Exploring the Effects of Access to Light on Fungal Growth

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Abstract

This study was conducted to explore the relationship between fungal growth and access to light. The relationship was explored by finding fungal populations on UBC campus and measuring the population's number of individuals and distance from an obvious clearing. It was thought that the further from a clearing a population was, the less access to light it would have. Previous research has shown that some fungal species exhibit decreased growth in response to light, and some species' growth is unaffected by access to light. It was hypothesized that if distance from a clearing does increase the number of fungal individuals that grow in an area, then there would be significantly more fungal individuals found at further distances from a clearing. Data was divided into four groups based on distance to the nearest clearing, and statistical analysis was conducted on the data to test the hypothesis. The results of this study were that there was no significant difference between the number of fungal individuals in each group, and it can be concluded that distance from a clearing did not influence the number of fungal individuals found in this research.

Introduction

Fungi exists everywhere in nature, and plays an important role in all ecosystems, largely through mycorrhizal interactions with plant roots. Mycorrhizal interactions are a symbiotic association between appropriately termed "mycorrhizal" fungi and the roots of plants, in which both the plant and fungi benefit. These interactions are necessary for mycorrhizal fungi to grow and reproduce, and as a result of participating in mycorrhizal interactions, plants experience increased mineral nutrition, water absorption, disease resistance and growth. Over 90% of plant species, including many important crops and forest trees, can participate in these beneficial interactions (Bonfante et al. 1). Thus, it is important to understand what factors influence fungal growth, so mycorrhizal fungi can be used as a tool to encourage plant growth in ecosystems and agricultural settings (Linderman 343). Previous studies have found that some fungal species exhibit decreased growth in response to increased light, while some species were unaffected (Yusef and Allam 81). This study aimed to gain further knowledge about how access to light influences fungal growth.

The research was conducted by finding fruiting fungi at the University of British Columbia (UBC) Point Grey campus, and measuring the distance from the population to a clearing. In this study, a "clearing" was defined as an area where sunlight has a clear path to the ground which is unobstructed by plant growth or buildings. To ease data collection, fungi which were observed were limited to those with fruiting bodies, such as mushrooms and puffballs. The primary source of data collected was the number of individuals in each population of fungi and the population's distance to the nearest clearing. Data was collected and split into four arbitrarily chosen distance groups for analysis, based on distance from a clearing. These groups were: 0-4 feet, 5-9 feet, 10-14 feet, and 15+ feet. Following data collection, statistical analysis was conducted using one-way analysis of variance (ANOVA) testing to determine if the results were significant.

The relationship being analyzed in this study was fungal growth in response to light, where distance from a clearing was thought to decrease access to light. It was hypothesized that if distance from a clearing does increase the number of fungal individuals that grow in an area, then there would be significantly more fungal individuals found at further distances from a clearing. Thus, significant results from statistical analysis would imply that the amount of fungi in an area is affected by the distance of that area from a clearing.

Methods

Data collection was done at the UBC Point Grey campus, which I explored to find natural areas where fungal growth might occur. When fungal populations were found, I counted the number of individuals in the population and measured the distance from the population to the nearest clearing. To collect the data, I measured the distances using a Stanley brand 25 foot measuring tape, and photographed all fungal populations observed using an iPhone camera. Figure 1 shows an example of the data collection process.

After I collected the data, I sorted the number of fungal individuals observed in a population into groups based on the distance of each population to the nearest clearing. The groups I used were 0-4, 5-9, 10-14, and 15+ feet from a clearing. Finally, I conducted statistical analysis on the number of individuals in each distance category by one-way ANOVA testing. I selected one-way ANOVA as the testing method because it is best suited for the multiple treatment groups, single dependent variable, and single independent variable used in this study. The aforementioned group and variables in this research were the distance groups, the number of fungal individuals in the distance group, and the actual distances each group was from a clearing respectively.

Figure 1: Pphoto showing how fungal populations distance to nearest clearing was measured. This particular population was under the cover of a tree and found to be 14 feet from a clearing.

