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

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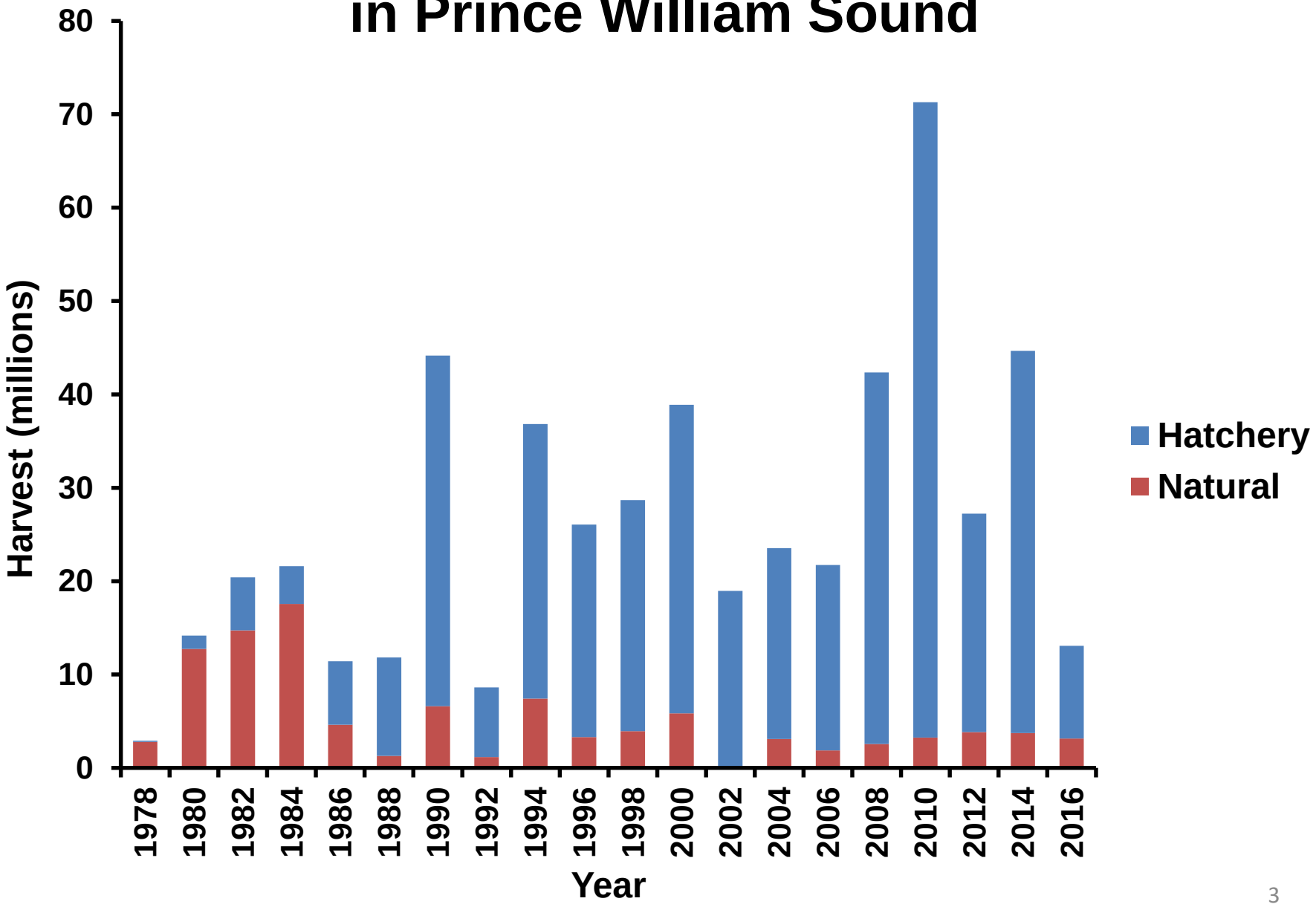
Anchorage, AK

Outline

- **Background**
- **Laboratory work**
- **Data analysis**
- **Summary**
- **Future study**

