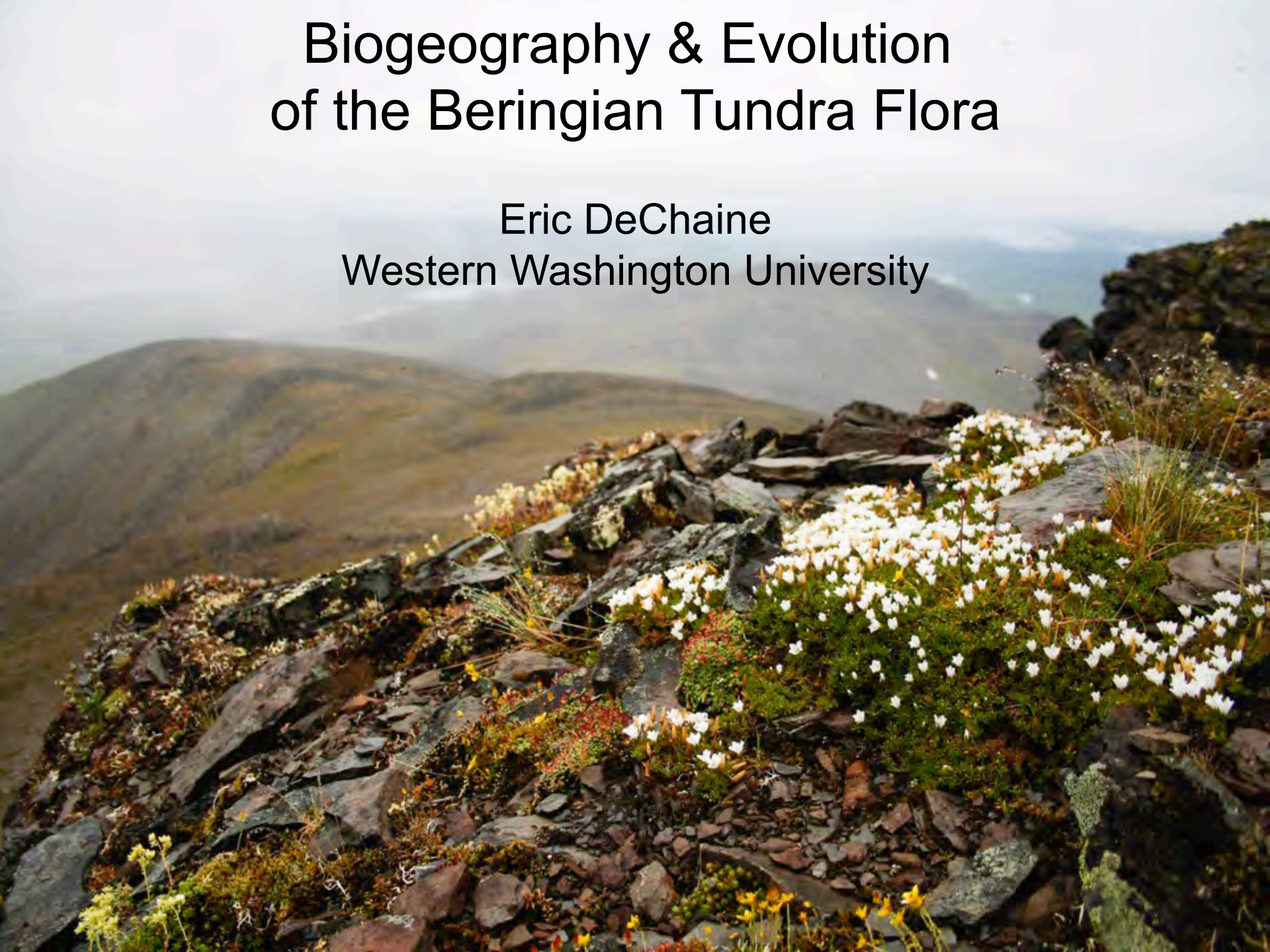
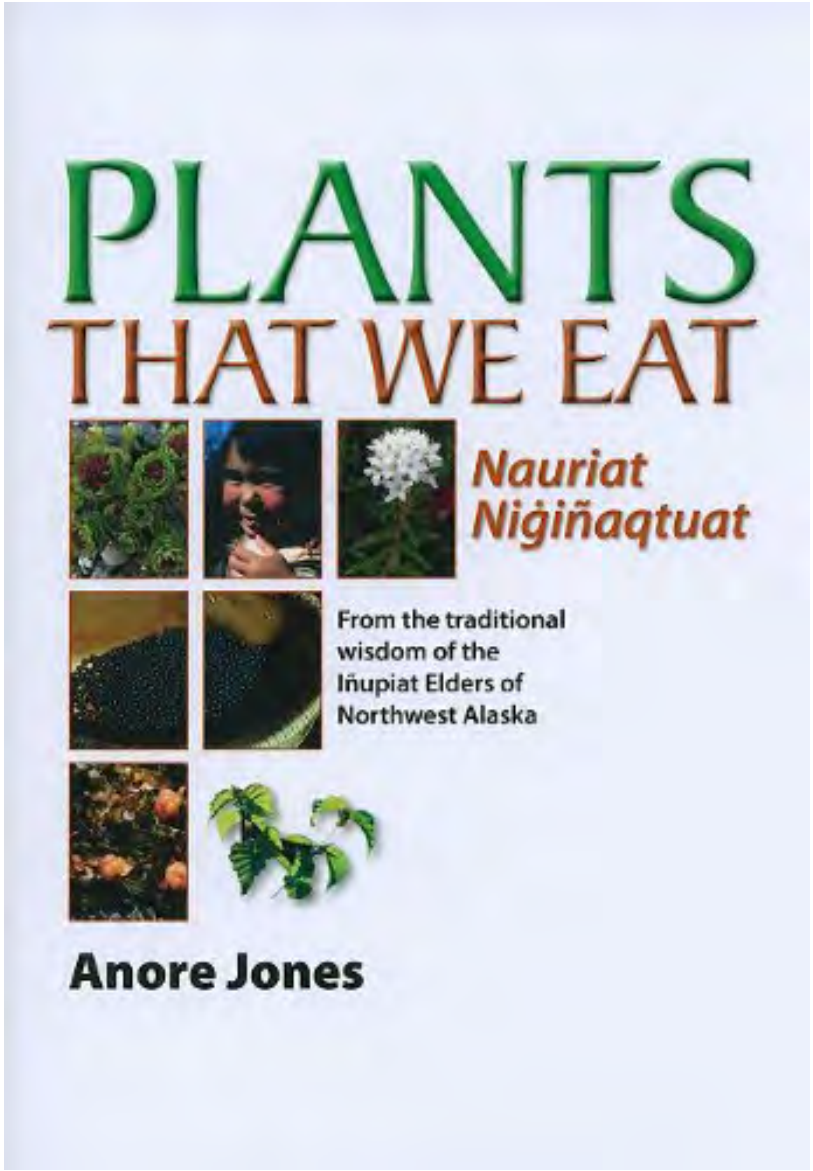
Biogeography & Evolution of the Beringian Tundra Flora

