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Investigating the Relationship Between Mushroom Distribution and Trees

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Abstract

The distribution of mushroom species in open area and in shaded area by trees was investigated. A count of mushrooms was conducted in a 6×9 m^2 area surrounded by trees in Totem Park, University of British Columbia. Regression test shows a significant, strong negative correlation (correlation coefficient = -0.855, p-value=0.03) between mean mushroom counts and the distances from trees. The shaded area does not show significantly different mushroom counts than the open area (p-value=0.143).

Introduction

Mushrooms are fungi that produce a conspicuous fruiting body, mostly from the order Agaricales. Mushrooms are worldly distributed, and some species are regularly consumed by humans, for food or pharmaceutical uses (Yang *et al*. 2019). The growth of mushroom is affected by various factors, including soil moisture (Karavani *et al*. 2018), light (Zhang *et al.* 2018), and nutrients (Egli *et al*. 2010). Mushrooms favor high moisture, low light availability, and high nutrient content. A study by Egli *et al* (2010) demonstrated the growth of some edible mycorrhizal mushrooms are affected by the growth of the trees. Another study by de-Miguel *et al* (2014) found that mushroom growth positively correlates with trees. Therefore, this study aims to test if mushroom distribution were affected by the distances from trees and the presence of shade under trees. A mushroom count would be conducted in a 6×9 m^2 area surrounded by trees in Totem Park, UBC. The hypothesis is that mushroom abundance would increase with

decreasing distances from the tree due to increasing nutrients, and that the shaded area should have more mushroom abundance than the open area due to less exposure to light.

Methods

I measured a straight line tangent to two trees at the border of the open area using a measuring tape and marked the two ends by sticks. Then, I placed the sticks one meter apart from the original line since only 2 mushrooms were in that area, calling it *Line Zero*. Since the field was adjacent to a trail, I placed a stick to where the first mushroom appeared apart from the trail, calling it *Origin*. I placed sticks every 1 meter apart from *Origin* along *Line Zero* until encountering an area with minimum mushrooms, where 9 intervals were obtained (columns). Then, I repeated the above process from *Origin* towards the open area, where 6 intervals (rows) were obtained. Crossing the intervals, I obtained 54 squares of 1 m^2, naming each square a unit (denoted as Row number×Column number). I counted mushroom in each unit down each row, from the open area towards *Line Zero*. Due to insufficient sticks, I marked units in one row at a time and relocated the sticks when moving forwards.

I analyzed the data using R studio. I did one Welch two-sample t-tests that analyzed the mean difference in counts between open and shaded areas and a one-way analysis of variance (ANOVA) test on the mean counts by rows. In addition, I analyzed the data for correlation between mushroom counts and distance from trees.

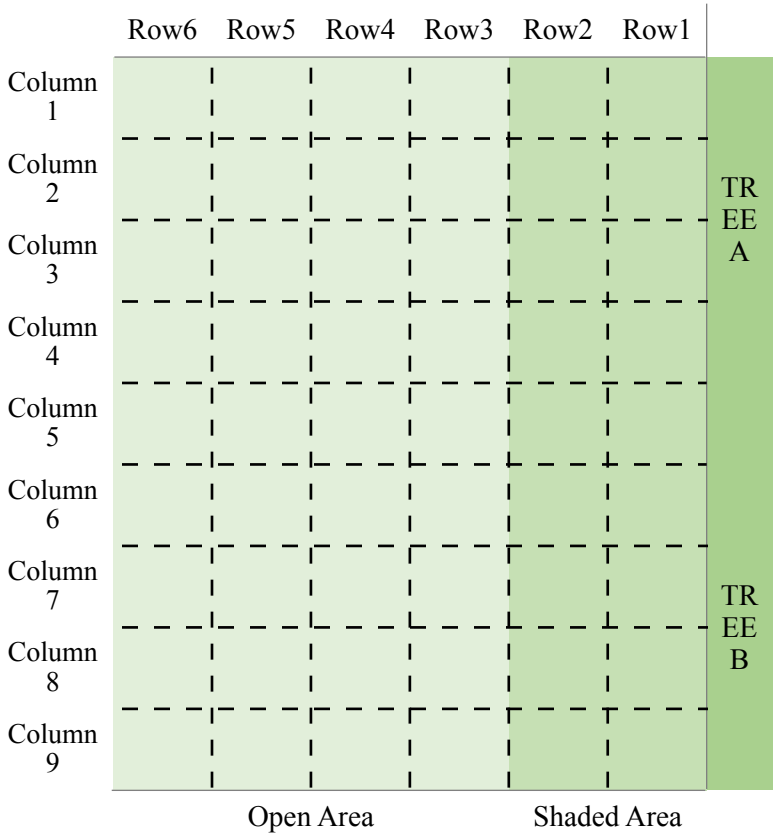

Fig.1. Illustration of the Field

An illustration of the field. Each rectangle represents a 1×1 m^2 unit area. The positions of the trees are approximate. The bolded dashed line indicates an exposed part of root above ground.

Results

In total 128 mushroom fruit bodies were counted in the field, including at least 21 species of order Agaricales. Pearson correlation test of the data generates a correlation coefficient of 0.855 and a p-value of 0.03. The two-sample t-test comparing mushroom counts in open and shaded areas generate a p-value of 0.143. The one-way ANOVA generated a p-value of 0.03.