Commercial Harvest of Pink Salmon in Prince William Sound



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

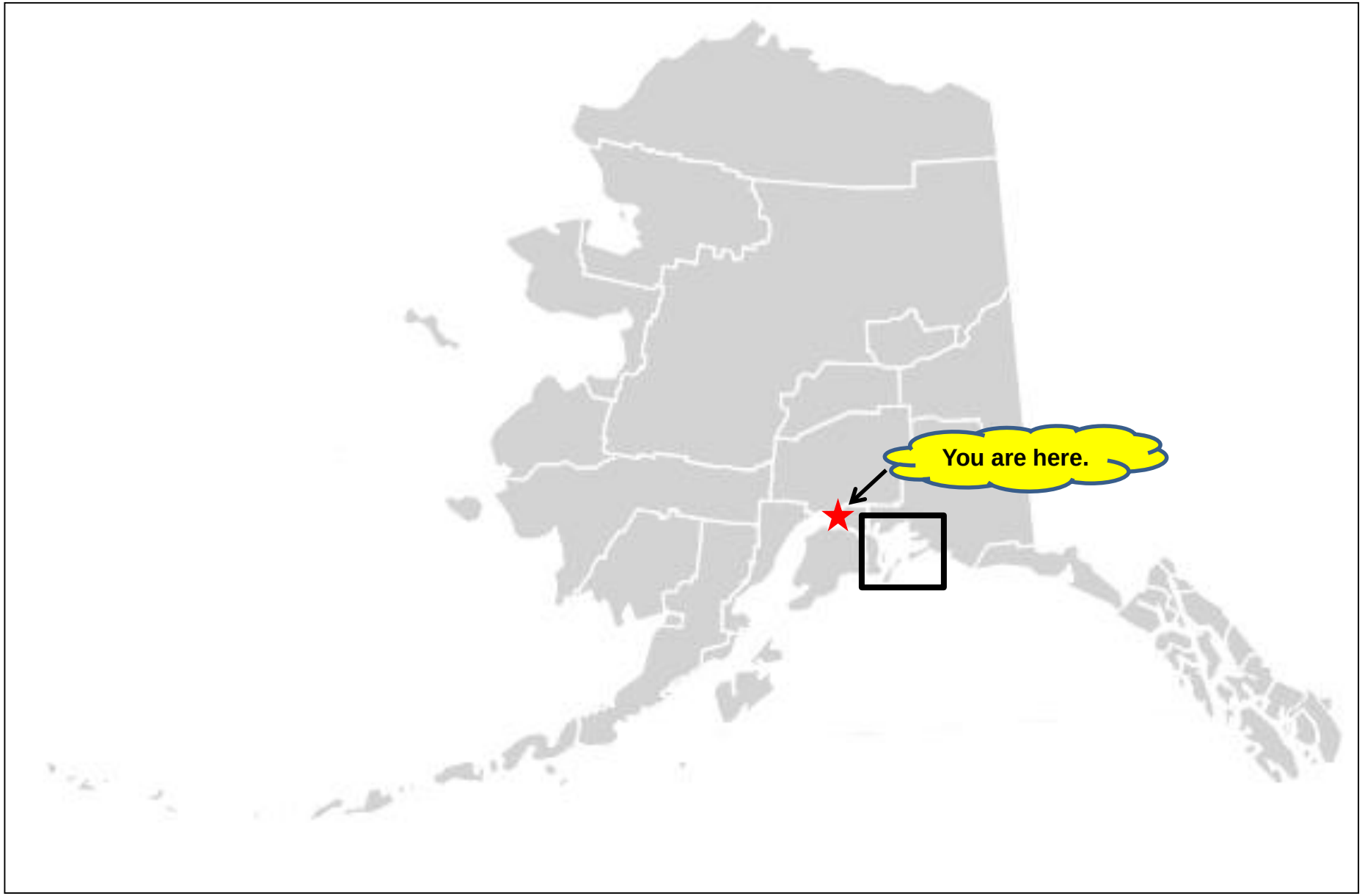
CACACACACA

CACACACACACACACACACA

- **16 markers (Beacham *et al*. 2012)**

Study Design

	Contemporary	Historical
Natural Pink Salmon	√	
Hatchery Pink Salmon	√	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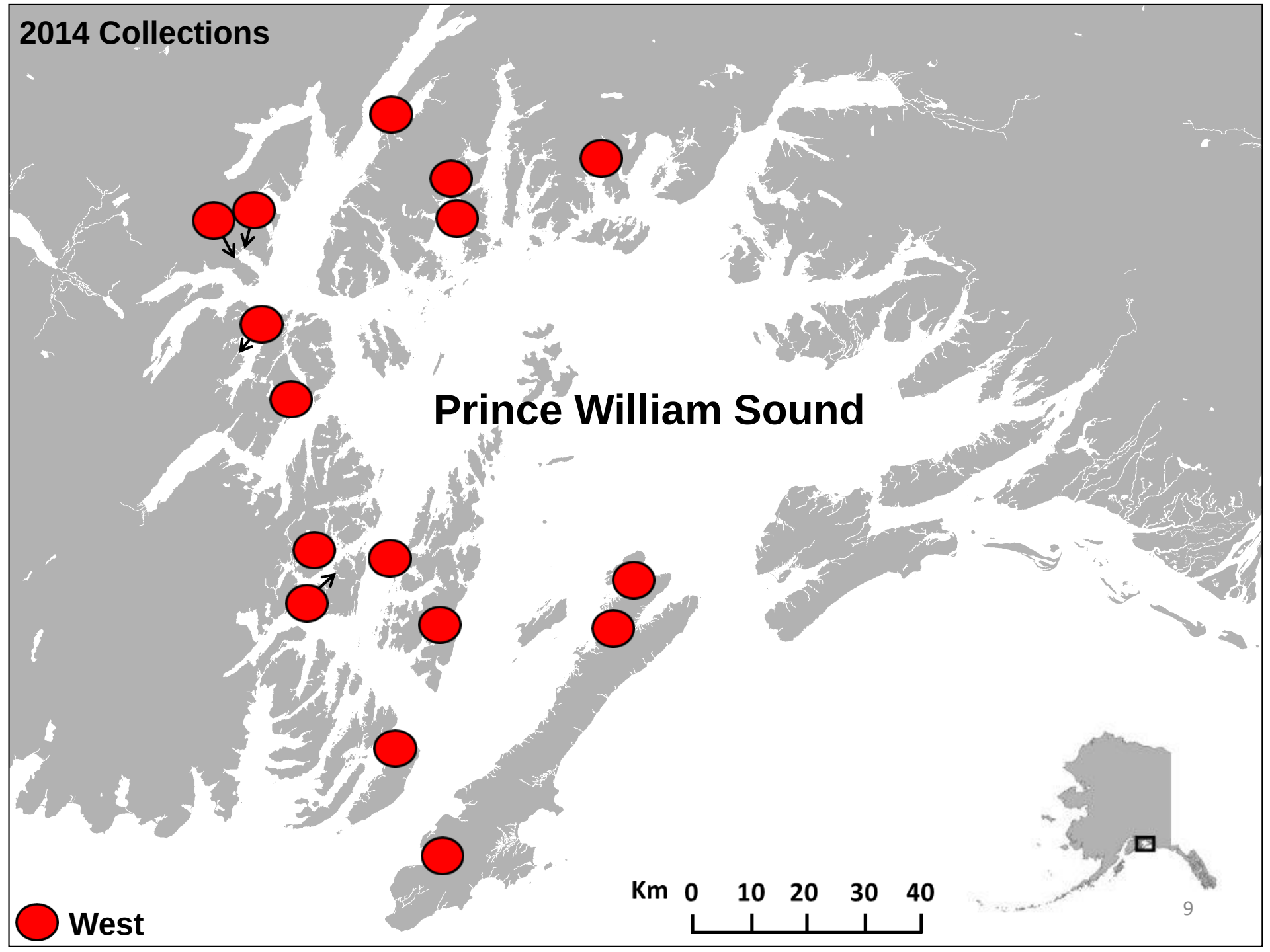
