

Pink salmon genetics: worth another look?



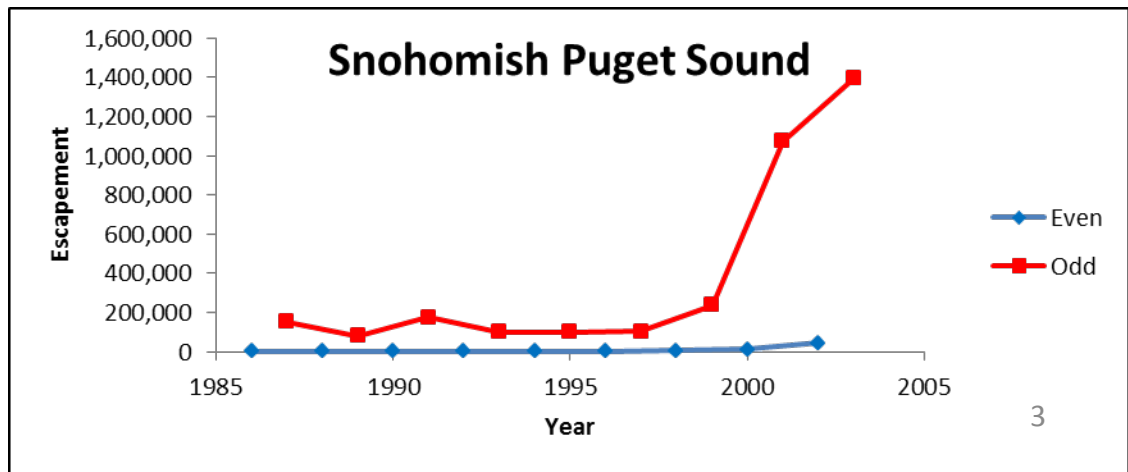
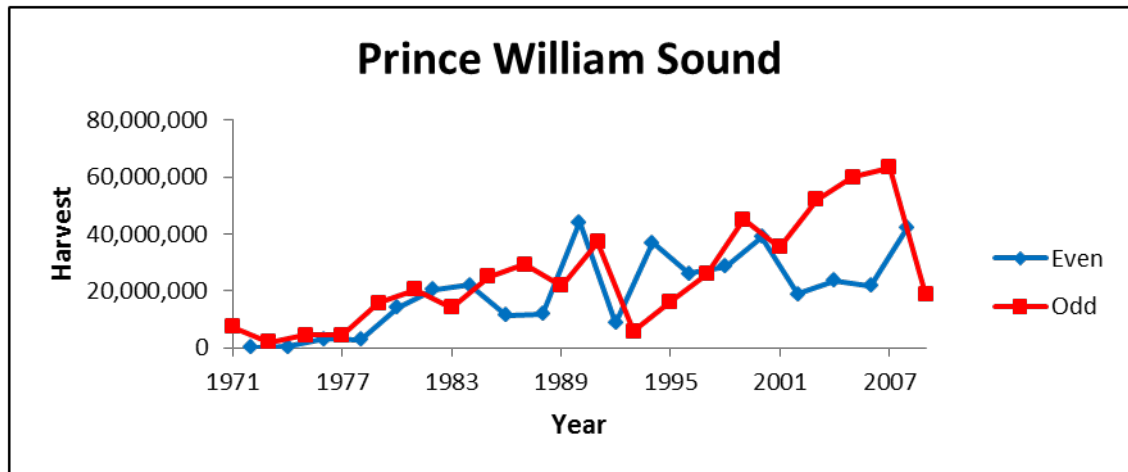
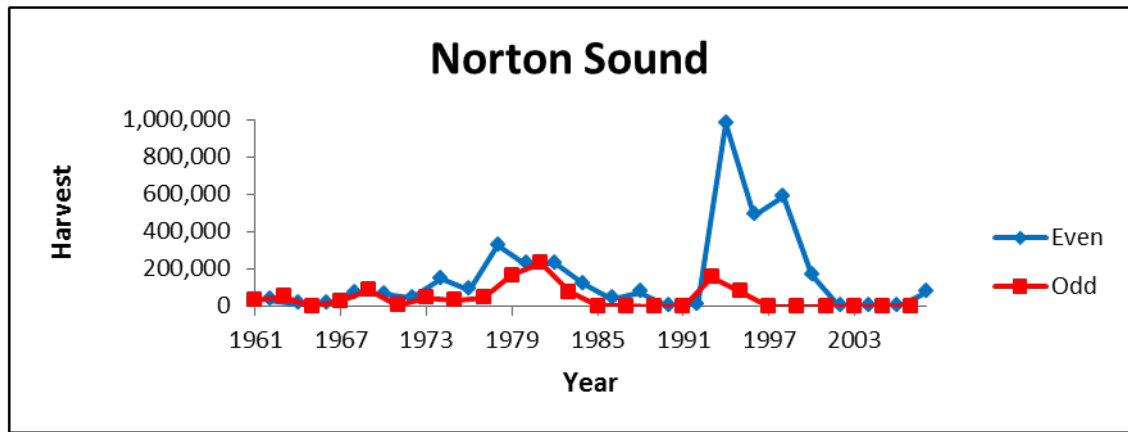
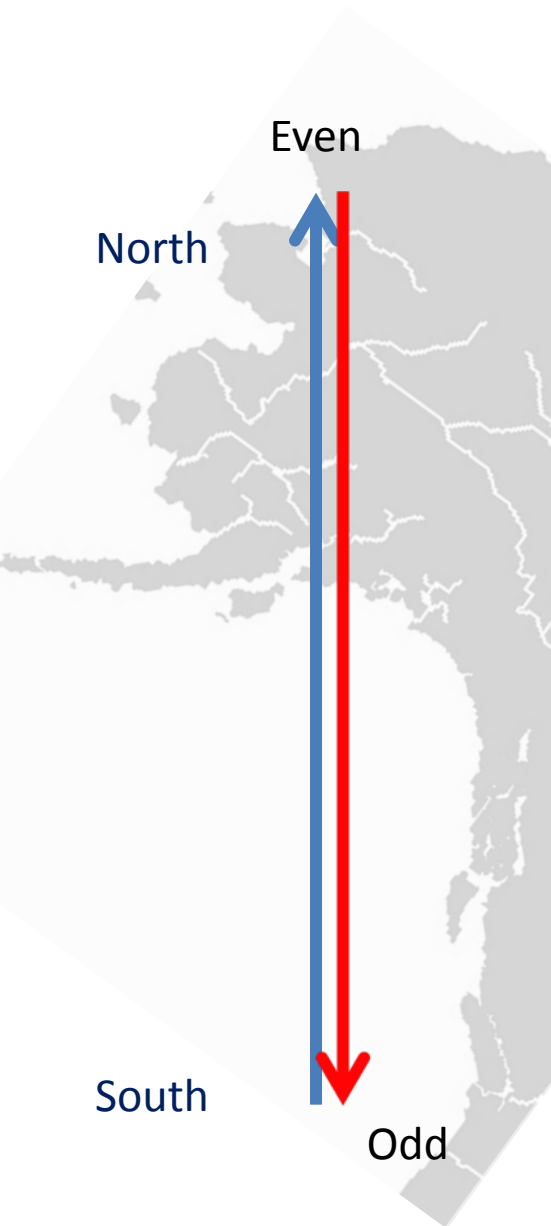
Lisa Seeb, Ryan Waples, Jim Seeb
University of Washington

