# Trends in Arctic biodiversity: A multi-disciplinary and inter-agency approach to investigate and predict community changes through time

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# Arctic Biodiversity Assessment

» **Nowadays all of the tundra is on the move now. Many forest animals are coming to tundra now. Moose is moving towards the tundra proper nowadays.**

Alexey Nikolayevich Kemlil, a Chukchi reindeer herder from Turvaurgin in northeastern Sakha-Yakutia, Siberia; T. Mustonen in litt.

- Change
- Components of biodiversity – forest/tundra
- Humans – cause and consequence

# Key findings from this symposium

- Beringia is exemplified by high diversity, high endemism, and inter-continental exchange
- Beringian biodiversity has a dynamic history governed by unique climate and geography
- Managed for many uses and experiencing increased and novel human-related stressors.
- Comprehensive understanding of historical responses is perhaps our best asset for accurate prediction and management of future biodiversity trajectories.

# How can we apply this knowledge?

- Synthesize data from decades of Beringian research
- Combine ecological and evolutionary inferences to span many timeframes
- Adopt a comparative statistical approach to analyze communities
- Target major management regions in addition to biogeographic provinces
- Maintain and expand field-based inventory and monitoring efforts to test future hypotheses


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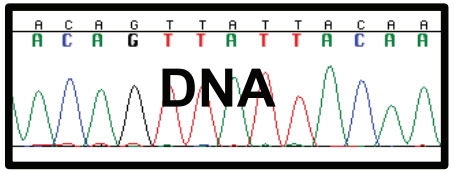


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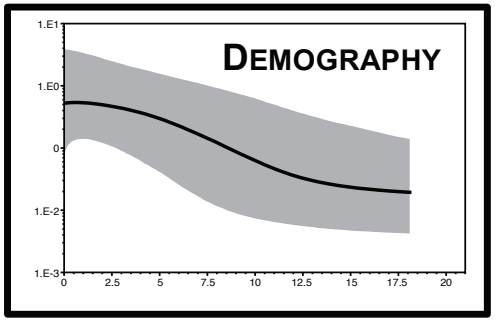


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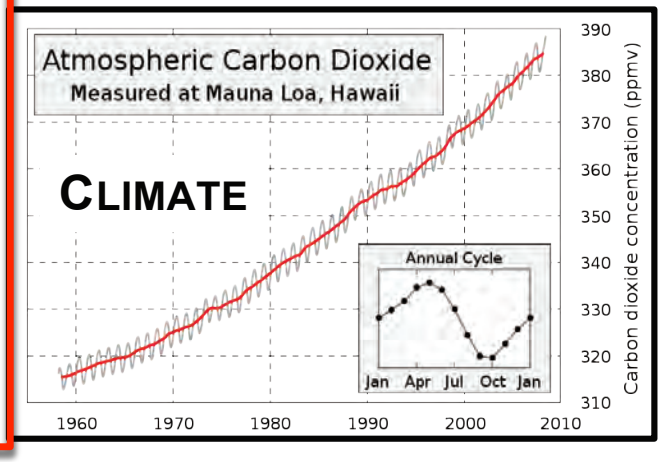


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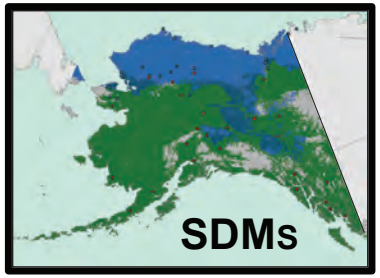


Georeferenced Contemporary and Fossil Specimens

Inventory, Monitoring, Field Collection

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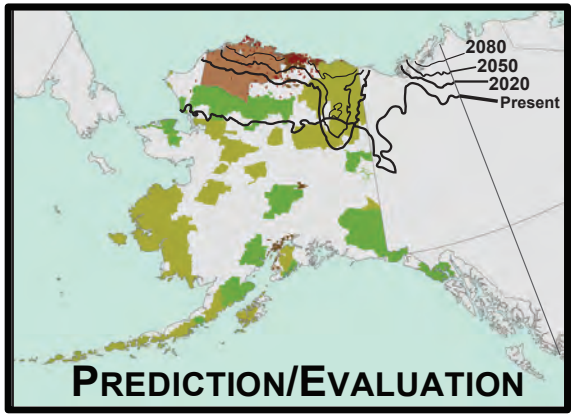


Management/ Conservation

DEVELOPMENT/ LAND-USE

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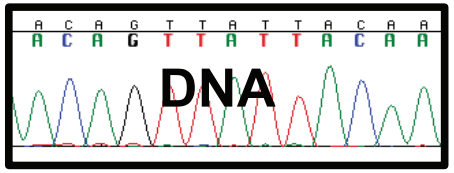


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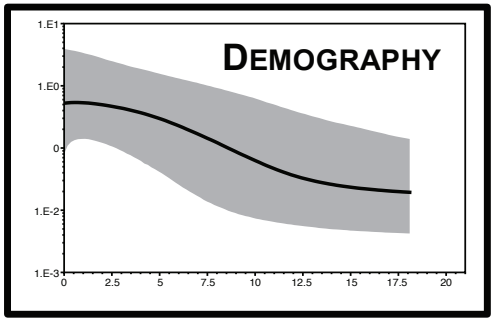


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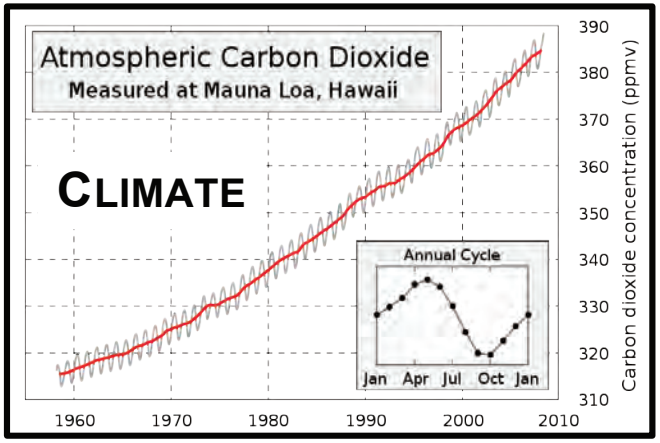