Results

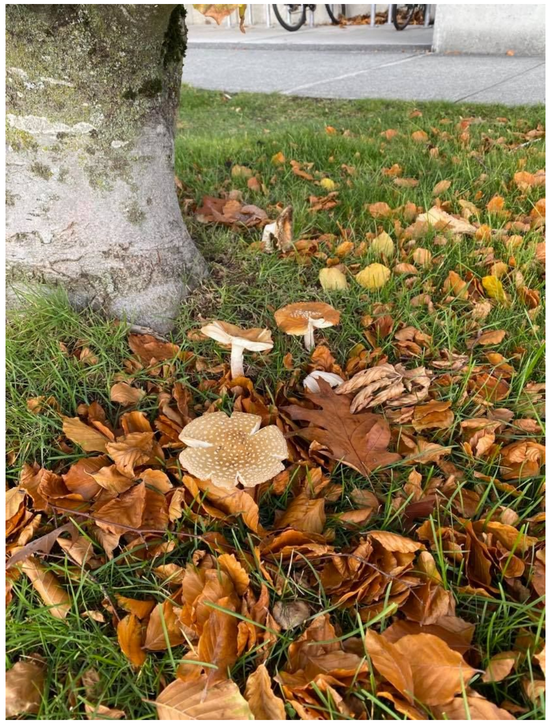

Figure 2: Example of a fungal population found growing under a tree by the UBC Forestry building. This population contained 6 individuals, 4 of which are visible in the photo, and was 6 feet from a clearing.

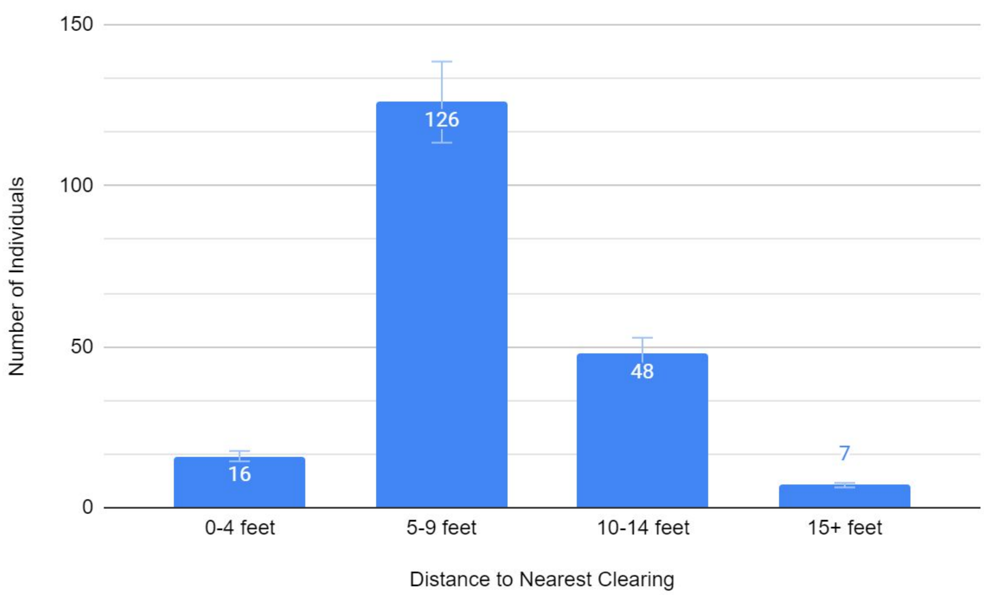

Figure 3: Graphical representation of data grouped into categories based on distance to the nearest clearing, with 10% error bars, and numbers indicating the total number of fungal individuals found at each distance. In total, 197 individuals were observed. By far, the largest number of fungal individuals were observed between 5 and 9 feet from the nearest clearing, which contained 126 individuals accounting for 64% of all individuals observed

One-way ANOVA

The results of the ANOVA test ran on the above data using α = 0.05 gave a p-value of 0.36, which is clearly larger than α, indicating that there was no significant difference in the number of fungal individuals found between the distance groups. Other results from the ANOVA test did not need to be considered after a p-value greater than α was obtained.

