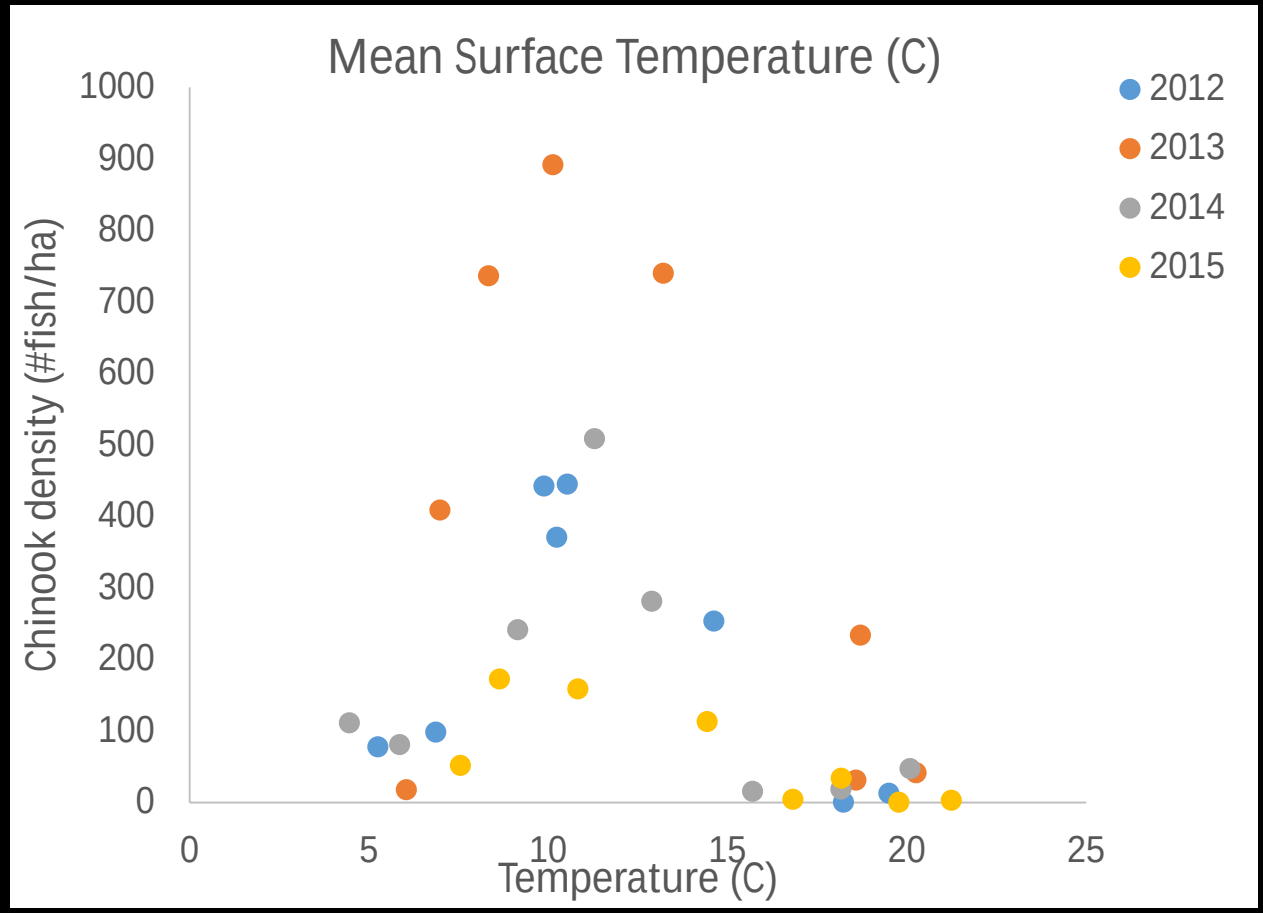




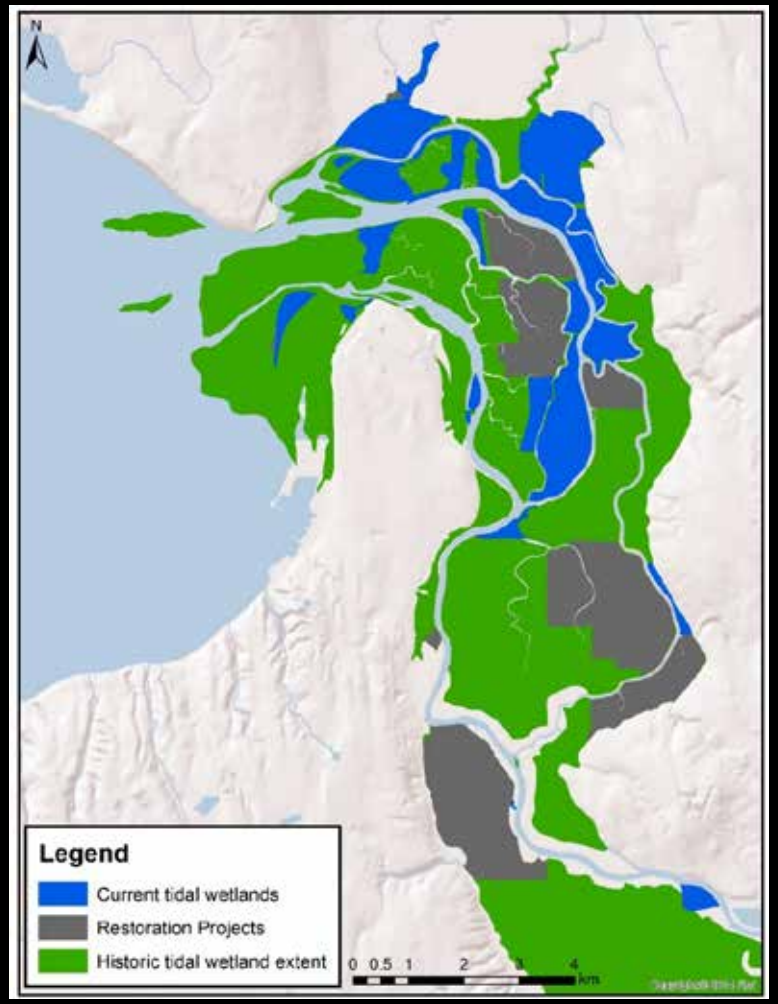

500
450
400
350
300
250
200
150
100
50
0
Tidal Wetland Area (ha)
1
2
3
4
5
6
7
Zone


January
February
March
April
May
June
July
August
September
October
November
December
Average Temp (C)
0.0 - 1.0
1.1 - 2.0
2.1 - 3.0
3.1 - 4.0
4.1 - 5.0
5.1 - 6.0
6.1 - 7.0
7.1 - 8.0
8.1 - 9.0
9.1 - 10.0
10.1 - 11.0
11.1 - 12.0
12.1 - 13.0
13.1 - 14.0
14.1 - 15.0
15.1 - 16.0
16.1 - 17.0
17.1 - 18.0
18.1 - 19.0
19.1 - 20.0
N
2
km


Mean Monthly Surface Temperature (C)
TEMPERATURE (C°)
25
20
15
10
5
0
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
2012
2013
2014
2015


Mean Surface Temperature (C)
Chinook density (#fish/ha)
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
15
20
25
Temperature (C)
2012
2013
2014
2015

- Spatial/Temporal patterns in Chinook density captured by two trends
  - Pulsed outmigration and rearing signals
  - Rearing pattern coincides with areas of available habitat
- Temperature determines how long and how many