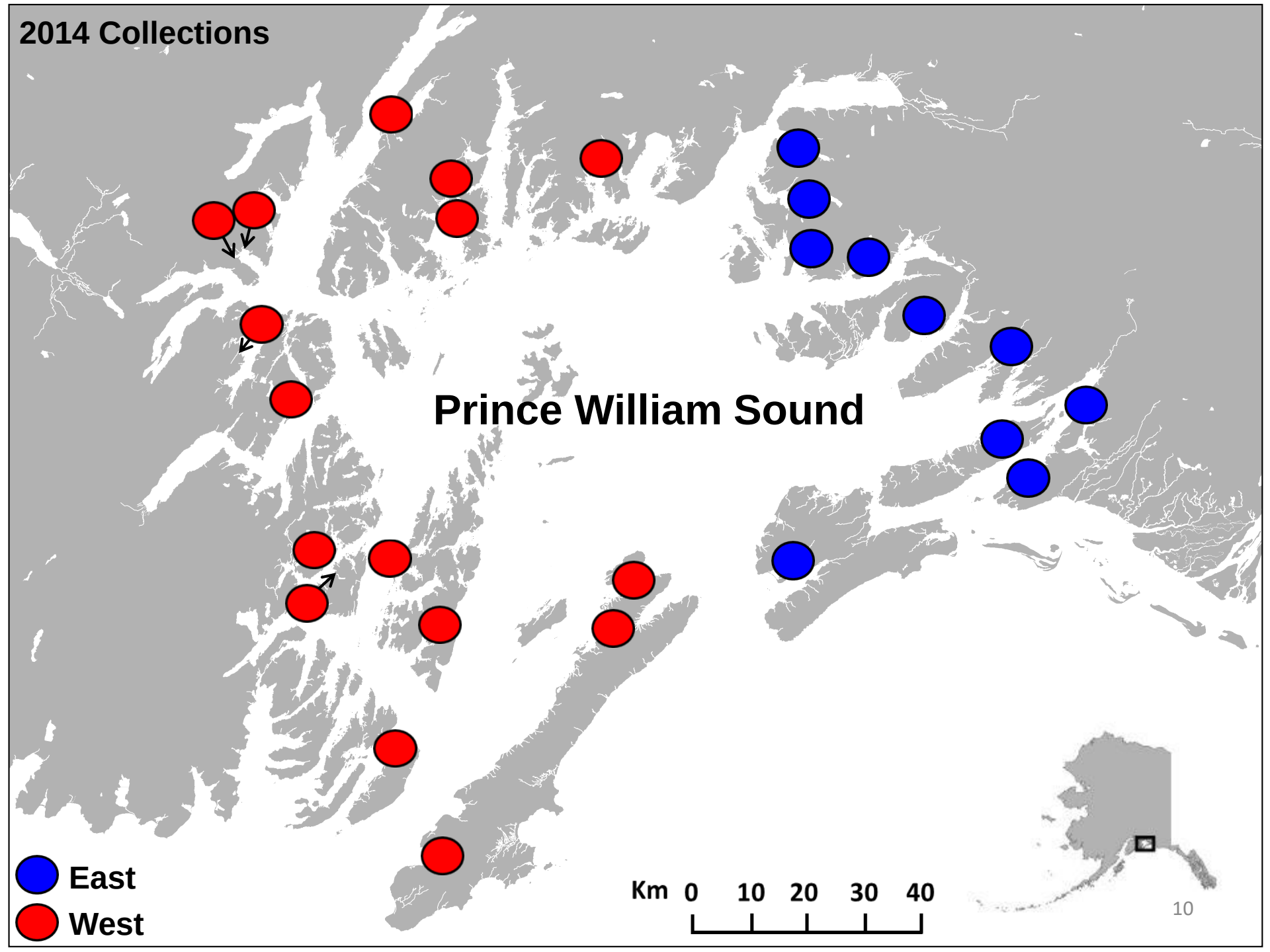

2014 Collections
Prince William Sound
West
Km 0 10 20 30 40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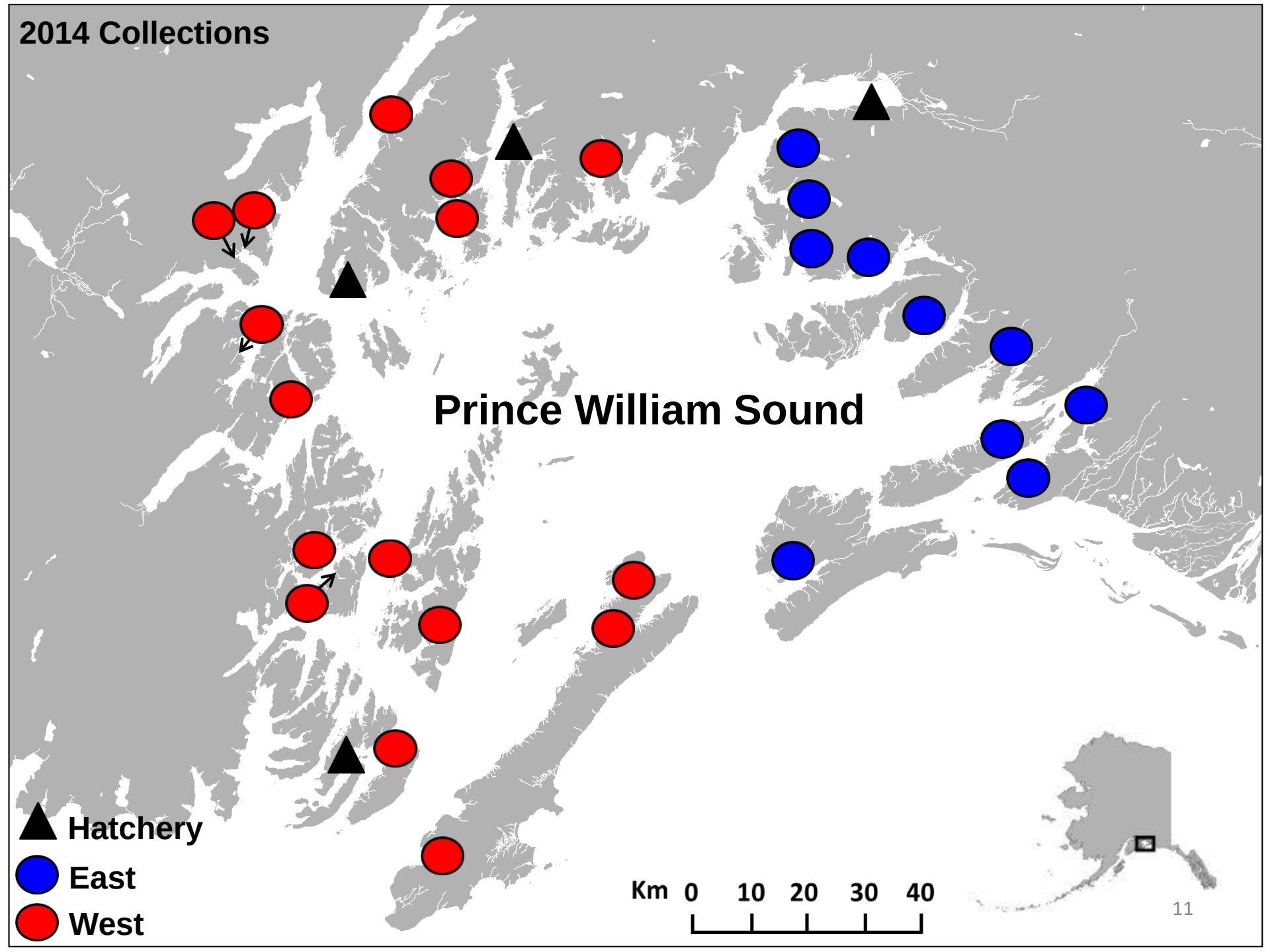
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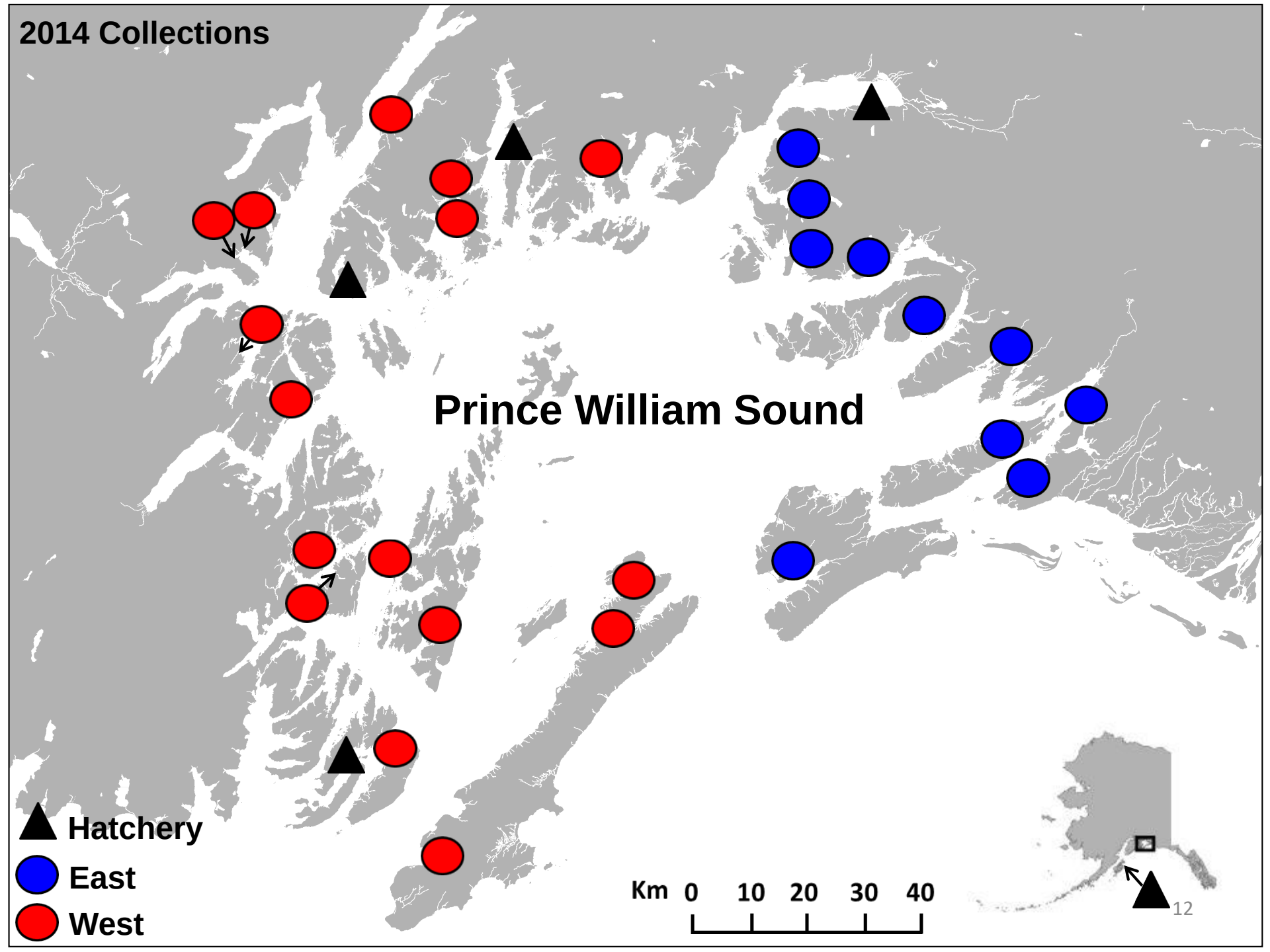
2014 Collections
Prince William Sound
Hatchery
East
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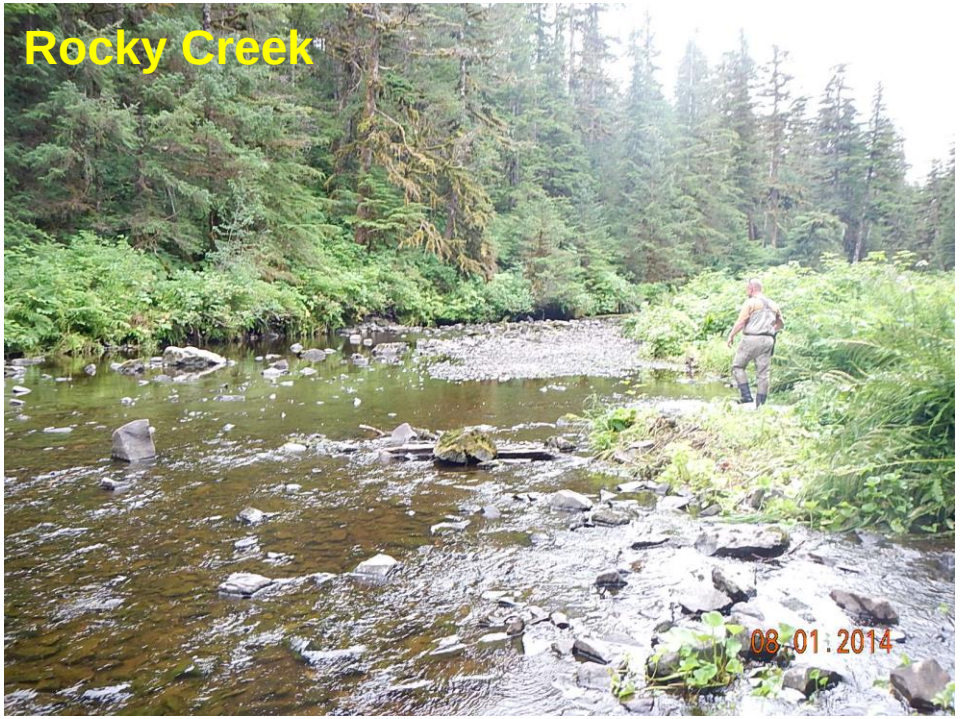
Km 0 10 20 30 40