Eric DeChaine
Western Washington University



Vegetation's Vital Role in the Arctic Ecosystem



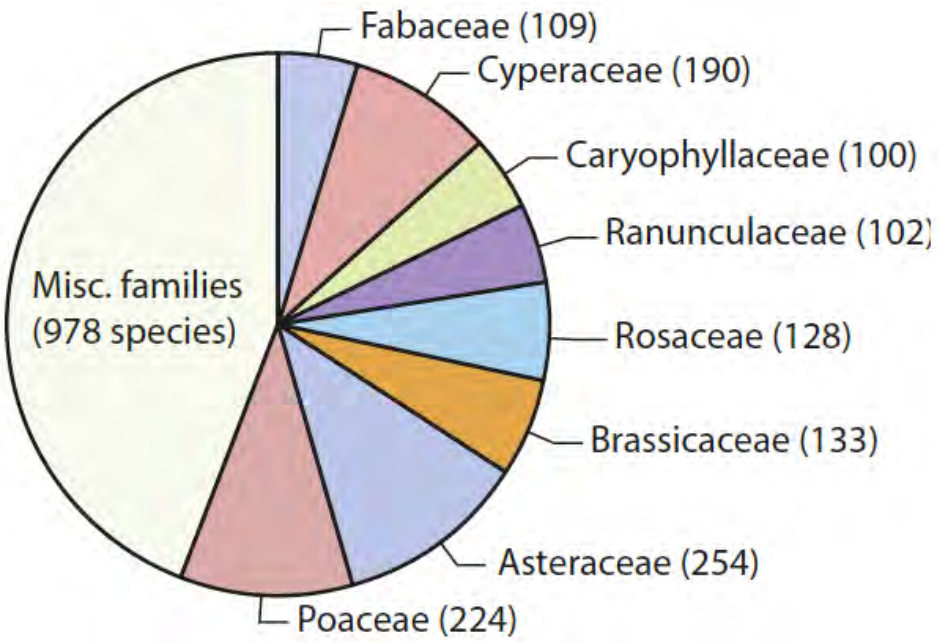
Indigenous Use

Production
& Herbivory

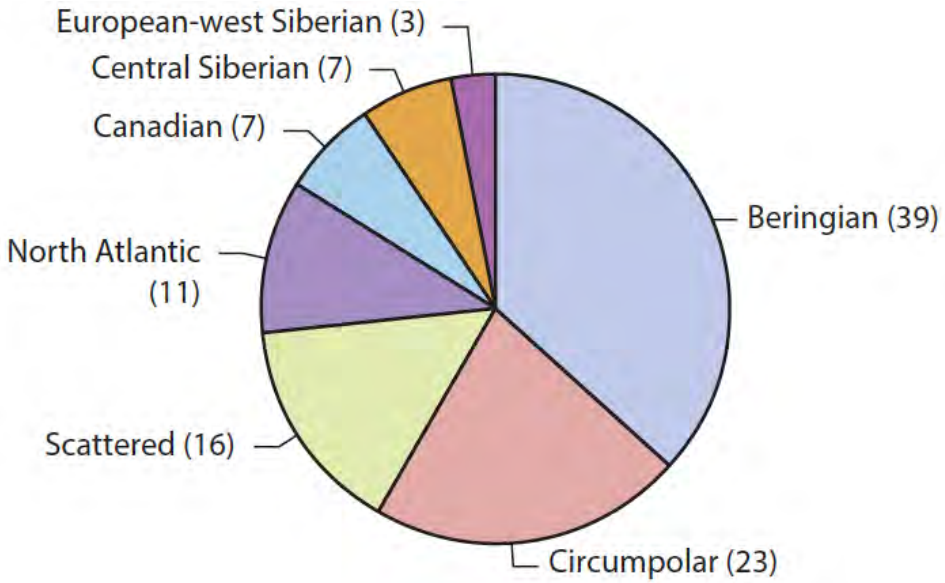
Fungi &
C cycling

The Arctic Flora

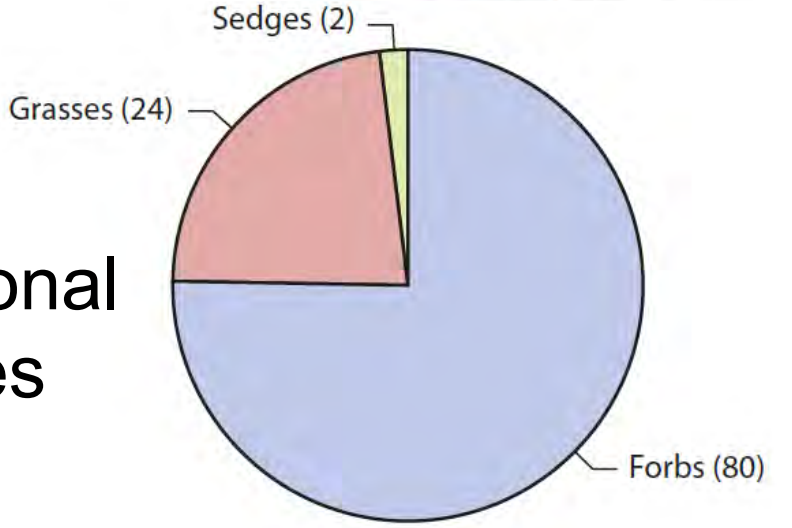
Diversity



Distribution



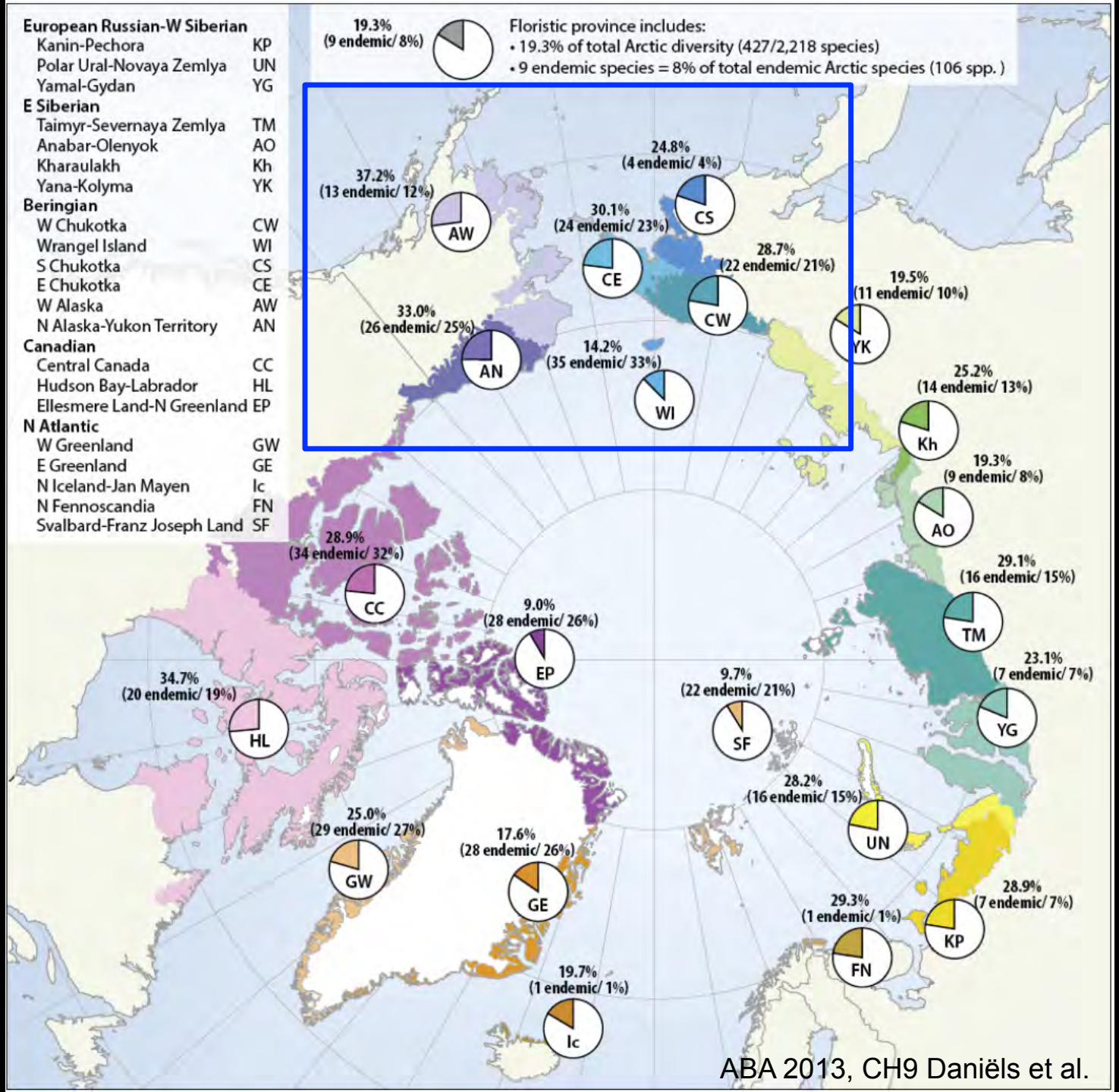
Functional Types



ABA 2013, CH9 Daniëls et al.

