May 15th, 10:00 AM - 2:00 PM

One Hundred Years of Vegetation Succession in the Easton Glacial Foreland, Mount Baker, Washington, USA

Katherine Rosa

Western Washington University

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One Hundred Years of Vegetation Succession in the Easton Glacial Foreland

Mount Baker, Washington, USA

Katherine A. Rosa¹ and Andrew J. Bach, Ph.D.²
1 Graduate Student at Western Washington University: Lead Author: rosa1@students.wwu.edu
2 Associate Professor & Graduate Advisor, Environmental Studies Department, Western Washington University: andybach@wwu.edu

ABSTRACT

This research will examine the relationship between species composition, terrain age class, elevation, aspect, and soil moisture in the Easton foreland of Mount Baker, Washington. A glacier foreland is the distinct area of newly exposed land in front of a glacier terminus that was previously ice covered. Globally, glaciers have experienced general retreat over the last 30 years due to climate change. As glaciers retreat the glacier foreland area increases, exposing new terrain available for vegetation development. It is important to document and understand vegetation succession in glacier forelands because the implications of climate change on alpine vegetation remain uncertain. The Easton glacier has experienced fluctuations over the last one hundred years: it advanced from 1912 to 1956, advanced until 1990, and has retreated since 1990. This non-linear timeline creates a dynamic environment for vegetation succession. Patterns of vegetation succession vary among study forelands around the world; however, there have been few studies documenting the vegetation in the glacier forelands in the Cascade Mountain Range of North America, especially on Mount Baker. This research will be conducted in the late summer of 2015 and will include measurements at sixty-five study sites throughout the Easton foreland (See Figure 1). The field work will consist of identifying existing vegetation species and quantifying each species by measuring percent canopy cover, percent frequency, and density of individuals within each species. Additionally, the independent variables (terrain age class, elevation, aspect, and soil moisture) will be measured at each study site throughout the Easton foreland. Terrain age classes will be established by historic records that indicate the year and elevation of the Easton glacier terminus. Elevation will be measured using a GPS unit in meters above sea level. Although the Easton foreland is a south-facing slope, micro-site aspects are likely to vary and will be measured using a compass in degrees, minutes, and seconds. Soil moisture will be measured as percent using a soil sensor probe to a fixed five-inch depth. Once the data is gathered, statistical correlation tests will determine the strength of the relationship between the importance value of each species and each independent variable. I hypothesize that soil moisture and elevation will have strong positive relationships with the importance value of each species found in the Easton foreland. The results of this research will inform future studies of vegetation development in glacier forelands with similar characteristics as the Easton Foreland.

STUDY AREA

This research will take place in the Easton glacier foreland of Mount Baker, Washington (48°48′38″ N, 121°48′48″ W). Located approximately 50 kilometers due East of Bellingham, Washington, Mount Baker is influenced by a strong west-coast maritime climate. It is an active stratovolcano and the highest peak in the North Cascade mountain range (3285 meters). Mount Baker maintains a 38.6 km² footprint of continuous soil with a 1990-2010 glacier area of 36.0 km². Ten major glaciers (Pelto & Brown, 2012). The Easton glacier is located on the southeast aspect of Mount Baker and has experienced changes in mass balance over the last century. The Easton glacier generally retreated from 1912 to 1956, then re-advanced until 1990, and has retreated since 1990. This non-linear timeline creates a dynamic environment for vegetation succession. Patterns of vegetation succession vary among study forelands around the world; however, there have been few studies documenting the vegetation in the glacier forelands in the Cascade Mountain Range of North America, especially on Mount Baker. This research will be conducted in the late summer of 2015 and will include measurements at sixty-five study sites throughout the Easton foreland (See Figure 1). The field work will consist of identifying existing vegetation species and quantifying each species by measuring percent canopy cover, percent frequency, and density of individuals within each species. Additionally, the independent variables (terrain age class, elevation, aspect, and soil moisture) will be measured at each study site throughout the Easton foreland. Terrain age classes will be established by historic records that indicate the year and elevation of the Easton glacier terminus. Elevation will be measured using a GPS unit in meters above sea level. Although the Easton foreland is a south-facing slope, micro-site aspects are likely to vary and will be measured using a compass in degrees, minutes, and seconds. Soil moisture will be measured as percent using a soil sensor probe to a fixed five-inch depth. Once the data is gathered, statistical correlation tests will determine the strength of the relationship between the importance value of each species and each independent variable. I hypothesize that soil moisture and elevation will have strong positive relationships with the importance value of each species found in the Easton foreland. The results of this research will inform future studies of vegetation development in glacier forelands with similar characteristics as the Easton Foreland.

RESEARCH QUESTIONS

- What species exist in the Easton foreland?
- What is the frequency of each species?
- What is the density of each species?
- What is the canopy cover of each species?
- What is the importance value for each species?
- What is the terrain age throughout the Easton foreland?
- What is the elevation throughout the Easton foreland?
- What is the aspect throughout the Easton foreland?
- What is the soil moisture throughout the Easton foreland?
- How does each environmental variable correlate with each Importance Value for each species?

STATISTICAL ANALYSIS

IV = RC + RD + Rf,

where

IV = Importance Value
RC = Relative Cover
RD = Relative Density
Rf = Relative Frequency

Importance Value (IV) for a species is defined by the sum of Relative Cover, Relative Density, and Relative Frequency. Importance Value is an index used to describe the overall influence of a species within a community.

Correlation Tests

To understand the strength of the relationship between species IV and each environmental variable, Spearman’s Ranks and Pearson’s Ranks Correlation tests will be run. I expect my output to be similar to the graph below (Figure 2). This graph indicates a negative correlation between elevation and vegetation cover, meaning as elevation increases, the vegetation cover decreases. The output of my research will be similar graphs showing the relationship between each species IV and each independent variable (terrain age class, elevation, aspect, and soil moisture).

METHODS

At each study site, I will assemble a square 0.25m x 0.25m quadrant to designate the site within which I will take measurements of species composition, elevation, aspect, and soil moisture. Within each quadrant I will:

- Identify plant species rooted in quadrat using standard dichotomous keys
- Quantify each plant species by measuring percent canopy cover, percent frequency, and individual density (See Table 1)
- Measure elevation using a GPSMAP 60Cx unit
- Document micro-site aspect using a magnetic compass
- Measure soil moisture percentage using a VG-METER 200 soil sensor meter

<table>
<thead>
<tr>
<th>Variable</th>
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<th>Data Source</th>
</tr>
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<tbody>
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<td>0 Year Age ≤ 20 Year Age ≤ 100 Year Age &gt; 100 Year Age</td>
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<td>Count # of rooted individuals</td>
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To examine the strength of the relationship between species composition and environmental variables:

- Terrain age
- Elevation
- Aspect
- Soil moisture

At the end of each study site, I will take measurements of species composition, elevation, aspect, and soil moisture. Within each quadrant I will:

- Identify plant species rooted in quadrat using standard dichotomous keys
- Quantify each plant species by measuring percent canopy cover, percent frequency, and individual density (See Table 1)
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