Discussion

The results indicate that there was no significant difference in the number of fungal individuals found between the four distance groups. This conclusion was made based on the p-value obtained from ANOVA testing, which was greater than the α value. Thus, no further statistical analysis on the data was conducted, and we failed to reject the null hypothesis.

Although the results did not confirm that there was a significant difference in the number of fugal individuals found in each distance group, an interesting trend exists in the number of individuals found 5-9 feet from a clearing, With 126 individuals, this group accounted for 64% of all 197 individuals observed, and had more than twice as many individuals than any other group. If more observations were made, perhaps this trend would have continued and the results may have shown to be significant.

As previously mentioned, some fungal species exhibit decreased growth in response to increased light, while some species were unaffected (Yusef and Allam 81). Assuming that areas further from a clearing are exposed to less light, the results agree with this information. It was found that there was no significant difference in the number of individuals between distance groups, implying that both species whose growth was decreased in response to light, and species whose growth would be unaffected may have been observed. In the future, if this study was limited to select species which were suspected to exhibit decreased growth in response to light, different results may be obtained.

Limitations of this study were that the study was conducted over a short period of time, that the data was collected in a relatively small area which was the UBC campus, and that the study only examined one dependent variable which was the number of fungal individuals in a population. All of the data was collected over one week in November, and this short data collection period was a limitation to this study because different fungi fruit at different times throughout the year (Fry). If the length of this study was increased significantly, to observe fungal populations over one or more years, more species of fungi which fruit at different times throughout the year would be observed, and the role of light on fungal growth could potentially be explored over all fruiting species in an area. Additionally, data was only collected on the UBC campus, limiting the species of fungi observed by those present in the ecosystem around the campus. Lastly, by measuring more than one dependent variable to determine fungal growth, such as mushroom cap size, or area which a population covers, different results may have been obtained. Future studies should aim to avoid these limitations.

Possible sources of error in this experiment are only human error, of which there were several possibilities. Firstly, there may have been errors when determining which clearing was the closest to a fungal population, as the definition of a clearing in this study was somewhat subjective, and the population's distance from a clearing may have been incorrectly measured as a result. To avoid this source of error in the future, a device to measure light intensity to determine where the nearest clearing's location would be a possible solution. A second source of human error in this experiment was in identifying fungal populations in the first place, it was expected that all fungal populations in the area explored would be observed, and if some were overlooked by accident or ignorance, this would have introduced errors in the data. A final source of human error in this experiment was selection bias, because the research was exploring the relationship between access to light and fungal growth, data collectors may have been more inclined to search for fungi in areas with non-uniform lighting.. For example, just by knowing the hypothesis, shaded areas may have been favoured when seeking out fungal populations for data collection. The latter source of error can be mostly overlooked, because it was not proven that more fungi grow further from a clearing, while the former sources should be minimized in future studies of this nature.

Conclusion

The relationship between fungal growth in response to light was explored by locating fungal populations, counting the number of individuals in the population, and measuring the population's distance to the nearest clearing. It was hypothesized that if distance from a clearing does increase the number of fungal individuals that grow in an area, then there would be significantly more fungal individuals found at further distances from a clearing. The results of this study conclude that there is no relationship between distance from a clearing and number of fungal individuals growing.

Acknowledgements

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Works Cited

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Appendix

Collection Date (DD/MM/YYYY)	Location	Number of Individuals	Distance to Nearest Clearing (Feet)	Notes	Photo Gallery ID
15/10/2020	UBC Thunderbird Residence Courtyard	13	1.5	Growing in a small garden box, underneath a tree. Suspected species *A. muscaria*	A
15/10/2020	UBC Forestry Building	6	6	Growing under a tree near Tim Hortons. Suspected species *A. muscaria*	B
15/10/2020	UBC MacMillan Building Courtyard	9	14	Under a tree outside MacMillan, small red-orange mushrooms	C
15/10/2020	UBC MacMillan Building Courtyard	20	9	Under a different tree at MacMillan courtyard, mamy small, black, rubbery mushrooms	D
15/10/2020	UBC Biology Building Courtyard	3	0	White puffballs in direct sunlight at the BIOL building courtyard	E
15/10/2020	UBC Geography Building Courtyard	7	20	Small rubbery pale-orange mushrooms, at the top of the stairs by GEOG, under a tree.	F
15/10/2020	UBC Irving K. Barber Learning Centre, East Side	16	14	Large white brown-speckled puffball-like fungi growing in clusters, under a tree.	G
15/10/2020	UBC Biology Building, towards fountain	Roughly 50*	7	First of three large groups in the area. White brown-speckles puffball-like fungi, growing under trees	H
15/10/2020	UBC	Roughly	8.5	Second of three large groups	I