The Beringian Flora

Heterogeneous Beringian Habitats



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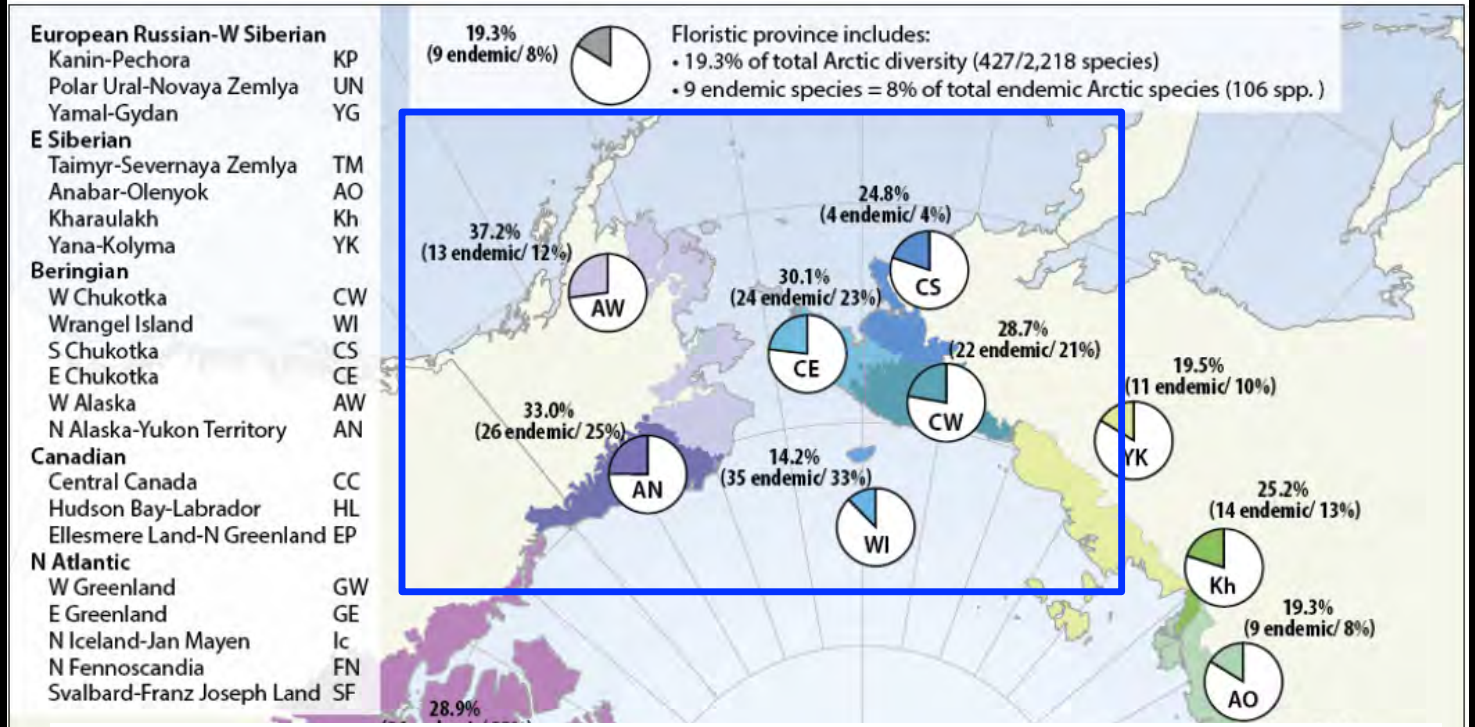


~ 1550 species (2218 in Arctic)

Richest Provinces:
Western Alaska & Chukotka

Highest Endemism & Fewest Introduced:
Wrangell Island

ABA 2013, CH9 Daniëls et al.

Tertiary & Quaternary Origins of the Flora

- Late Pliocene, Circumarctic Tundra by 3 Ma
  - Matthews & Ovenden 1990

- Relatively recent origins of the Arctic Flora
  - Murray 1995

Flora Derived from:

- Tertiary arctic forest

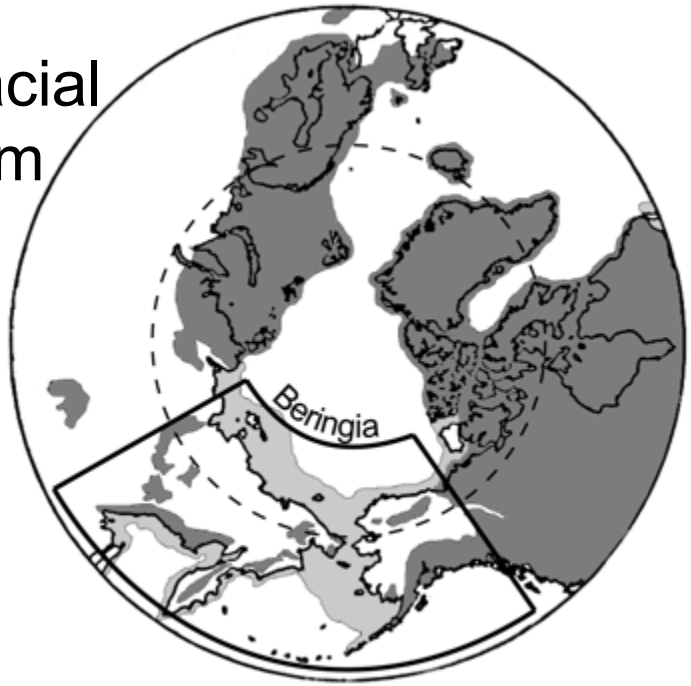
- Colonization from south

Boykinia richardsonii

Saxifraga spinulosa

A History of Environmental Change

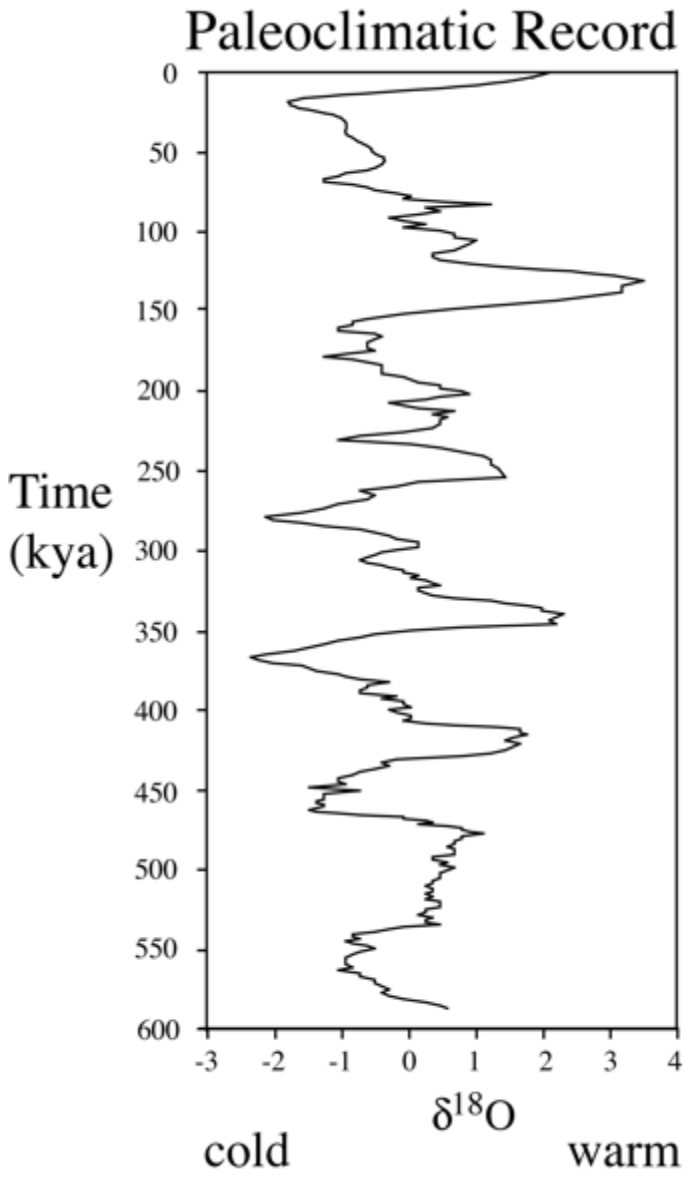
Last Glacial Maximum



Present

Glacier Land extension

DeChaine 2008



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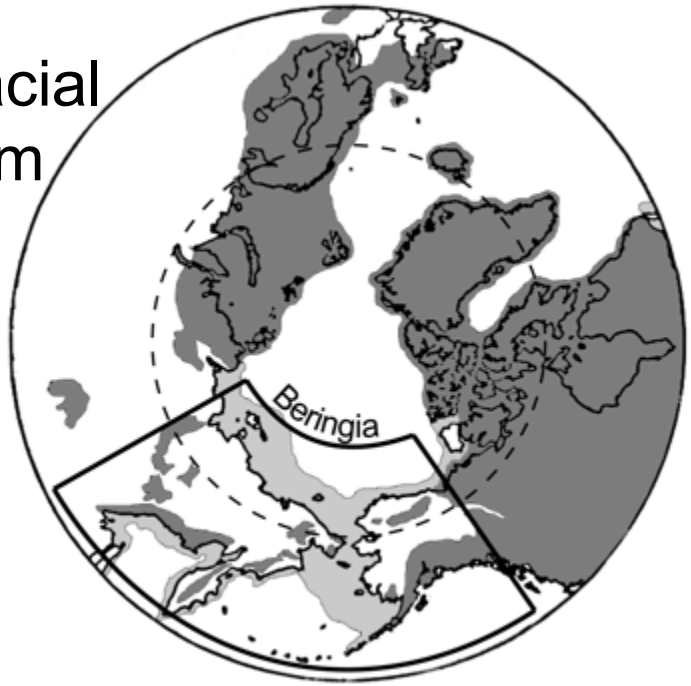