What's Unique About Pink Salmon?

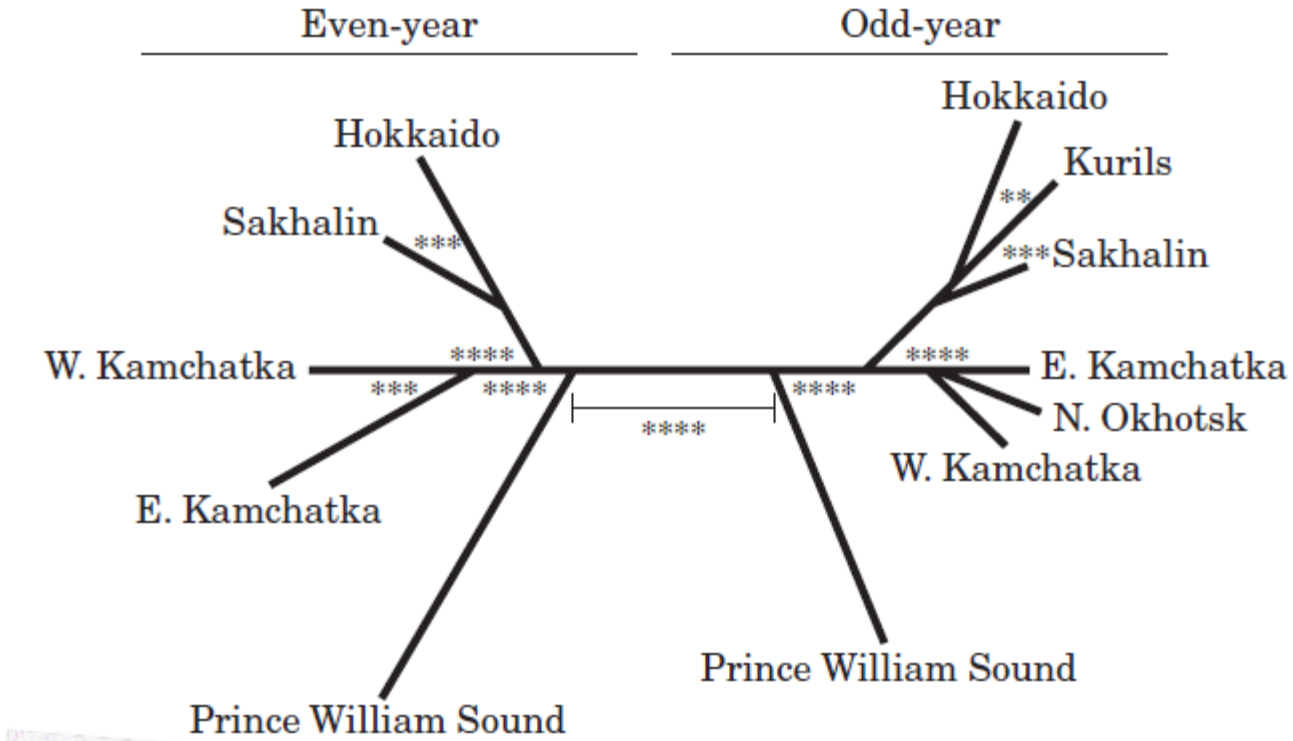
- Strict two-year life cycle-no gene flow
- Dominance of one broodline in many areas
- Currently high abundance, colonizing



