

Berry Exciting: Changing Fruit Quantity & Quality in a Warming Arctic

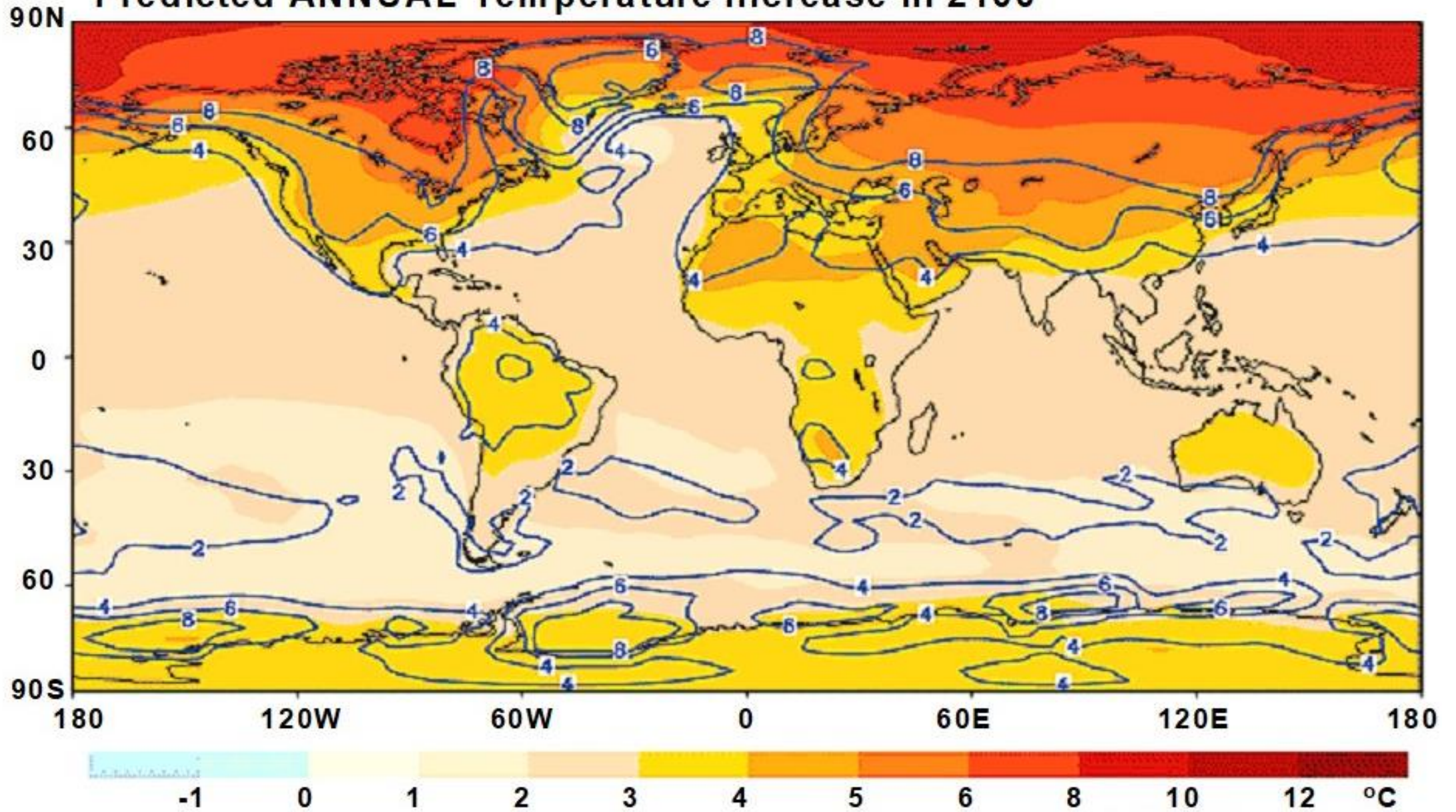
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Predicted ANNUAL Temperature Increase in 2100 ¹



Warming Impacts Vegetation...

- Cover
- Community composition ²
- Phenology
- Growth ^{3, 4}
- Nutrient availability
- Resource allocation ^{5, 6, 7}



Warming Impacts Arctic Berries...

- Number ^{8, 9}
- Size ⁸
- Quality ^{10, 11, 12}
 - Phenolic content
 - Water content
 - Sugar content
 - Organic:Inorganic components



The Known

- Berries compared on temporal and spatial gradients
- Models generated using berry and climatic data used *only* to predict berry **quantity** on the **same gradient** ⁸
- Best predictors? ^{8, 13}



The Unknown

- Can we use climatic data to predict berry **quality**?
- Can berry quantity/quality **on a temporal gradient** be predicted by quantity/quality **on a spatial gradient** (and vice versa)?