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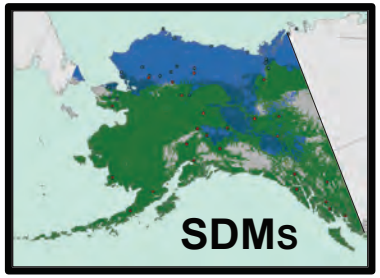


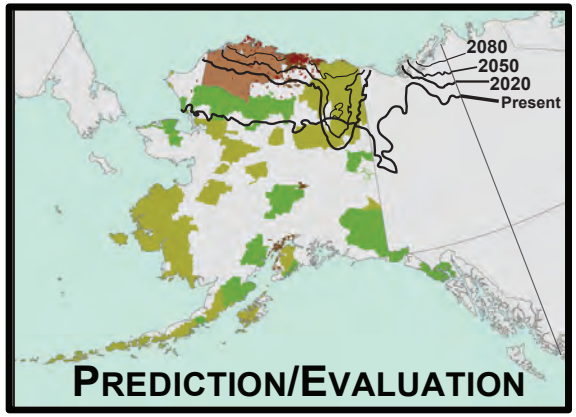


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DEVELOPMENT/ LAND-USE

Management/ Conservation

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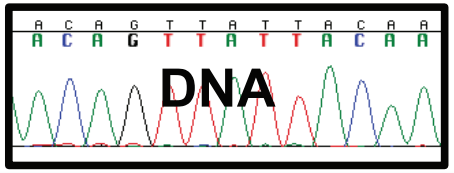


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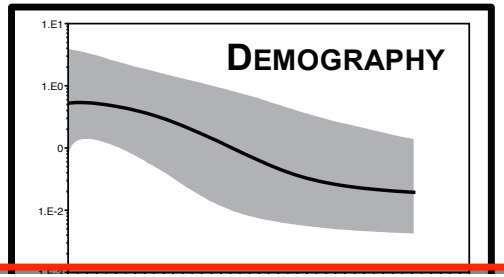


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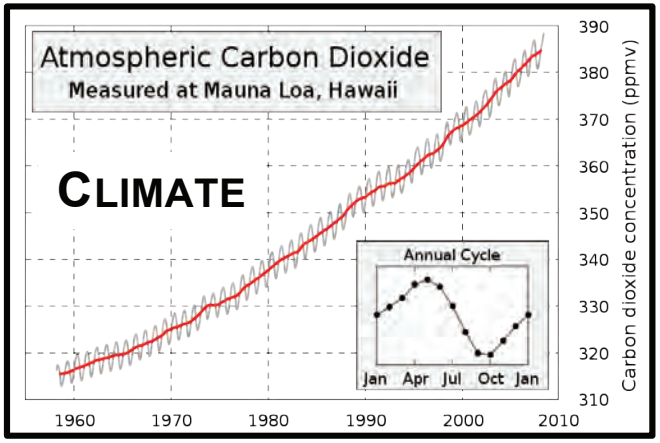


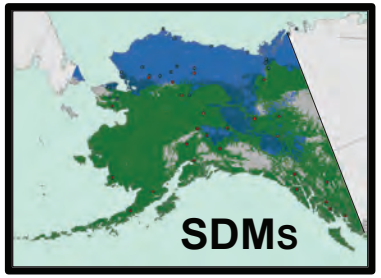


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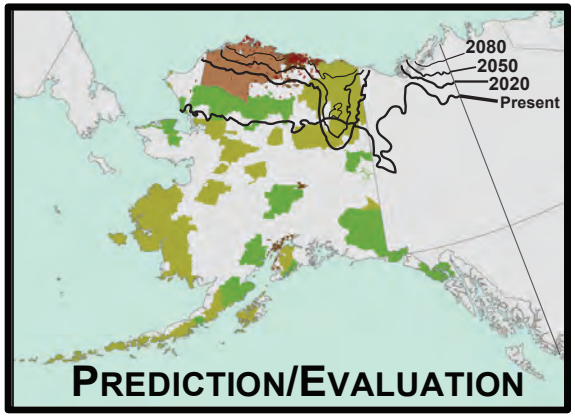


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DEVELOPMENT/ LAND-USE

Management/ Conservation

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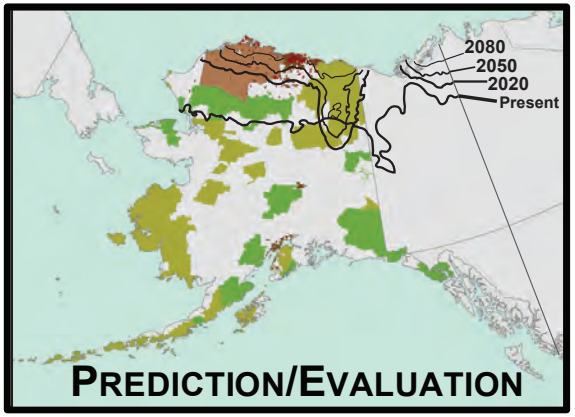