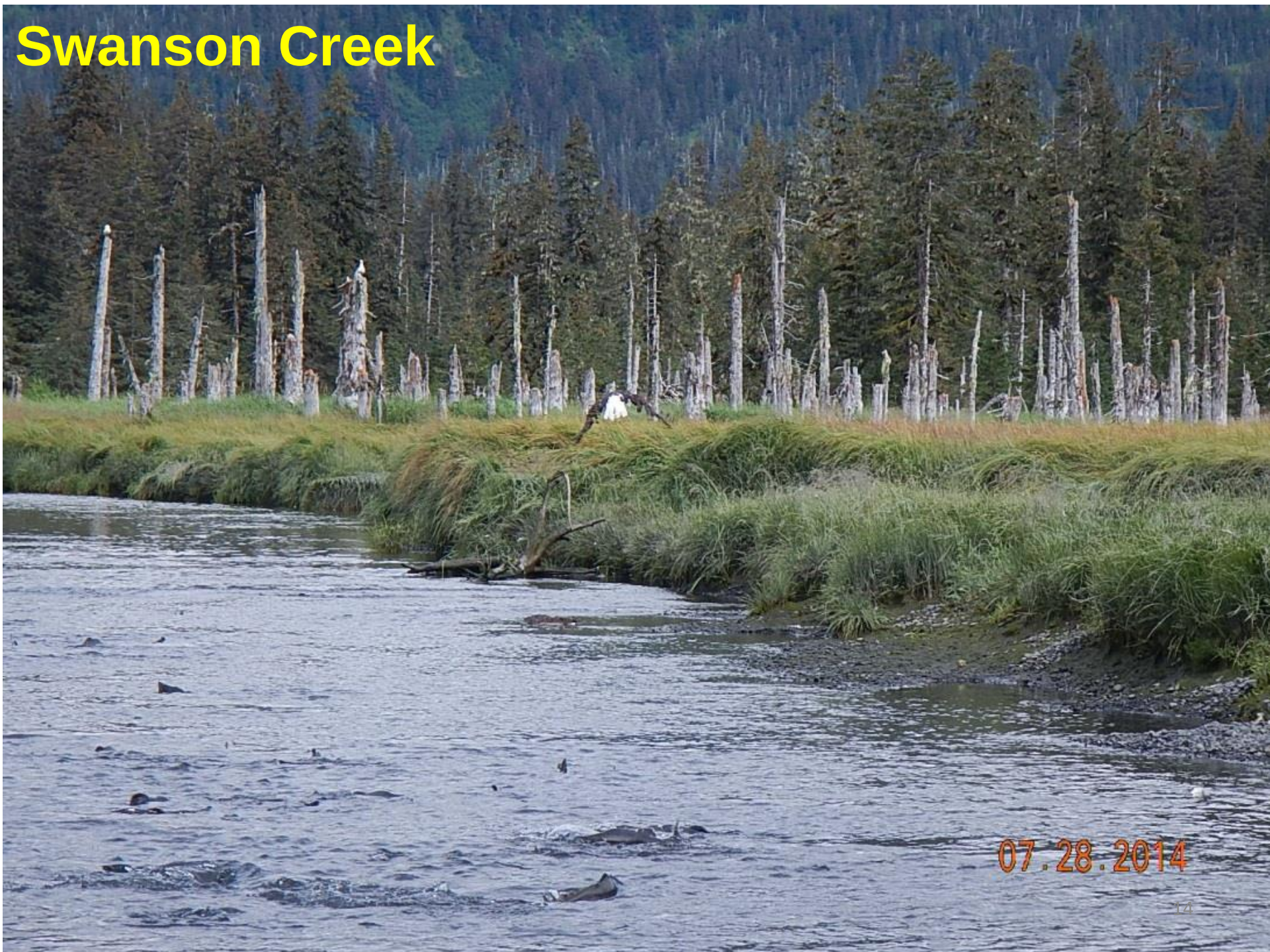

Swanson Creek
07 28 2014


McCleod Creek
07 31 2014


Rocky Creek
08 01 2014


Duck River
08 04 2014

Swanson Creek




McCleod Creek
07.31.2014


Rocky Creek
08.01.2014

Duck River

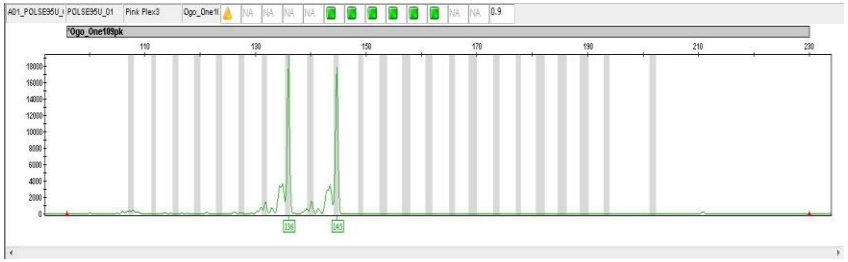
Laboratory Work

Tissue collection

DNA isolation

PCR

Genotype

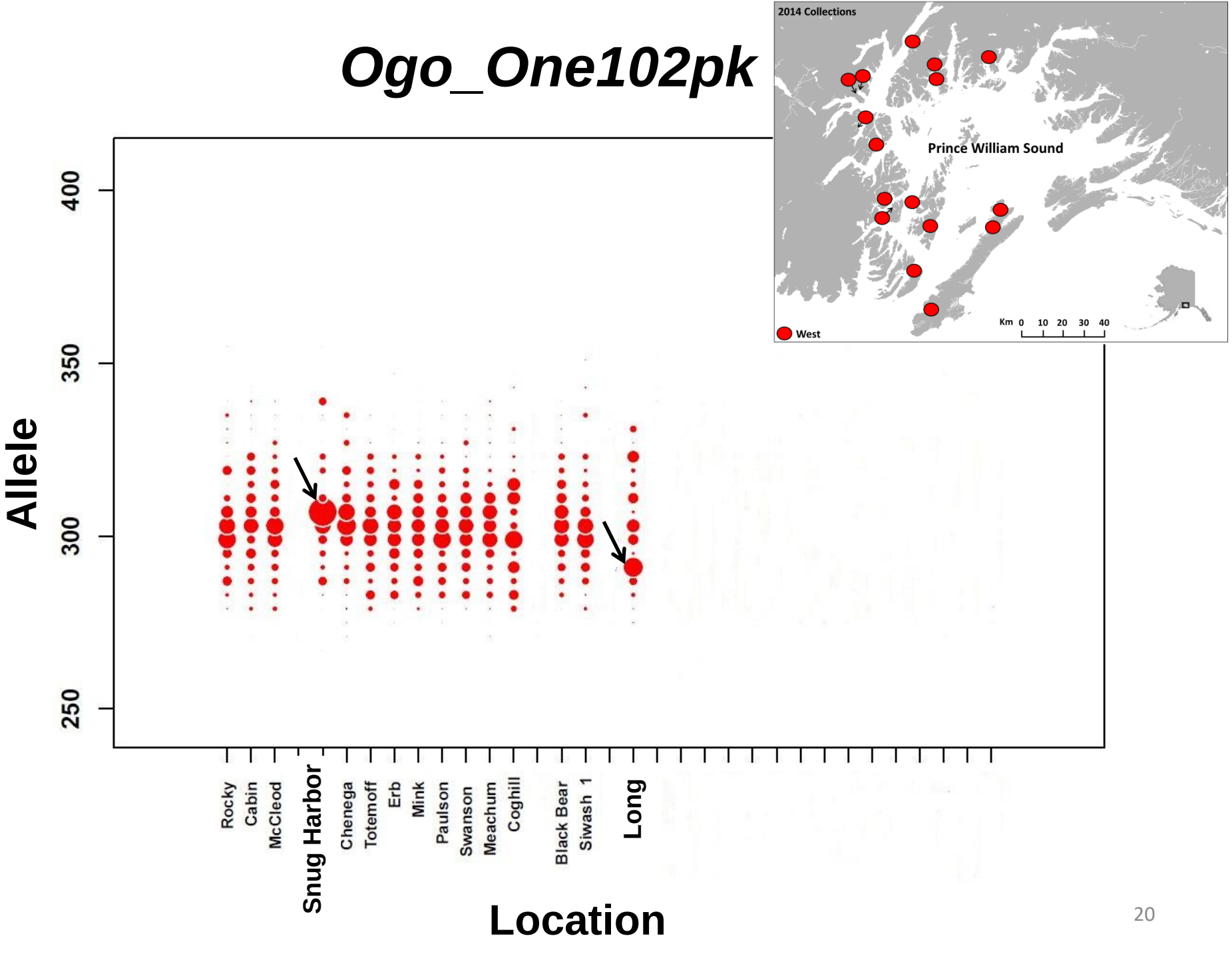


Score

Data Quality Analyses

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

Ogo_One102pk



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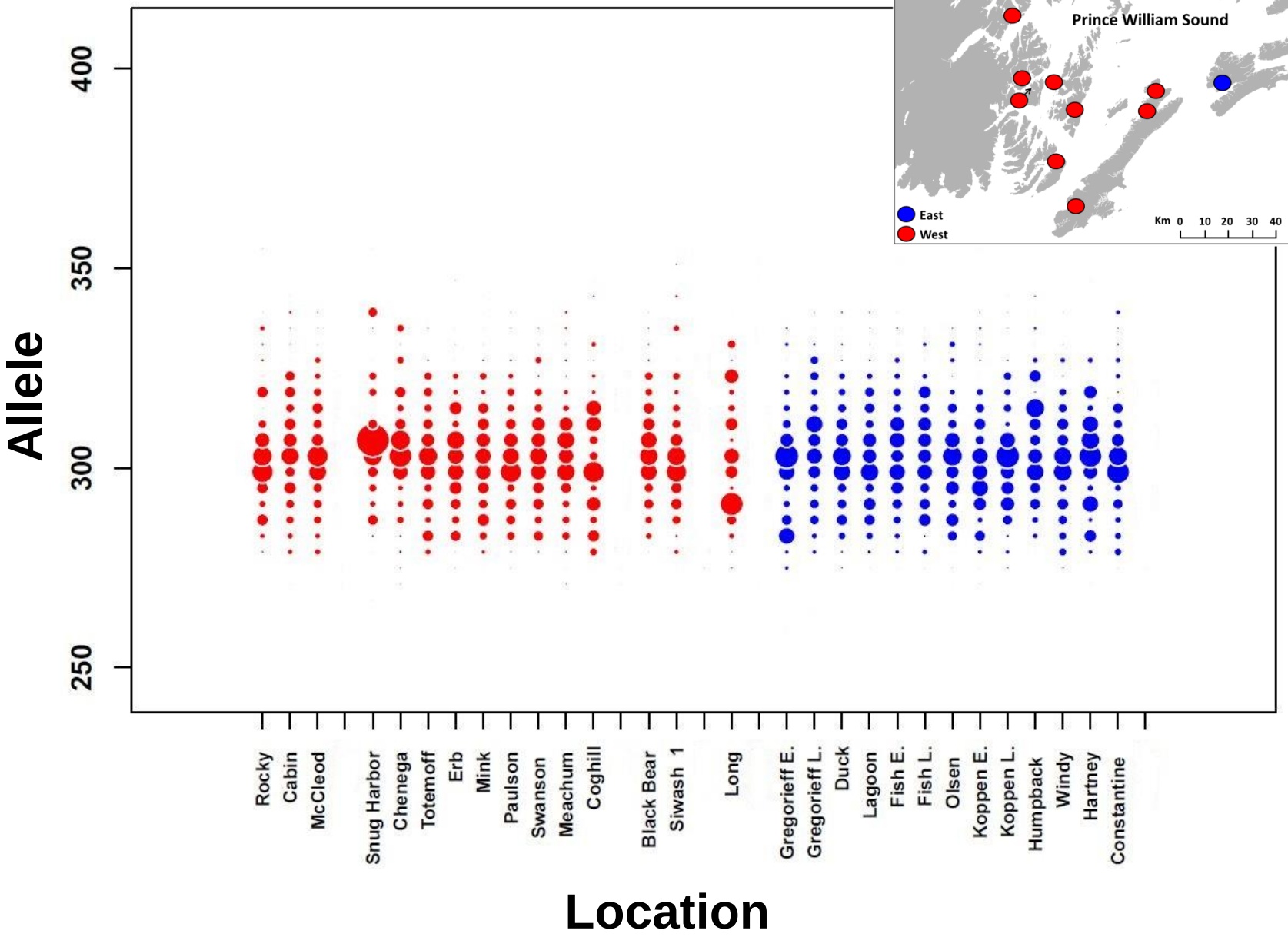

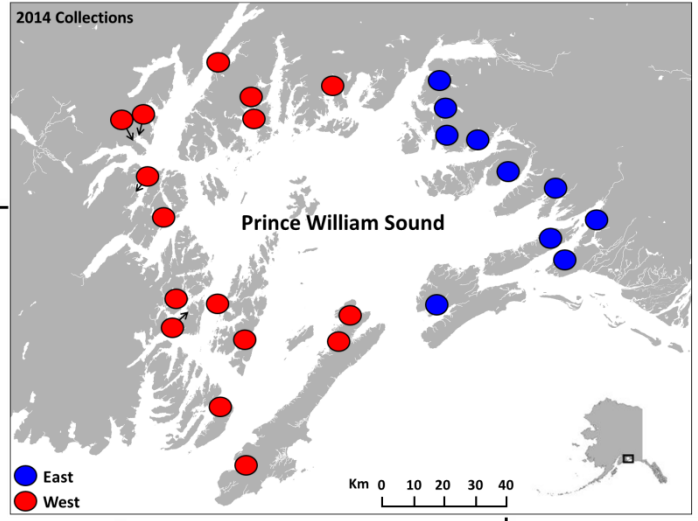

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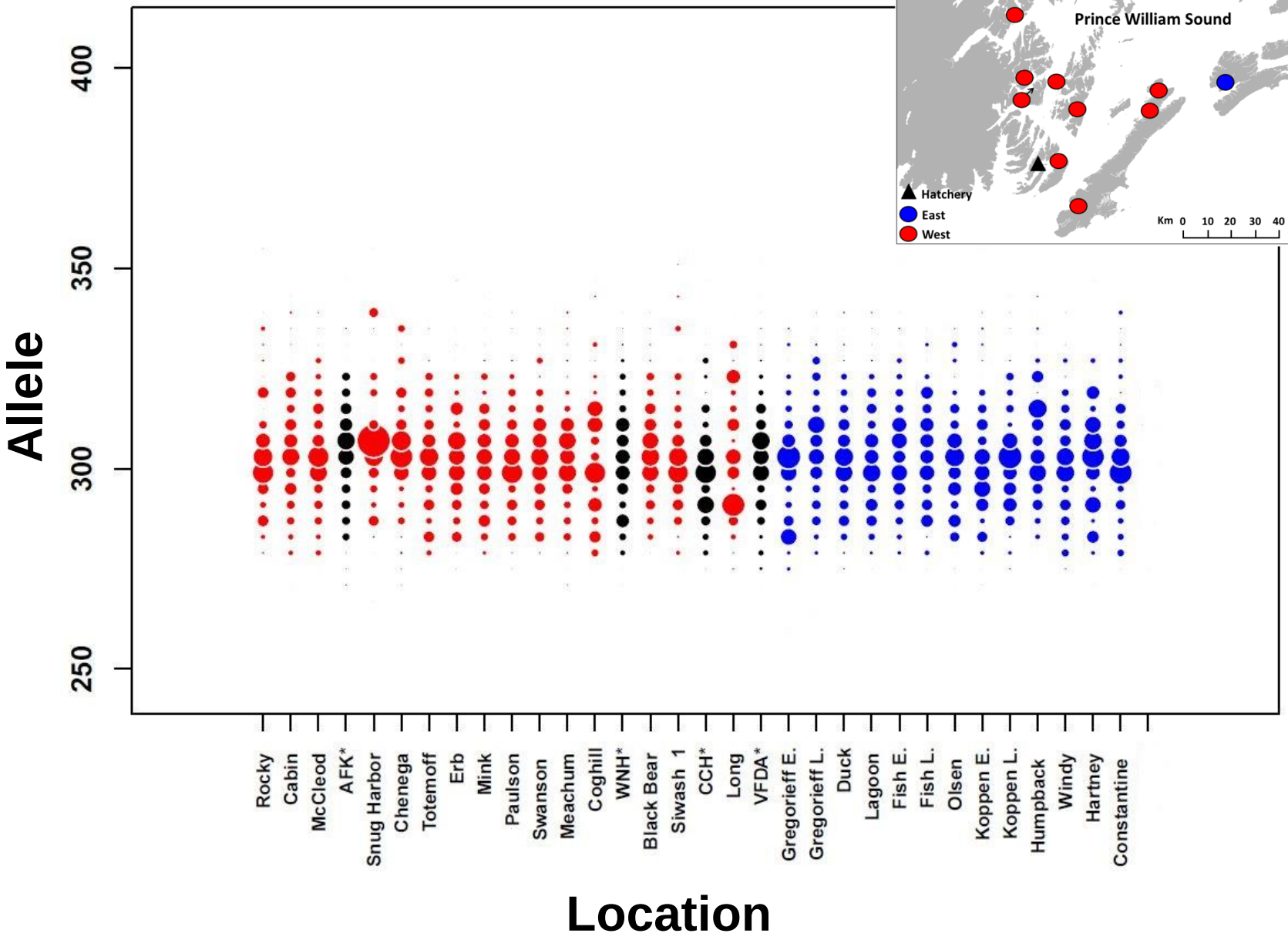