Present

Glacier Land extension

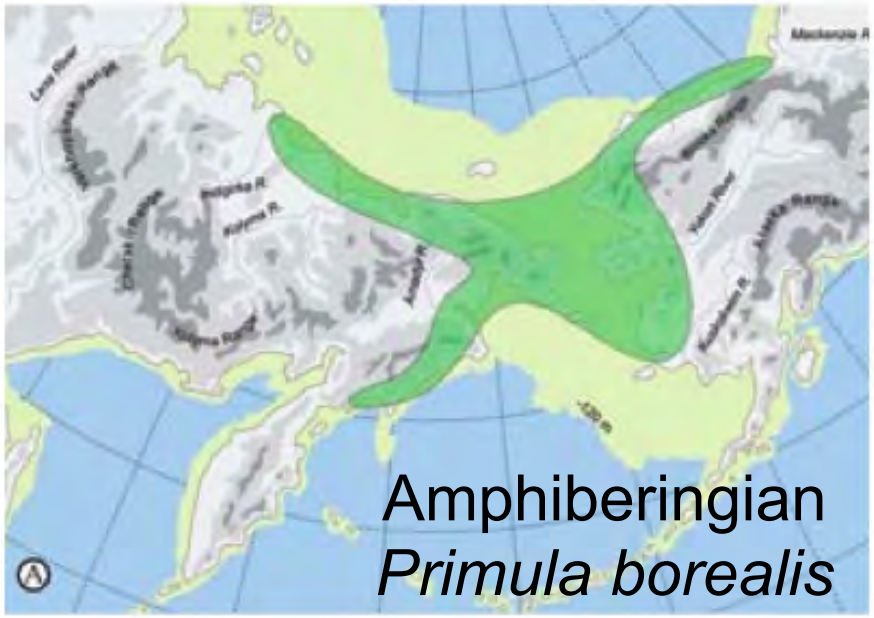
DeChaine 2008

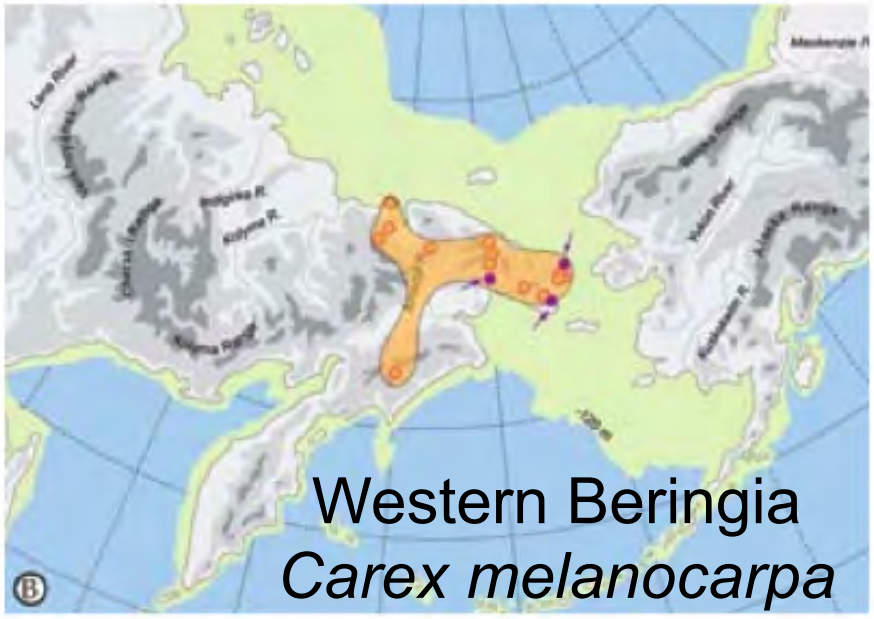
Beringia – Glacial Refugium
Hultén 1937

Asymmetric Dispersal
Hopkins 1967

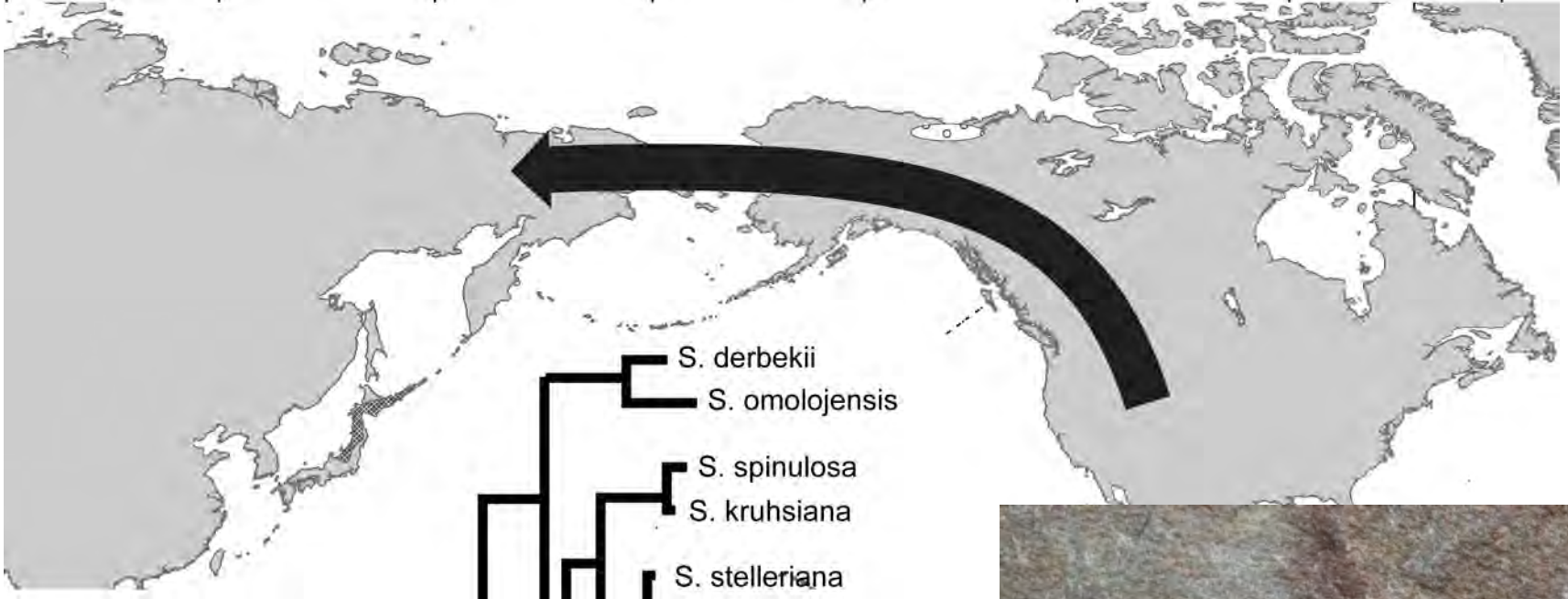
Eastern Flora ‘appendage’ of Asia
Yurtsev 1972

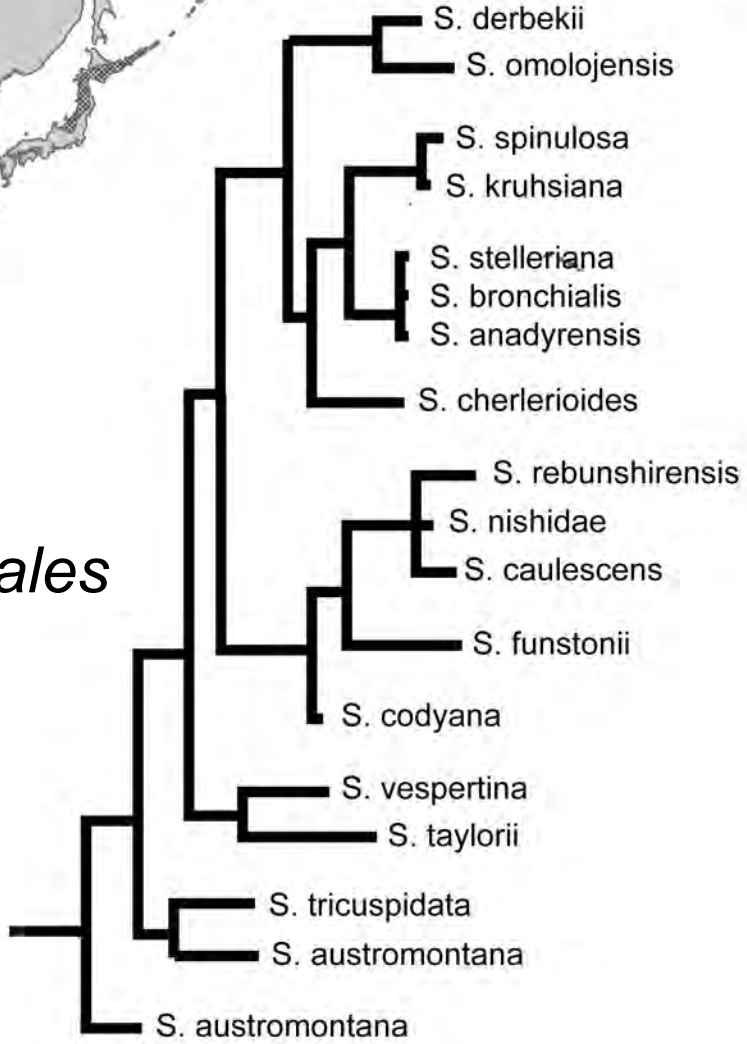
Distribution Patterns of the Beringian Flora





