

# Molecular Genetic Studies of Red King Crab



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# Crab Genetic Studies

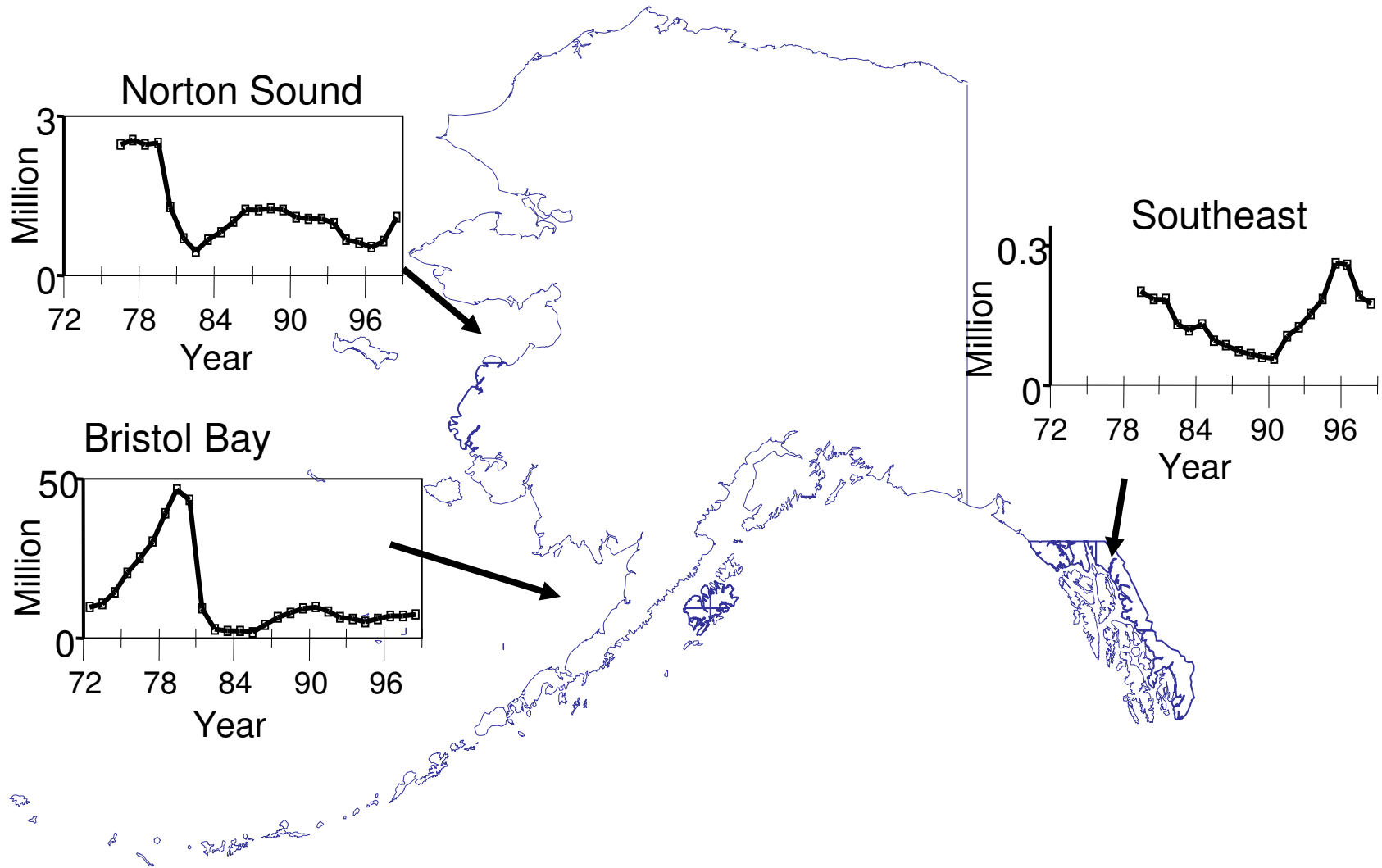
- Identify stock management units
  - Demographic
  - Genetic
    - Temporal and spatial divergence
- Estimate gene diversity and gene flow



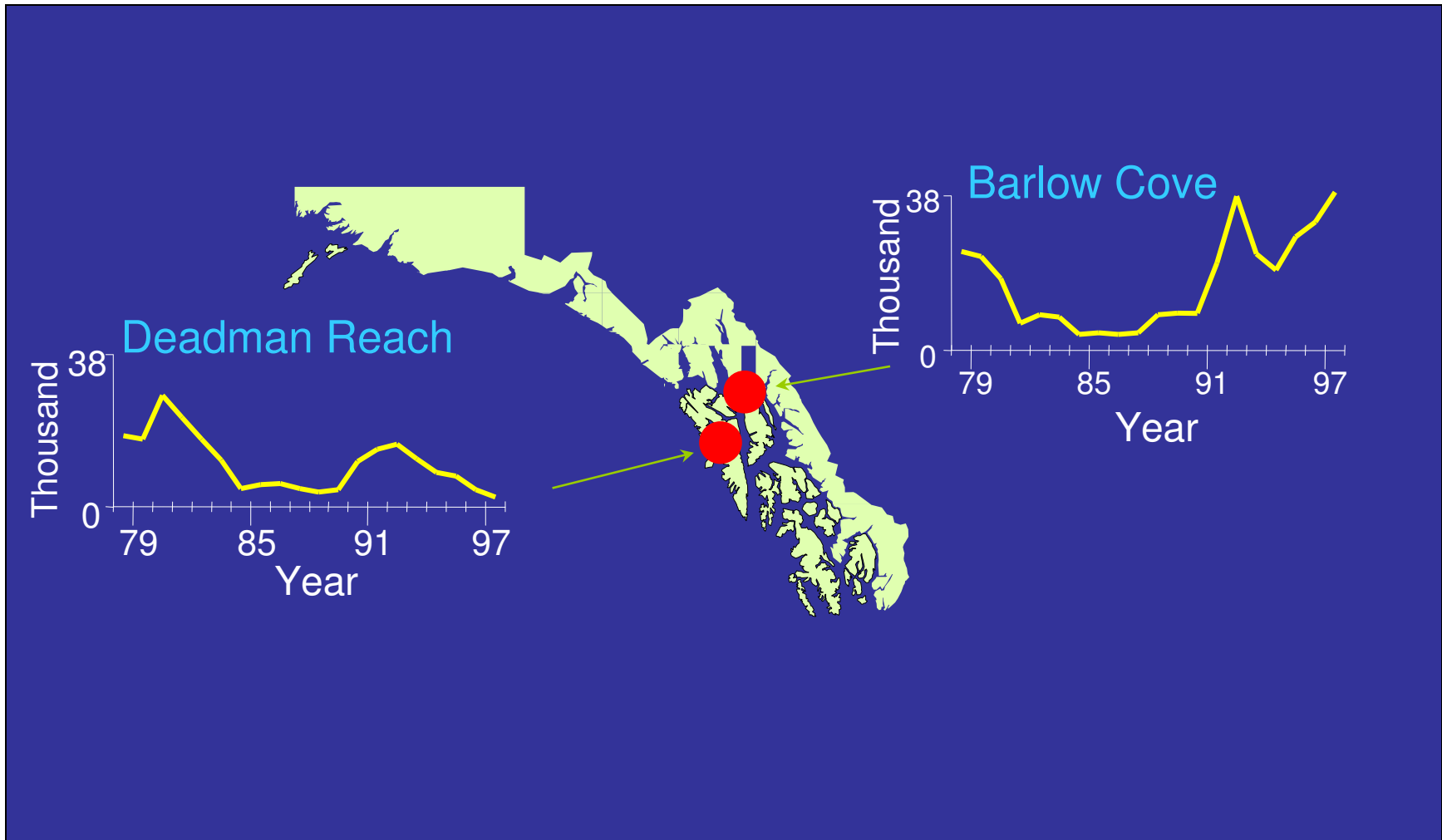
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# Evidence for Demographic Independence