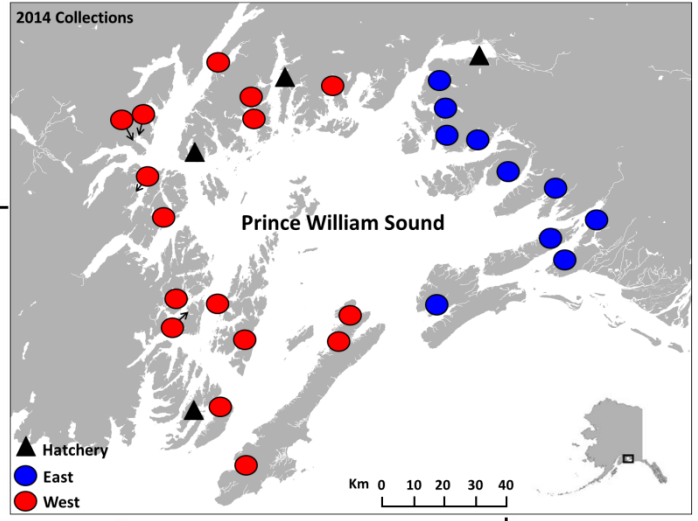

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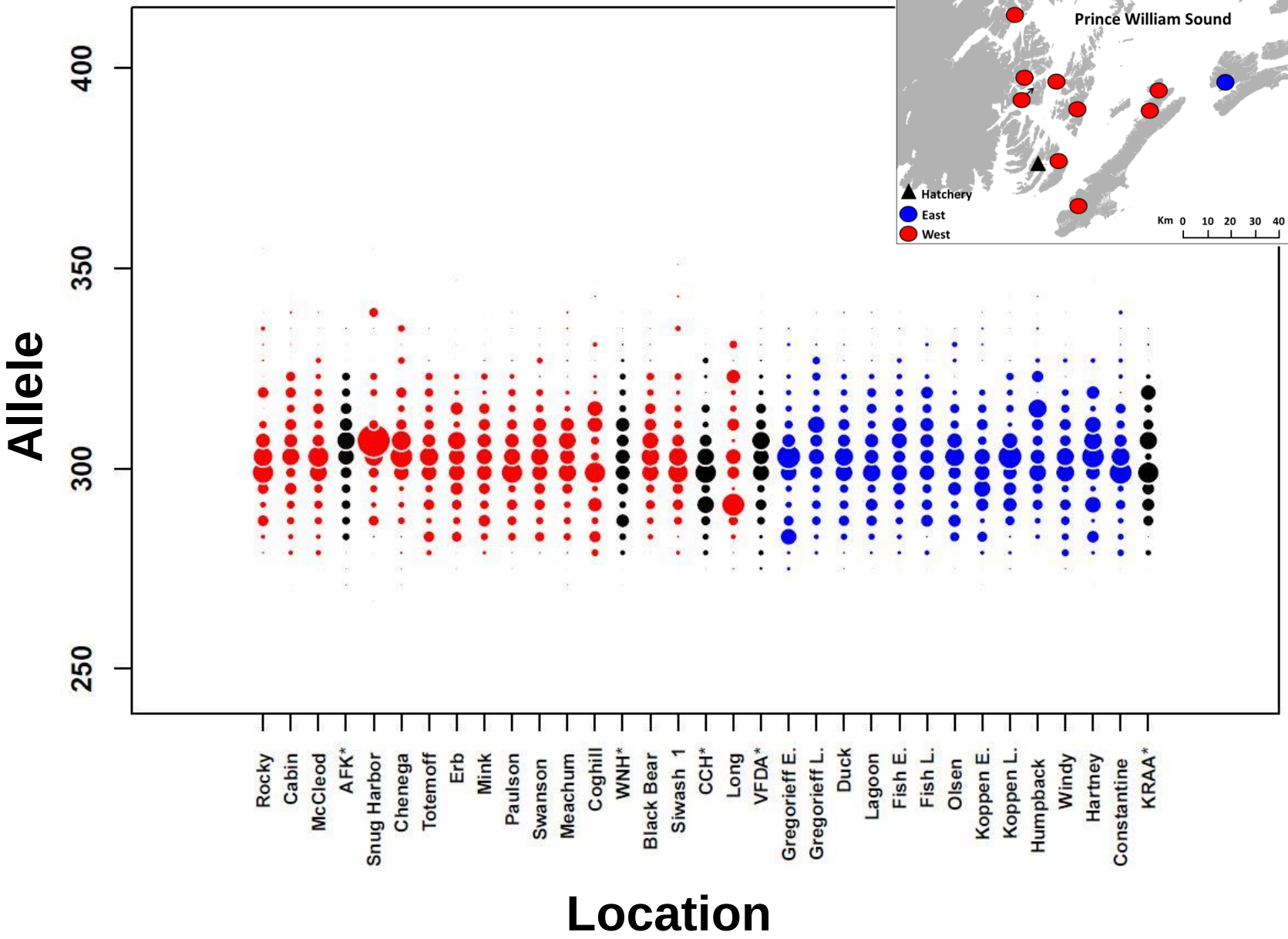

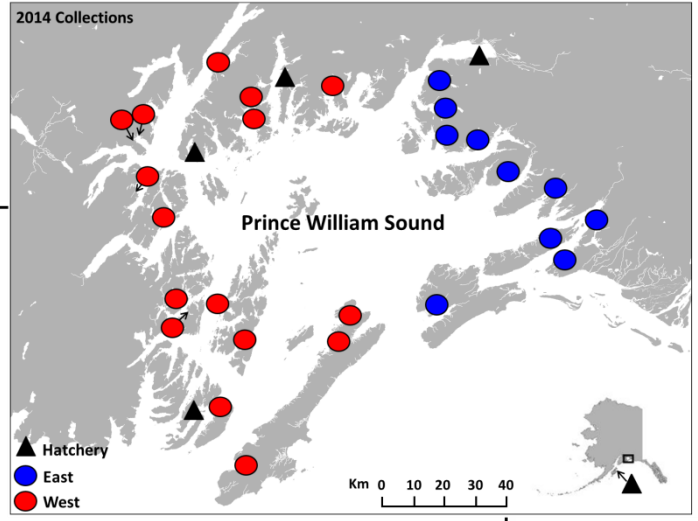

Population Structure Analyses

- **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**

- **$0 \leq F_{ST} \leq 1$**

Study	Marker	Geography	Pops/Sites	Spatial scale (km)	F_{ST}
Cheng et al.	Microsatellite	PWS, AK	32	~10-200	0.0006 (even year)