11, 14, 15



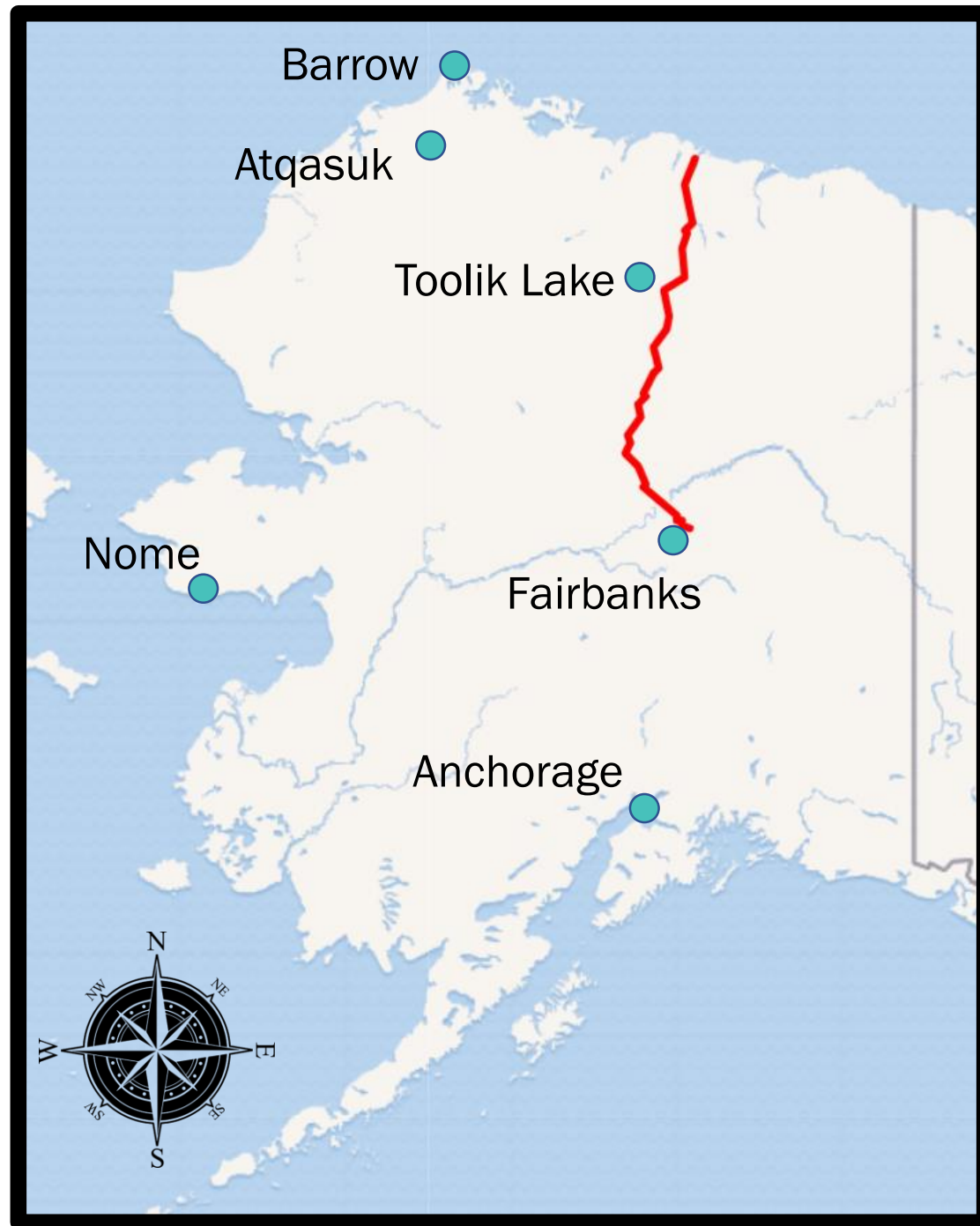
16, 17, 18

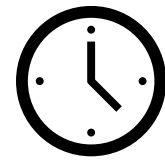
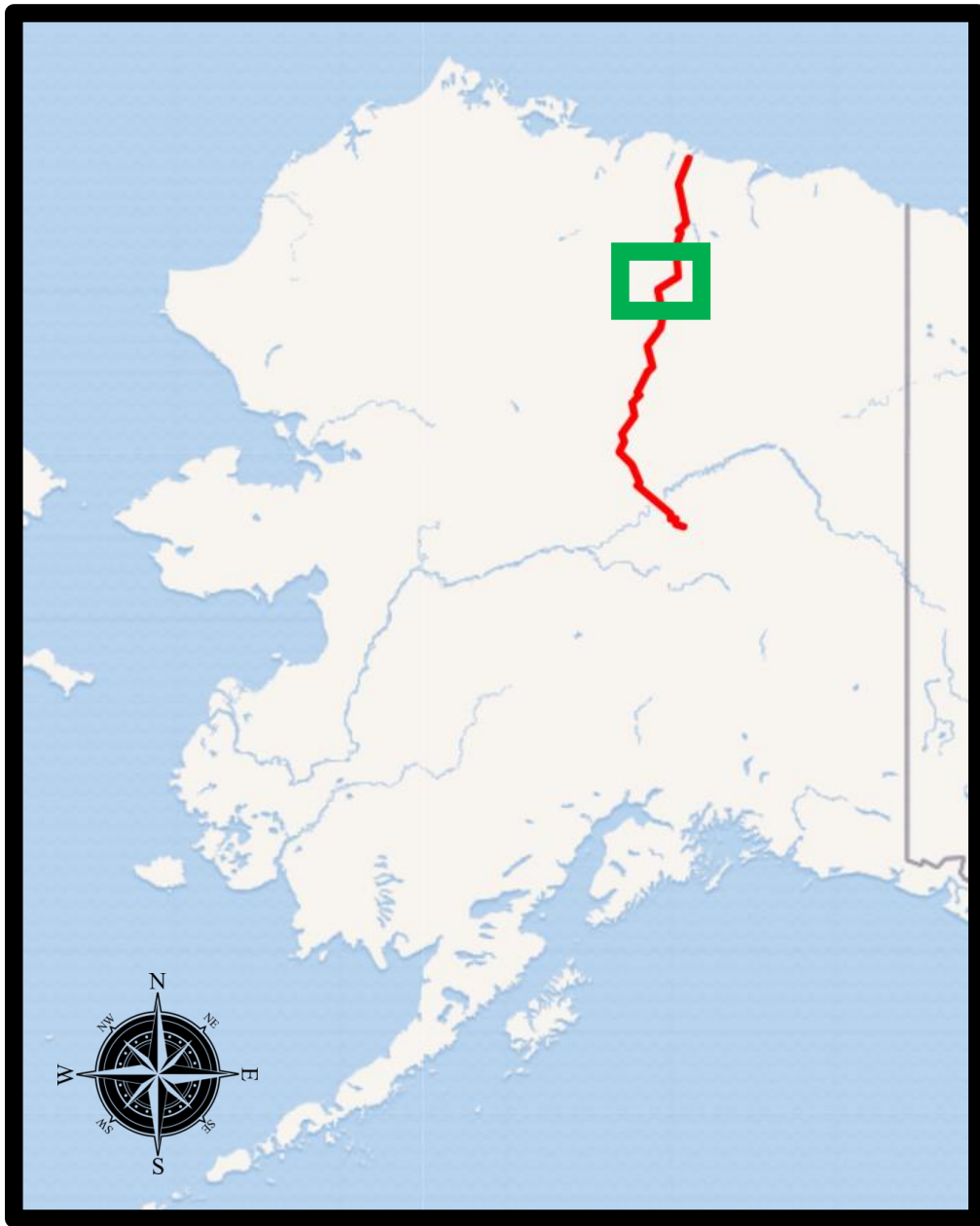
Objectives

- I. Determine variability in berry crop size
- II. Determine variability in berry crop quality
- III. Predict changes in berry crop size
- IV. Predict changes in berry crop quality