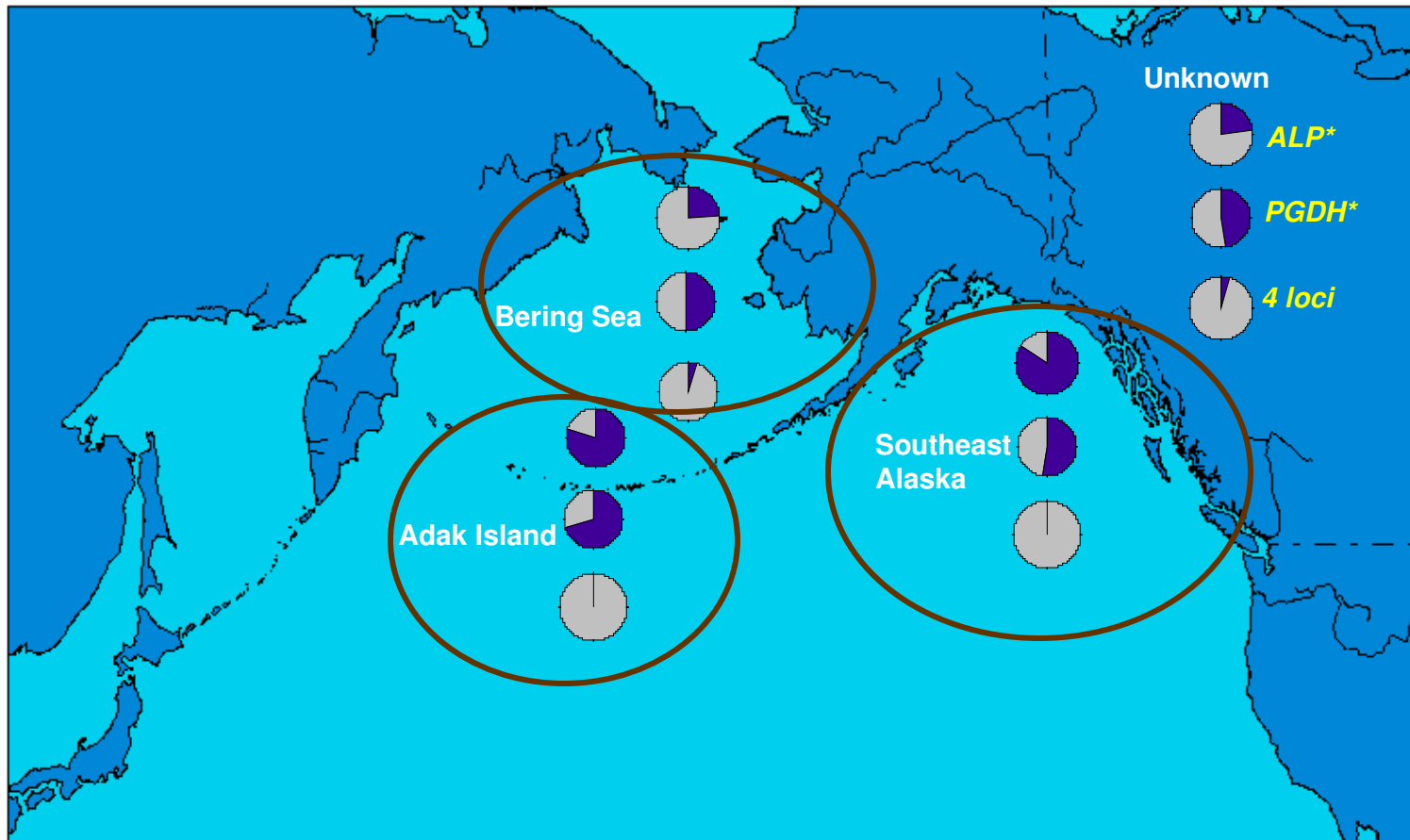
## Abundances of adults



# Abundance Estimates of Legal Red King Crab

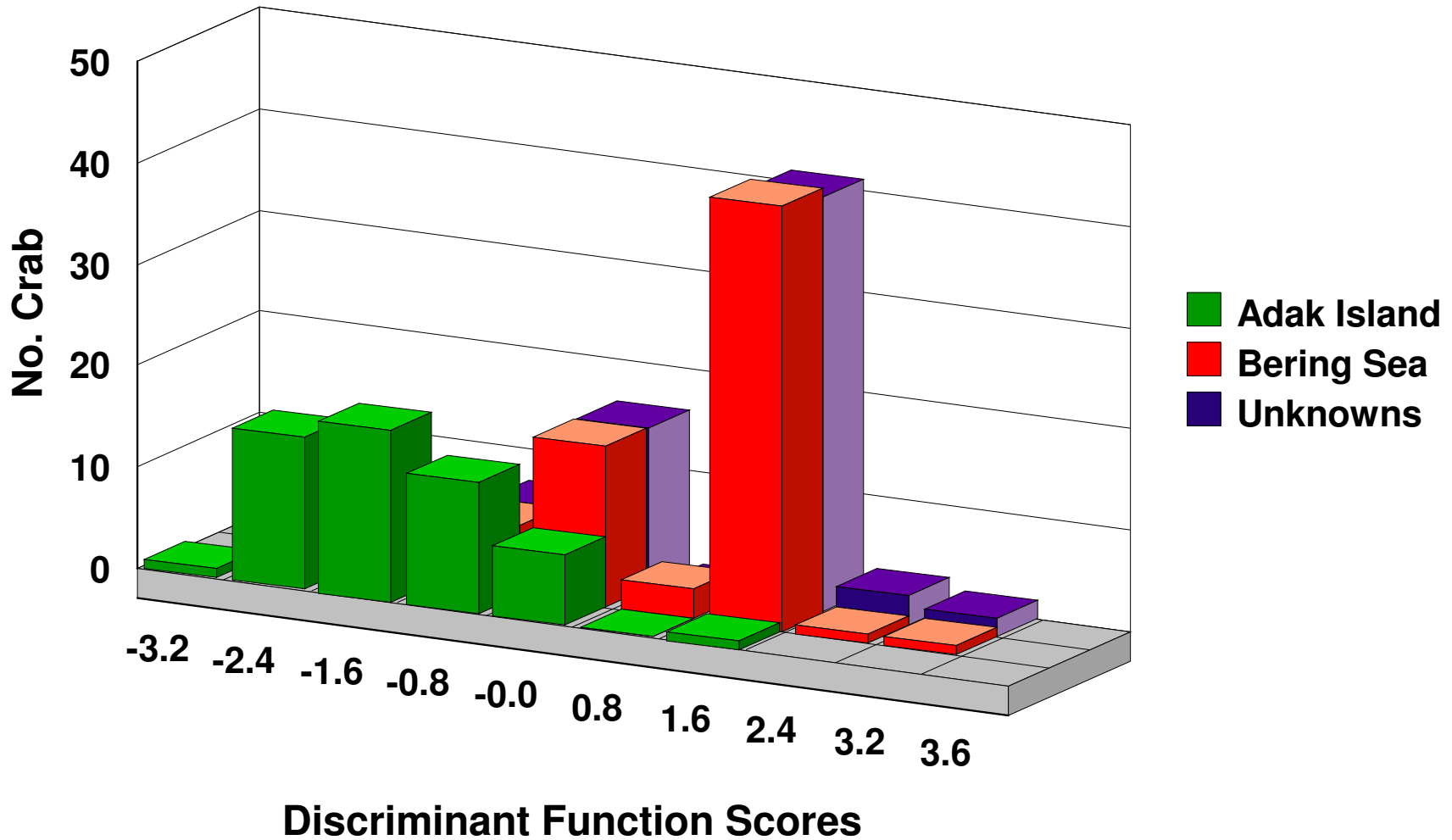


# Allozyme loci define three discrete stocks in 1990:

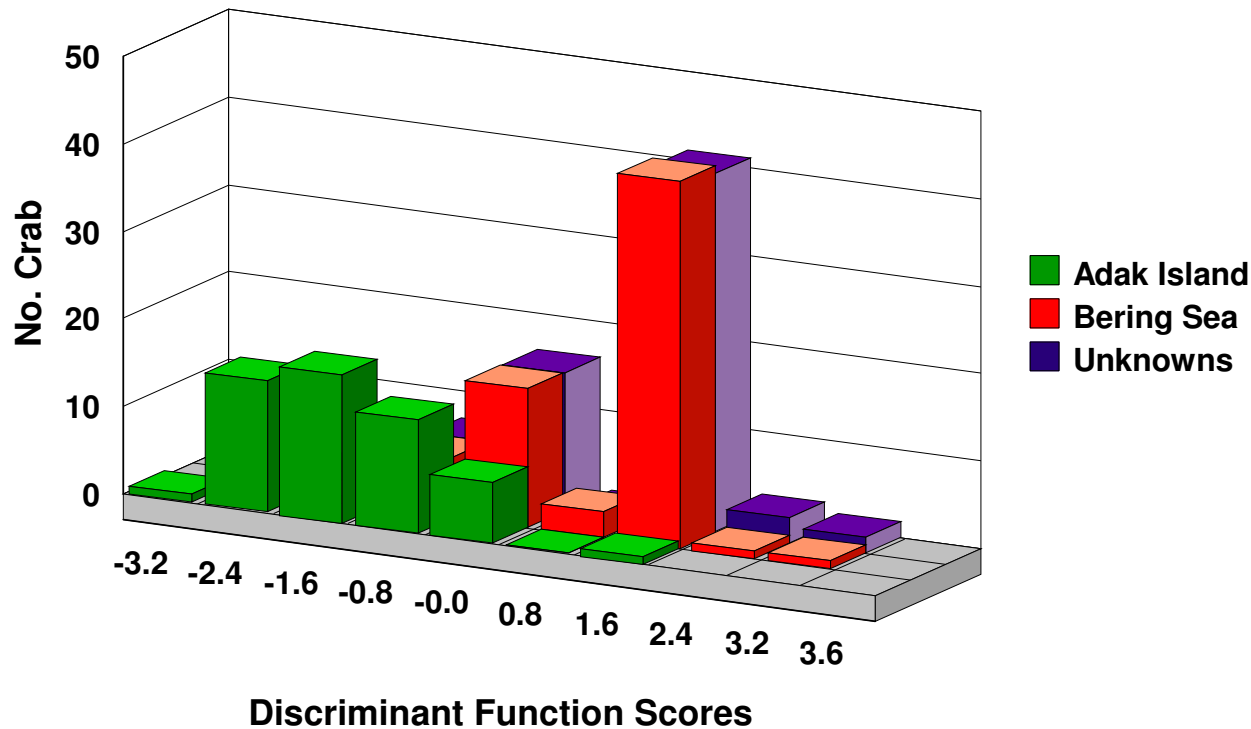


# Poached Red King Crab

## Discriminant Analysis



# Poached Red King Crab



- Crabs were alleged to have originated from Adak
- Not supported by genetics
- Skipper paid \$565,000 fine

# Hardy-Weinberg & Heterozygosity

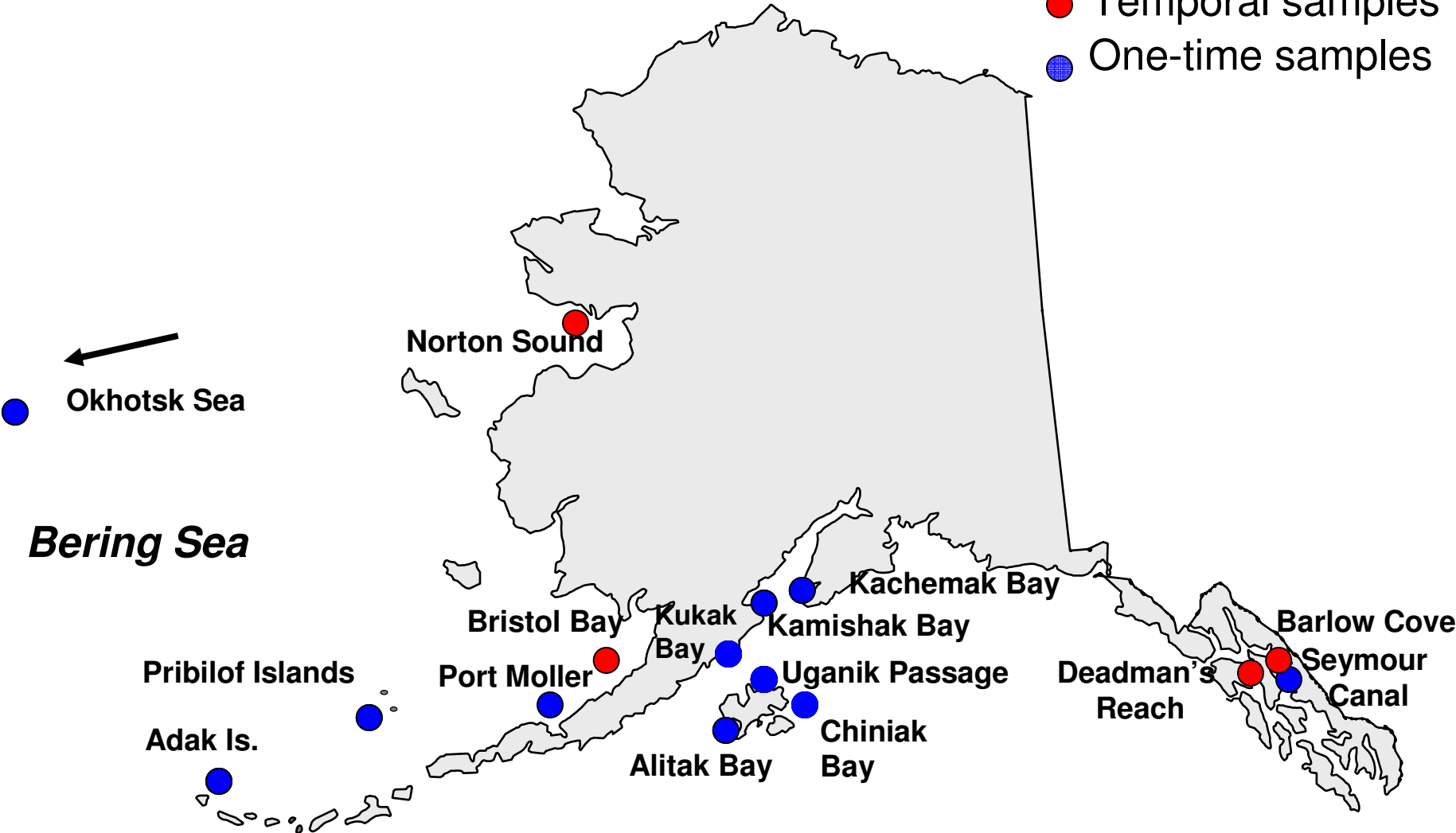
Locus	1	2	3	4	5	6	7	$H_E$	$H_O$
<i>sAh</i>								0.02	0.02
<i>Alp</i>			*	*				0.37	0.30
<i>Gpi-1A</i>								0.01	0.01
<i>Pgdh</i>								0.51	0.46
di- <i>Pca4</i>	*	*		*	*	*	*	0.92	0.69
<i>Pca13</i>	*	*		*	*	*	*	0.95	0.73
<i>Pca14</i>	*	*		*	*	*	*	0.84	0.56
<i>Pca24</i>			*	*	*	*	*	0.87	0.71



# Hardy-Weinberg & Heterozygosity

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<i>Pca14</i>	*	*		*	*	*	*	0.84	0.56
<i>Pca24</i>			*	*	*	*	*	0.87	0.71
tri- <i>Pca100</i>	*	*	*	*	*		*	0.67	0.51
<i>Pca103</i>							*	0.81	0.80
tetra- <i>Pca101</i>	*	*				*		0.79	0.75
<i>Pca104</i>	*			*				0.83	0.76
<i>Pca107</i>				*				0.89	0.84
$H_O$	0.52	0.55	0.60	0.62	0.59	0.60	0.56		

