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

Joshua Chamberlin  
*NOAA Northwest Fisheries Science Ctr., United States*, Joshua.chamberlin@noaa.gov

Jason E. Hall  
*NOAA Northwest Fisheries Science Ctr., United States*, Jason.Hall@noaa.gov

Todd Zackey  
*Tulalip Tribes Natural Resources, United States*, tzackey@tulaliptribes-nsn.gov

Frank Leonetti  
*Snohomish County, Surface Water Management, United States*, frank.leonetti@snoco.org

Michael Rustay  
*Snohomish County, Surface Water Management, United States*, mike.rustay@snoco.org

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

Joshua Chamberlin¹, Jason Hall², Todd Zackey³, Frank Leonetti⁴, Michael Rustay⁴, and Casimir Rice¹

¹ NOAA Fisheries, NWFSC, Fish Ecology, Watershed Program, Mukilteo Research Station
² Cramer Fish Sciences, Issaquah, WA
³ Tulalip Tribes, Natural Resources Division
⁴ Snohomish County, Surface Water Management
The Snohomish Estuary Monitoring

The Snohomish River Estuary

Habitat loss: Historic vs. Current
≈50% of Historic Habitat Extent

High Restoration Potential

≈50% of Historic Habitat Extent
• Stratified the landscape
• Extensive and Intensive fishing effort
• Continuous monitoring of temperature and salinity

Sampling Design
Snohomish Estuary Monitoring
Spatial And Temporal Distribution Patterns

Snohomish Estuary Monitoring

- Trend 1
- Trend 2

Time

Chinook density
Snohomish Estuary Monitoring

Spatial And Temporal Distribution Patterns

Normalized Mean Chinook Density (#fish/ha)

State 1


State 2

Tidal Habitat Distribution in Snohomish estuary

Snohomish Estuary Monitoring

The bar chart shows the tidal wetland area (ha) for different zones in the Snohomish estuary.

- Zone 1: 0 ha
- Zone 2: 0 ha
- Zone 3: 50 ha
- Zone 4: 100 ha
- Zone 5: 200 ha
- Zone 6: 400 ha
- Zone 7: 450 ha
Temperature Patterns

Snohomish Estuary Monitoring

January
February
March
April

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

May
June
July
August

September
October
November
December

2 km

N
Temperature Effects on Distribution

Snohomish Estuary Monitoring

Mean Monthly Surface Temperature (C)

- Feb
- Mar
- Apr
- May
- Jun
- Jul
- Aug
- Sep

TEMPERATURE (°C)

0 5 10 15 20 25

Mean Surface Temperature (C)

0 5 10 15 20 25

Chinook density (#fish/ha)

0 5 10 15 20 25

Mean Surface Temperature (C)

0 5 10 15 20 25

Chinook density (#fish/ha)

0 5 10 15 20 25

- 2012
- 2013
- 2014
- 2015
Conclusions

- 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
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Boots on the Ground

Rockstar Volunteer Craig Wollam!

Barney Boyer VCC Intern

Washington Conservation Corps
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 distribution?

Kubo et al. 2013. Snohomish outmigration report. Tulalip Tribes
Initial Model Results

2 Trends + Temperature

Trend 1: Seasonal Outmigration

Trend 2: Potential rearing signal