Assemblage of Lichen Communities on Rocky Shorelines of the North Woods

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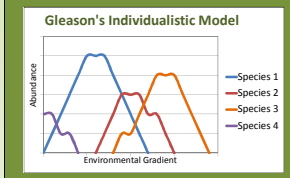
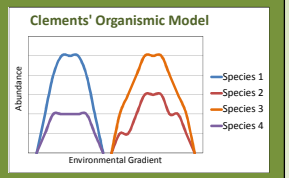
Objective

Two classic theories attempt to explain how natural communities assemble: Gleason's Individualistic model and Clements' Organismic model.





Gleason postulated that:
- Individual physiological needs determine species' distribution along environmental gradients.
- Species are abundant where their needs are met; competition is *not* a factor in their distribution.

Clements postulated that:
- Competition determines species' distribution along environmental gradients.
- Groups of species interfere with each other, creating distinct boundaries along an environmental gradient.

To test these theories, we examined lichen communities along rocky shorelines of the Boundary Waters Canoe Area Wilderness. We recorded the species present and measured environmental factors that might influence their distribution and abundance: distance from shoreline, slope, canopy cover, and aspect.

Methods

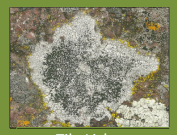
Rocky outcrops along BWCAW lakeshores were sampled. At each site we:
- Surveyed a 5-meter transect from the shoreline by placing a 30 cm^2 quadrat at 1-m increments along the transect.
- Determined at each meter along transect:
  1. Relative abundance of each species present
  2. Canopy cover
  3. Slope
  4. Aspect
- Our quadrat had a 6x6 grid overlay of 5 cm^2 squares. We determined relative abundance of species present by recording the number of occupied squares within the quadrat.

Identifying lichen species along the transect

The sampling quadrat

Measuring canopy cover

Rock Shield



Tile Lichen

Plated Rock Tripe

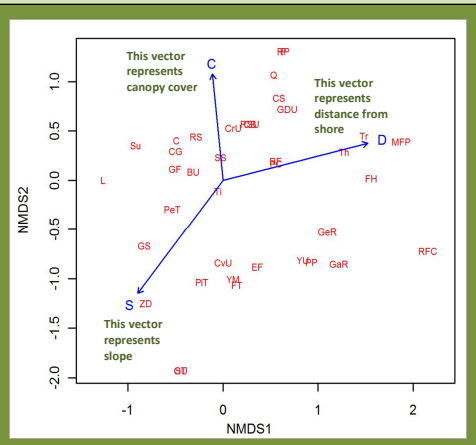


Figure 1: Multi-Dimensional Analysis

A multi-dimensional analysis simultaneously examines the effects of all measured variables on the lichen species in our survey.
- The red letters correspond to individual lichen species.
- The blue arrows are vectors representing the environmental variables that influenced lichen species distribution and abundance. The further away from the origin, the greater the variable's effect.
- The closer two species are to one another on the graph, the more similar they are in terms of their environmental preference.

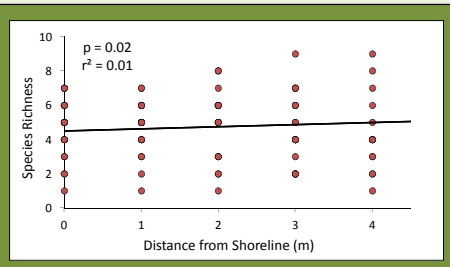


Figure 2.A: Richness vs. Distance from Shoreline

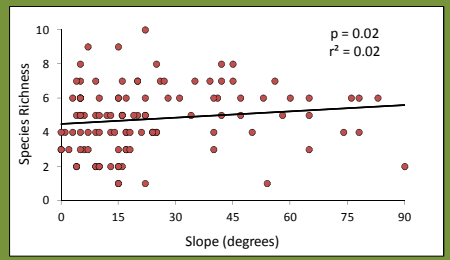
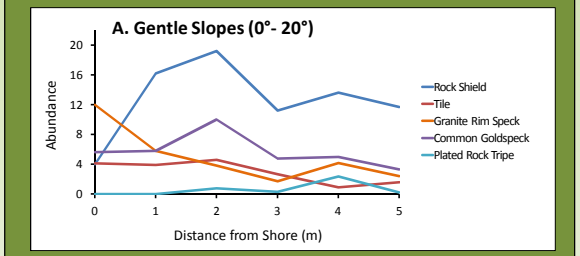


Figure 2.B: Richness vs. Slope



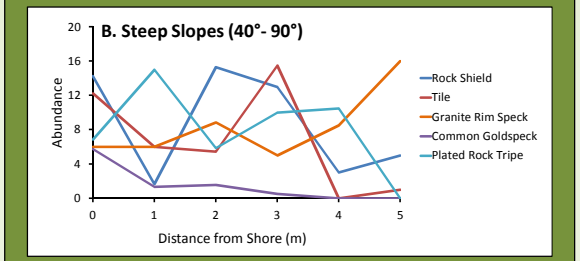


Figure 3: Abundance of Common Species vs. Distance from Shore on Gentle (A) and Steep (B) Slopes

Conclusions and Implications

Species Arrangement (Figure 1)
Our multi-dimensional analysis shows that the lichen communities studied do not form exclusive species groups, supporting Gleason's Individualistic model. However, clustering of species is apparent on the figure, indicating that some species do have similar environmental preferences.

Species Richness (Figure 2)
Species richness was found to be slightly, but significantly influenced by slope (Figure 2.A) and distance from shoreline (Figure 2.B). This indicates that physical factors influence lichen community membership along these gradients.

Species Abundance (Figure 3)
Of the most common species, the formation of discrete species groups do not occur along the environmental gradients examined (Figures 3, A and B). This supports the idea that species grow according to their own physiological needs, and that competition is not the primary factor affecting formation of lichen communities in the Boundary Waters.

Acknowledgments

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