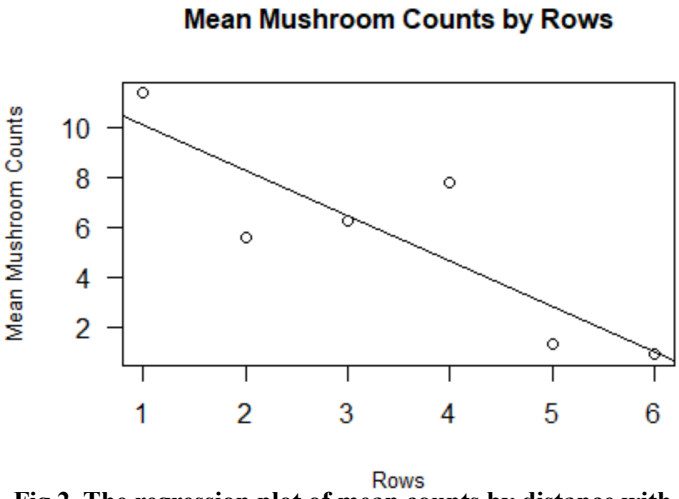

Fig.2. The regression plot of mean counts by distance with fitted line.
Circles represent mean mushroom counts in each row.

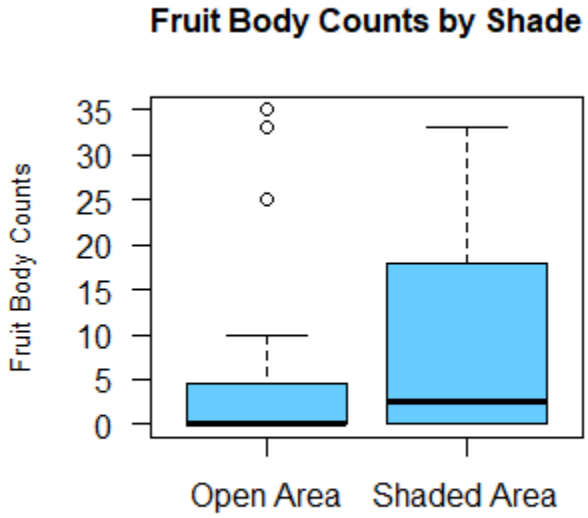

Fig.3. Comparison between open and shaded areas. The confidence interval of the shaded area is much larger than the open area. The open area has 3 outliers.

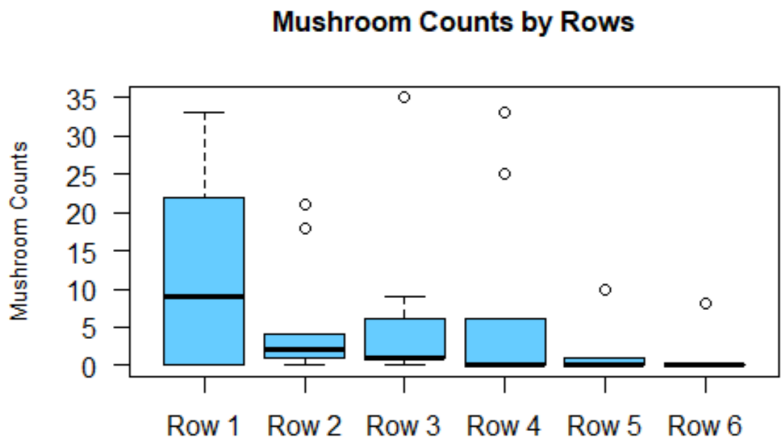

Fig.4. Mushroom counts by rows.
Dark bars indicate mean counts. Circles indicate outliers.

Discussion

The t-test generated a p-value 0.143 and failed to reject the null hypothesis at 95% confidence level, which indicates no significant difference between mean mushroom counts in the open area and in the shaded area. However, the ANOVA results indicates a significant difference among the mean mushroom counts by the rows (p=0.03). Moreover, the regression test result (p=0.03) shows a strong, negative correlation between the distance from trees and mean mushroom counts by rows.

The results are in accordance with the studies of Egli *et al* (2010) that mushrooms increase in proximity to trees, which could be explained by more availability of carbohydrate close to tree roots. I did not count the mushrooms by species, yet a difference in mushroom diversity was observed in different area. For instance, mushrooms in unit 3-9 are exclusively *Rickenella fibula*, which were not found in any other units. Lacking consideration of special

differences could lead to less conclusive results. However, a complete classification was not done due to insufficient knowledge and resource.

The comparison of counts between shaded and open areas could be affected by lack of sunlight during the raining season, which the difference in light exposure was minimized in such condition.

The presence of tree root in the field could have affected the mushroom distribution and the results of statistical tests. Since the presence of root would increase nutrients at the area, while this factor was not considered in this study. Therefore, the presence of the extended root could interfere mushroom growth in surrounding areas and thus affected the results.

Future study could be conducted in peripheral area of a standalone tree. In this study, abundant mushrooms were found in proximity with one of the trees at a different direction. A peripheral counting by circular area may give a better insight into the mushroom-tree relationship.

Conclusion

The study shows a negative correlation between the distance from trees and mushroom abundance. The mushroom abundance in open and shaded areas show no significant difference. However, lack of consideration of possible factors such as species and tree root organization made the results less conclusive.

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References

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Appendix

Table.1

	Row 6	Row 5	Row 4	Row 3	Row 2	Row 1
Column 1	8	10	6	0	4	1
Column 2	0	0	25	9	1	0
Column 3	0	1	33	3	1	0
Column 4	0	0	0	6	0	0
Column 5	0	1	0	1	0	9
Column 6	0	0	0	1	2	25
Column 7	0	0	0	1	3	33
Column 8	0	0	6	0	18	12
Column 9	0	0	0	35	21	22