- Temporal samples
- One-time samples



22 Collections  
15 Locations  
1800 Crab

*Gulf of Alaska*

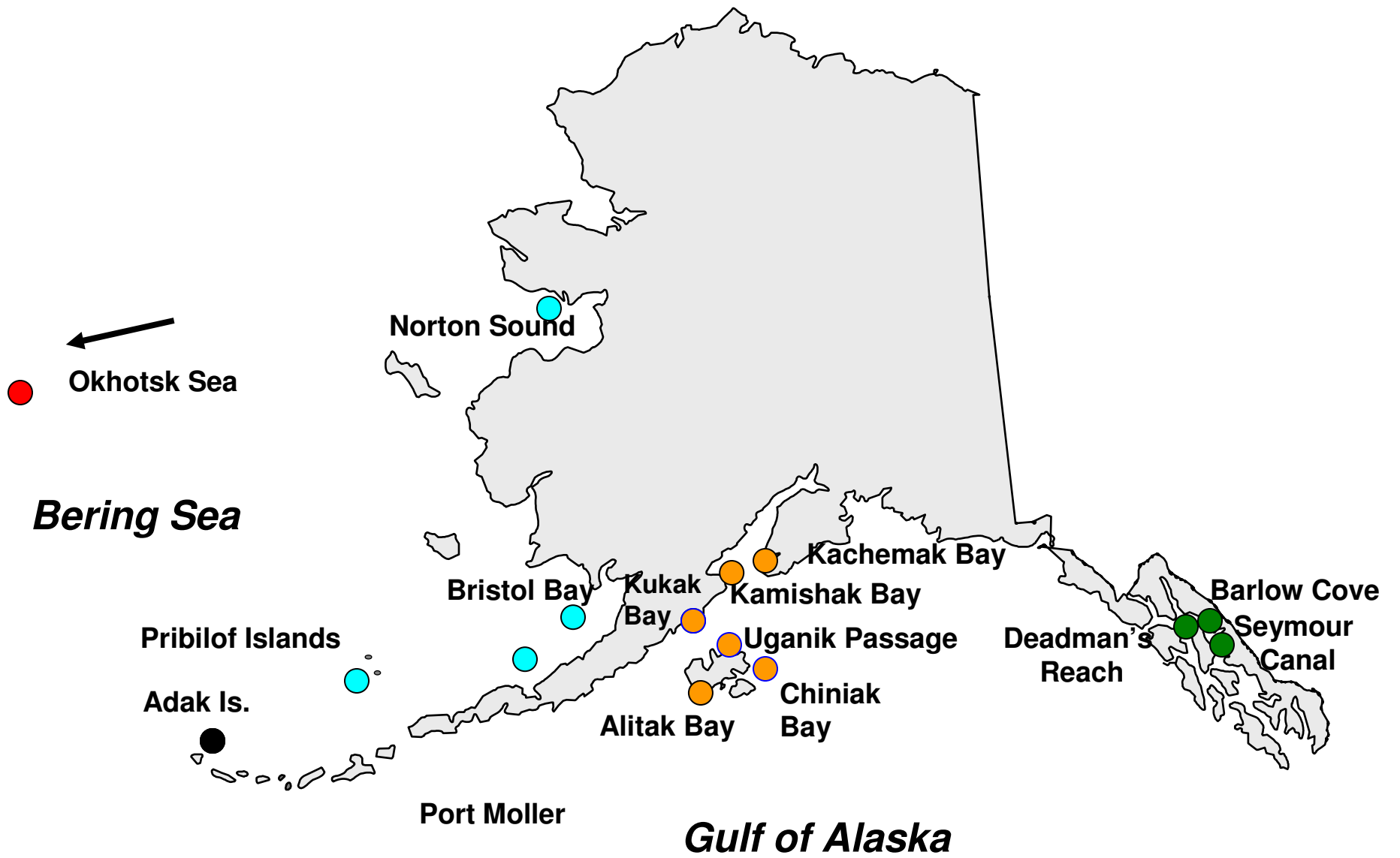


*Sampling under the ice,  
Norton Sound*

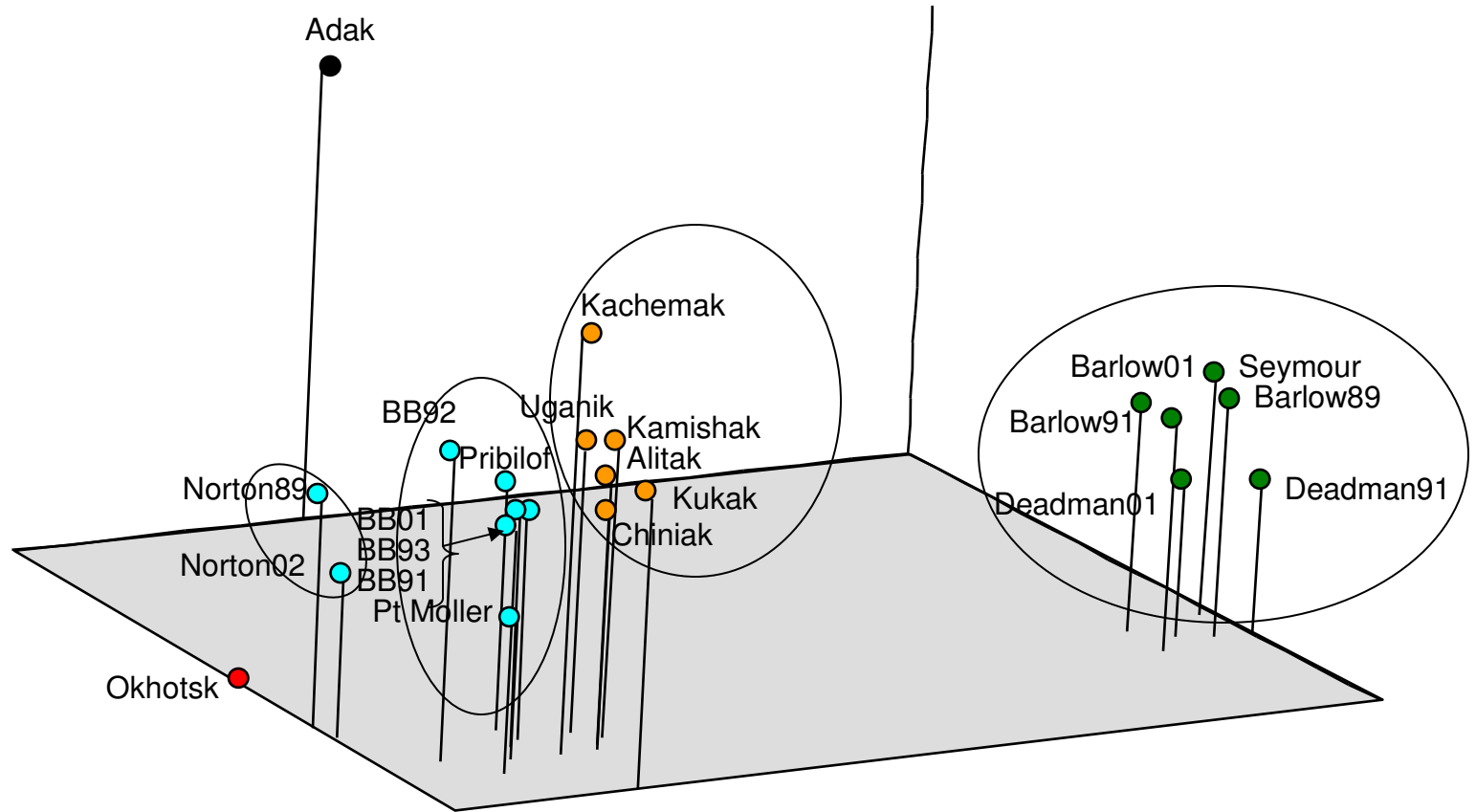
## Temporal Sampling

Location	#	Year Span
Norton Sound	2	13
Bristol Bay	4	10
Barlow Cove	3	11
Deadman's Reach	2	10

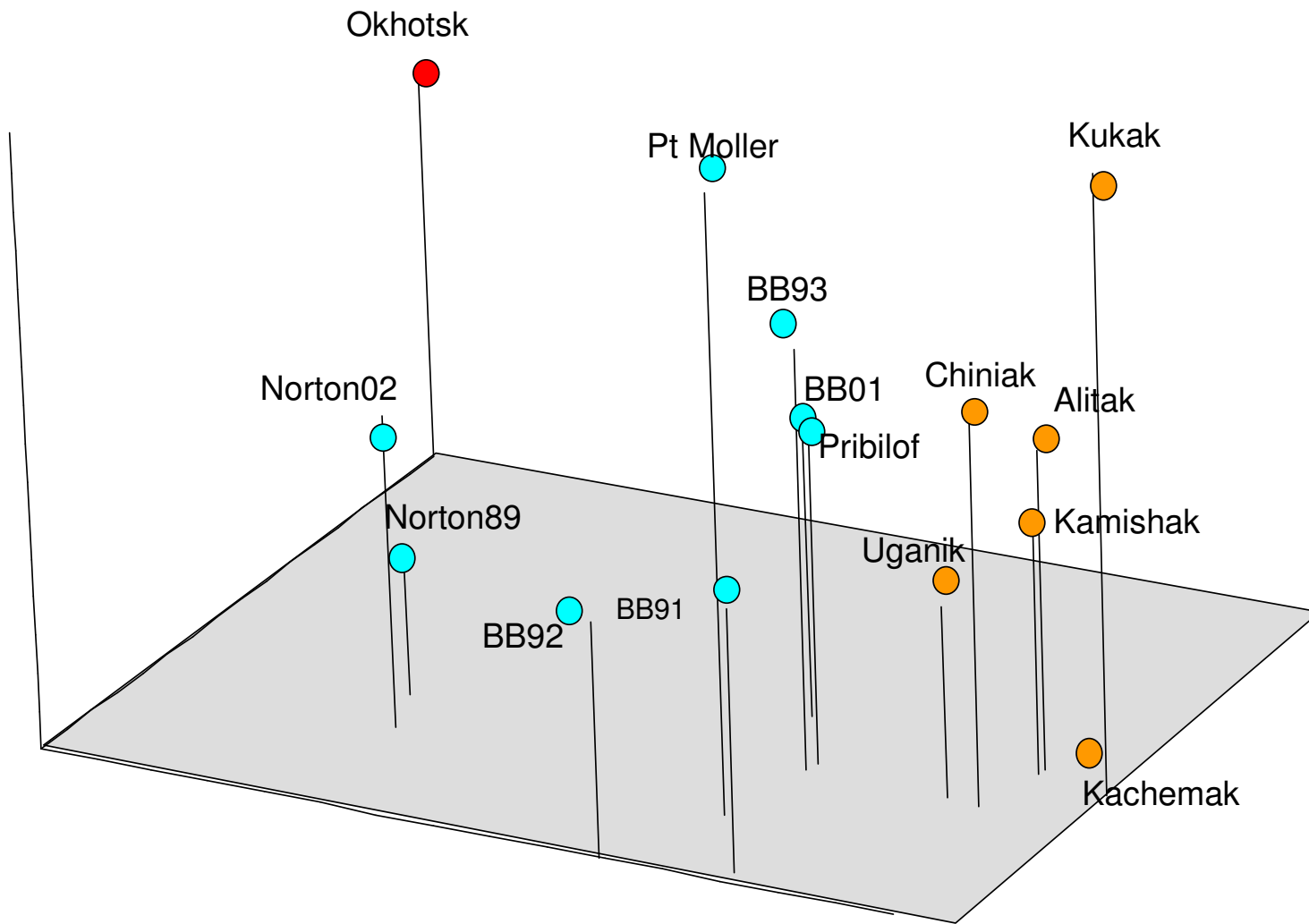
No significant difference in pairwise tests