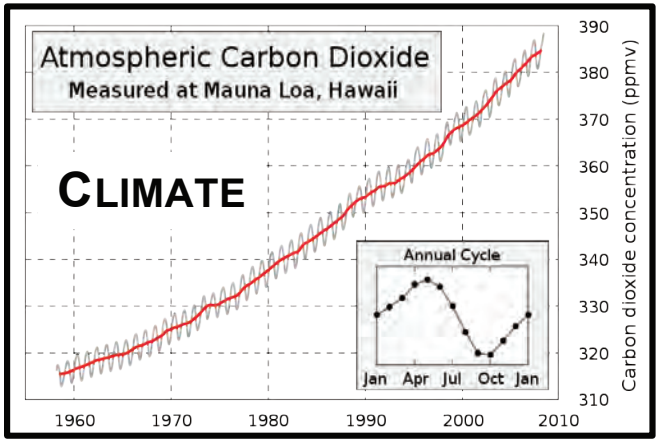


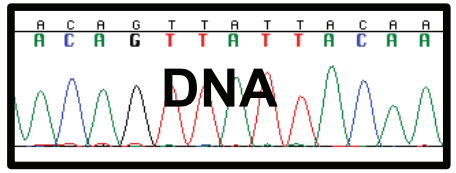


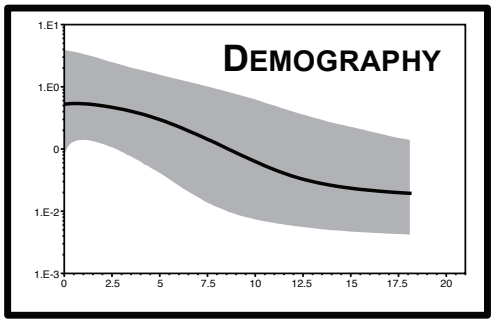


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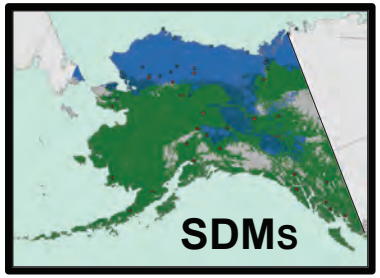


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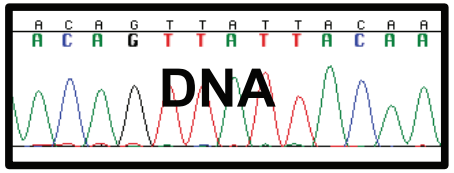


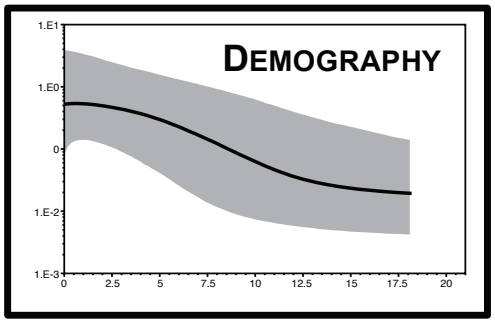


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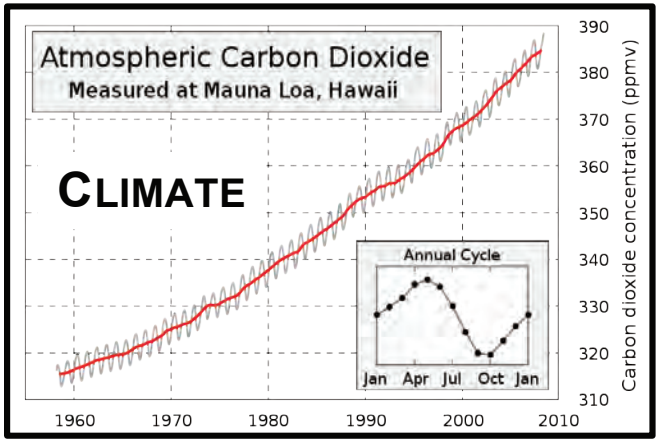


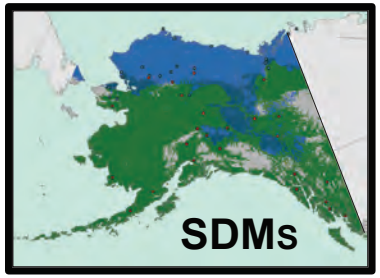


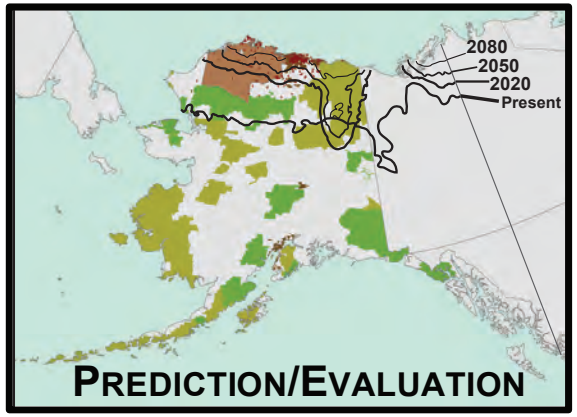


Management/ Conservation

DEVELOPMENT/ LAND-USE

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Georeferenced Contemporary and Fossil Specimens

Inventory, Monitoring, Field Collection

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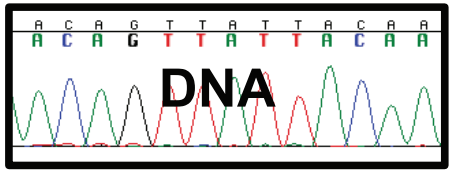


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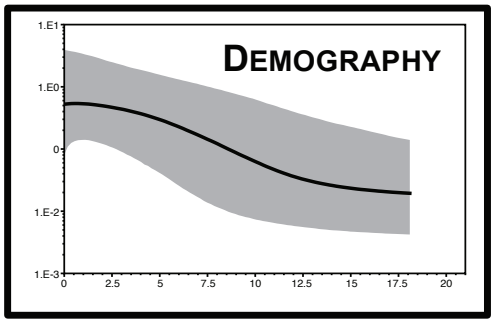