Broodline Dominance

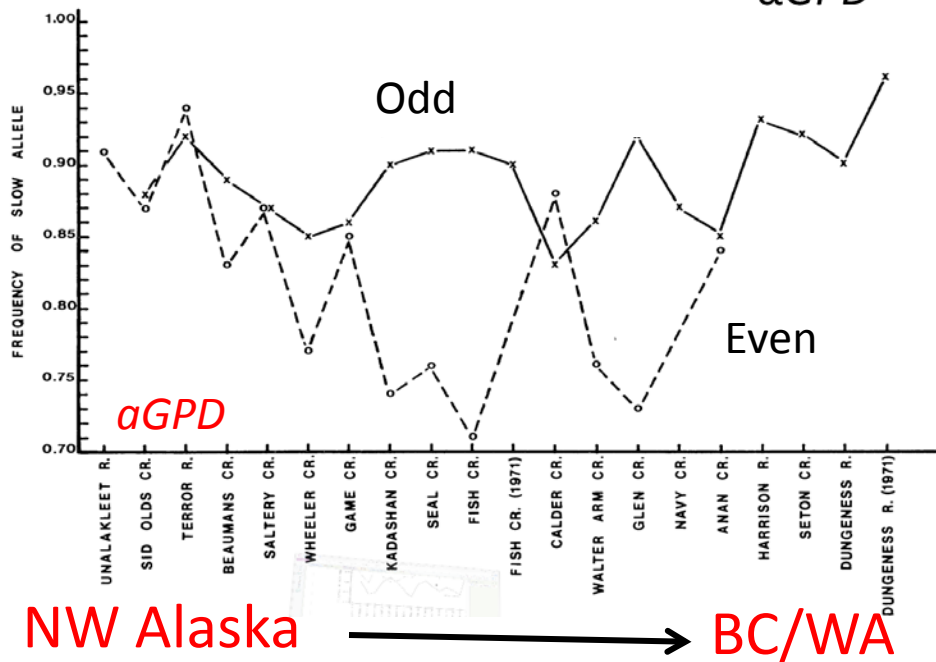
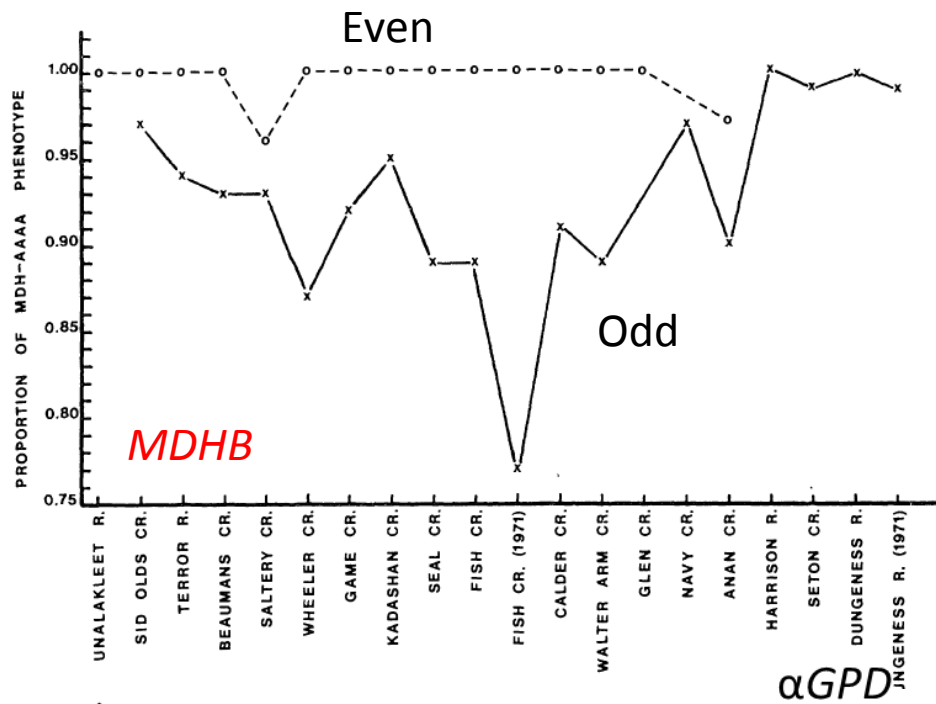


ODD- AND EVEN-BROODLINE ASIAN PINK SALMON



Hawkins et al. (2002)





- Aspinwall (1974)
 - allele frequency differences between even and odd in similar locations supports neutral-random drift hypothesis rather than balancing selection

What Can Genomics Add?

- Signals of adaptation (selection)
- Can broodlines be used as replicates to identify adaptive loci?
- Provide higher resolution markers



Paired even/odd collections

- Geographically dispersed pairs of even/odd populations
- Temporal replicates
 - Sample sizes 20 to 24
- **What are expectations for neutral and selective markers?**

Nome R, Norton Sound
1994/1991

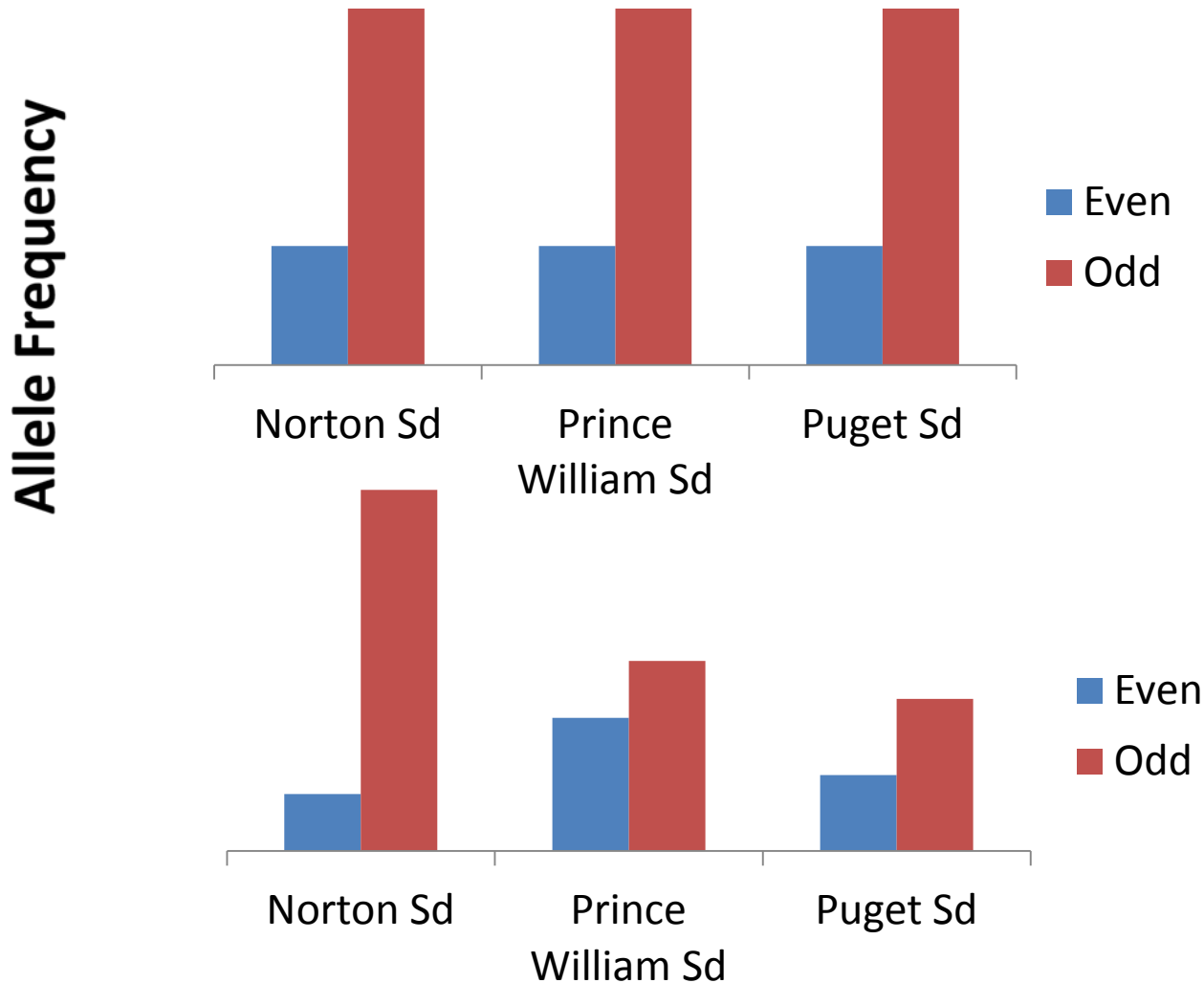
Koppen Cr, Prince William Sound
1996/1991