# Multidimensional Scaling

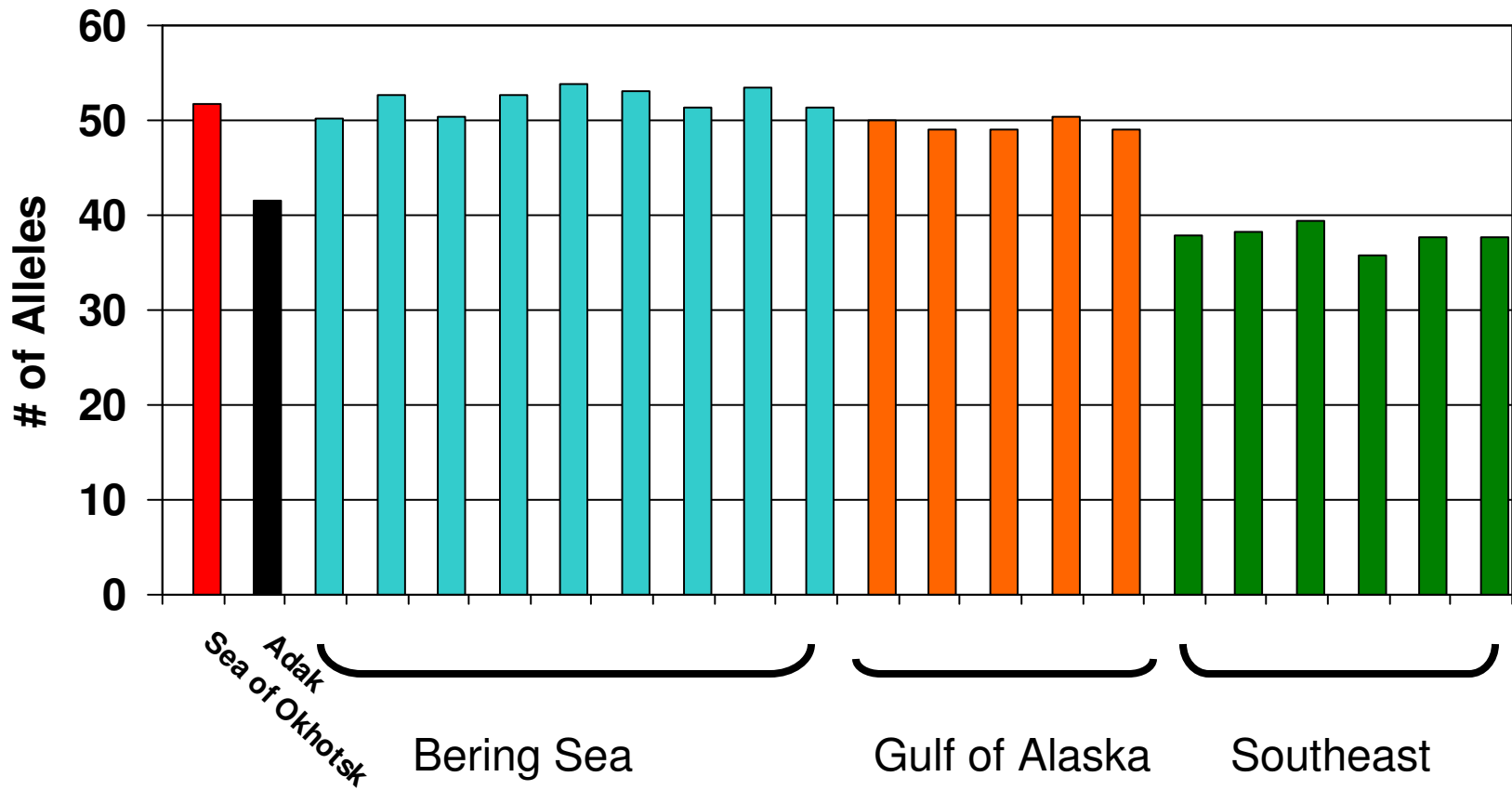


**Fst = 0.024**

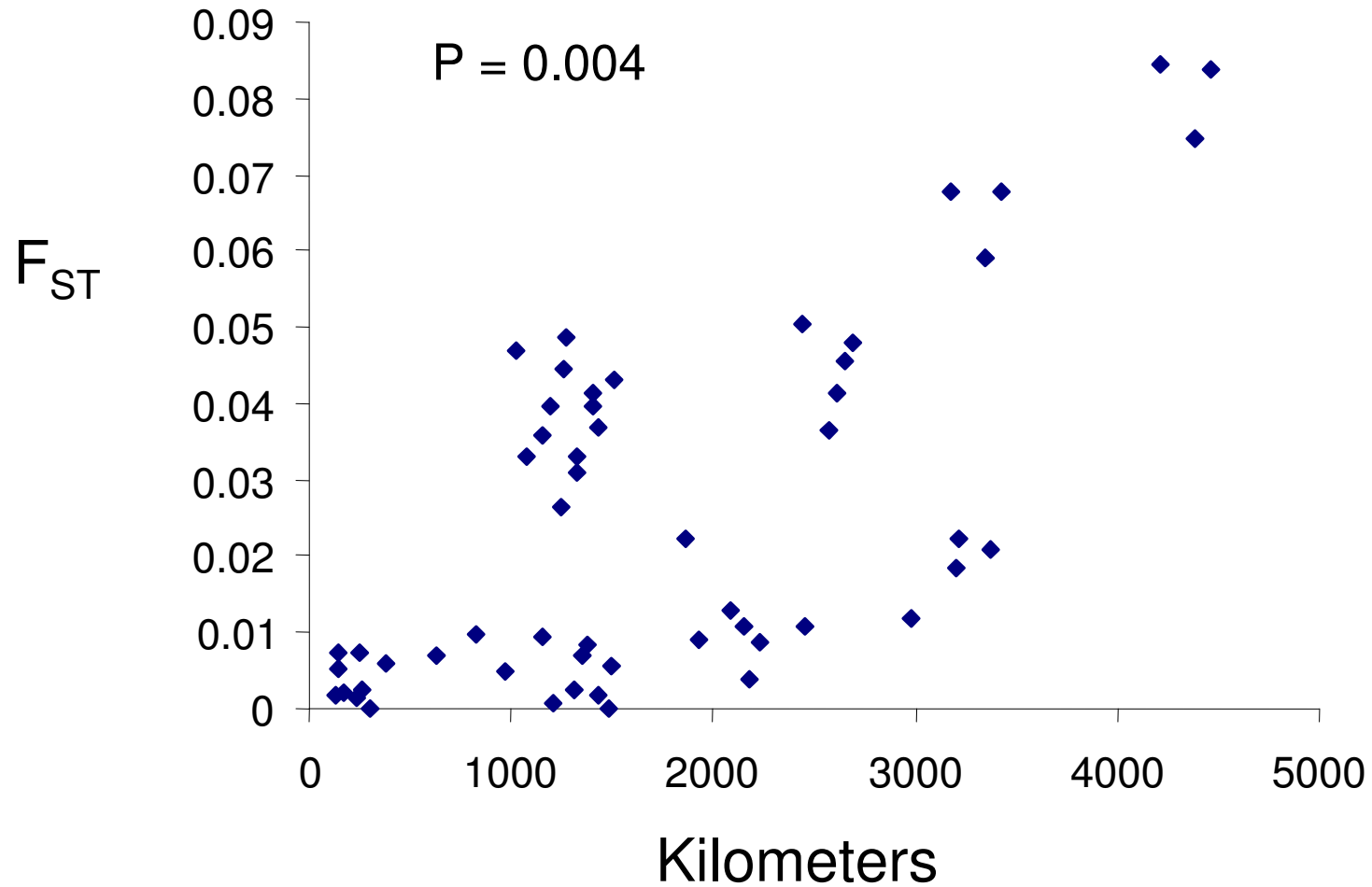


Western Lineage

# Allelic Richness

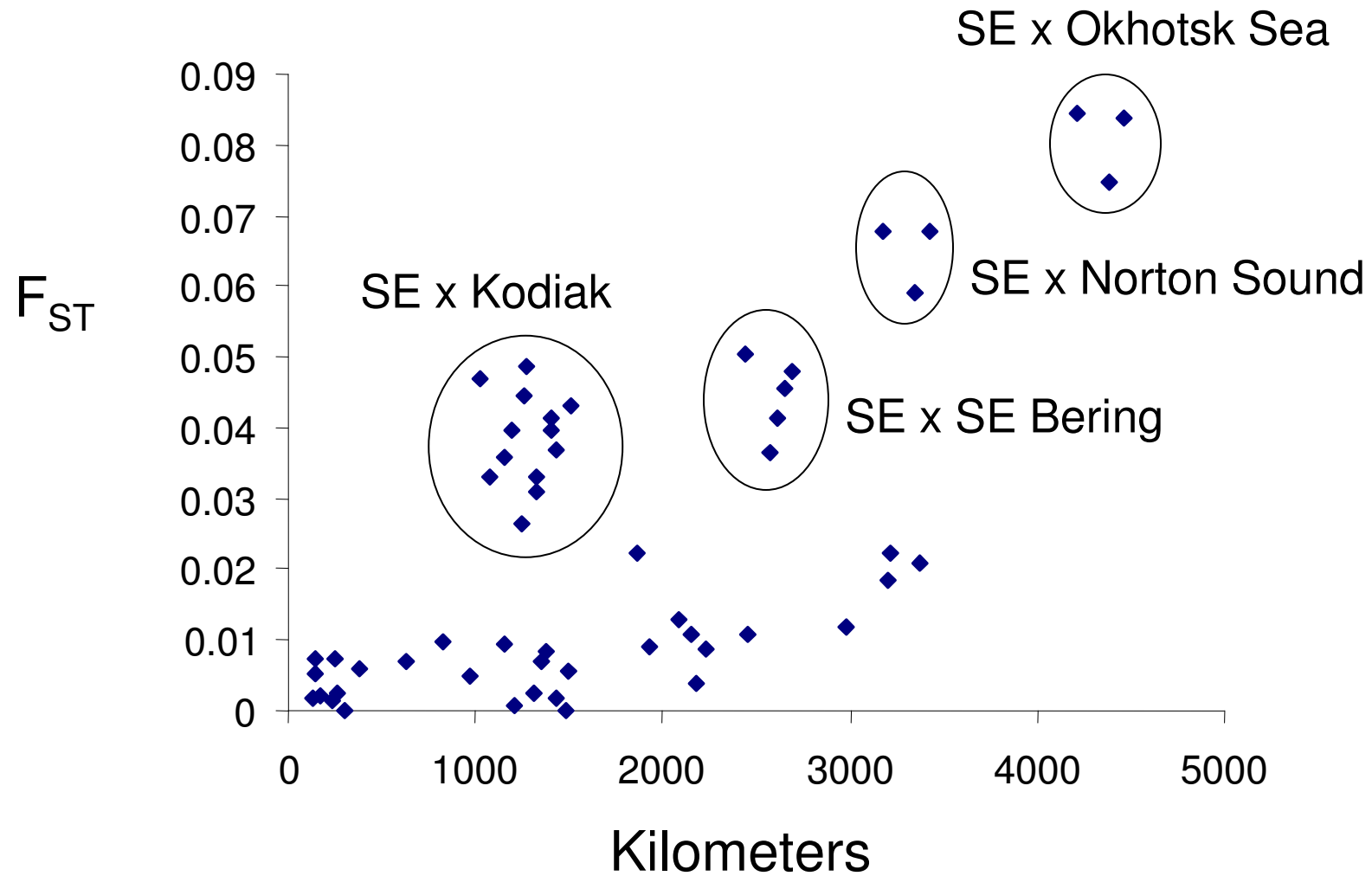


# Isolation by Distance

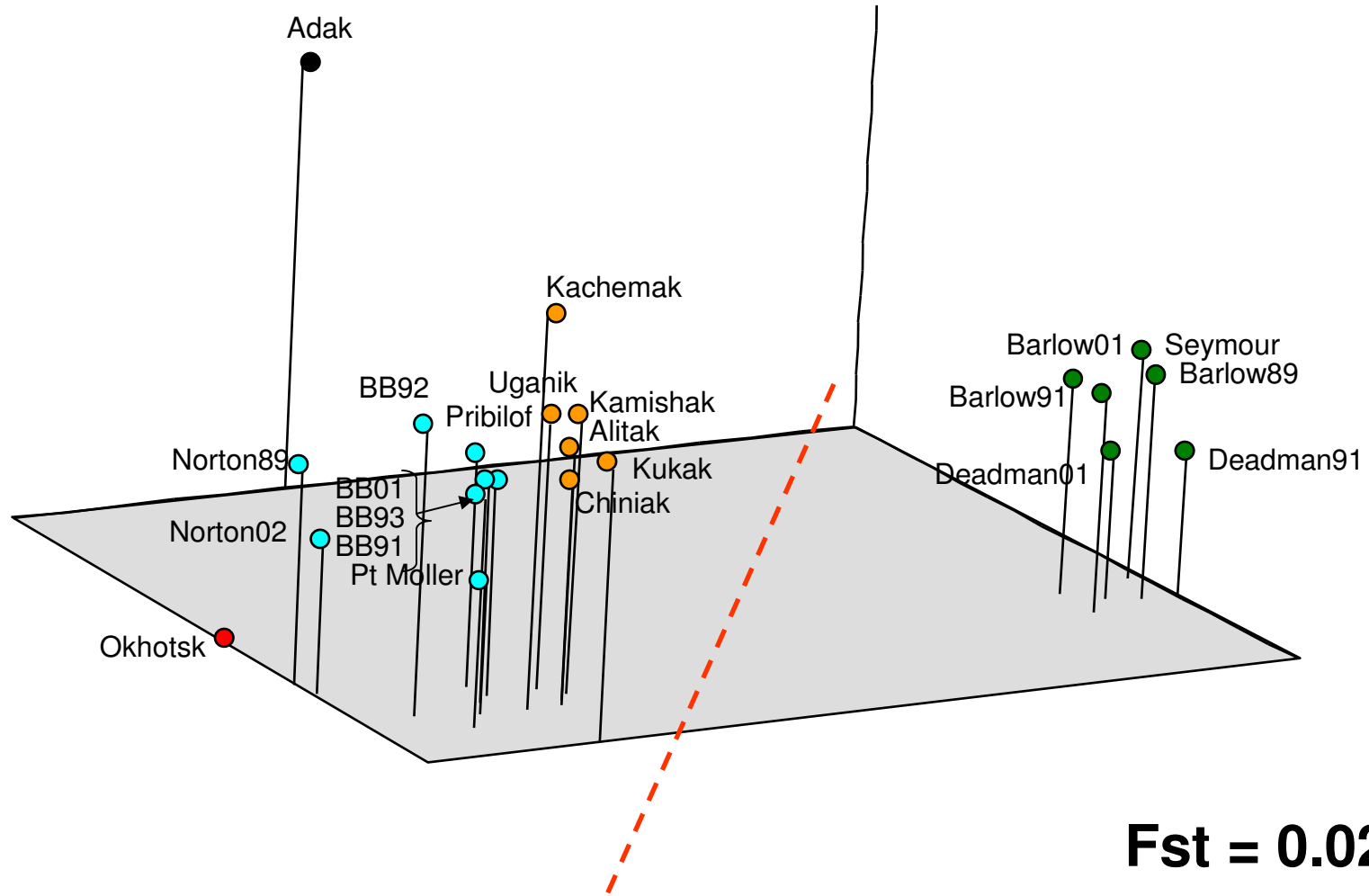


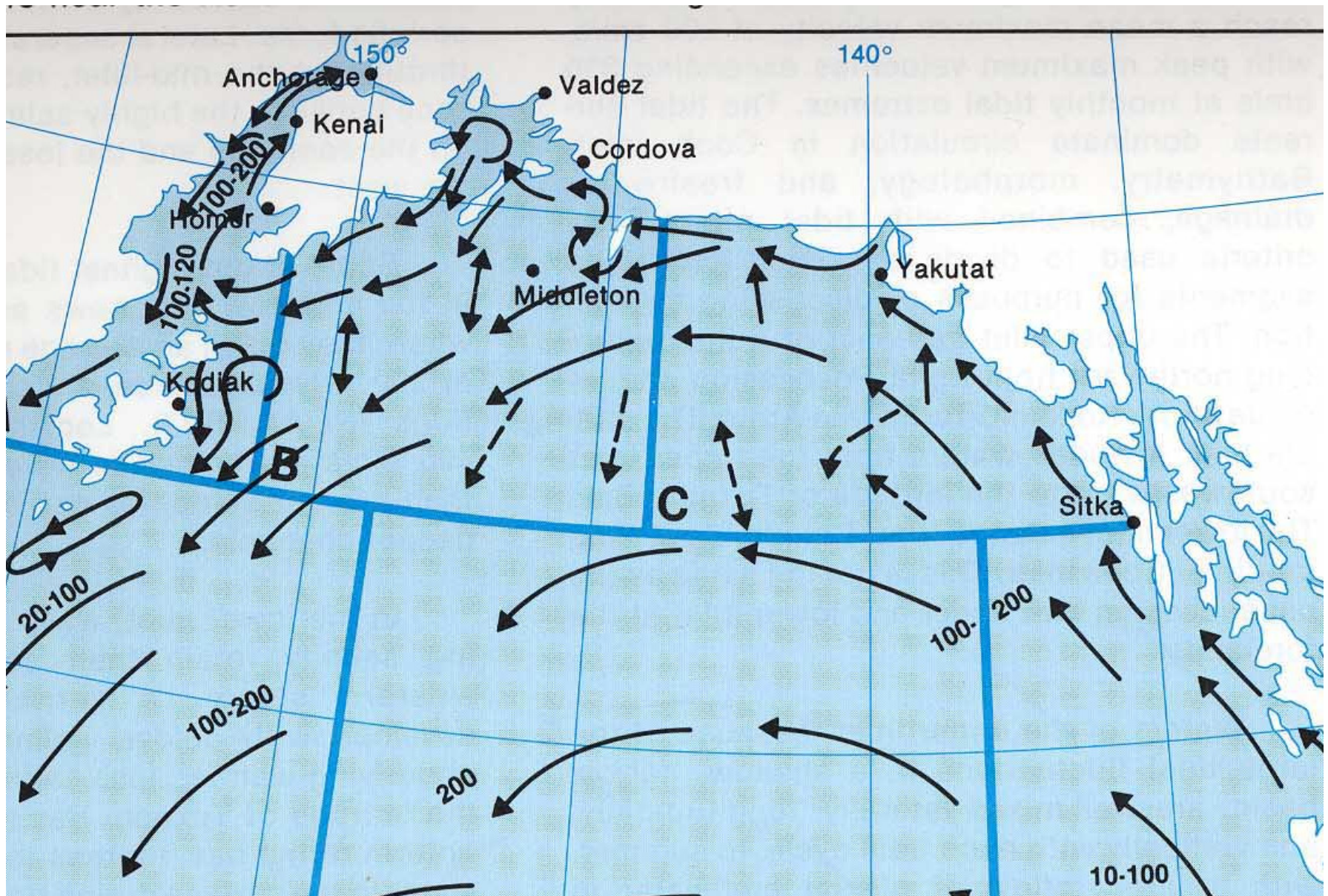