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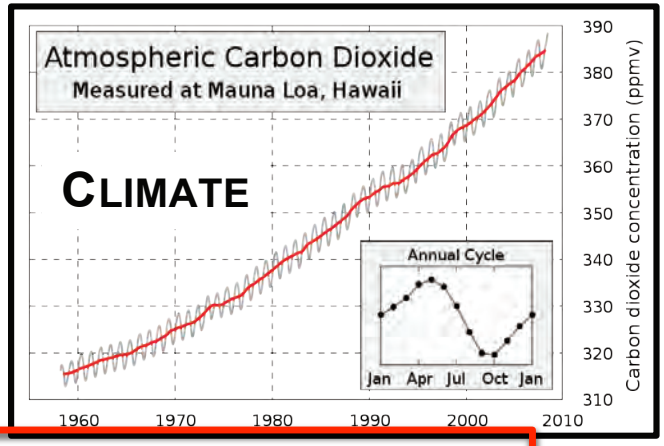


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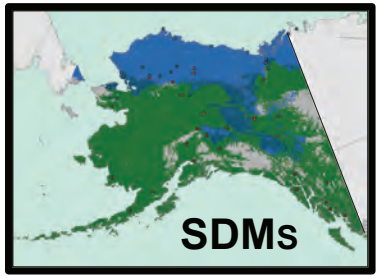


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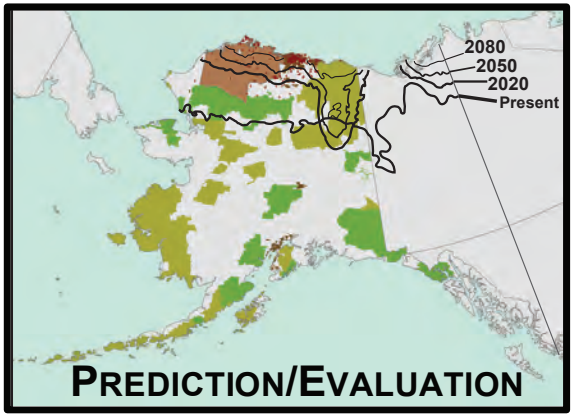


Management/ Conservation

DEVELOPMENT/ LAND-USE

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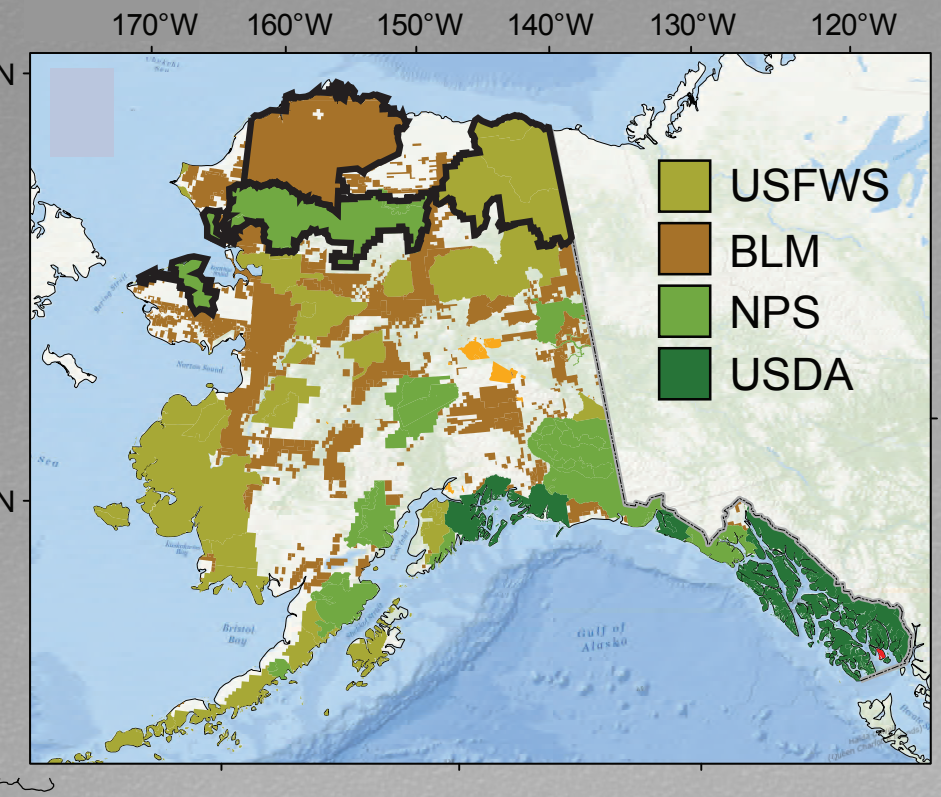
# Small mammals as indicators of change

