

ESCI 340 BIostatistical Analysis

Project 6: Moss Cover on Maples, Multiple Hypotheses

Roughly 900 mosses are found in northwestern North America. In coastal old growth forests of the Pacific Northwest, mosses and lichens may contribute nearly half of the primary productivity (Vitt, Marsh, and Bovey 1988). Mosses play important roles in forest water and nutrient cycles. In some PNW forests, mosses in the canopy contribute to the formation of canopy soils, creating unique resources and habitats. Mosses provide important habitat structures for many forest wildlife. Moss establishment and growth can enhance processes of forest restoration, soil retention, and maintaining hydrological regimes. Clearly, understanding determinants of moss cover and growth is important to basic ecology and applications to forest management, riparian restoration, and wildlife conservation.

In this project, you will compare several hypotheses explaining moss cover on Bigleaf maple trees (*Acer macrophyllum*) in Sehome Arboretum. Moss cover varies between trees and among different locations on a given tree. Several factors likely cause differences in moss cover, and importance of those factors likely range from low to high. Your analysis for this project will assess the relative importance of each factor by evaluating empirical support (patterns in the data) for each hypothesis.

Research Question

What is the relative importance of various factors affecting moss cover on Bigleaf maple trees?

Hypotheses

- 1 Moss cover is random and does not depend on any variables below.
- 2 Tree age. Moss cover increases over time. Tree diameter provides a surrogate for tree age, so moss cover increases with tree dbh.
- 3 Sun exposure and drying. “Moss grows on the north side of trees.” Moss growth requires moisture, so moss grows more densely on surfaces that retain moisture longer. Moss cover is lowest on south-facing aspects and increases toward north-facing aspects.
- 4 Proximity to ground. Moss growth requires moisture, which increases toward the ground and moisture contained in soil and leaf litter.
- 5 Moss cover increases with both tree dbh and northerly aspect.
- 6 Moss cover increases with both dbh and proximity to ground.
- 7 Moss cover increases with both northerly aspect and proximity to ground.
- 8 Moss cover increases with all three variables: tree dbh, northerly aspect, and proximity to ground.

Models for Each Hypothesis

- 1 Moss cover (M) is a random deviation from the mean.
 Model: $M_j = \mu + \varepsilon_j$ $K = 2$
- 2 Moss cover increases with tree dbh (Age: A).
 Model: $M_{ij} = \alpha + \beta A_i + \varepsilon_{ij}$ $K = 3$
- 3 Moss cover increases with aspect, angular direction from south (D).
 Model: $M_{ij} = \alpha + \beta D_i + \varepsilon_{ij}$ $K = 3$
- 4 Moss cover decreases with height above ground (H).
 Model: $M_{ij} = \alpha + \beta H_i + \varepsilon_{ij}$ $K = 3$
- 5 Moss cover increases with tree dbh (Age: A) and angular direction from south (D).
 Model: $M_{ijk} = \alpha + \beta A_i + \gamma D_j + \varepsilon_k$ $K = 4$
- 6 Moss cover increases with tree dbh (Age: A) and decreases with height above ground (H).
 Model: $M_{ijk} = \alpha + \beta A_i + \gamma H_j + \varepsilon_k$ $K = 4$
- 7 Moss cover increases with direction from south (D) and decreases with height above ground (H).
 Model: $M_{ijk} = \alpha + \beta D_i + \gamma H_j + \varepsilon_k$ $K = 4$
- 8 Moss cover increases with tree dbh (A), direction from south (D), and height above ground (H).
 Model: $M_{ijkl} = \alpha + \beta A_i + \gamma D_j + H_k + \varepsilon_l$ $K = 5$

Field Methods

Find two or three partners and walk to Sehome Hill Arboretum.

- 1 Select a bigleaf maple tree at random from all bigleaf maples in your vicinity. Try to restrict your sample to trees with nearly vertical trunks, and avoid trees leaning markedly.
- 2 You will select a height on the maple trunk at random, up to two meters above the ground. Select a random number between 0 and 100. Multiply this number by 2. The result is the height above ground level in centimeters (cm) at which you will measure moss coverage.
- 3 At the height you selected in step 2, place your quadrat frame on the north-facing side of the maple trunk. Estimate the moss coverage to the (nearest 10%) within the quadrat frame. At the same height, place your quadrat frame on the east, west, and south-facing sides of the maple trunk. Estimate moss coverage within the quadrats on those sides.
- 4 Record moss cover, height, and direction for all 4 quadrats on the data form on the next page.
- 5 Measure diameter at breast height (dbh) of the tree and record it on the data form for each quadrat.
- 6 Repeat steps 1-5 until you have measured moss coverage on at least ten trees (40 quadrats).

Data Sheet

Tree #	DBH(cm)	Height(cm)	Moss cover, upper side (%)	Moss cover, lower side (%)	Tree lean angle (°)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
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20					