Snohomish R, Puget Sound
1996/2003



Expectations of Neutral SNP

Reflect Broodline and Geographic Divergence



Share local environmental conditions, pathogens exposure



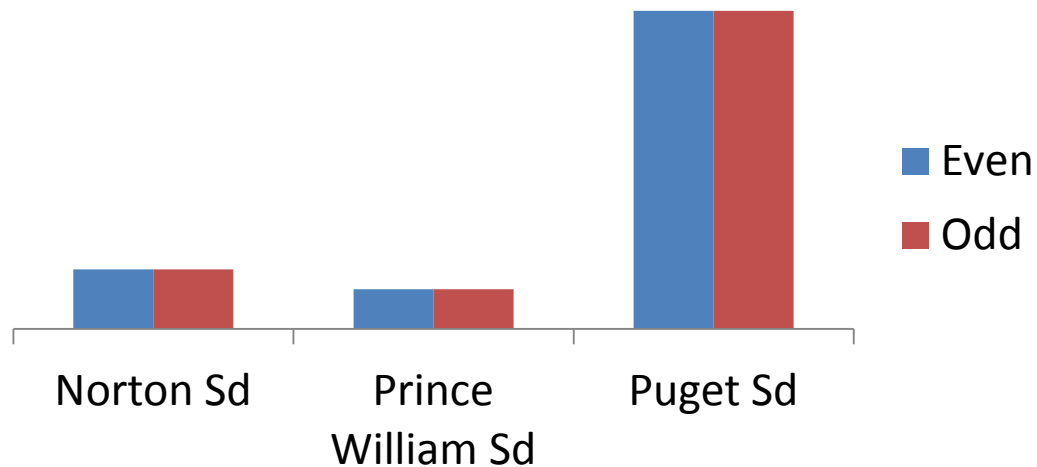
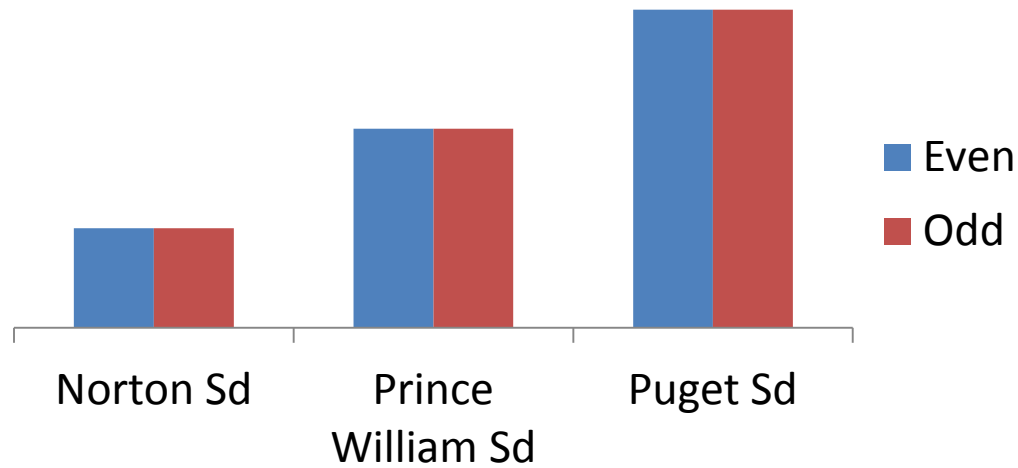
Share spawning location, timing, substrate



Expectation of SNPs

Reflecting Local Adaptation & Selection

Allele Frequency



Pink RAD Pipeline

Restriction-site Associated DNA

- Identified over 70,903 putative SNPs
 - 1 bp differences, exclude close variants (PSVs)
- Assign genotypes from sequence counts
- Final data set after conservative filtering