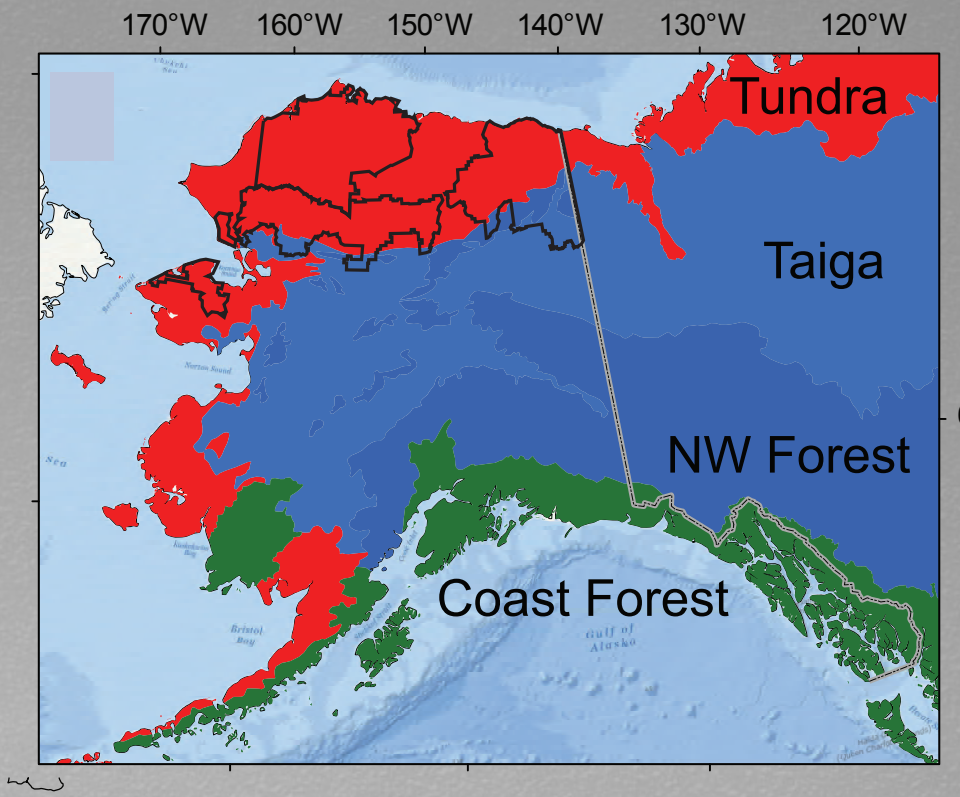
- Diverse communities and high abundances
  - Relatively well-studied
- Resident, so experience year-round conditions
- Respond rapidly to environmental change
- Rapid generation times → fast evolution
- Host to diverse parasite faunas

