Poster #183049

Vascular Vegetation & Soil Microbiota on Juneau Icefield Nunataks

Deirdre Collins, Samuel Hepner, Eric Kittilsby, Polly Bass, Catharine White

Juneau Icefield Research Program 2016

Introduction

Abstract:
Alpine environments are particularly vulnerable to climate change, and alpine plant populations of the Juneau Icefield are currently experiencing increased environmental stress. In this study, vascular plants on selected nunataks of the Juneau Icefield of the Coast Range Mountains are investigated. Sixty meter transects, spanning an elevation range, are collected along prominently vegetated portions of each study site. The population of vascular plants found is considered in relation to the nunatak soil microbiota, elevation, latitude, nunatak emergence and geology. Results provide data on nunatak soil microbiota and provide baseline information that may be used for future studies.

Students analyzing a transect on the C26-Nunatak. Photo by Samuel Hepner

Common Vegetation on the Juneau Icefield:

Carex nardina Fr., Spike sedge
Carex nigricans C.A. Mey., Black alpine sedge
Cassiope mertensiana (Bong.) G. Don, White heather
Chamerion latifolium (L.) Holub, Dwarf fireweed
Cryptogramma crispa (L.)R.B., Crisp rockbrake, Parsley fern
Harrimanella stelleriana (Pall.) Coville, Alaska mountain heather
Juncus drummondii E. Mey., Drummond's rush
Leutkea pectinata (Pursh) Kuntze, Partridge foot
Lupinus nootkatensis Donn ex Sims, Nootka lupine
Luzula wahlenbergii Rupr., Wahlenberg's wood-rush
Phyllodoce glanduliflora (Hook.) Coville, Yellow mountain heather
Poa glauca Vahl, Glaucus bluegrass
Rhodiola rosea L., Roseroot or Stonecrop
Salix arctica Pall, Arctic willow
Saxifraga bronchialis L., bSpotted saxifrage
Sibbaldia procumbens L., Creeping sibbaldia or Prostrate sibbaldia
Vaccinium ovalifolium Sm., Oval-leaf blueberry or Alaska blueberry
Vaccinium uliginosum L., Bog blueberry

Methods

The number and percent cover of various plant species in each meter segment of a 60 m x 0.3 m transect were recorded for each nunatak. Transects were placed along the most heavily vegetated and accessible portions of each nunatak. This site selection process allowed for the vegetation change over a vertical gradient from the top to the bottom of the transect to be analyzed, as well as for the relative species richness and evenness of each nunatak to be evaluated. Focusing on the most heavily vegetated areas allowed for the greatest number of species to be considered in each transect.

The Shannon-Wiener Index, which quantifies the species diversity by taking into account species richness and evenness, was calculated for 10 nunataks of the Juneau Icefield based on data taken from transects. These indices were computed using data for the number of individuals of each plant species counted in the entire transect. Higher Shannon Wiener indices suggest a higher level of species diversity, in terms of species evenness and richness, or both, in that area. Nunataks were also surveyed to ensure species present, but not in the transects, such as *Salix* sp., Willow, and *Tsuga mertensiana,* Mountain hemlock, were recognized in this baseline study.