131 of 140 Individuals

6,743 Loci

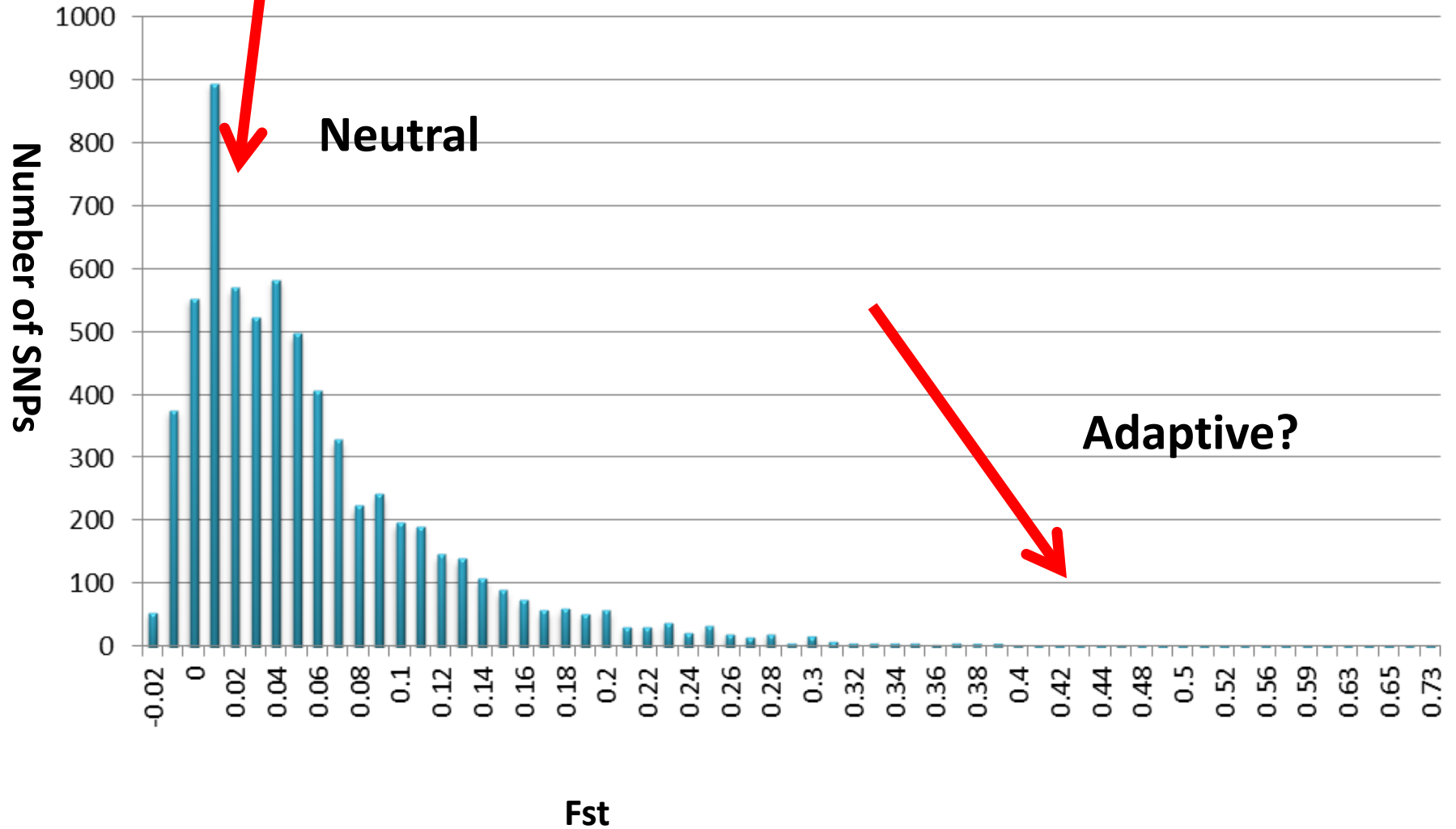
AGCTGACTTGACCT	C	GAAGTGCATTGCTAGGTCGCGATTG
AGCTGACTTGACCT	C	GAAGTGCATTGCTAGGTCGCGATTG
AGCTGACTTGACCT	C	GAAGTGCATTGCTAGGTCGCGATTG
AGCTGACTTGACCT	C	GAAGTGCATTGCTAGGTCGCGATTG
AGCTGACTTGACCT	C	GAAGTGCATTGCTAGGTCGCGATTG
AGCTGACTTGACCT	C	GAAGTGCATTGCTAGGTCGCGATTG
AGCTGACTTGACCT	C	GAAGTGCATTGCTAGGTCGCGATTG
AGCTGACTTGACCT	A	GAAGTGCATTGCTAGGTCGCGATTG
AGCTGACTTGACCT	A	GAAGTGCATTGCTAGGTCGCGATTG
AGCTGACTTGACCT	A	GAAGTGCATTGCTAGGTCGCGATTG
AGCTGACTTGACCT	A	GAAGTGCATTGCTAGGTCGCGATTG
AGCTGACTTGACCT	A	GAAGTGCATTGCTAGGTCGCGATTG