# Isolation by Distance



# Multidimensional Scaling



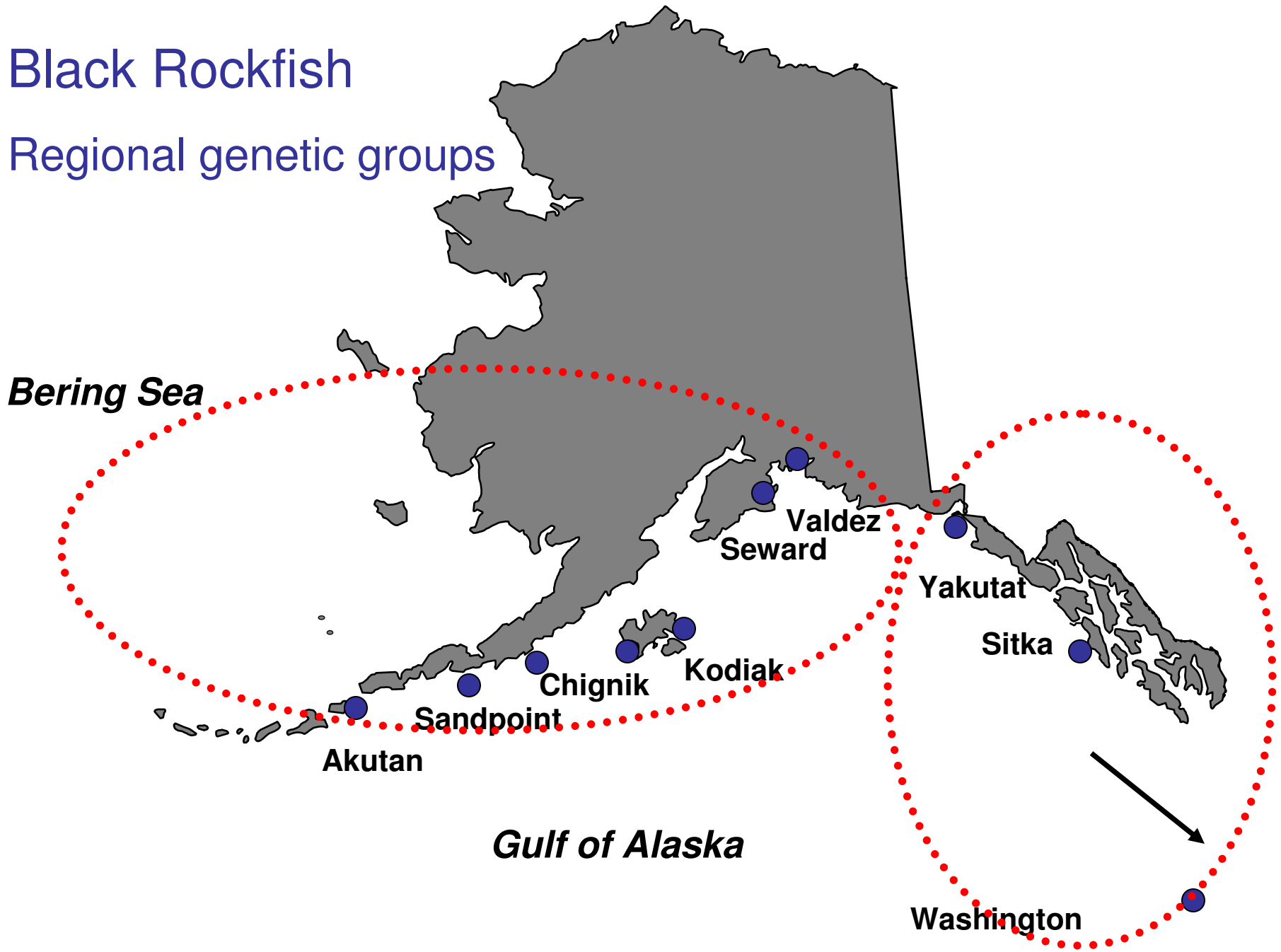


OCSEAP, 1986



# Black Rockfish

## Regional genetic groups



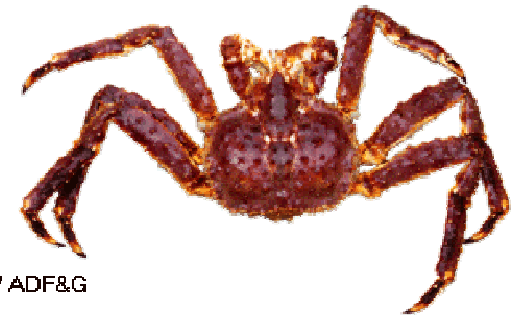
# Red King Crab Summary

- At least two major lineages
  - Southeast Alaska, Western
  - Limited gene flow between lineages
- Significant differences among of Western lineage
  - Gulf of AK, Bristol Bay, Adak, Norton Sound, Okhotsk
- Southeast Alaska has significantly lower diversity



# 2009 Research Directions (ABL, UAF)

- Created genomic DNA library
- 22 potential SNP markers discovered resulting in 9 TaqMan assays
- Surveying in 20 populations
- Also will survey 18 newly discovered dinucleotide microsatellites