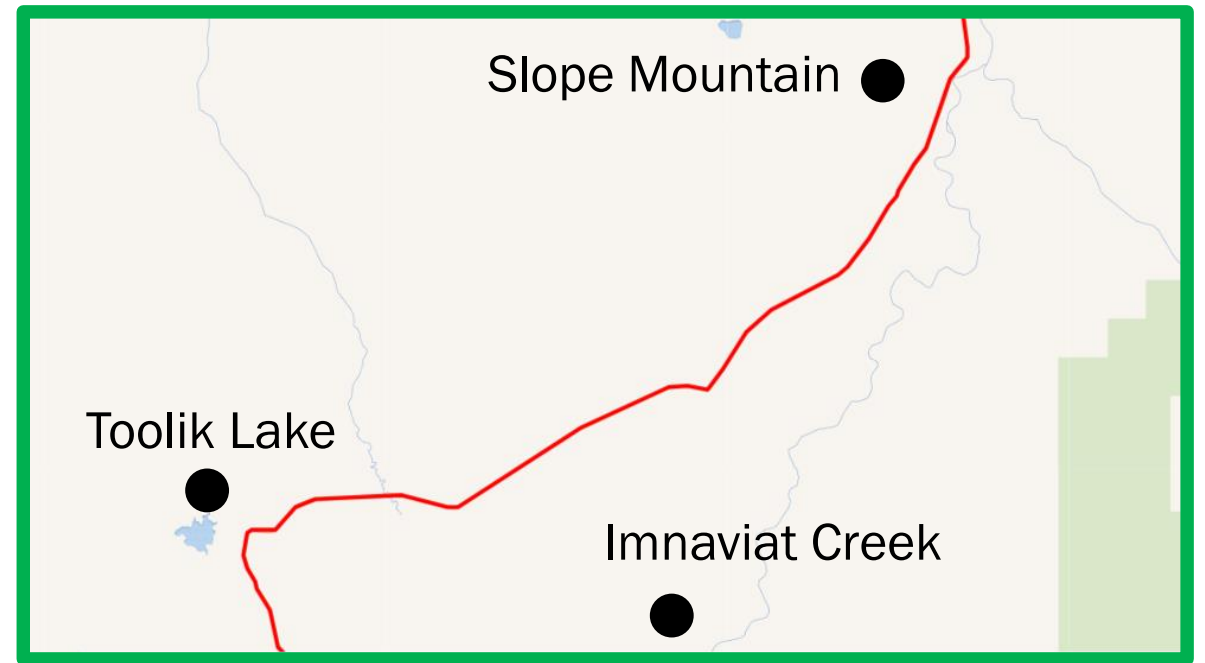


Site Maps



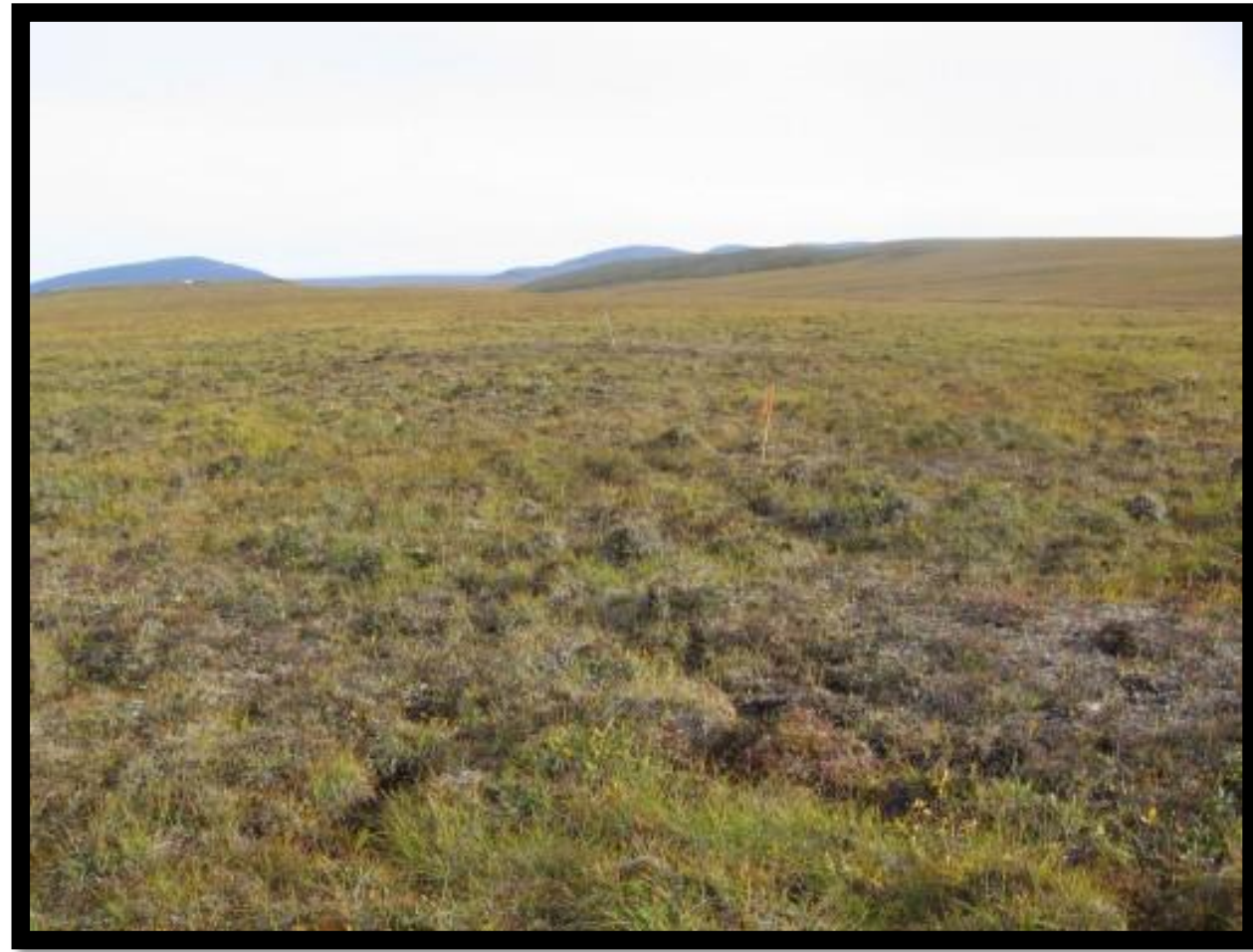


Temporally Isolated Sampling