AGCTGACTTGACCT	C	GAAGTGCATTGCTAGGTCGCGATTG
AGCTGACTTGACCT	A	GAAGTGCATTGCTAGGTCGCGATTG

A:C Heterozygote



Fst Distribution Histogram



Diversity Among North American Pink Salmon

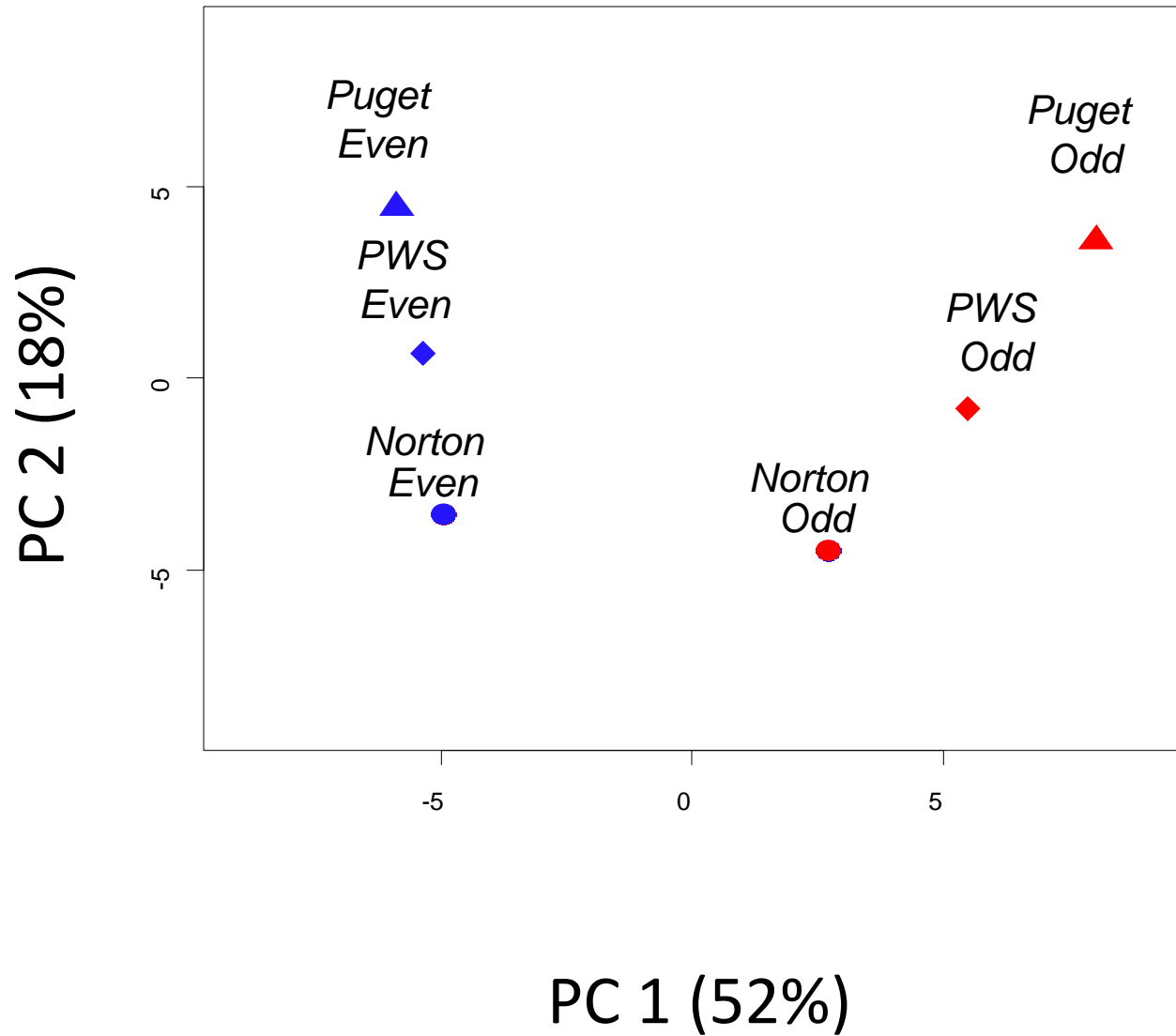
6,743 SNPs

Broodline	Fst
Even	0.036
Odd	0.053
Even + Odd	0.086

Pairwise by Location	Fst
Norton Sd	0.065
Prince William Sd	0.098
Puget Sd	0.146

Pink Salmon PCA

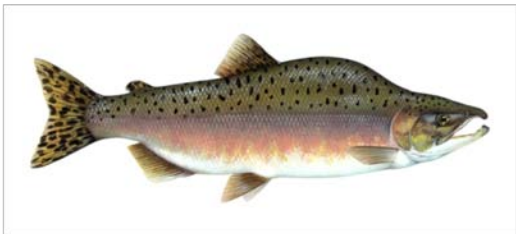
6,743 SNPs



Eigenvector Loadings

Correlation Coefficients

- PC 1
 - Explains 52% of variance
 - 244 significant SNPs

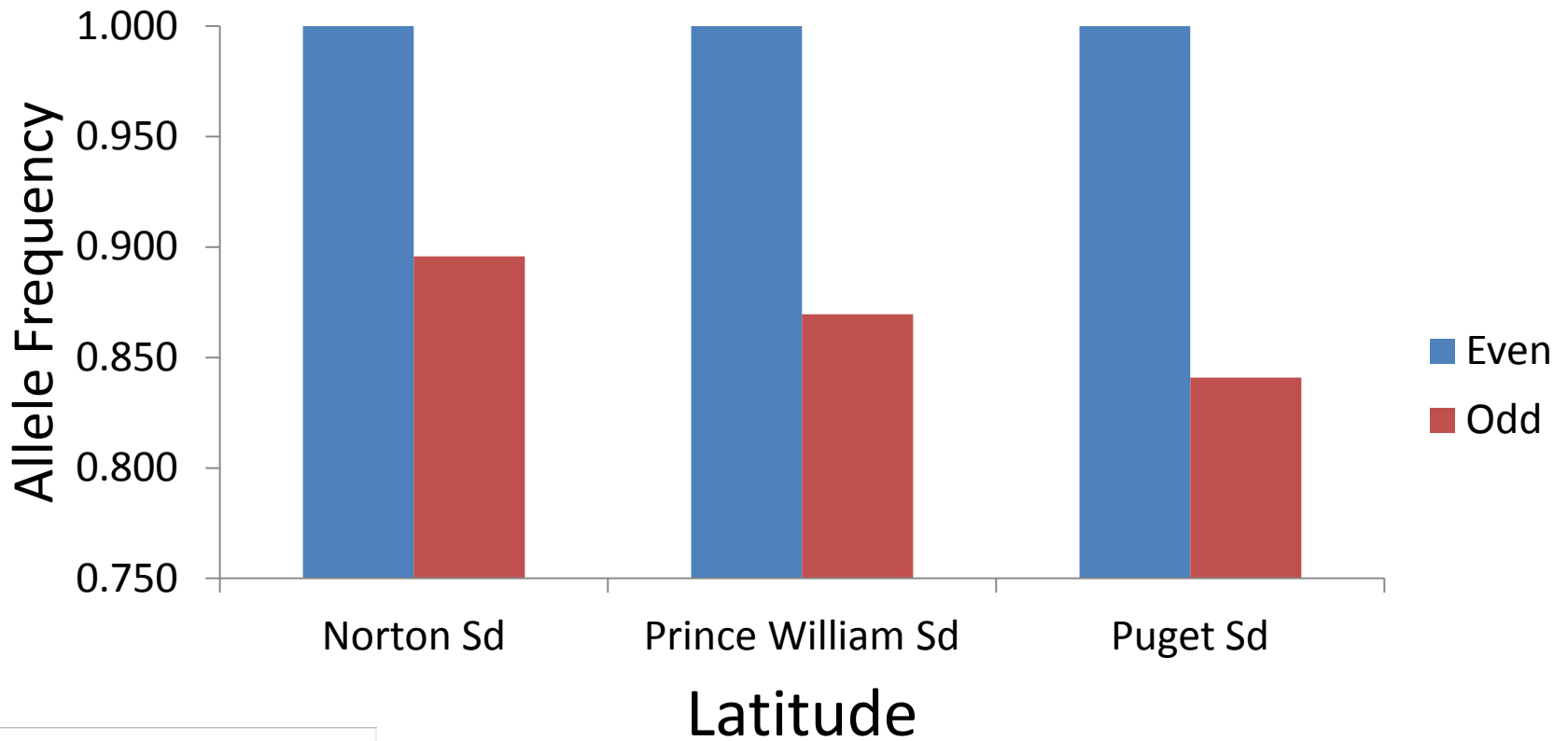


Critical Value (0.95)

Eigenvector Correlations with PC 1

Reflecting Geographic and Broodline

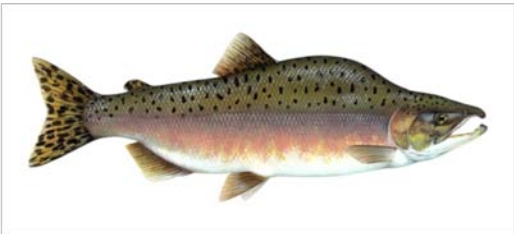
SNP 58947



Eigenvector Loadings

Correlation Coefficients

- PC 1
 - Explains 52% of variance
 - 244 significant SNPs
- PC 2
 - Explains 18% of variance
 - 27 significant SNPs