	Biology Building, towards fountain	50*		in the area. White brown-speckles puffball-like fungi, growing under trees	
15/10/2020	UBC Biology Building, towards fountain	23	12	Third of three large groups in the area. White brown-speckles puffball-like fungi, growing under trees	J

Figure A1: Raw data collected. A total of 197 individuals were observed.
*Fungi were growing in large, overlapping clusters making it difficult to precisely count them. For the sake of statistical analysis, the number of individuals was rounded down to 50.

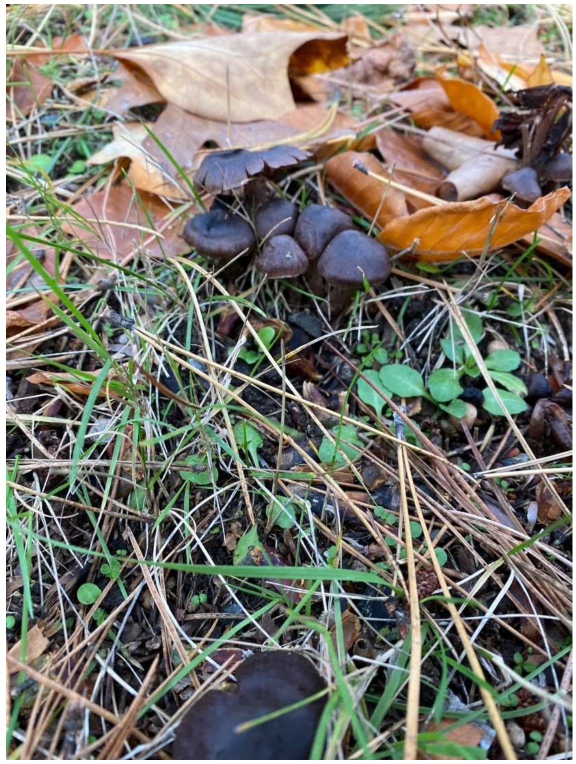
Photo Gallery:

A.

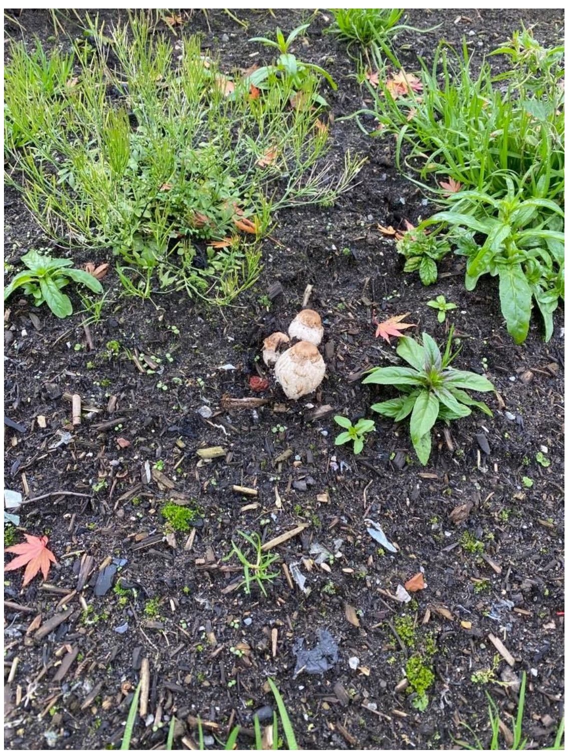
B.

C.

D.

E.



F.

G.

H.

I.

J.