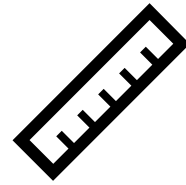
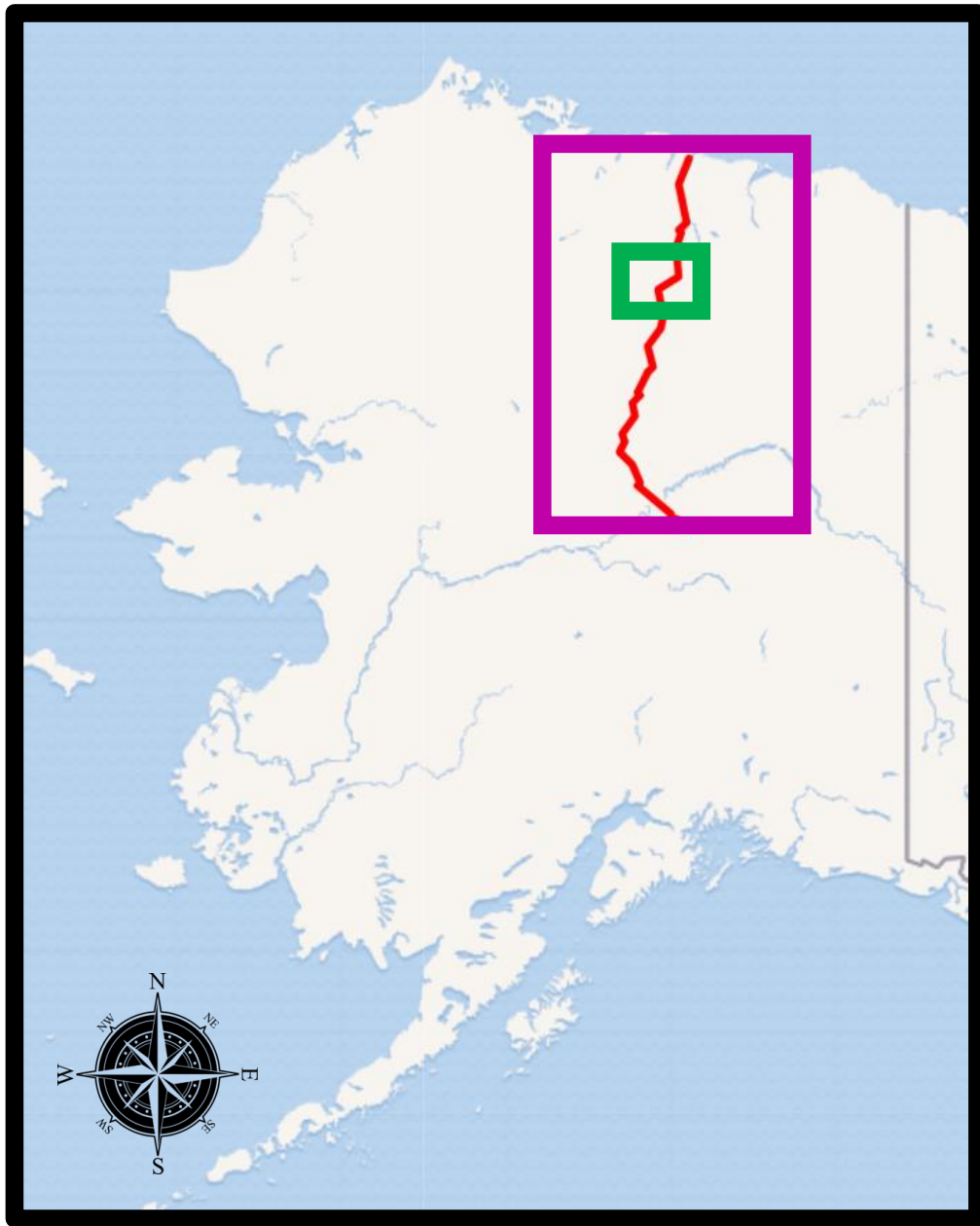
- 3 pre-established study areas
- Data since **2016**