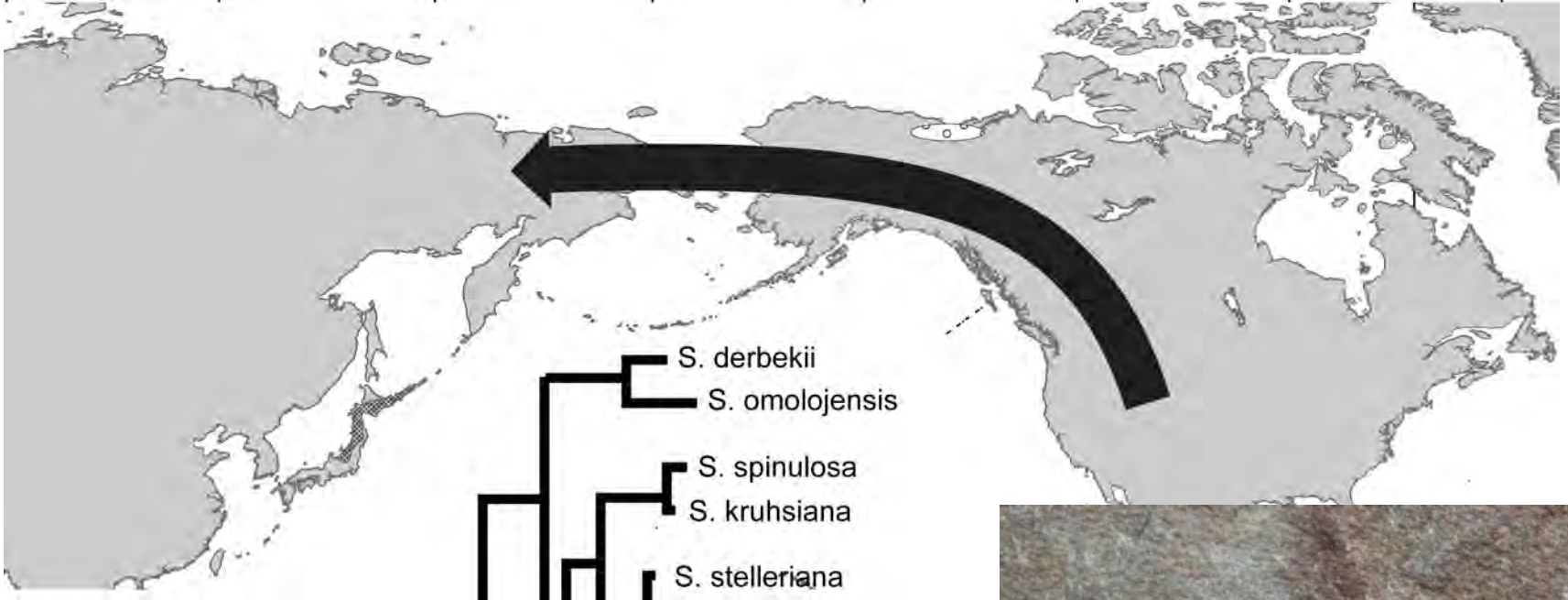
Ickert-Bond et al. 2009

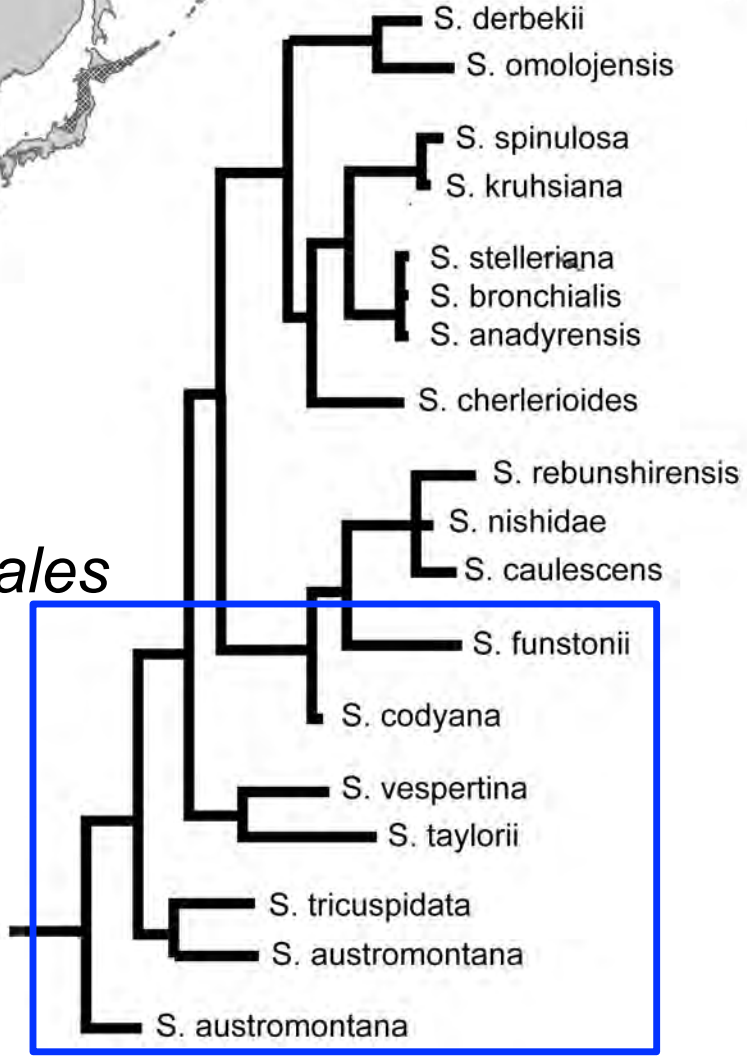




Saxifraga
sect. *Bronchiales*

DeChaine et al. 2013





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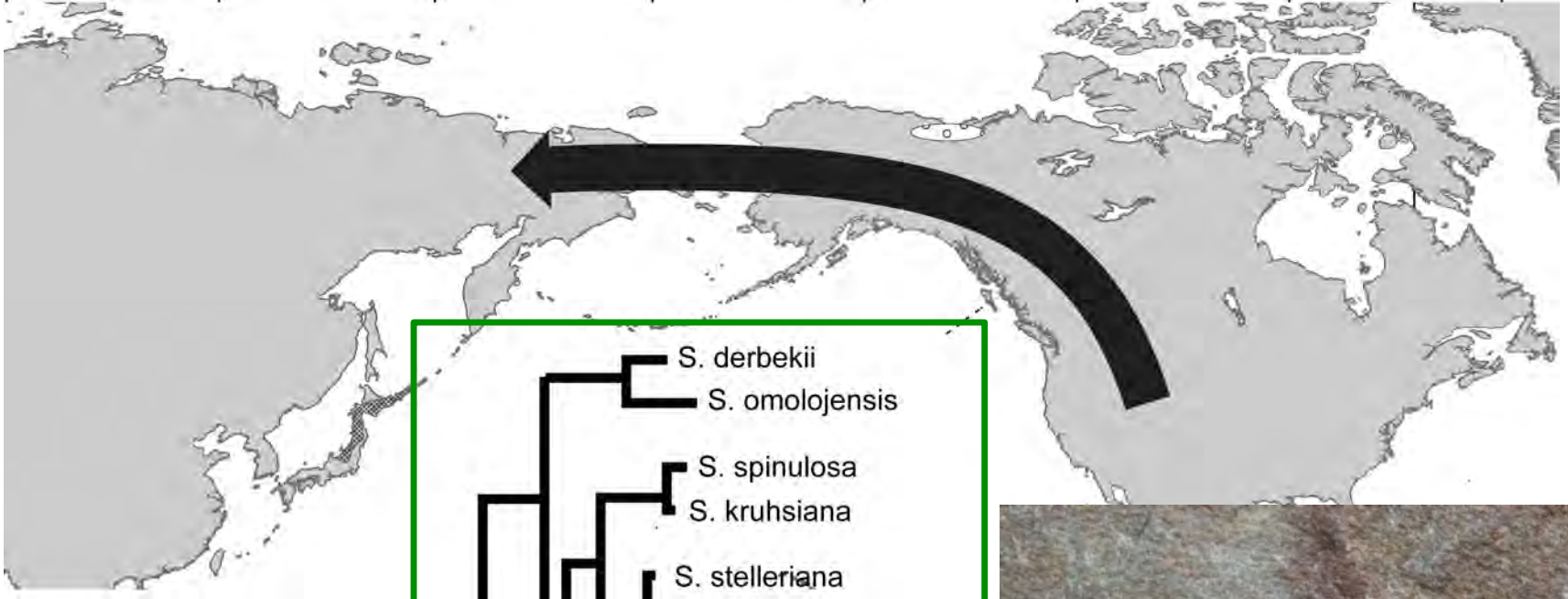

