Population Structure of Even-Year Pink Salmon from Prince William Sound, Alaska

Wei Cheng¹,², Christopher Habicht¹, William D. Templin¹, Zachary D. Grauvogel¹, and Anthony J. Gharrett²

¹Alaska Department of Fish and Game
Gene Conservation Laboratory
Anchorage, AK 99518

²University of Alaska Fairbanks
Fisheries Division
Juneau, AK 99801

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Outline

• Background
• Laboratory work
• Data analysis
• Summary
• Future study
Alaska Hatchery Research Program

Interactions of wild and hatchery pink and chum salmon in Prince William Sound and Southeast Alaska

• Genetic population structure
  – What is the genetic population structure of Pink Salmon in Prince William Sound?

• Extent and annual variability in straying of hatchery salmon

• Impact on fitness (productivity) of wild salmon due to hatchery straying
Population Structure

• Influenced by four evolutionary processes
  – natural selection
  – genetic drift
  – mutation
  – migration

• Population structure is quantified by allele frequencies
Microsatellite Marker

• DNA markers

Variable repeat numbers

CACACACACACA
CACACACACACACACACACA

• 16 markers (Beacham et al. 2012)
# Study Design

<table>
<thead>
<tr>
<th></th>
<th>Contemporary</th>
<th>Historical</th>
</tr>
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<tbody>
<tr>
<td><strong>Natural Pink Salmon</strong></td>
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</table>
You are here.
2014 Collections

Prince William Sound

East
West
Swanson Creek
Duck River
Laboratory Work

- Tissue collection
- DNA isolation
- PCR

Genotype

Score
Data Quality Analyses

- Allele Frequencies
- Hardy-Weinberg Equilibrium tests
- Linkage Disequilibrium tests
Ogo_One102pk

Location

Allele

Prince William Sound

2014 Collections

Km 0 10 20 30 40
Ogo_One102pk

![Map of Prince William Sound with locations marked as East and West]

- **Allele**
  - Rocky
  - Cabin
  - McCleod
  - Snug Harbor
  - Chenega
  - Tolofon
  - Erb
  - Mink
  - Paulson
  - Swanson
  - Meachum
  - Cognill
  - Black Bear
  - Sivash 1
  - Long
  - Gregories E.
  - Gregories L.
  - Duck
  - Lagoon
  - Fish E.
  - Fish L.
  - Olsen
  - Koppen E.
  - Koppen L.
  - Humpback
  - Windy
  - Hartney
  - Constantine
Ogo_One102pk

Allele

Location

Prince William Sound

2014 Collections

Km

0
10
20
30
40

East

West

Rocky, Cabin, McLeod, AFK, Snug Harbor, Chenega, Tolemoff, Erb, Mink, Paulson, Swanson, Meacham, Coghill, WNH, Black Bear, Sivash 1, CCH, Long, VFD, Gregorieff E, Gregorieff L, Duck, Lagoon, Fish E, Fish L, Olsen, Koppen E, Koppen L, Humphack, Windy, Hartney, Constantine
Population Structure Analyses

• Fixation index ($F_{st}$)

• Homogeneity tests

• Principal component analyses (PCA)

• Multidimensional scaling (MDS)
Fixation Index ($F_{ST}$)

• A measure of population differentiation due to genetic structure

• $0 \leq F_{ST} \leq 1$
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Testing for Difference: Kodiak vs. Prince William Sound

\[ p < 10^{-6} \ (\alpha = 0.05) \]
Testing for Differences: among Prince Willian Sound Locations

$p < 10^{-6}$ ($\alpha = 0.05$)
Testing for Differences: Between Early and Late Collections
Testing for Differences: Between Early and Late Collections

$p < 0.05 (\alpha = 0.05)$
Assumed Migration Pathway

2014 Collections

Prince William Sound

- Hatchery
- Blue: East
- Red: West
Estimated Hatchery Pink Salmon Fraction within Prince William Sound Streams

Data from Knudesen et al. 2015
Principal Component Analysis

PC 2 (5.81%)

PC 1 (6.05%)

Rocky
Coghill
Long
Siwash 1
Humpback
Snug Harbor

Fish (L.)
Multidimensional Scaling (MDS)

2014 data

Fish (L.)
Snug Harbor
Rocky
Coghill
Long
Siwash 1
Humpback
Summary

• Kodiak vs. Prince William Sound (PWS)
  – Significantly different

• Population structure in PWS
  – Significant

• Early run vs. late run
  – genetically different within 3 out of 5 creeks in eastside of PWS
Future Study

- Investigate other variables
  - Temperature
  - Run time

- Contemporary vs. historical data

- The origin of Pink Salmon in Prince William Sound
Acknowledgements

• Hatcheries
  – PWSAC, VFDA, KRAA

• Prince William Sound Science Center

• Fisheries and Oceans Canada
  – Pacific Biological Station

• Alaska Department of Fish and Game

• Alaska Hatchery Research Program Science Panel

• University of Alaska Fairbanks – Juneau Center