Dry Heath Tundra

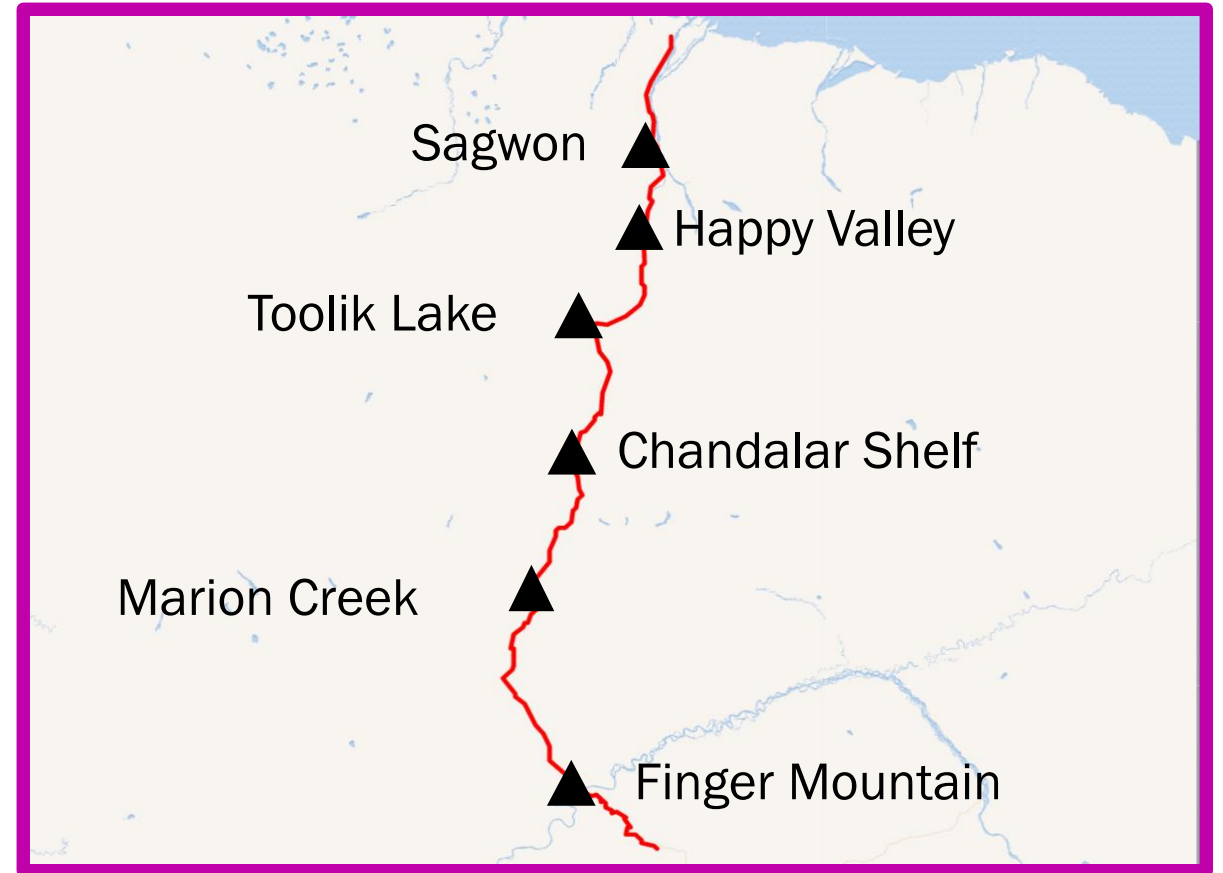


Moist Acidic Tundra





Spatially Isolated Sampling



- 6 newly established study areas
- Data since **2021**



Alpine blueberry

Vaccinium uliginosum



Alpine blueberry

Vaccinium uliginosum

Black crowberry

Empetrum nigrum





Alpine blueberry



Vaccinium uliginosum



Black crowberry

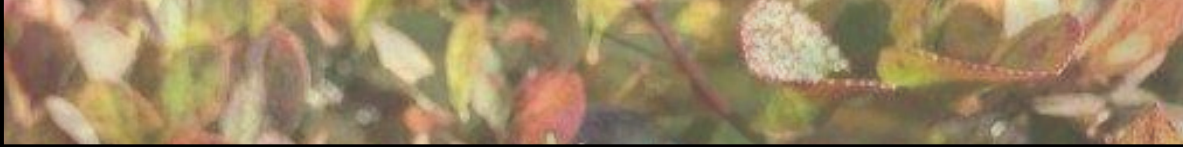
Empetrum nigrum

Alpine bearberry

Arctous alpina



Alpine blueberry



Vaccinium uliginosum



Black crowberry

Empetrum nigrum



Alpine bearberry

Arctous alpina

Lingonberry

Vaccinium vitis-idaea

Berry Quantity methods

- 12 *random* replicates per site
- **Count and harvest** berries within frame boundary
- **Separate** by species
- **Store** for further analysis
- Methods performed twice seasonally

$\frac{1}{4}$ m



$\frac{1}{4}$ m

Berry Quality Methods

- Temporal samples since 2016
- Spatial samples since 2021
- **Quality** = water, carbon, and sugar content
- Sample size?