# Study Area

## Public Lands in Alaska




## Ecoregions

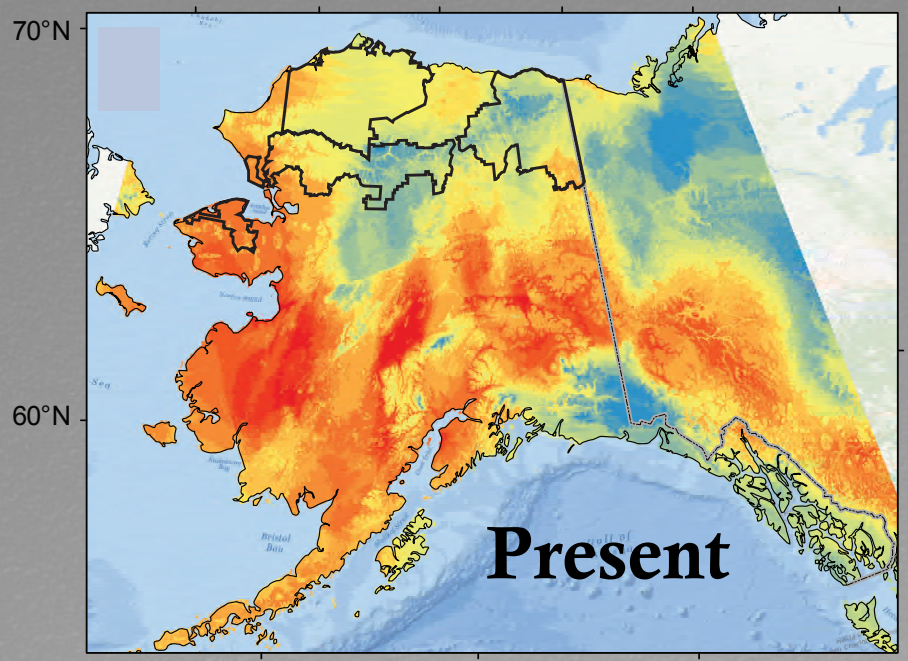


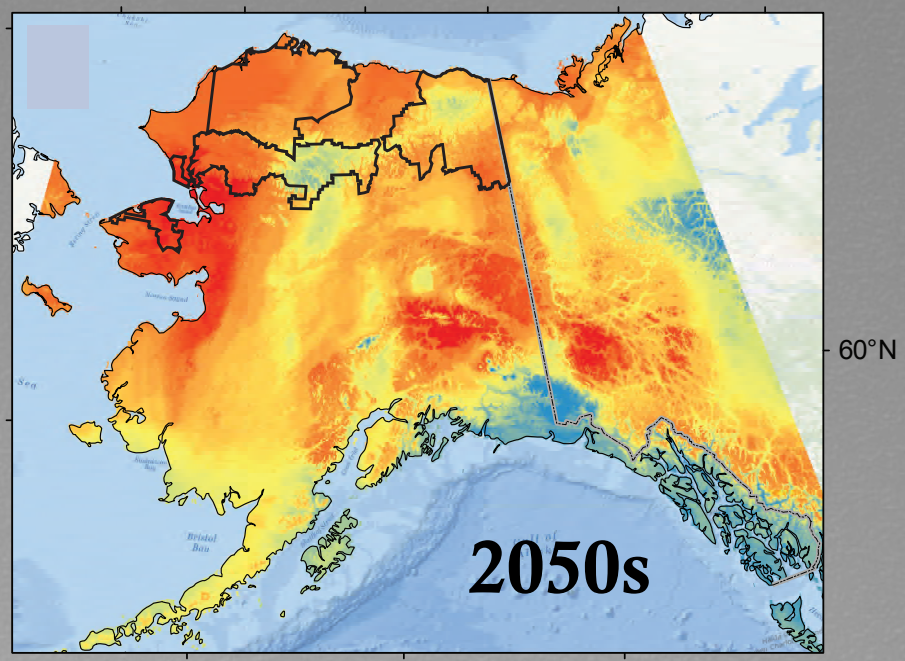
# Challenges from the ABA

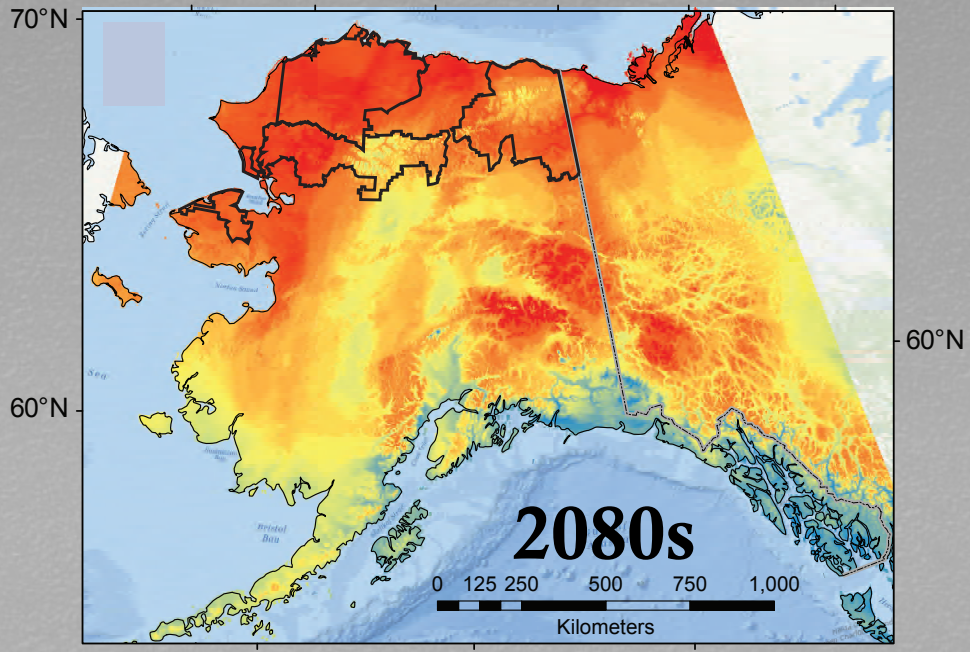
- Where will future hotspots of Arctic diversity be located?

- What are the scientific recommendations for effective future management of biodiversity?