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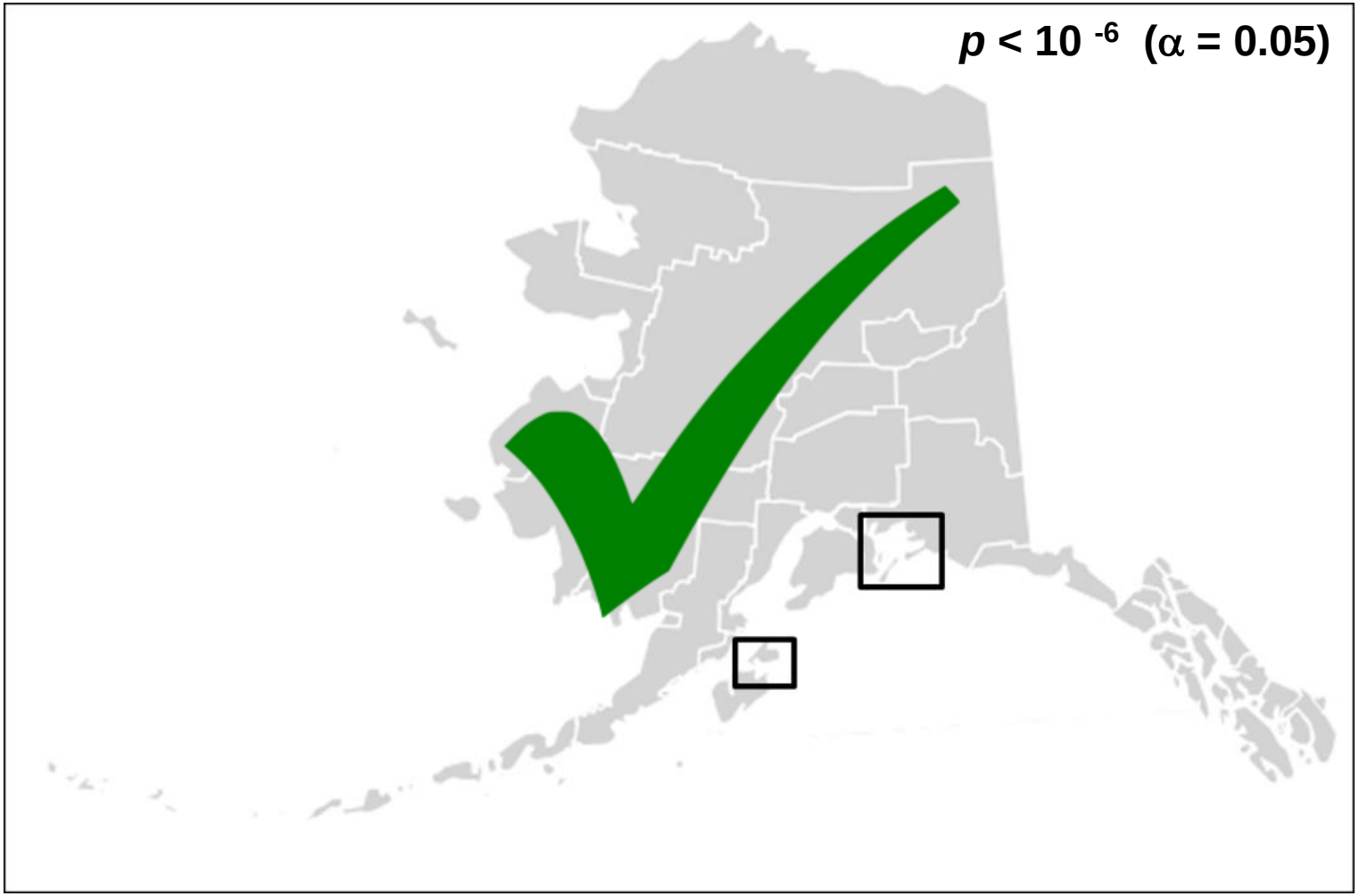
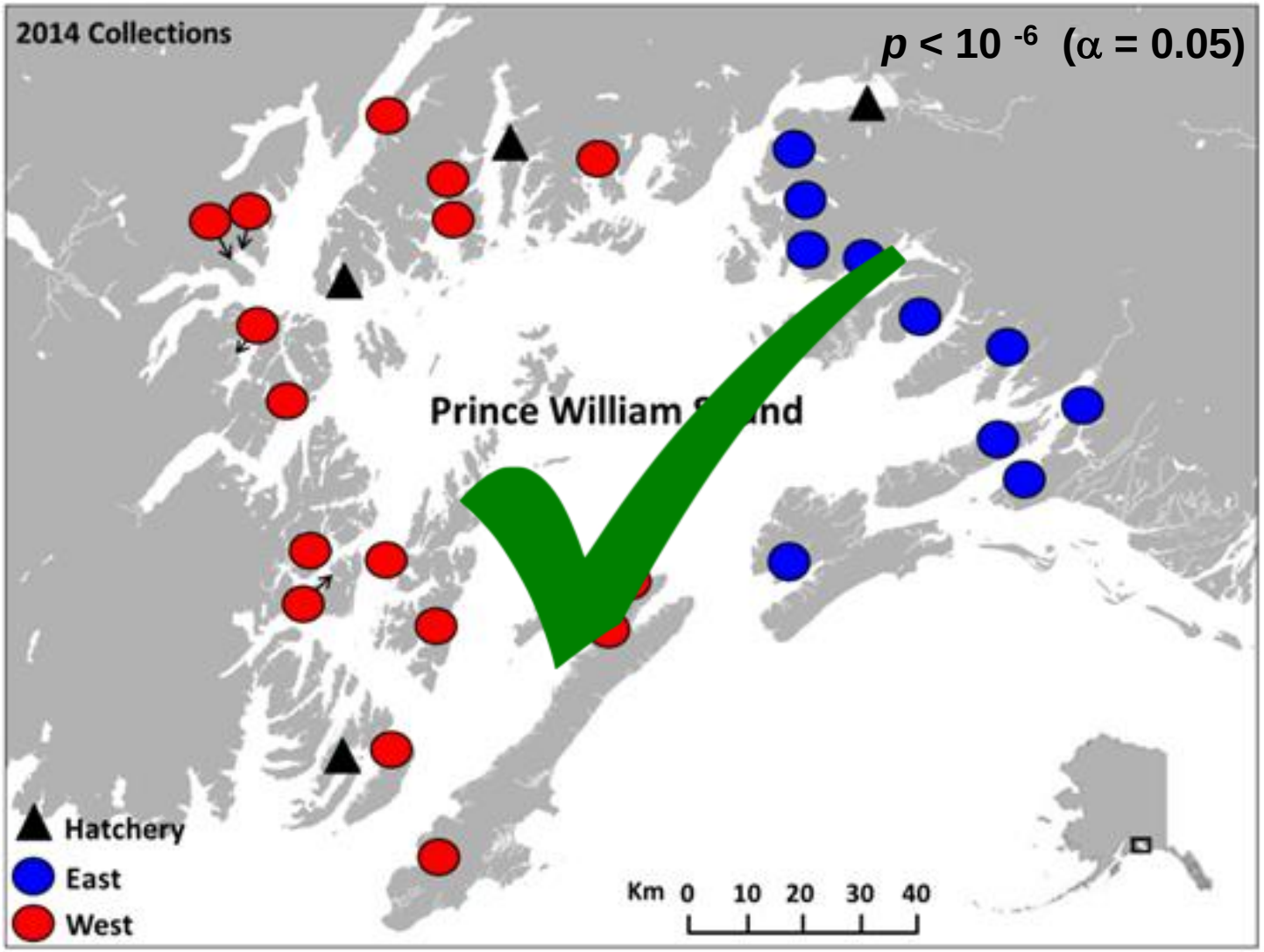
Cheng et al. (2016)	Microsatellite	PWS, AK	22	~10-200	0.002 (odd year)
Beacham et al. (2012)	Microsatellite	BC and WA	116	~1,400	0.005 (odd year)

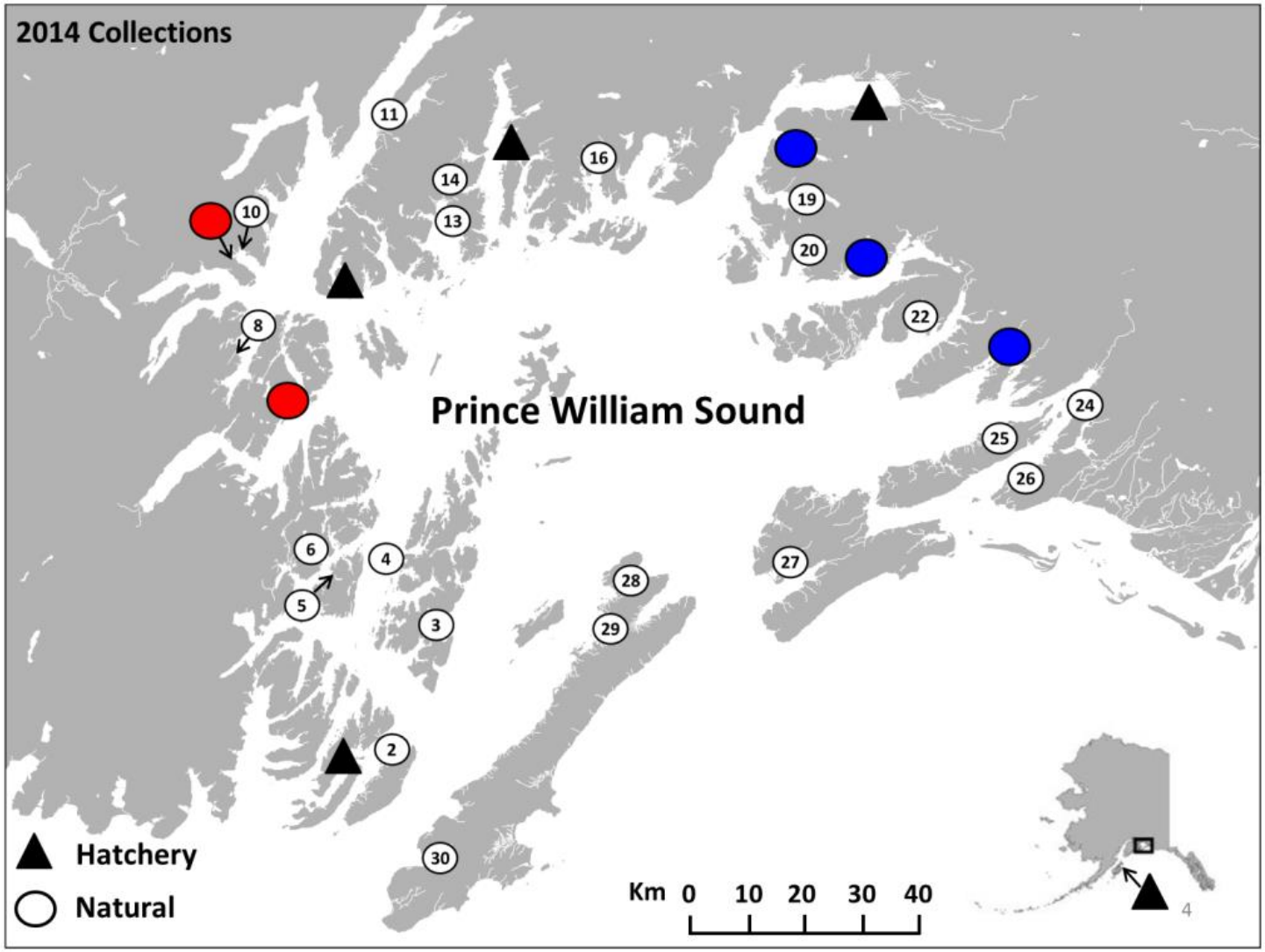
Testing for Difference: Kodiak vs. Prince William Sound