Quality Methods: Water Content

- Moisture confers fruit shelf stability, size, and nutrient density
- Oven drying
 1. Sample preparation
 2. Wet weight
 3. Drying
 4. Dry weight



Quality Methods: Organic/Inorganic Content

- Inorganic/organic content confers shelf stability, nutrient density, appearance/taste
- Dry ashing
 1. Pre-dry
 2. Dry weight
 3. Homogenize
 4. Dry ash
 5. Ashed weight



Quality Methods: Sugar Content

- Sugar content confers fruit shelf stability, appearance/taste, and ripeness
- High Performance Liquid Chromatography (HPLC)
 1. Rehydration
 2. HPLC Testing
 3. Refractive index testing



I. Determine variability in berry crop size



Temporally isolated plots

- Compare variation in berry number between **years**



Spatially isolated plots

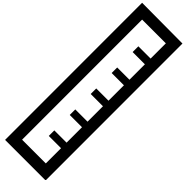
- Compare variation in berry number between **sites**

II. Determine variability in berry crop quality



Temporally isolated plots

- Compare quality metrics across **years**



Spatially isolated plots

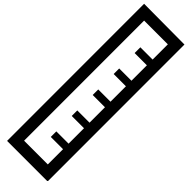
- Compare quality metrics across **sites**

III. Predict changes in berry crop size



Temporally isolated plots

- Compare berry count and local climatic data to create a linear model predicting berry quantity per **year**



Spatially isolated plots

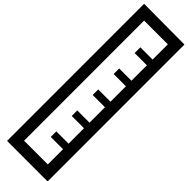
- Compare berry count and local climatic data to create a linear model predicting berry quantity per **site**

IV. Predict changes in berry crop quality



Temporally isolated plots

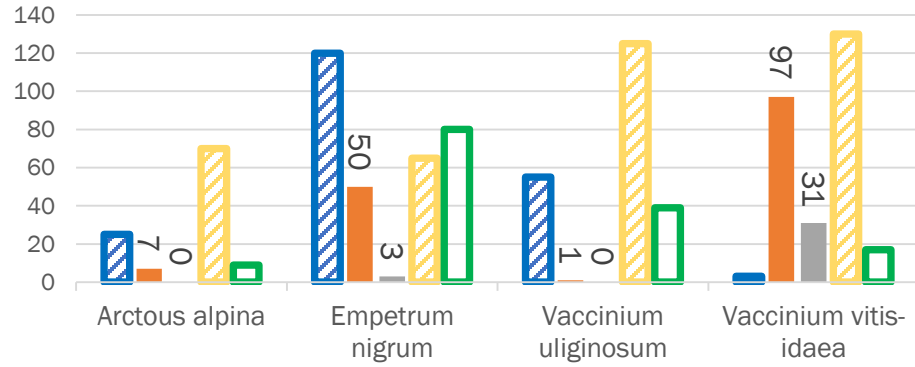
- Compare berry quality and local climatic data to create a linear model predicting berry quality per **year**



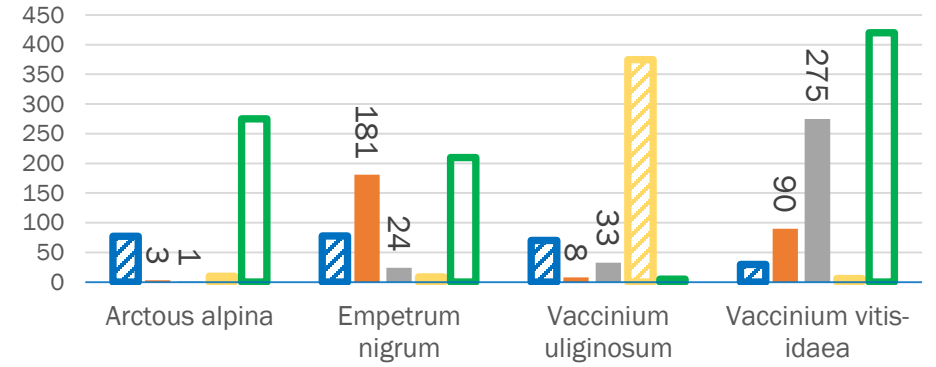
Spatially isolated plots

- Compare berry quality and local climatic data to create a linear model predicting berry quality per **site**