# Change in Total Diversity – 25 Mammals



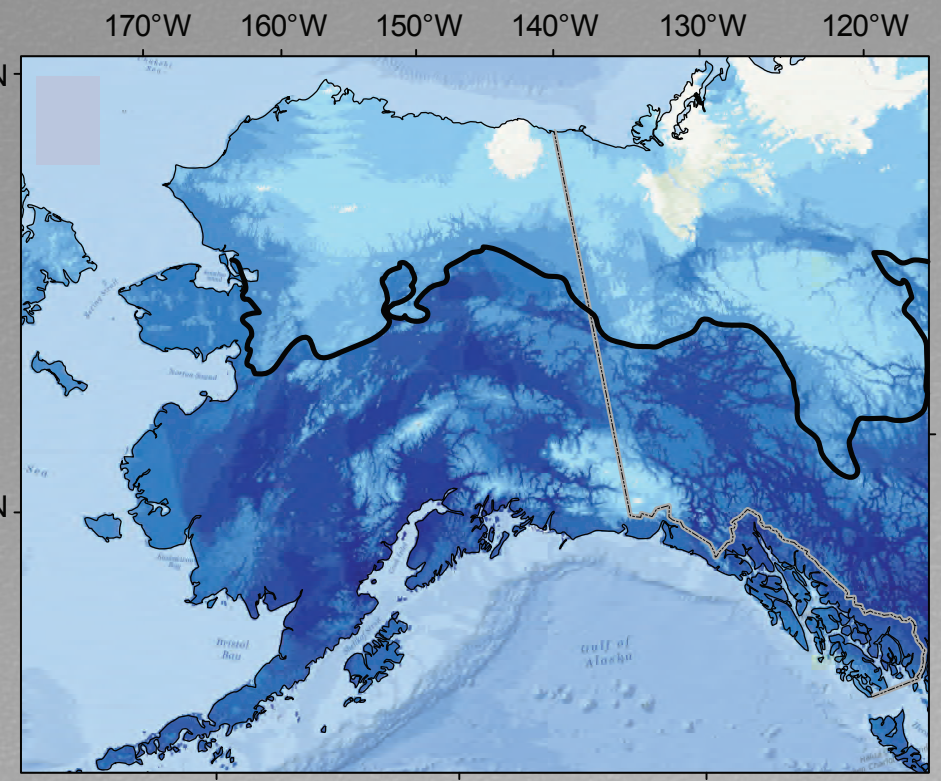



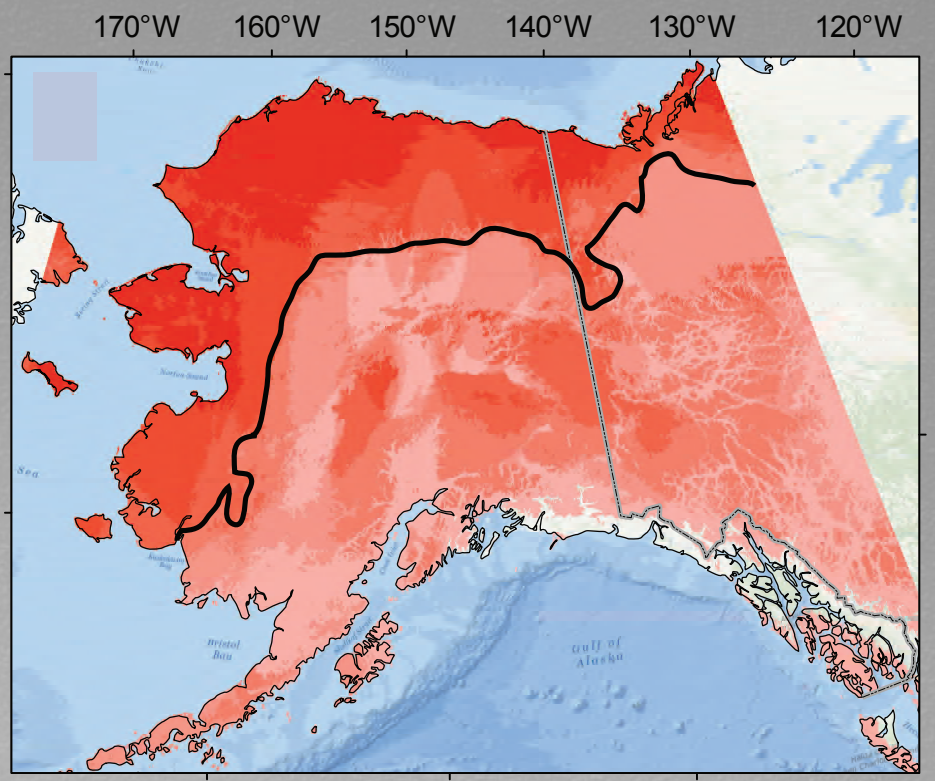
# Distinct Biomes

## Present time

### Boreal



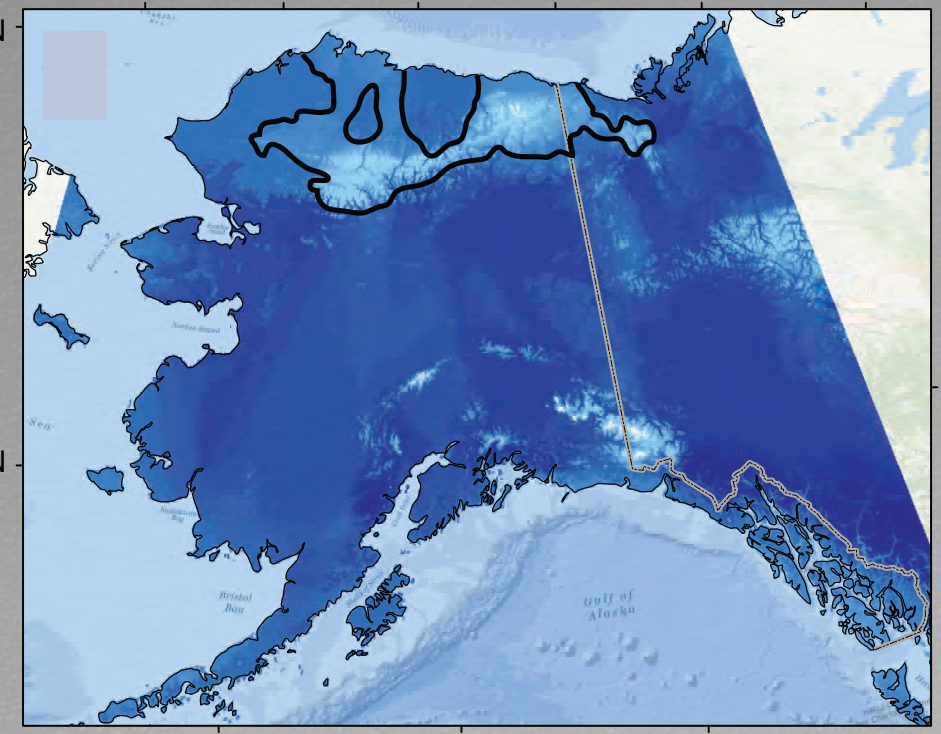

### Tundra



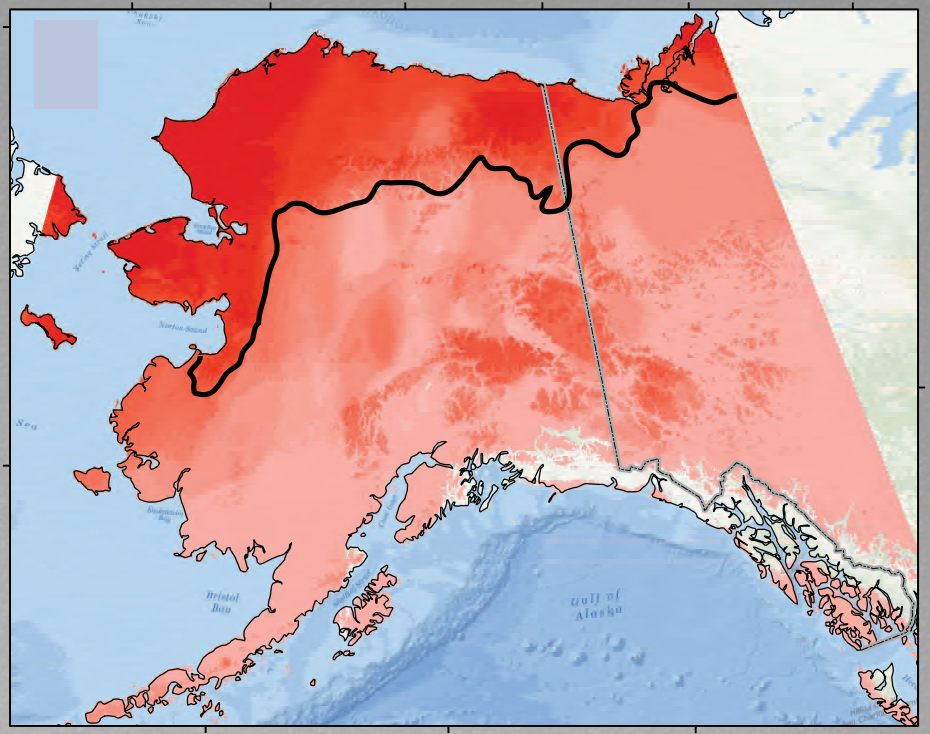
# Distinct Biomes

## 2050s

### Boreal



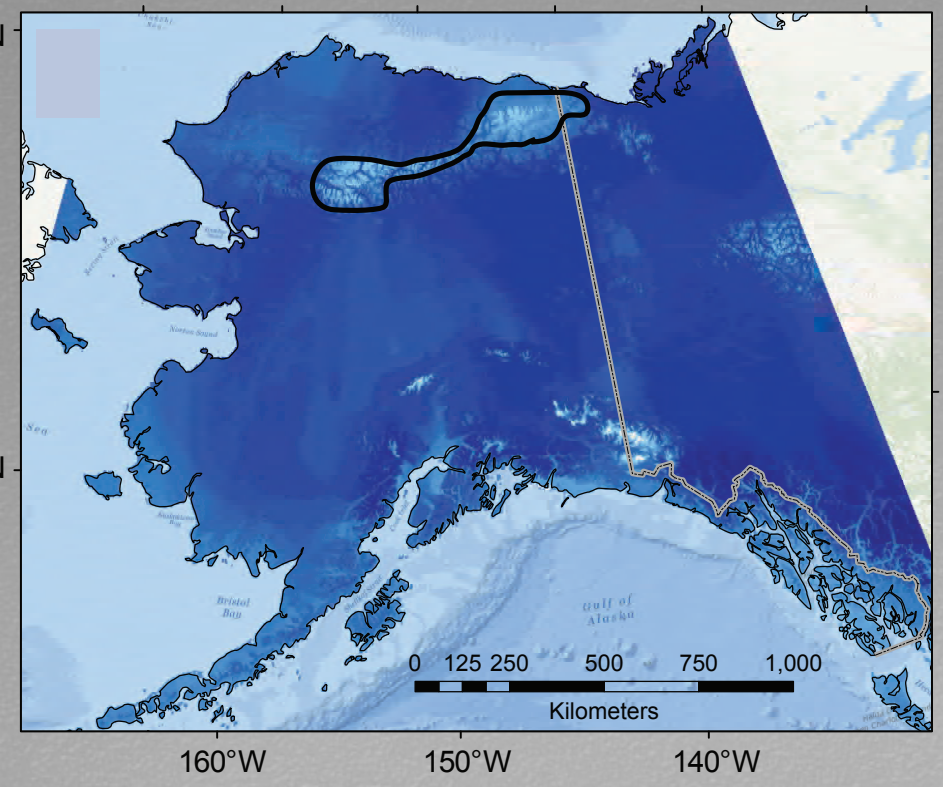

### Tundra



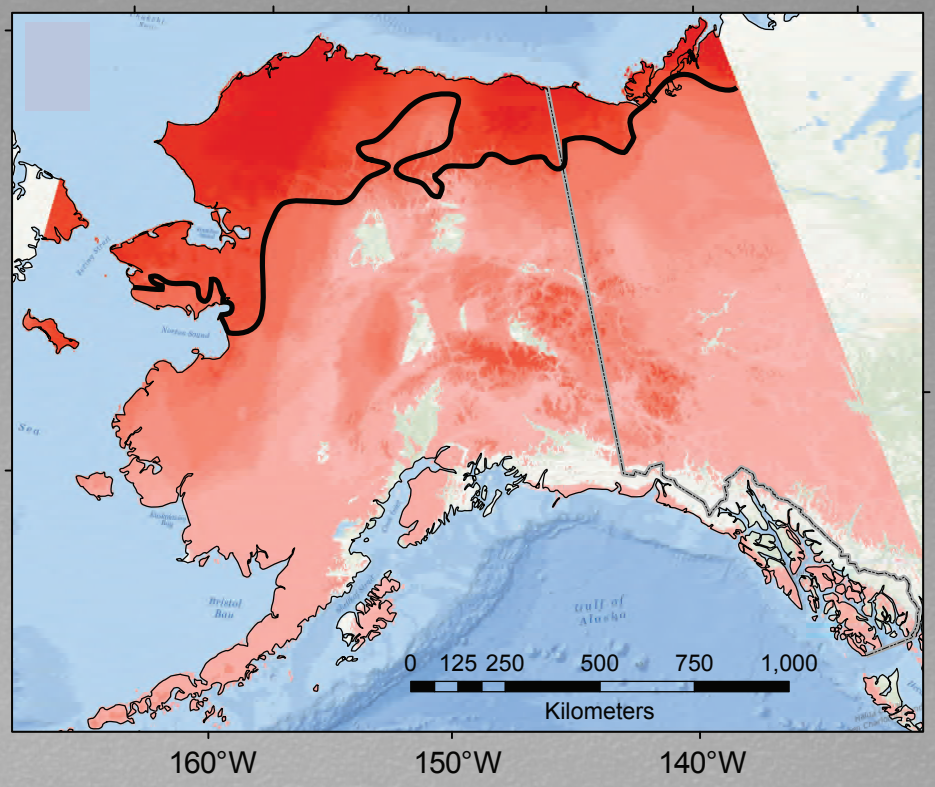
# Distinct Biomes

## 2080s

### Boreal




### Tundra



# Future directions

- Add other distinct components of diversity
- Develop analyses for both genetics and modeling
- Implement integrated methods beyond Beringia
- Investigate dynamics at the transition between boreal and tundra
- Test predictive hypotheses as time progresses with further field initiatives

# Acknowledgements









# Main Findings

- Total biodiversity is shifting northward
- But, distinct biomes indicate different community responses
- Investigating ecotone dynamics will be critical
  - Hybridization, competition, spread of disease
- We can predict future refugia for tundra diversity
  - Coincident with managed lands
  - Partly non-overlapping with boreal diversity