How Does Percent Coverage of Different Types of Lichen Change with Elevation and Rock Size in Rural Arctic Environments?

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Introduction:

It is well known that lichen are vital to the process of nutrient cycling (Nelson, McCune, & Swanson, 2015) and colonizing recently uncovered land masses (Favero-Long, 2012).

Climate change and warming has played an important role in the distribution of lichen at varied elevations. Elevation has been a longstanding tool allowing the research of global species diversity (Parmesan and Yohe 2003).

Observation at higher elevations offers a projection of the past while lower elevation have those of the future global patterns.

Many studies demonstrate the effects of Arctic warming on lichen and other cryptogams (Lang, 2012). No current studies have shown how rock size and elevation gradients influences lichen percent coverage on rock. This study focuses in knowing how elevation and rock size affect lichen in order to better understand how to preserve the declining number of lichen species.

Methods

The Mt. Saana trail located in Kilpisjärvi, Finland was the location of this experiment.

Data collection ran from June 15th-18th of the year 2018.

Percent coverage of lichen and other non vascular photosynthetic organisms were examined on different rocks classified by size. Lichen were categorized by growth form and color (i.e. 'black/brown crustose' or 'green foliose' etc.)

Rocks were chosen randomly and then grouped into three categories according to radii measurements. Rocks between 25-40 cm were labelled as 'small', 41-56 cm 'medium' and finally 57-80 cm were labelled as 'large'. Rocks less than 25 cm or greater than 80 cm were not sampled.

For data collection, large rocks were divided in 9 spots from which 5 were randomly selected and averaged for sampling. Similarly, medium rocks were divided in 6 spots and 3 were randomly selected and averaged for sampling. Small rocks had one sample per rock.

Percent coverage of each 'spot' was determined with a 10x10 grid made up of string and metal wire from which each square was 2.5 cm x 2.5 cm. This grid was placed on randomly selected spots in the designated rock and photographed for later examination.

Data collection happened within a 3.5 km distance every 150-200 m. Three small, three medium and three large rocks were sampled every sampling site. A total of thirteen sites were examined with the highest elevation being 616m and lowest elevation being 472 m. In total, 101 'spots' were analyzed in this investigation.

Research Question:

How does percent coverage of rock-dwelling lichen change with the size of the rock and elevation?

Hypothesis:

1) Percent coverage of lichen decreases as rock size increases.
2) There will be lower diversity in lichen types at higher elevations.

Results:

a) The hypothesis of decreasing diversity of lichen as elevation decreases was rejected (p-value> 0.05).
b) The hypothesis of percent coverage of lichen decreasing as rock size increases was rejected as well (AVG R^2= <0.5).
c) Rock size had no significant impact in lichen diversity.
d) Higher elevations had the highest diversity of lichen followed by low elevations, with middle elevations being the lowest in diversity (Simpson index of Diversity 1-D: 0.85, 0 .78, 0.72). However, difference of diversity was not significantly different from each other (Table 2 T-test-2, two-tailed).

Discussion:

No current studies show how rock size affects lichen in a negative or positive manner. More research is required in order to determine if the size of rock affects lichen or not. On the other hand, it is possible that higher diversity was observed in high and low elevations since these areas had partial tree coverage. This allowed enough sunlight for more lichen species to grow while providing enough shade to preserve water on the surface of rocks throughout the Artic summer days. These partial-foliaged areas might have increased habitability than tree-covered mid elevation areas. It is worth to mention that the area with the highest diversity, high elevations, was near or on the tree line. This means that high elevations had even higher sunlight exposure than low elevations, which might explain its slightly higher score in diversity. A study examining functional diversity of lichen showed that, in general, diversity of 143 lichen species increased with solar exposure and elevation, with elevation having the strongest effect on diversity (Bässler,2015). A BLS study of 1997 found similar results to this study as well (British Lichen Society, 1997). In our study, the area with highest diversity had a combination of high sunlight exposure and high elevation which is supported by the 2015 Functional Diversity study. Since these findings are strongly supported by the Bässler et al., the non-significance of the diversity figures might suggest that a larger sampling size is needed along with sampling at elevations higher than that of the tree line (Bässler, 2015).

Table 1

Rock size	Relationship	R^2
Large	Polynomial	0.03
Medium	Polynomial	0.49
Small	Polynomial	0.26

(Shows r^2 values for the line of best fit of percent coverage of rocks vs rock size)

Table 2

Elevations comparison T-test (P-values)		
Low/mid	Low/hi	Mid/hi
0.29	0.29	0.19

(Comparison of low, middle and high elevations. P > 0.05 means not significantly different)

Acknowledgents

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