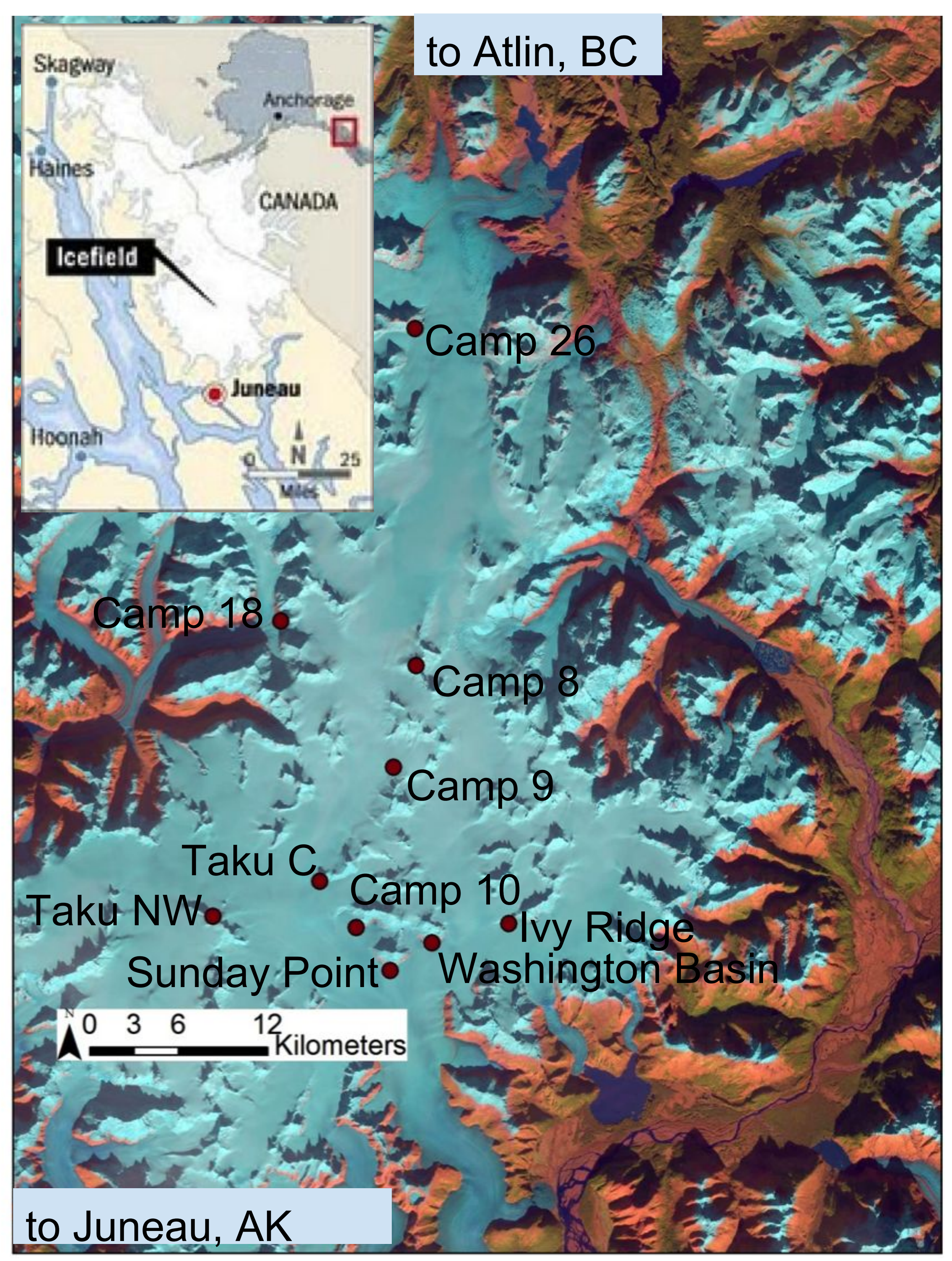

Figure 1. Species diversity was evaluated for nunataks across the Juneau Icefield from Juneau, Alaska to Atlin, British Columbia.
Map was adapted from SOURCE and olilyon.com.

Results

Shannon Wiener Diversity Indexes were computed for 10 nunataks on the Juneau Icefield ranging from more southern latitudes to more northern latitudes between Juneau, AK and Atlin, BC. Vascular plant diversity did not vary significantly according to latitude as the highest Shannon Wiener Indexes were computed for nunataks on the most southern (Washington Basin) and most northern ends of the Icefield (Camp 18 and 26) (Fig. 2). Shannon-Wiener Indexes typically range from 1.5 to 3.5, with values rarely exceeding 4. Species diversity ranged from extremely low, with 0 diversity on Camp 8 and 9 nunataks, to moderately high, with an index of 2.54 for the Camp 26 nunatak (Fig. 2). With a very large range of vascular plant diversities across nunataks on the Icefield, the geology of each nunatak and its distance from continuous, vegetated land were considered in relation to its vascular plant diversity. There was a weak inverse relationship between the distance of the nunatak from continuous, vegetated land and its Shannon-Wiener Index ($R^2 = 0.38559$, Fig. 3). Shorter distances between the nunatak and continuous land are weakly correlated with higher Shannon-Wiener Indexes for vascular plant diversity.

