Potential Impact of Selective Logging on Rainforest Composition

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Abstract

Selective logging, a form of forest degradation is increasingly occurring throughout the Amazon rainforest primarily for timber sale and distribution. Studies have indicated that selective logging impacts canopy structure and overall forest function up to 8 years after logging occurred (Pinagé, 2019). This study aims to find a clear impact of selective logging on forest structure up to 40 years past the logging event occurred.

Introduction

Deforestation and other human disturbances have been an increasing area of concern throughout the past four decades throughout tropical forests. While deforestation is known to be the main concern of forest disturbances, typically done for agricultural purposes, selective logging for timber is known to cause widespread damage to surrounding trees and vegetation, further impacting soil composition, erosion, fires, carbon storage, and animal species (Asner, 2005). Selective logging impacts the spatial patterns and species composition within rainforests by creating canopy gaps and ground cover patches that are affected by different intensities of disturbance (Berry, 2008). When forests are selectively logged in an informal manner, trees being cut are not done by professionals, therefore consideration of a technique to decrease destruction rates of other forest life is unaccounted for, causing an increased amount of unnecessary damage. Studies have shown that the impact of selective logging may be more detrimental than deforestation as it is much more challenging to map and though it is against Peruvian law, regulations remain minimal. This study aims to determine the impact of informal selective logging on surrounding species composition in the rainforest. Little information is known about the extent of selective logging in southeastern Peruvian rainforests as it has been poorly studied in this region.

The null hypothesis of this study is that we will observe a clear difference of palm distributions in unlogged areas when compared to logged areas. I expect that from the study, I will find that there will be a higher diversity of palms in logged areas, due to the increased openness in canopy cover and gaps in ground cover, competition for light requirements and nutrients is expected to be higher, causing a higher diversity of palms.

Methods

This study takes places at the Fincas Las Piedras Research Station, located in the Madre De Dios region of Southeastern Peru. The site includes protected and unprotected but intact secondary rainforests, including Terra Firme and Swamp environments. Brazil Nut Trees are the dominant tree of this area with Aguaje palms dominating the swamp areas. This area is known to have been selectively logged up to 40 years ago, but no research has been done on these specific areas and their impacts on population densities of surrounding vegetation in the rainforest. Stumps that indicate selective logging will be identified and geolocated. Palms will be used as an indicator of species density and distribution in areas of logged and unlogged forests as palms are one of the dominant plant and tree species found in the rainforest, hold economic and ecological importance, and have been considered for reforestation efforts.

Data Collection

Data collection will take place along the general trail system of Fincas Las Piedras and will have a target number of 15 identified and geolocated tree stumps that are a product of informal selective logging. At each tree-stump, I will record the canopy cover availability from that stump using a gyroscope. From each of these sites, I will measure and identify each palm species above breast height within a 10-meter range of each stump. As a control, I will also plot a point 100-meters east of each stump and perform another survey of palm species within a 10-meter radius to find a potential difference in species density and distribution in a logged area versus an unlogged area. I plan to use Fisher's a diversity index measure trees within each stump radius (10m), this measures species richness and abundance in a single metric and is independent of sample size. With this information. To take account environmental variables, I plan to also measure canopy cover, vegetation cover (%) at ground level, and estimated canopy height. To understand how species diversity and the vegetation structure varies in spatial distributions of logged and unlogged plots, I plan to use a mantel correlation. The mantel correlation provides a statistical analysis that will work to compare specific species aggregations in each specific place using regression slopes.

Results

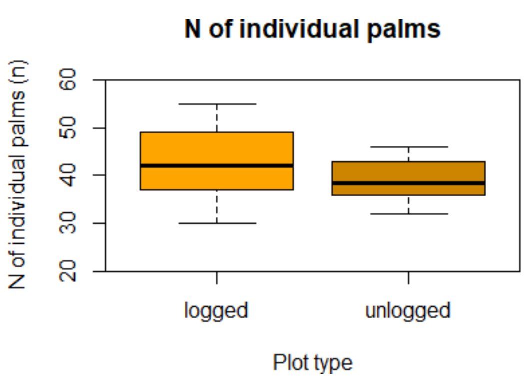

Fig 1. Number of individual palms in logged v unlogged plots

A higher number of individuals were found in logged plots when compared to unlogged plots. The mean number of individual palms in logged plots were 42.9, with a standard deviation of 7.781. The mean number of individual palms in control plots were 38.8 with a standard deviation of

4.516. A T-test was run to better understand the significance of the data where the p-value was 0.1709 with a 95% confidence interval of -1.984426, 10.184426.