Casey Rice

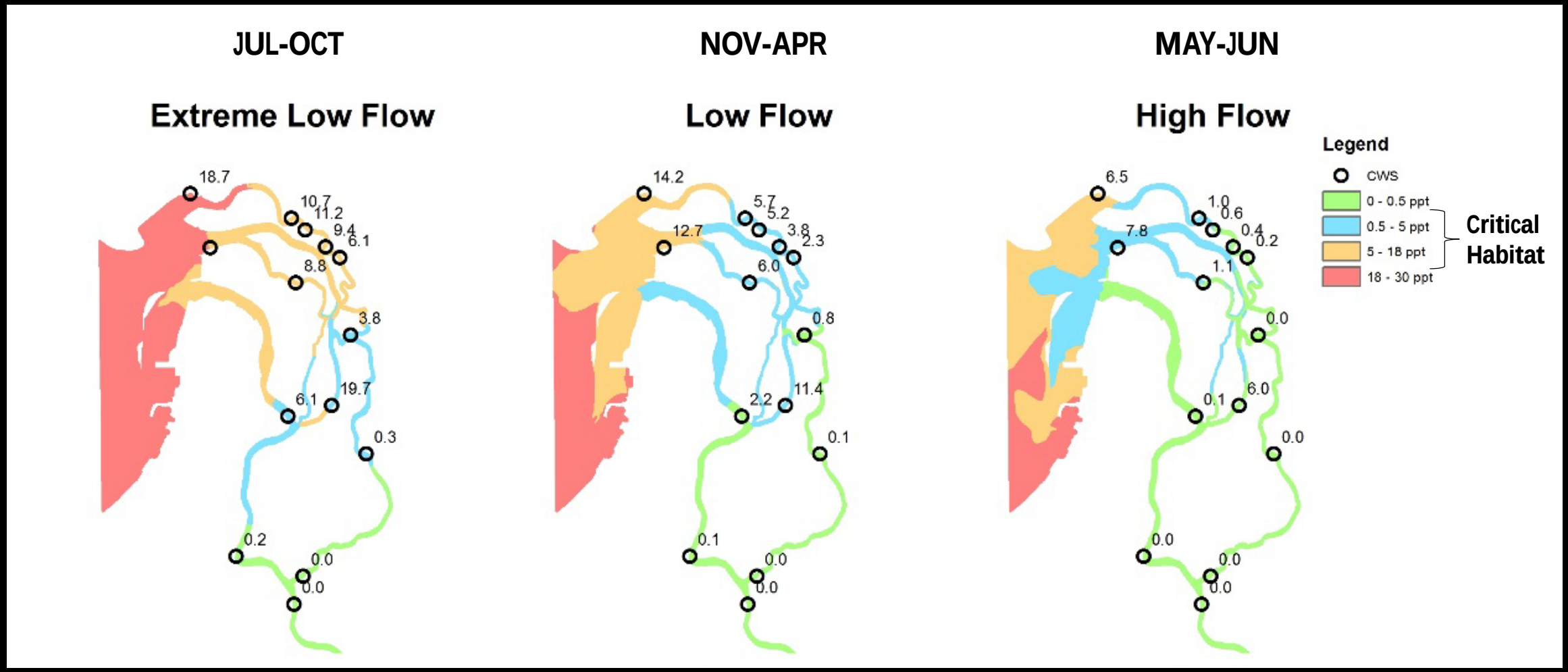
Partners & Funding

Boots on the Ground

Tulalip Tribes: Matt Pouley, Michael Abrahamse, Michelle Totman, & many others

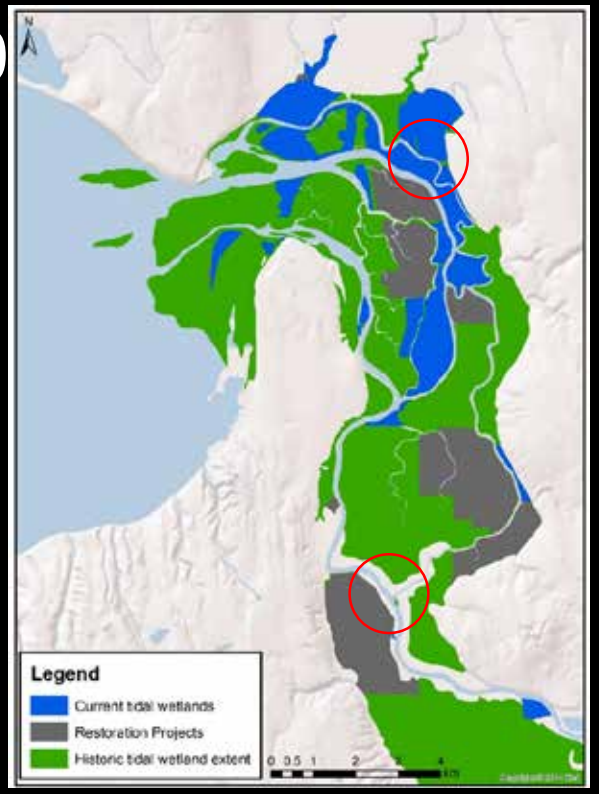
Snohomish County: Frank Leonetti, Michael Rustay, and many others