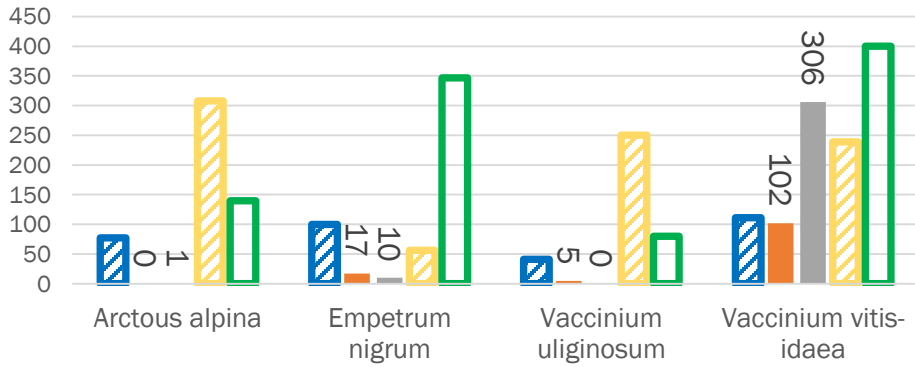
Slope Moist Acidic Tussock



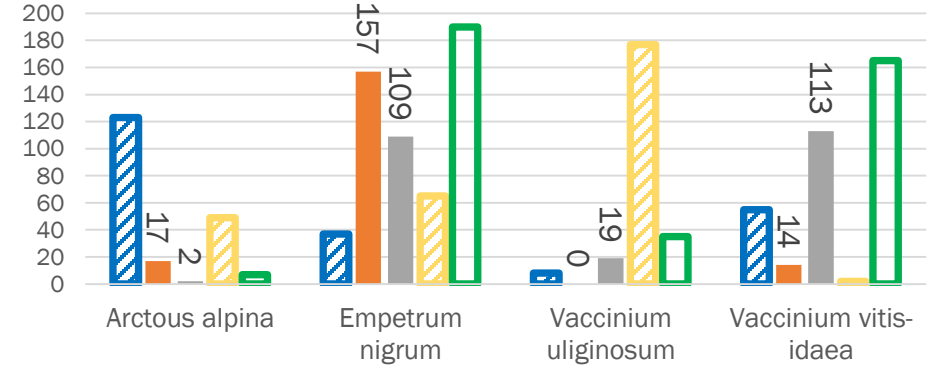
Slope Dry Heath



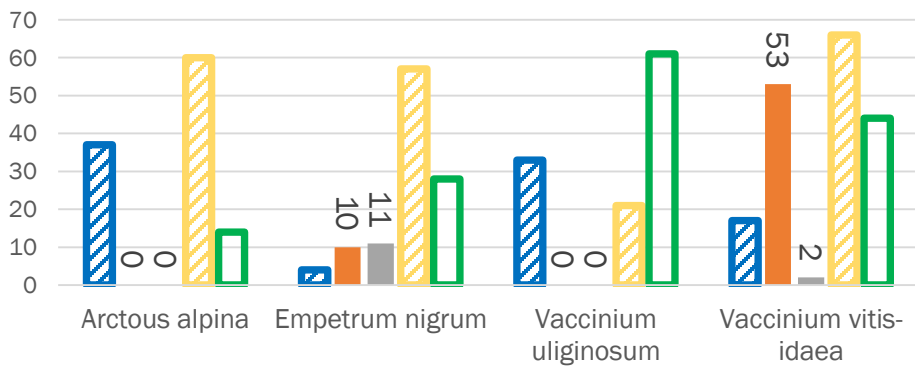
Toolik Moist Acidic Tussock



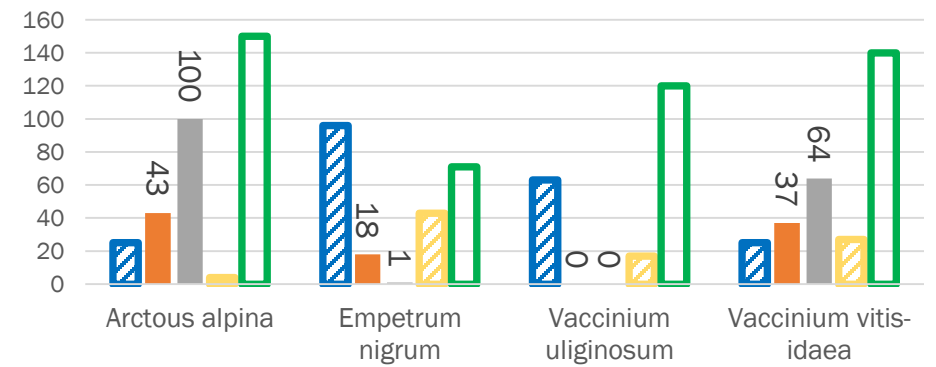
Toolik Dry Heath



Innaviat Moist Acidic Tussock



Innaviat Dry Heath



Questions?

Acknowledgements



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