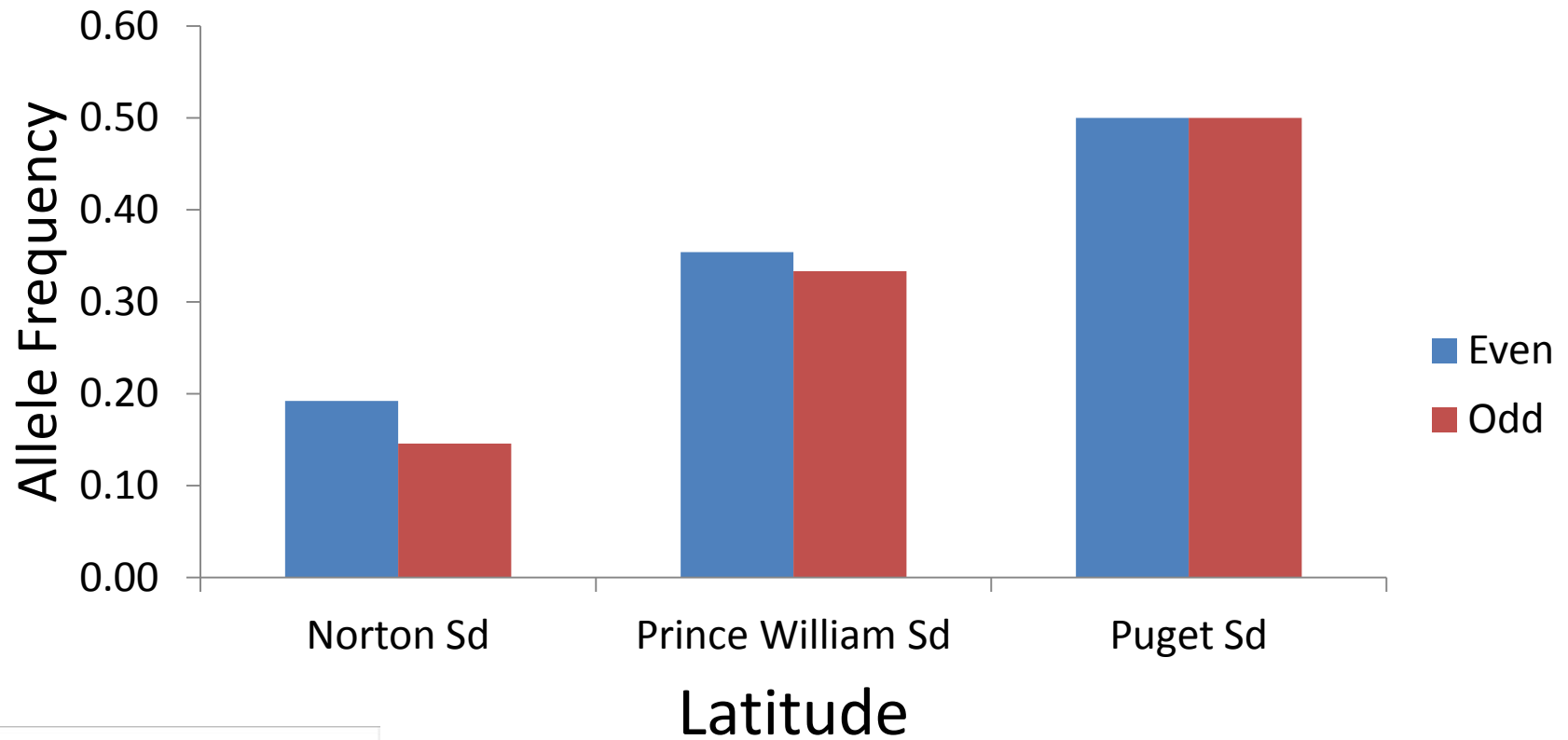


Critical Value (0.95)

Eigenvector Correlations with PC 2

SNP Reflecting Local Adaptation?

SNP 4744



Worth Another Look--Yes

- Identified 6,743 candidate SNPs
 - 27 with potential functional significance
 - Adaptive Markers, high GSI potential
- More diversity in odd
 - Even/odd more divergent in south
- Adaptive differences between broodlines?
 - One year derived from other?
 - Independent colonization and expansion?



Pink Takeover in Pacific Northwest?

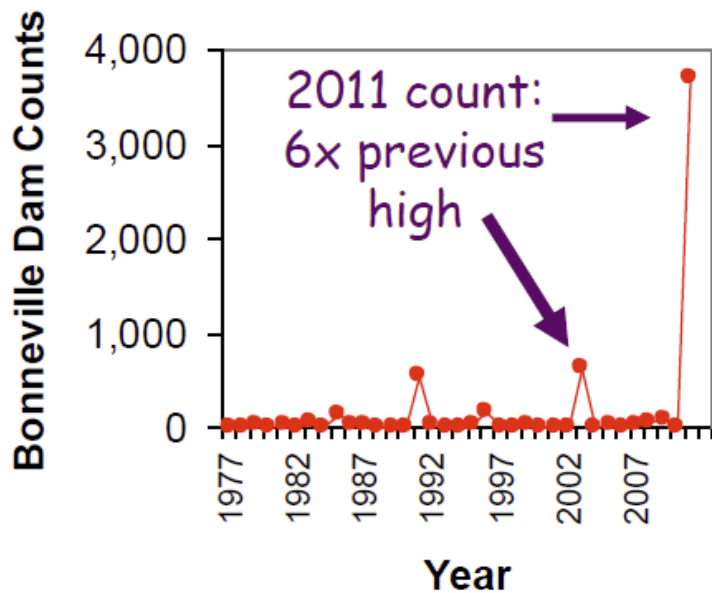
- Dramatic increase in last decade in Puget Sound and Columbia River in odd-year
- Abundant recreational opportunities
- Concerns that they may negatively affect ESA-listed populations