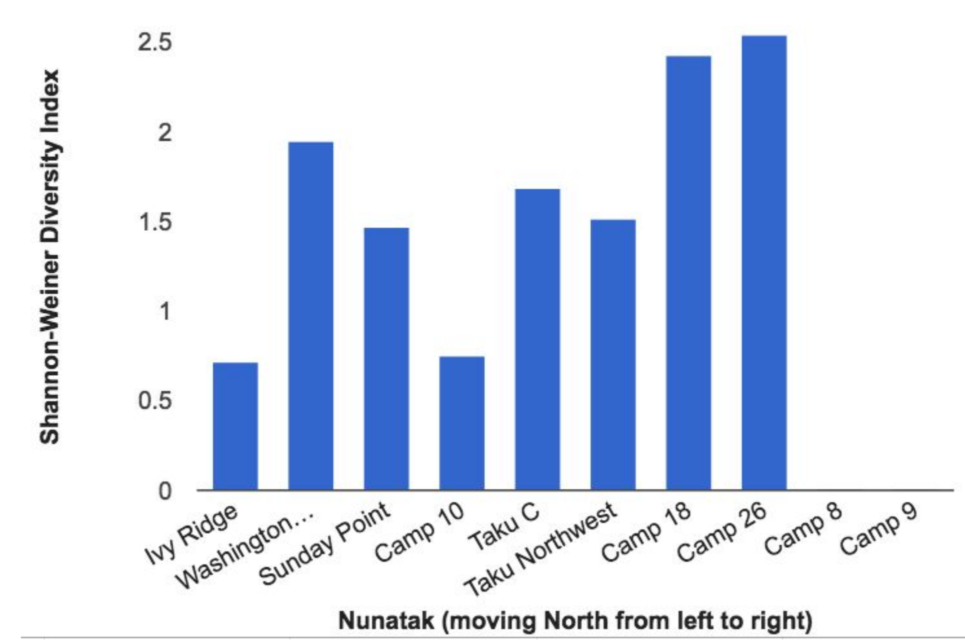

Figure 2. Vascular plant diversity, measured with the Shannon-Wiener Index, varies across nunataks on the Juneau Icefield, ranging from 0 to 2.54. Species diversity did not vary significantly according to latitude. One of the highest species diversities is found on the southern part of the Icefield on Washington Basin. Camp 18 and Camp 26, which have the highest diversity indices of the 10 nunataks, are more northern.