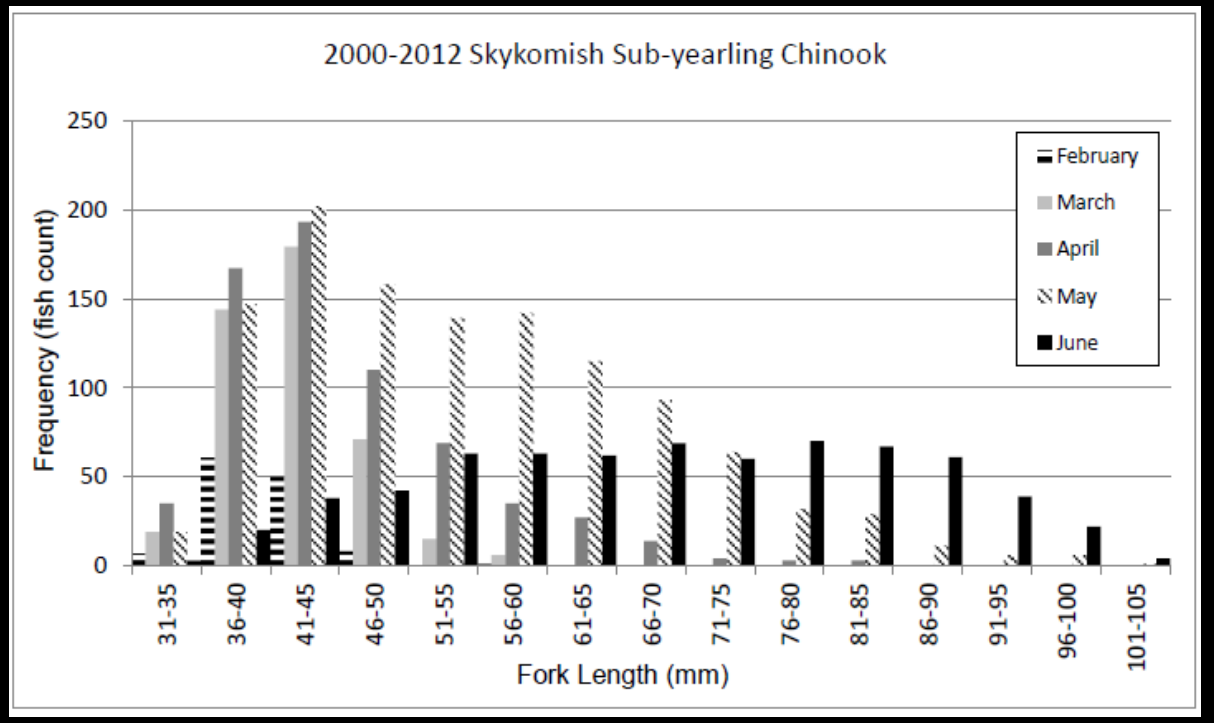
NWFSC Eric Ward, Mark Scheuerell, Eli Holmes


JUL-OCT
Extreme Low Flow
18.7
10.7
11.2
9.4
6.1
8.8
3.8
6.1
19.7
0.3
0.2
0.0
0.0
NOV-APR
Low Flow
14.2
5.7
5.2
12.7
3.8
2.3
6.0
0.8
2.2
11.4
0.1
0.1
0.0
0.0
MAY-JUN
High Flow
6.5
1.0
0.6
7.8
0.4
0.2
1.1
0.0
0.1
6.0
0.0
0.0
0.0
0.0
Legend
CWS
0 - 0.5 ppt
0.5 - 5 ppt
5 - 18 ppt
18 - 30 ppt
Critical Habitat