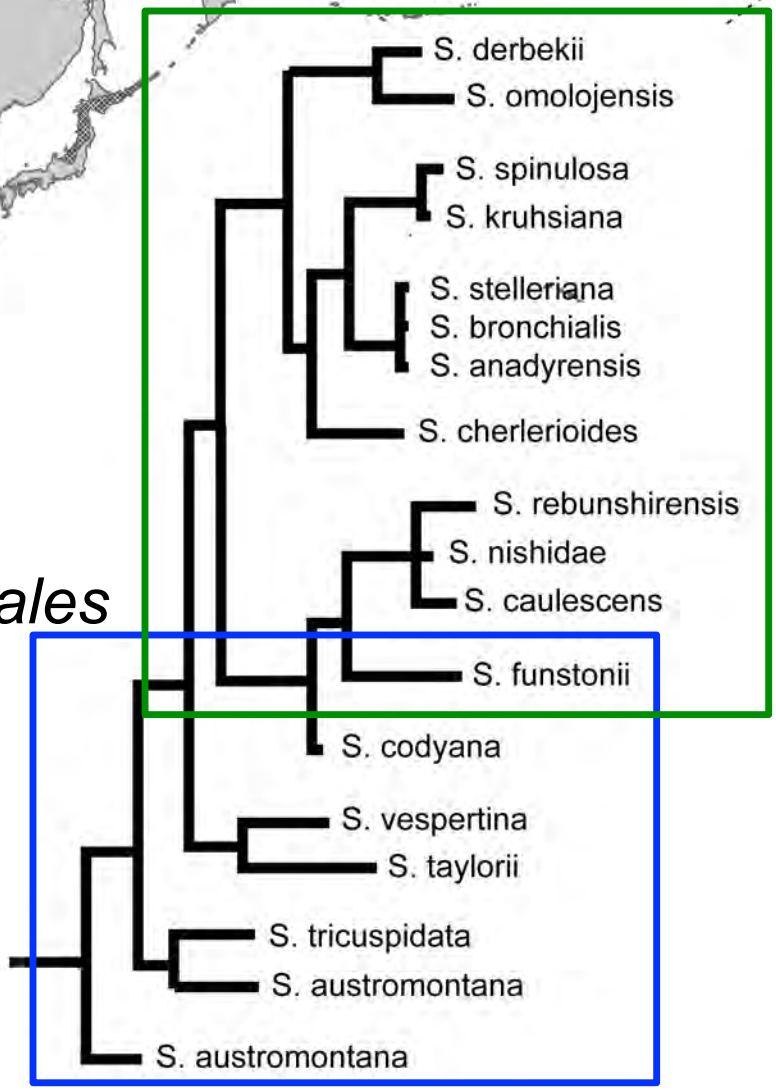

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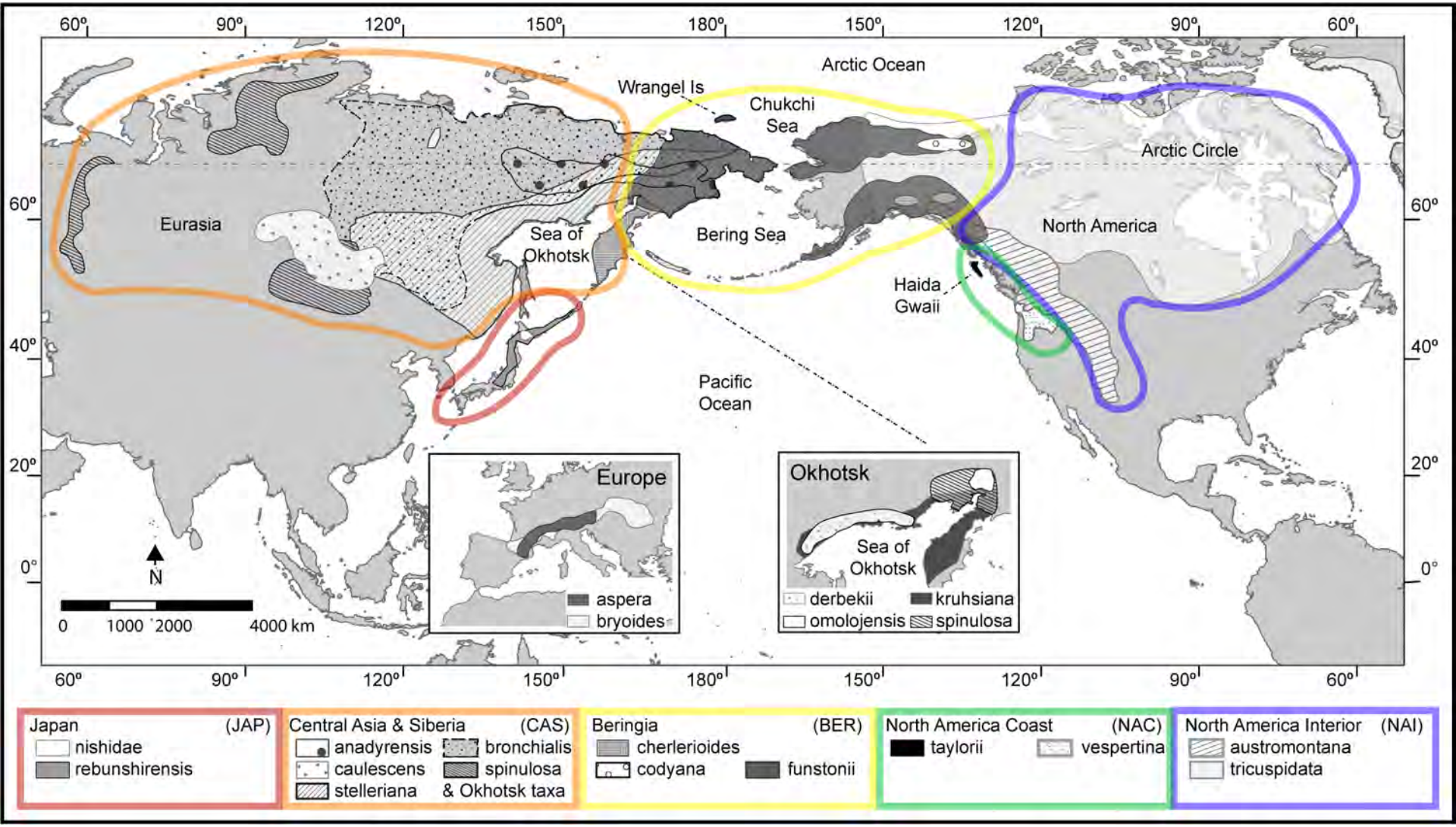