Testing for Differences: among Prince Willian Sound Locations



Testing for Differences: Between Early and Late Collections



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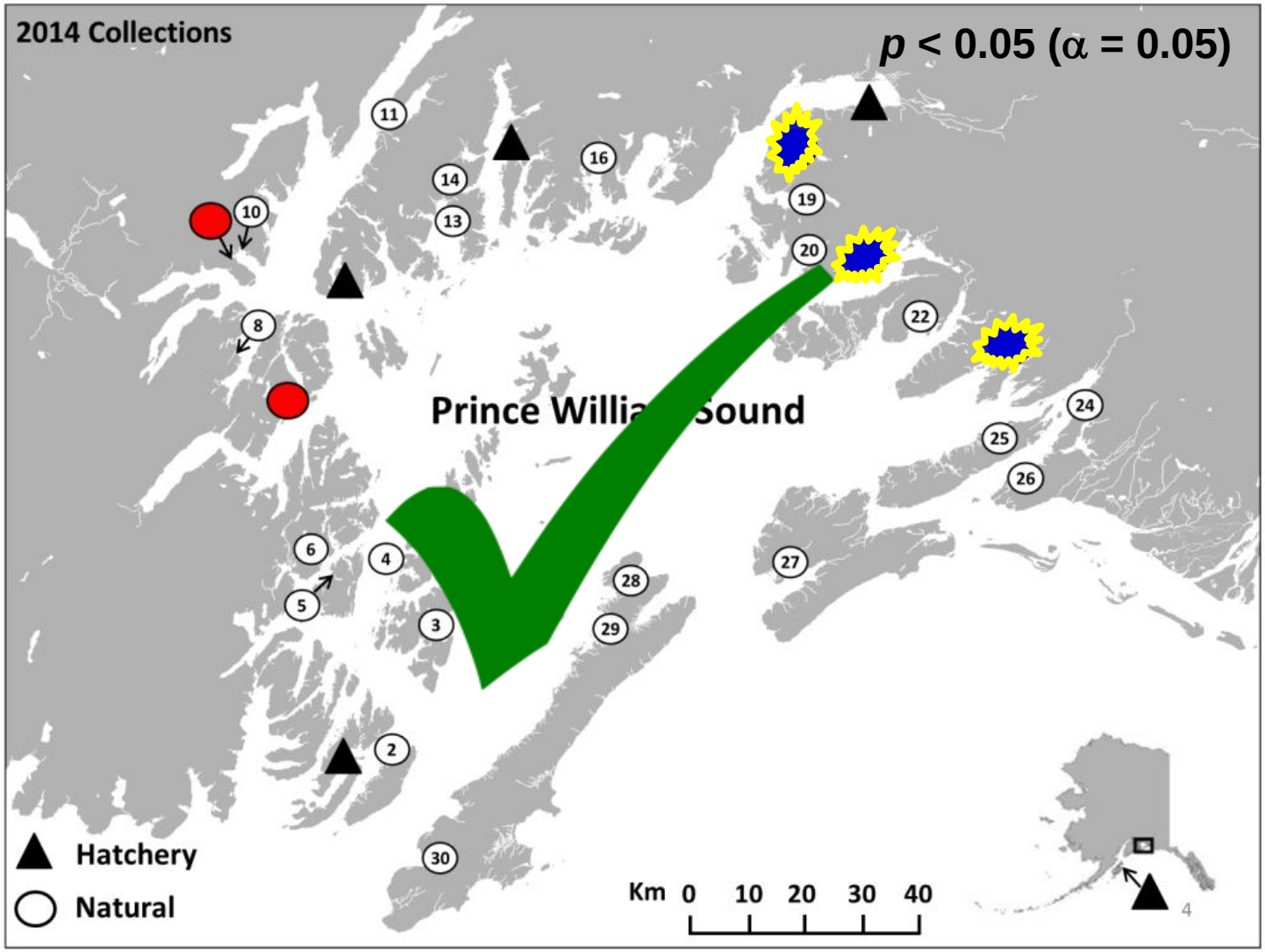
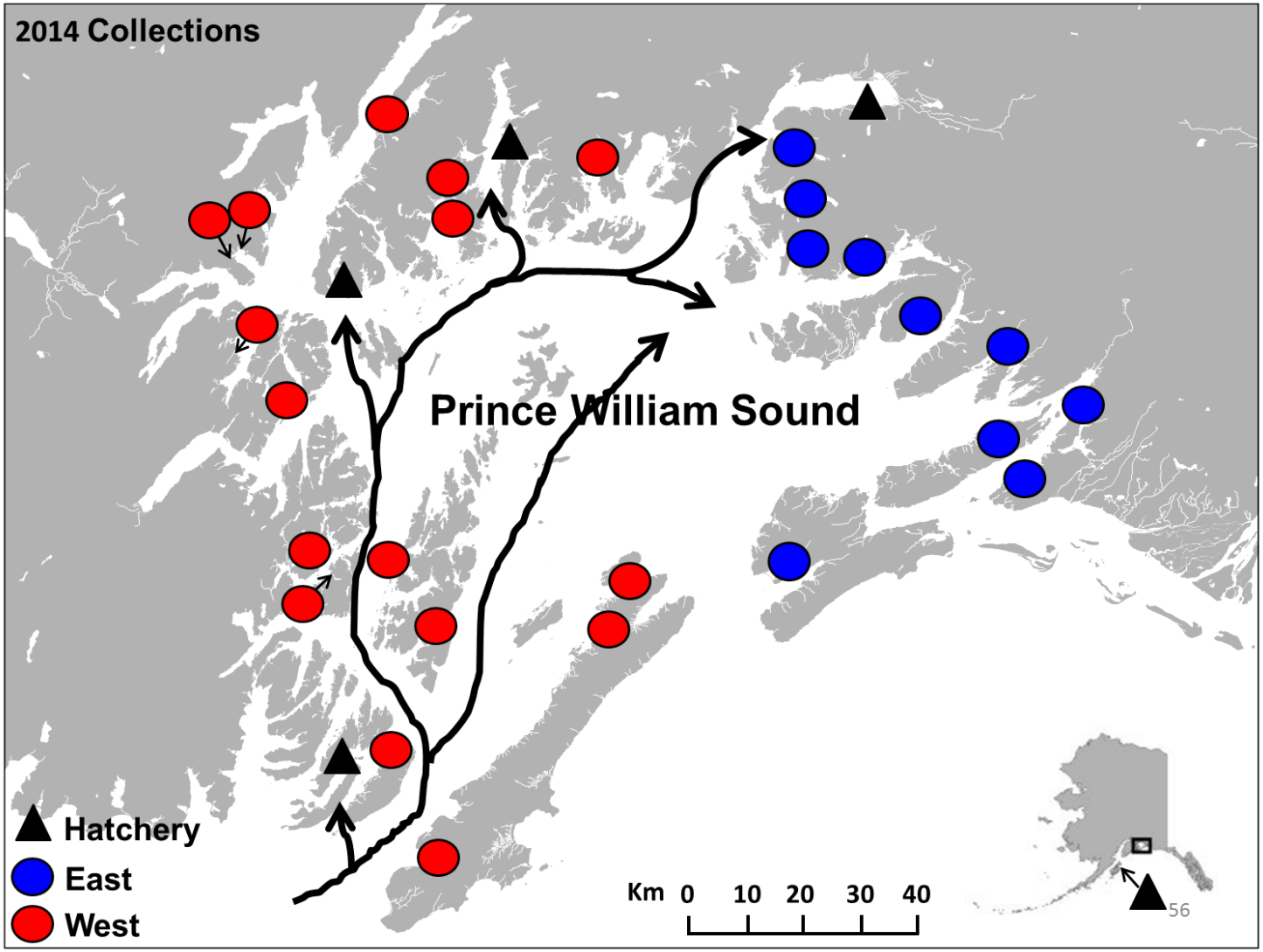
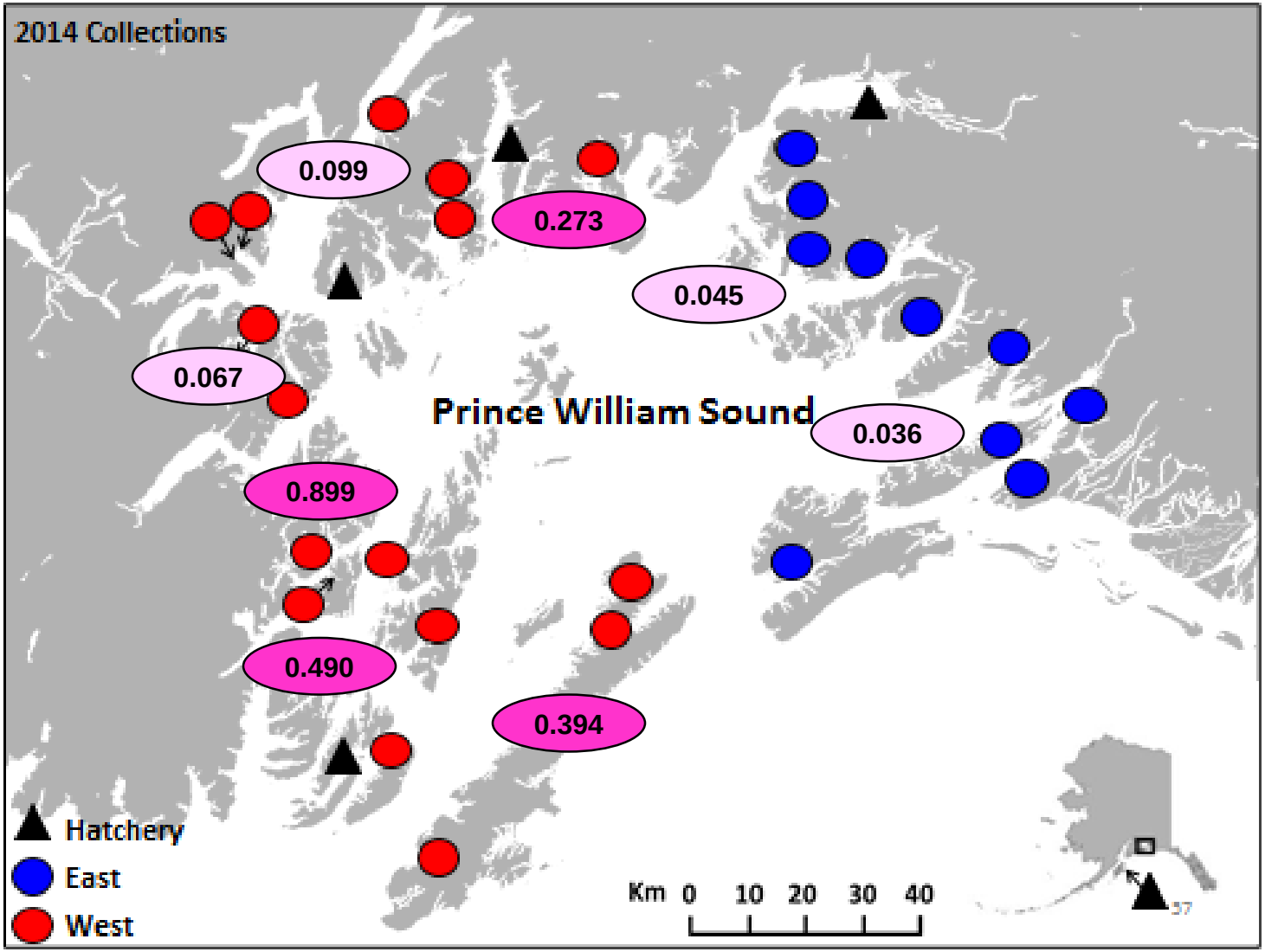