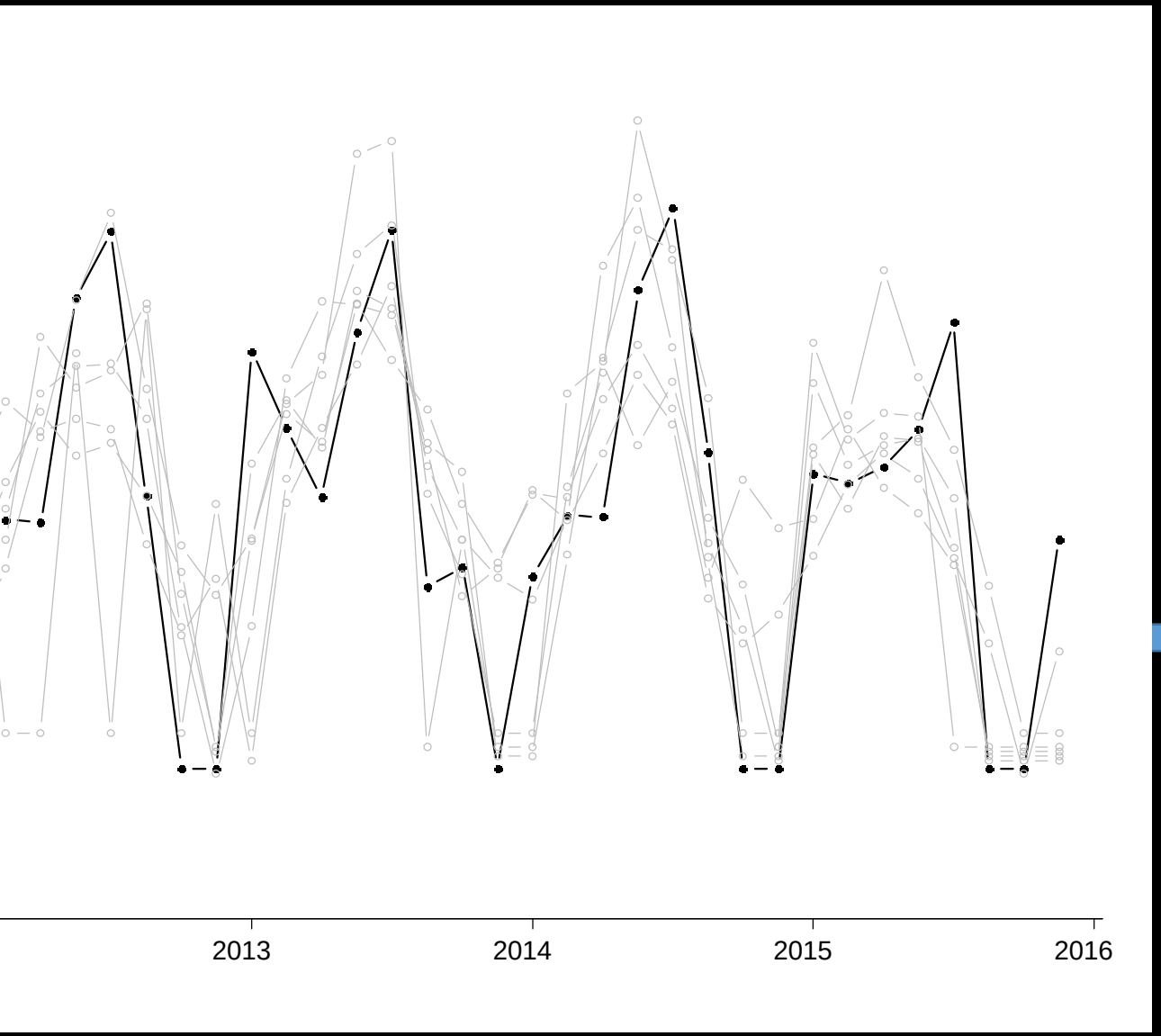
How can our science help inform restoration planning?

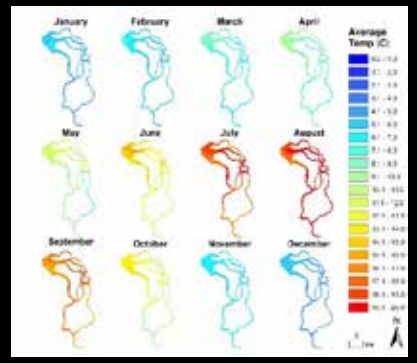
1. How are Chinook salmon distributed throughout the Snohomish River estuary?
2. How does temperature and/or salinity affect Chinook distrib

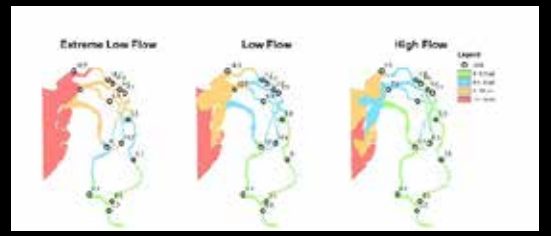




Kubo et al. 2013. Snohomish outmigration report. Tulalip Tribes


2013
2014
2015
2016


January
February
March
April
Average Temp (C)
May
June
July
August
September
October
November
December


Extreme Low Flow
Low Flow
High Flow

42

2 Trends + Temperature

Trend 1: Seasonal Outmigration

Trend 2: Potential rearing signal