Effects of sunlight on lichen growth on rough-bark trees

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INTRODUCTION

Lichen is a symbiotic mutualistic relationship between a fungus and a cyanobacteria or a photosynthetic organism. The fungus provides structural support and protection for the photosynthetic organisms while, in turn, they provide organic compounds for the fungus (Urry, 2017). Lichen can grow on rocks and trees (Urry, 2017). These growth conditions suggest that the lichen need a rougher surface on which to grow. Also, due to the presence of a photosynthetic organism, sunlight plays a role in the lichen's ability to grow and thrive. Lower light and non-ideal sun angles tend to decrease photosynthesis (Nash, 1996). Because of these growth mediums and reliance on sunlight, we hypothesize that more lichen growth will be observed on rough trees that are out in the sunlight versus rough trees in the shade. Our null hypothesis is that there will be no difference in lichen surface area on rough trees in the sunlight and rough trees in the shade. We predict that ten rough trees in the sunlight on average will host a larger surface area of lichen, based on the transect and the transparent grid in square inches, than ten rough trees in the shade due to their greater ability to undergo photosynthesis.

METHODS

Ten trees in the sunlight and ten trees in the shade were randomly chosen from the right side of buildings on Rhodes College campus. It was determined if the bark was rough or smooth and only rough barked trees were chosen for lichen measurement. Measurements were done by alternating north side and south side to keep data unbiased. The surface area of lichen on both trees in the shade and in sunlight was measured using a transparent grid in square inches (Fig. 1). A tree in sunlight was defined as full sunlight exposure on the side of the tree trunk being observed. A tree in shade was defined as mostly shaded on the side of the tree trunk being observed. Shapiro-Wilk and Mann-Whitney tests were performed using SPSS to analyze data (IBM Corp, 2013).

Figure 1 – Experimental setup.
The 11 inch by 8 inch transparent grid used to measure lichen on rough trees

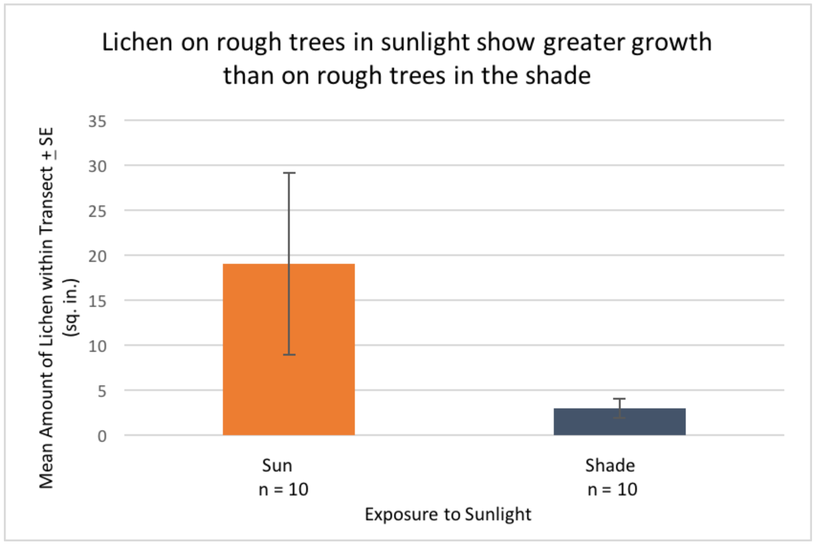

Figure 2 – Lichen growth is greater on rough trees in sunlight compared to rough trees in the shade. The two bars on the graph show the average lichen growth of the ten rough trees in the sunlight (19.05) and the ten rough trees in the shade (2.98), respectively. The standard error for the results was calculated and is shown on the graph by the error bars. Standard error for the trees in the sunlight is 10.05 and the standard error for trees in the shade is 1.04.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
VAR00001	.359	20	.000	.501	20	.000

a. Lilliefors Significance Correction

Mann-Whitney Test

Ranks

	Group	N	Mean Rank	Sum of Ranks
Lichen_Growth	1.00	10	11.45	114.50
	2.00	10	9.55	95.50
	Total	20		

Test Statistics[a]

	Lichen_Growth
Mann-Whitney U	40.500
Wilcoxon W	95.500
Z	-.724
Asymp. Sig. (2-tailed)	.469
Exact Sig. [2*(1-tailed Sig.)]	.481[b]

a. Grouping Variable: Group

b. Not corrected for ties.

Figure 3 – Because the data did not fit a normal distribution as shown in the Tests of Normality, a non-parametric statistical analysis was used. The specific nonparametric statistical analysis used was the Mann-Whitney test, which allows for two independent samples to be compared. The p-value is given in the table above.

RESULTS

The means of the data of sunny and shaded trees show a disparity between the two groups. Sunny trees had, on average, 16.08 square inches more lichen than shaded trees (Fig. 2). Standard errors for sun (10.05) and for shade (1.04) (Fig. 2). The test of normality shows that the data does not fit a normal distribution due to the p-value of 0.000 (Z = -.724) (Fig. 3). The Mann-Whitney analysis has a p-value of 0.481, which means that the null hypothesis was not rejected (Fig. 3).

DISCUSSION

The data collected shows that there is no significant difference between lichen growth on sunny trees and lichen growth on shaded trees. Thus, our experiment suggests that sunlight does not have a significant effect on lichen growth on rough trees. These results are contrary to what Cornelissen et al.(2001) found, reporting that shade contributes to lower photosynthetic rates and therefore, a decreased fitness in survivability. The lack of correlation between sunlight and lichen surface area could be due to environmental factors such as moisture and homeostatic disturbances, such as interaction with other organisms. Because the twenty rough trees that were used in this experiment were found on a college campus, it is possible that they experienced damaging interactions with other organisms causing lichen growth to decrease, despite the fact half of them had favorable sunlight conditions. Such factors can also account for the variances in the data within the two sunlight and shade groups. Moreover, the implications of the lichen growth in sunlight could be beneficial in determining the environmental status of the area in which the trees were surveyed. For example, if lack of sunlight is not the cause for the growth disparities, then the other surrounding conditions, such as moisture and air quality, could be to blame. The mutualistic relationship of lichen may play an important role in the interpretation of the data. The fungi necessary may thrive on the surveyed trees, but the cyanobacteria may not and vice versa. In that case, the organisms are not considered lichen and therefore were not measured in the experiment. Further experimentation can be done in a similar manner with a larger sample size and in an area with less disturbances in order to solely focus on the effect of sunlight presence and absence on the growth of lichen.

CONCLUSION

- Sunlight had no significant effect on the growth of lichen on rough barked trees.
- The environmental implication of this finding can allude to the health of the ecosystem of which the lichen are a part.

LITERATURE CITED

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