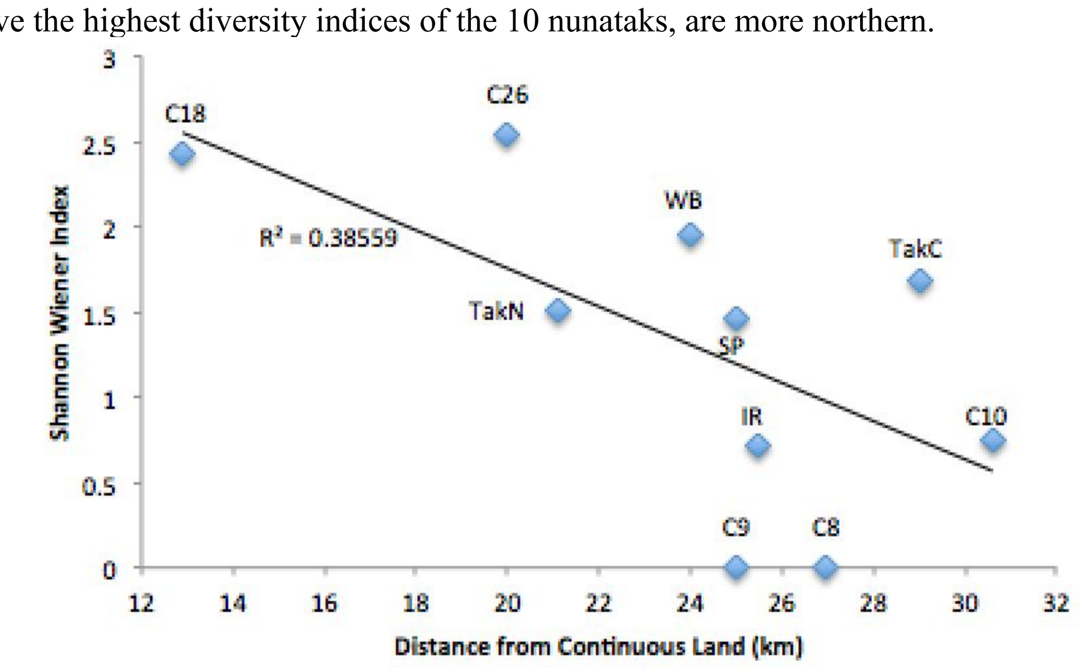

Figure 3. Vascular plant diversity of nunataks on the Juneau Icefield is weakly correlated with the distance between the nunataks and continuous land ($R^2 = 0.38559$). Nunataks that are further from continuous, vegetated land, like Camp 9 and Camp 8, which are 25 km and 26.97 km from land, respectively, tend to have lower Shannon-Wiener Indices. However, the correlation between vascular plant diversity and distance from continuous land is a relatively weak inverse relationship.

Conclusions

- Wide range of computed Shannon-Wiener Indexes for nunataks on the Juneau Icefield and weak inverse correlation between the Shannon-Wiener Indexes and distance between the nunatak and continuous land suggest that many factors contribute to vascular plant diversity on each nunatak (Fig. 3), Including:
  - Time at which the land was exposed from the ice/successional stage of the nunatak.
  - Nunatak geology, size, soil microbiota communities, and proximity to both continuous land and other nunataks.
  - Aspect of the vegetated slopes of each nunatak impacted diversity, as most vegetation was found on the southwestern-facing slopes.
- Weak correlation between plant diversity and proximity to continuous land was unexpected (**F**ig. 3).
  - Many vascular plants disperse their seeds via wind and animals. Nunataks nearer vegetated land were expected to have higher plant diversity due to the relatively easy dispersal of seeds from new species.
- **Future work:**
  - Compute diversity indexes for nunataks based on data from larger portions of each nunatak. Use plots, not transects.
  - Finish analyses of soil microbiota to determine correlations between soil bacteria taxa, and their diversity, and plant diversity.
  - Obtain approximate dates for nunatak emergence to test for relationships between time since exposure and vascular plant diversity.

Bibliography

Bass, P. 2007. *Nunataks and Island Biogeography in the Alaska-Canada Boundary Range: An Investigation of the Flora and Its Implications for Climate Change* Ph.D. Dissertation.
Hultén, E. 1968. *Flora of Alaska and Neighboring Territories: A Manual of the Vascular Plants,*Stanford University Press, Stanford, CA. 1008p.
ITIS, Retrieved November, 1, 2016, from the Integrated Taxonomic Information System on-line database, http://www.itis.gov (last accessed: 12/07/2016)
Hultén, E. 1968. *Flora of Alaska and Neighboring Territories: A Manual of the Vascular Plants,*Stanford University Press, Stanford, CA. 1008p.
Pojar, J., & MacKinnon, A. 1994. *Plants of coastal British Columbia: including Washington, Oregon & Alaska* . Lone Pine Press, Alberta, Canada.
Pojar, J., A. MacKinnon, et al.2013. *Alpine Plants of the Northwest, Wyoming to Alaska*, Lone Pine Press, Alberta, Canada, 537 p.