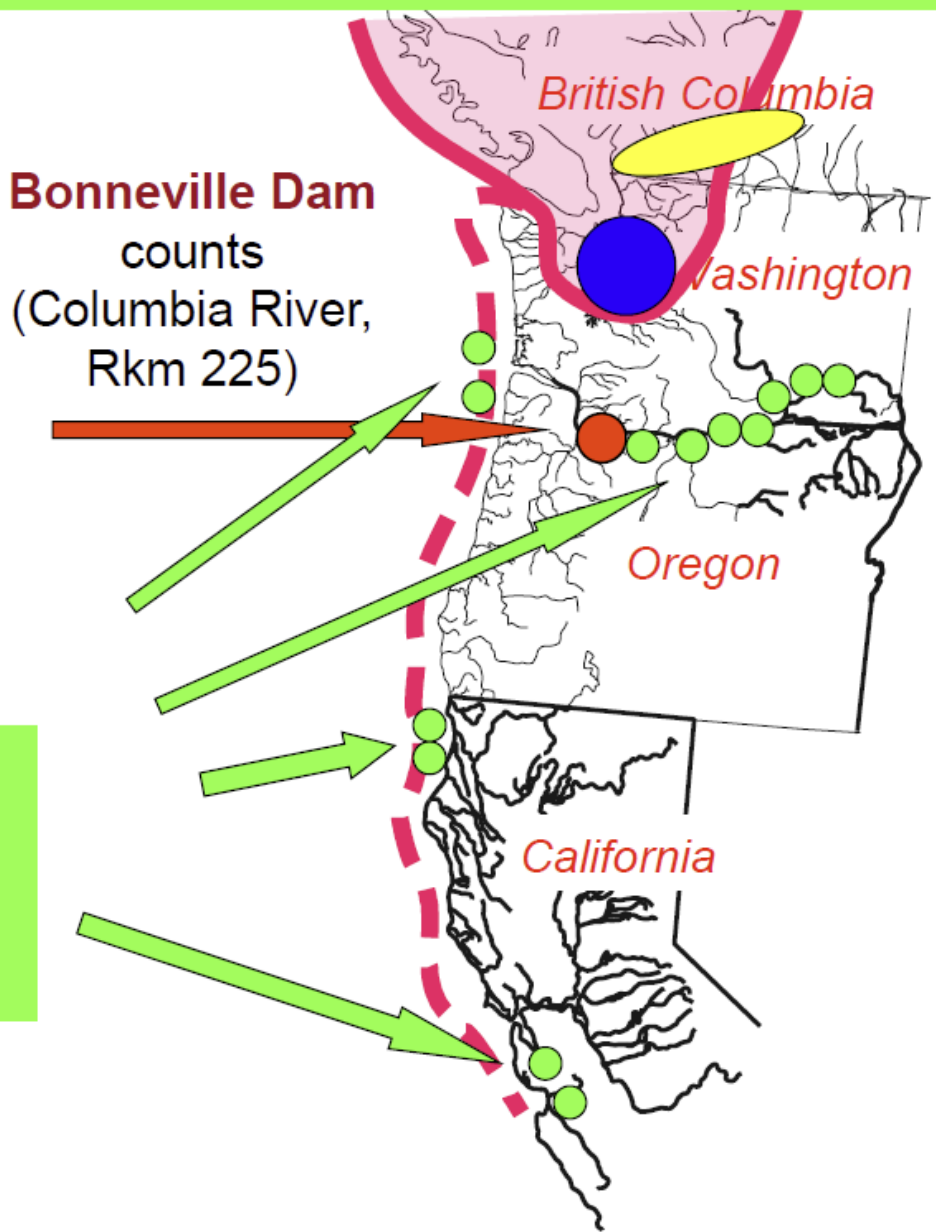
Puget Sound, Washington



Aside: 2011 adult pink salmon sightings



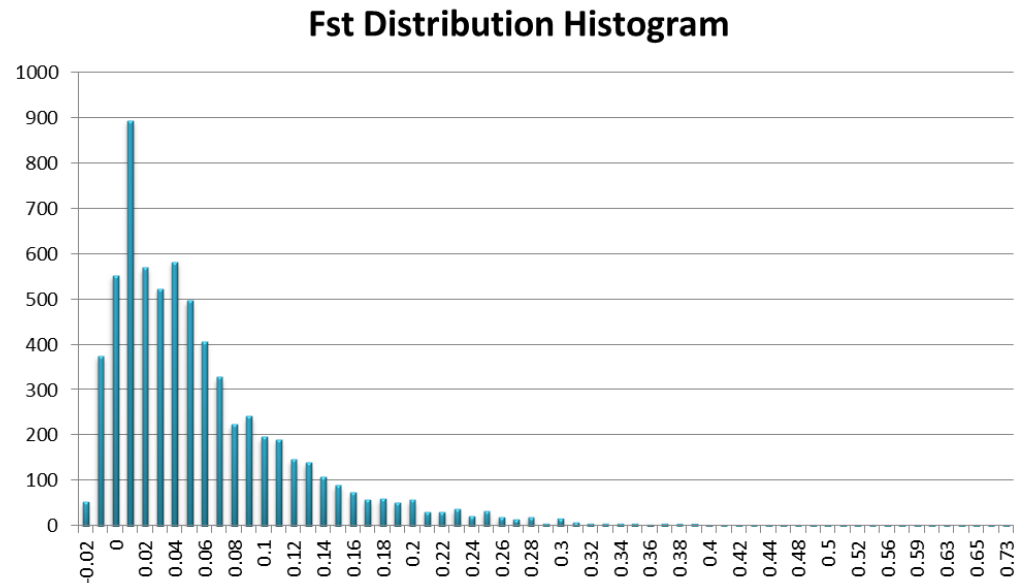
Summer and Fall 2011 sightings



From Laurie Weitkamp, NOAA

What's next?

- High-throughput assays for genotyping
 - High conversion rates directly from RAD data (approx. 90% to TaqMan)
- UW, WDFW, and NOAA (NWFSC) collaborating on SNP panels and baseline for Pacific Northwest



Potential Applications

- Track expansion and colonization
 - Origin of colonizers
- Genetic Mark Recapture— hatchery/wild interactions
 - Investigate straying, reproductive success
- Migration and stock interactions on the high seas
 - Expand range-wide panel
 - PacSNP Pink





Acknowledgements

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