Assumed Migration Pathway

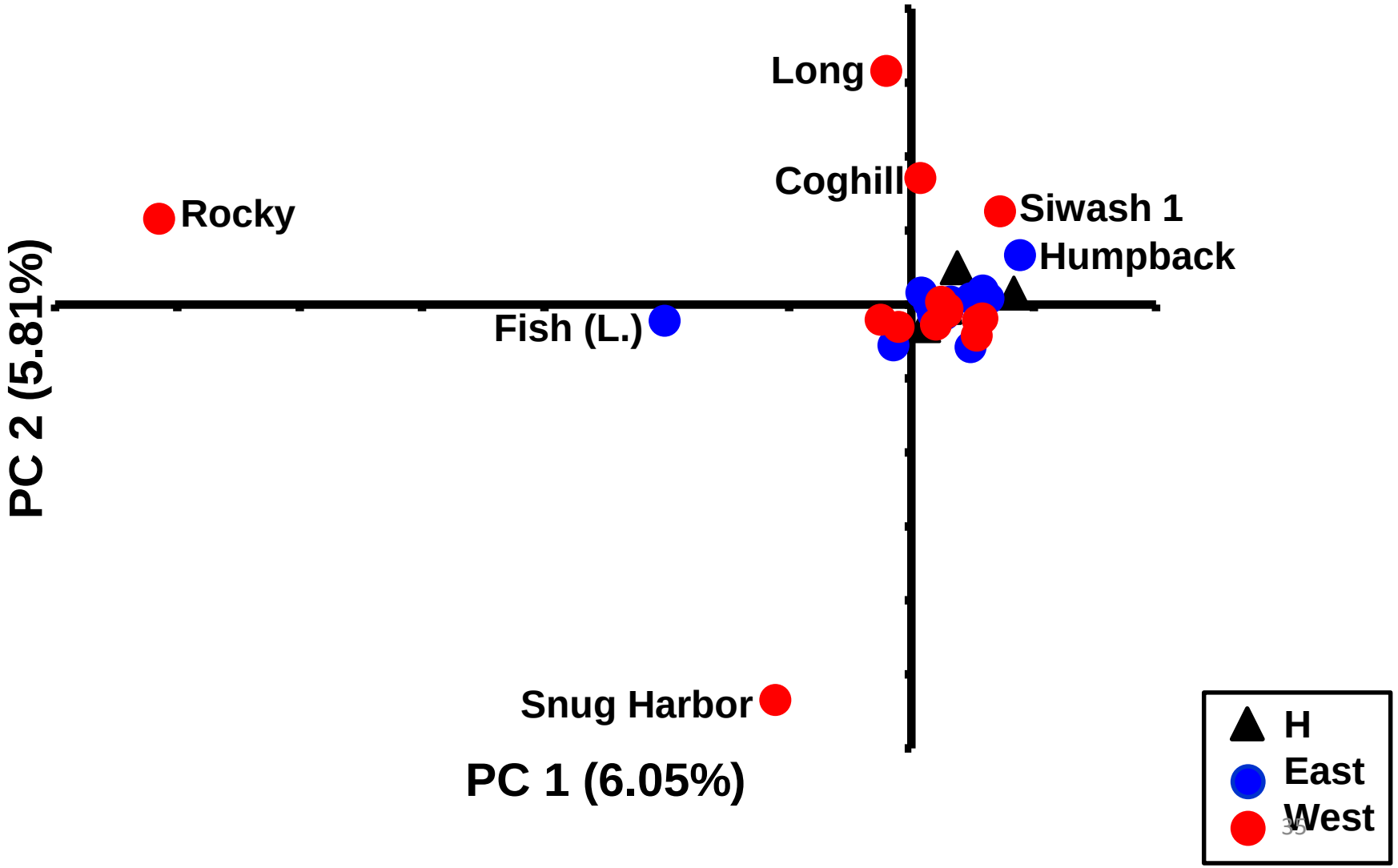


Estimated Hatchery Pink Salmon Fraction within Prince William Sound Streams



Data from Knudesen *et al*. 2015

Principal Component Analysis



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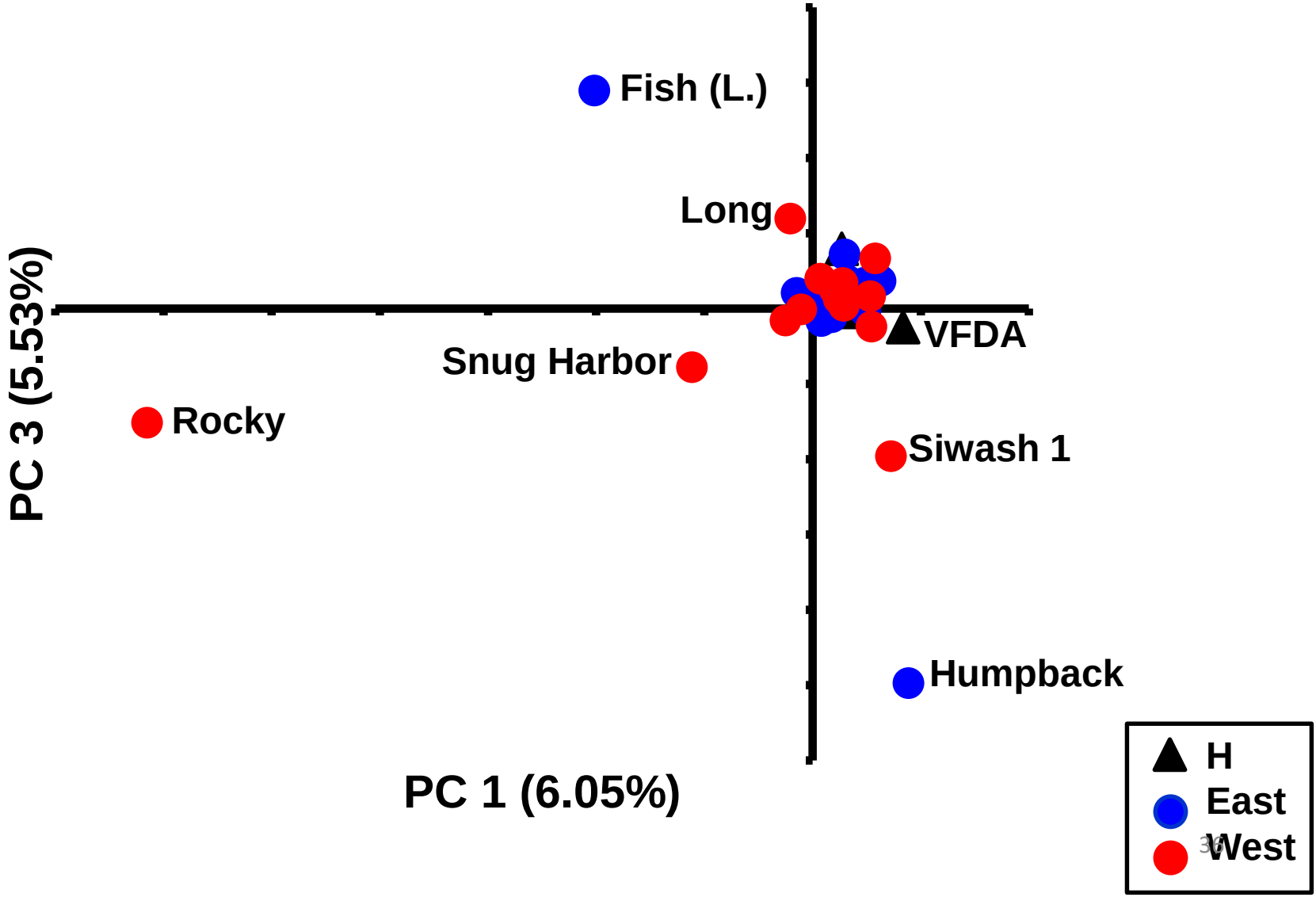
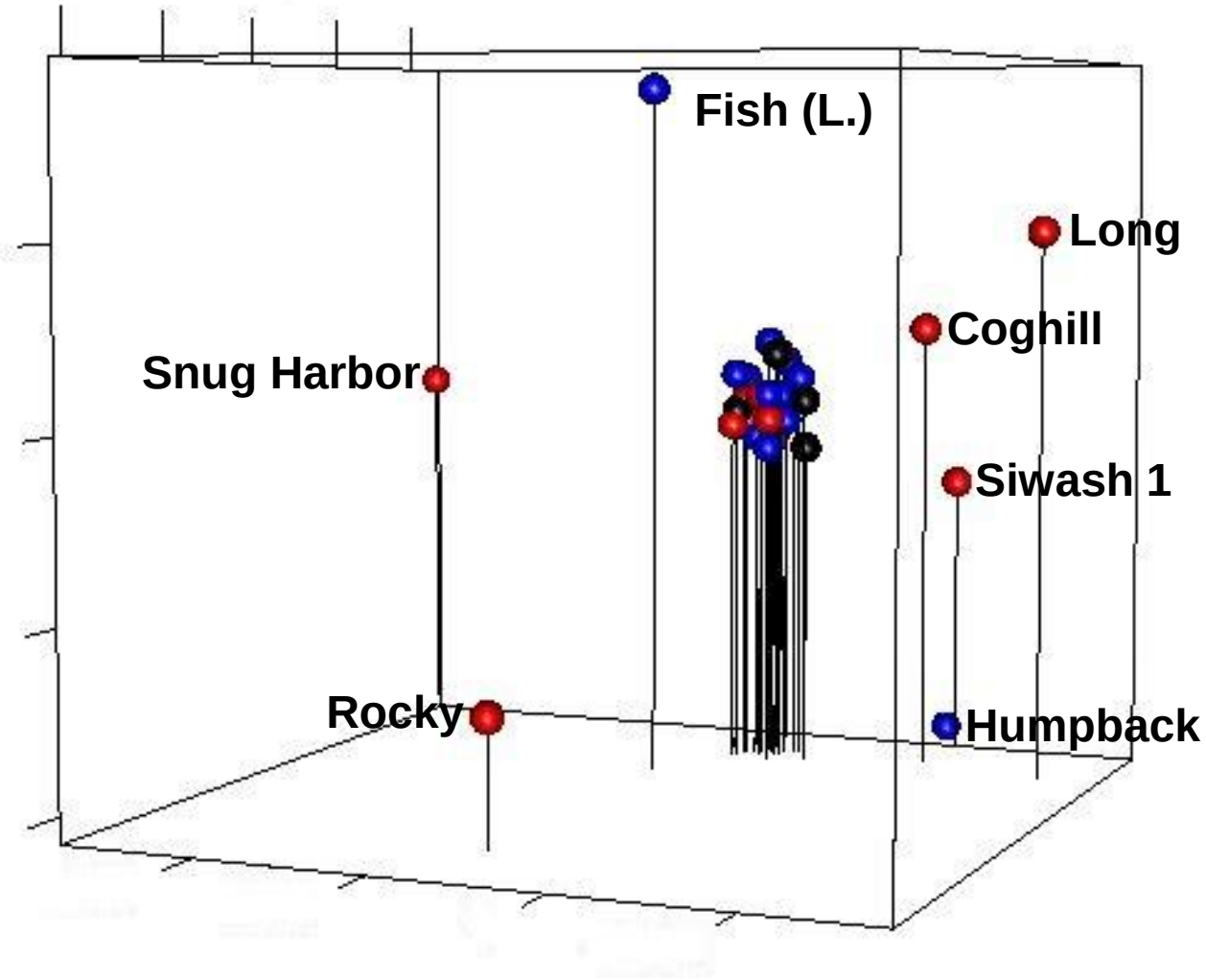


Multidimensional Scaling (MDS)

2014 data



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