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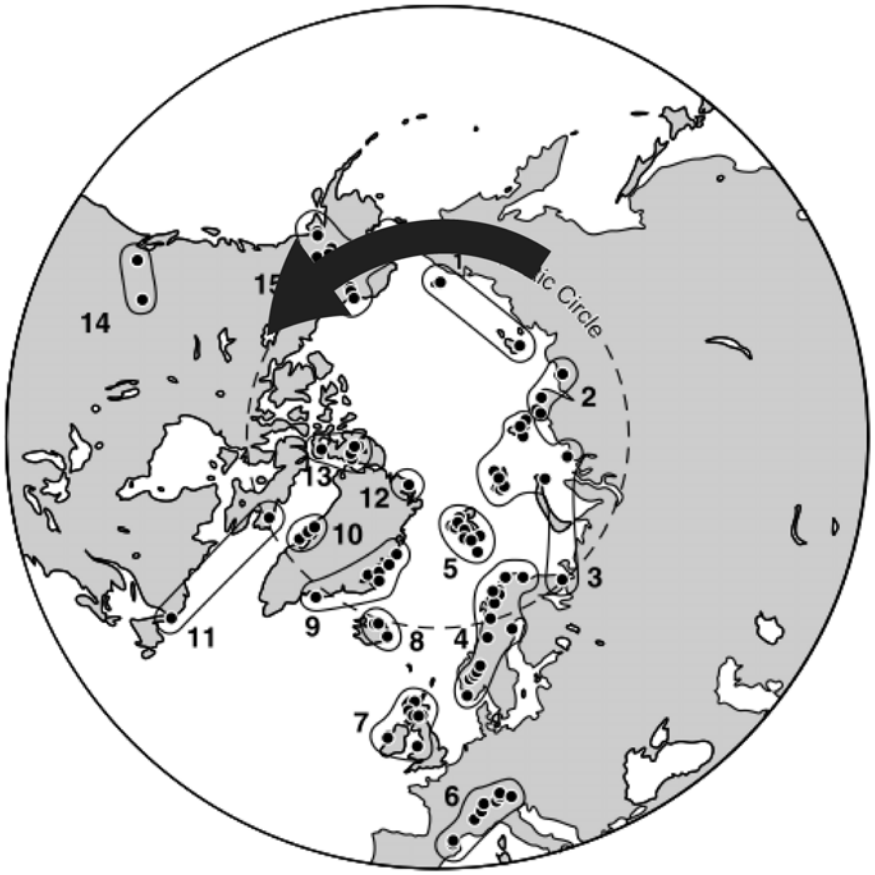
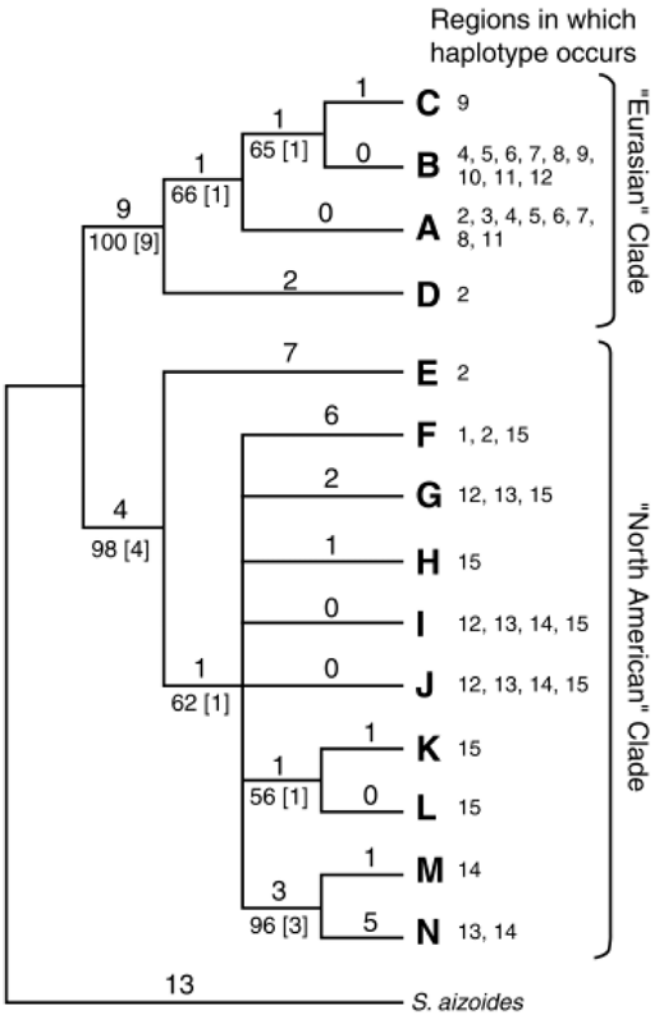
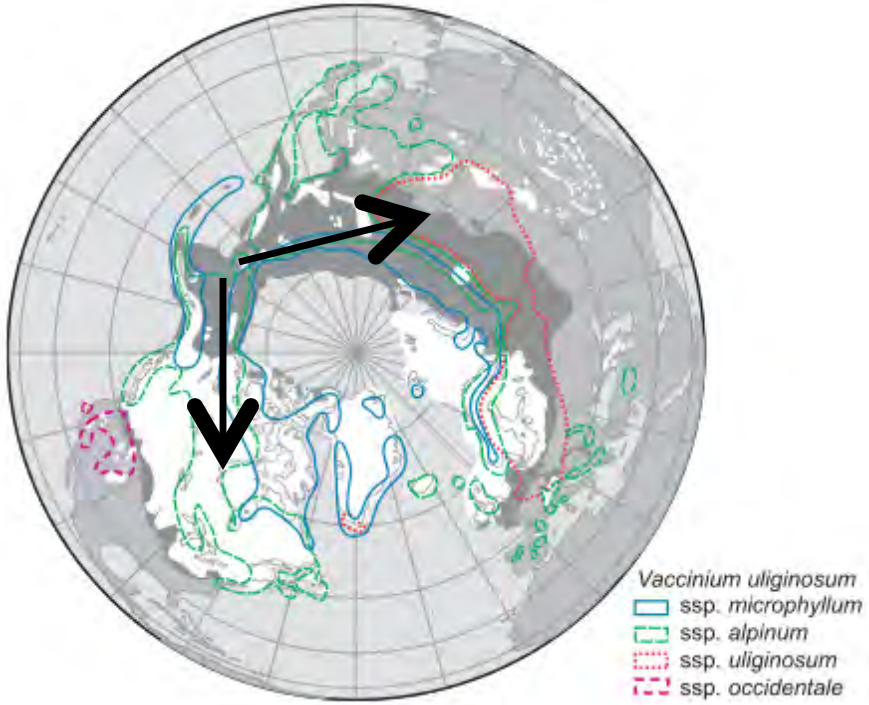


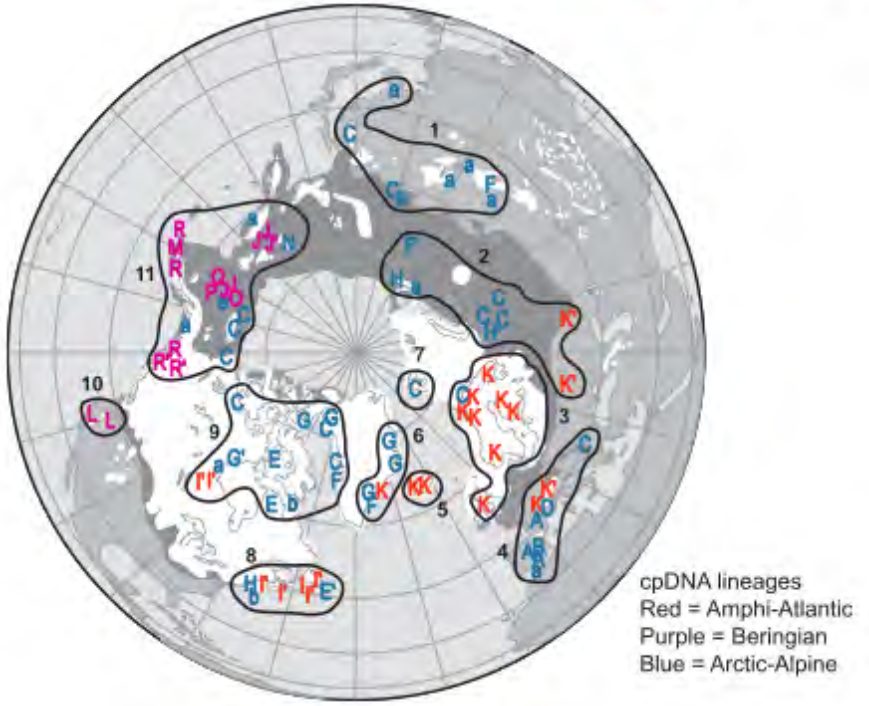


Saxifraga oppositifolia

Abbott et al. 2000

Vaccinium uliginosum





Alsos et al. 2005

Tertiary & Quaternary Origins of the Flora

Current flora derived from:

- Tertiary arctic forest elements
- Colonization and diversification from south
- Complex reticulation, cycles of fragmentation, expansion & reunion
- Majority are hybrids, allopolyploids

Analyses of history show that:

1. Beringia is an evolutionary and biogeographic hotspot, in addition to harboring high species richness.

2. Taxa responded individualistically to climatic variability.

3. Communities were re-shuffled with some having no modern analogues (ex. steppe-tundra).

4. Communities and species exhibit patchy distributions.

Implications:

1. Need regional conservation for preserving the evolutionary process

2. No more bridge nor glacial barriers

3. As climate warms, major concern will be competition arising from

    - Changes in community structure within Beringia
    - New colonists from the south
    - New colonists via long distance dispersal

Research areas needing emphasis:

Resilience & Adaptation

1. Coordinate East and West Beringia taxonomy.

2. Document and monitor taxa at the population level.

3. Within Beringia, where are hotspots of genetic diversity?

4. Assess how phenotypically plastic species are.

5. Improve understanding of genetic variation within species to better estimate each capacity to adapt.

Research areas needing emphasis:

Biotic Interactions

1. How will community structure change within Beringia (ex. shifts in relative abundance of taxa)?

2. Which are the likely taxa to invade from the south?

3. What are the potential outcomes of new species interactions?

4. What are the potential trophic-level outcomes of phenological changes (ex. Post et al. 2008).


NSF