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# Red King Crab

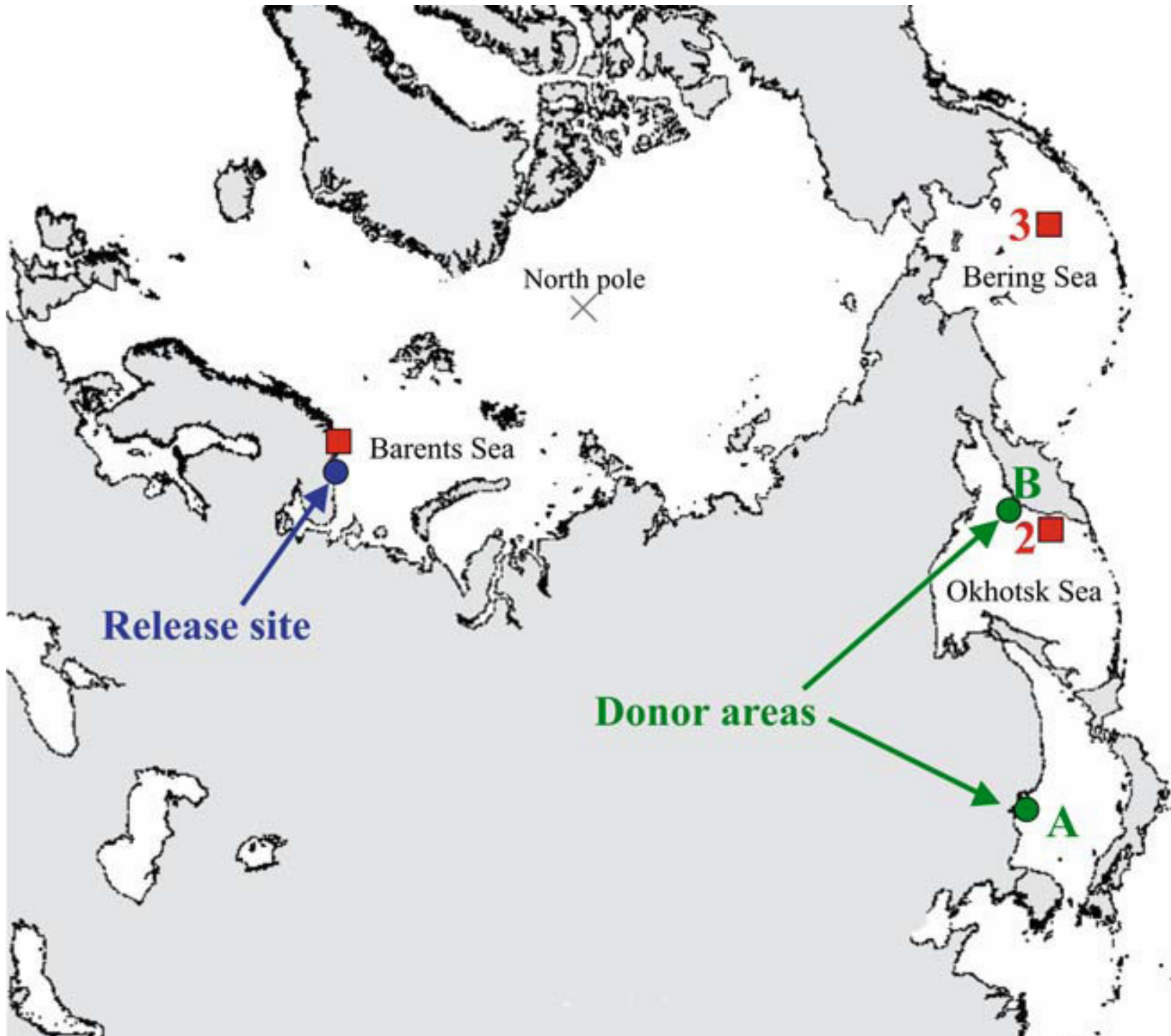
## Barents Sea Research

- Juvenile and adults introduced from Kamchatka into Norwegian Barents Sea, 1961-1978
- Very successful introduction
  - Nuisance species
- Barents Sea compared to Sea of Okhotsk and Bering Sea



*Red king crab in Norwegian Market*



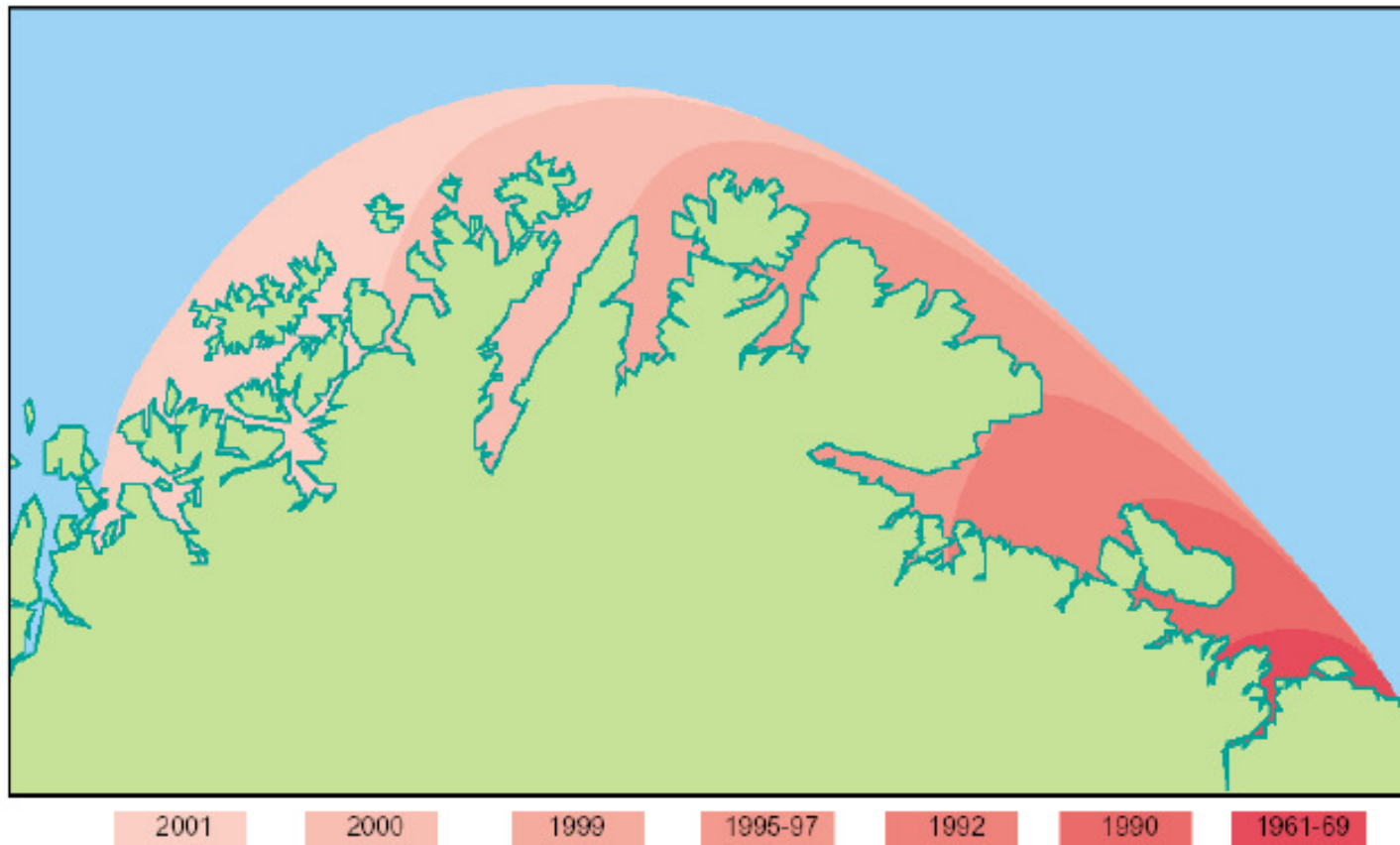


# Red King Crab Barents Sea Results

- $F_{ST}$  across all loci was relatively low 0.024
- No reduction in gene diversity or allelic richness
- Large individuals found in new areas of the Barents Sea and in Norwegian fjords indicating a western migration pattern.



# Barents Sea Invasion



*Evolution of the Red King Crab distribution in the Barents Sea since its introduction in the 1960s until 2001.*

Source: Institute of Marine Research, Norway

# Research Directions at SAFS

- Goal: detect local adaptation in high gene flow environment
  - Neutral markers have limited resolution
- Population genomic approach using next generation sequencing
  - Detect gene regions that are influenced by natural selection



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# Acknowledgements

Thanks to all samplers and laboratory assistance from ADFG and NMFS. Funding was provided from NOAA Federal Funds to ADF&G.