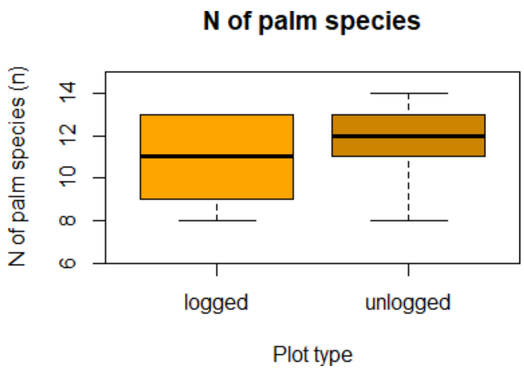

Fig 2. Number of palm species in logged v unlogged plots

A higher number of species was found in unlogged plots when compared to logged plots. The mean number of species in logged plots were 10.9 species and a mean of 11.7 was found in unlogged plots. The results from the t-test showed a p-value of 0.3362 with a 95 percent confidence interval of -2.5012153, 0.901315.

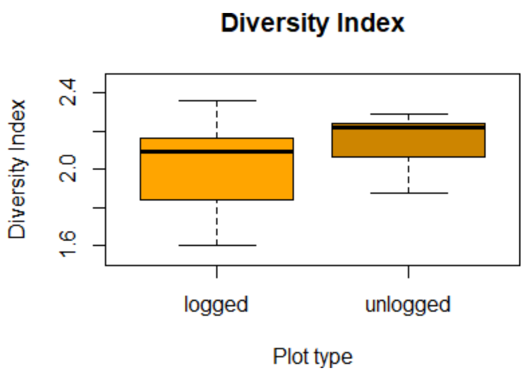

Fig 3.. Shannon Diversity Index

A diversity index was calculated, and it was found that unlogged areas had a greater palm diversity than logged areas.

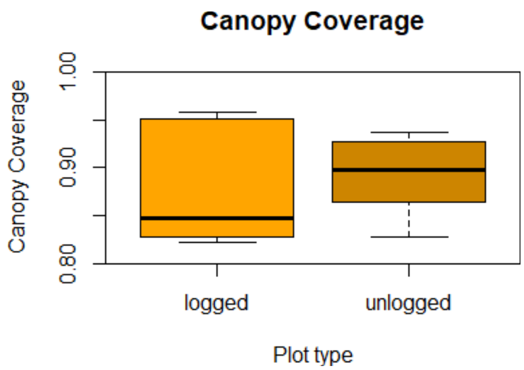

Fig 4. Canopy Coverage

Canopy coverage was found to be higher in logged areas when compared to unlogged areas. The mean canopy coverage percentage for logged areas was found to be 87.5% and the mean for unlogged areas was found to be 89.2%. The T-test values included a p-value of 0.4577 with a 95 percent confidence interval of -0.06366939, 0.03010539.

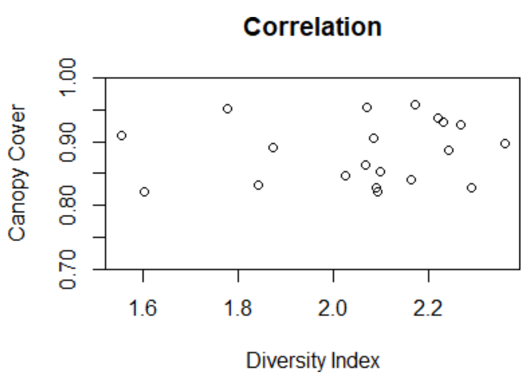

Fig 5. Spearman Correlation

No correlation was shown between canopy coverage and species diversity. Recorded p-value was 0.5812.

Discussion

The number of individual palms were counted in 10 plot types in each logged and unlogged sites (Fig.1). The data exhibited a higher mean number of individual palms in logged areas than those in unlogged areas, also with a higher standard deviation from the mean in logged areas. A potential reason for this may be due to the availability of more open space accompanied with less species competition. With the p-value calculated at 0.1709, the data was too similar in the control and test sites for the data to be considered significant. The next form of data analysis involved the number of recorded palm species in the logged areas compared to unlogged areas. It was found that a slightly higher number of species were found in unlogged areas when compared to logged. This likely due to potentially more resource availability because the areas was undisturbed, as well as the idea that because the area is undisturbed, this is likely the ideal growing environment for more species types. The p-value was 0.3362, therefore the data was considered to be insignificant, though there was a slight difference between each site. Logged areas were found to have a higher standard deviation from the mean (Fig. 2). A Shannon Diversity Index was also calculated from the data and was found to have a higher diversity in unlogged areas when compared to logged areas (Fig.3). Canopy coverage was recorded at each plot, and it was found that logged areas had an higher average canopy coverage than in the control plots, and a higher standard deviation around the mean (Fig.4). It was originally hypothesized that this study would exhibit a clear and non-random difference between forest structure in logged areas when compared to unlogged areas. Furthermore, it was theorized that areas exhibiting selective logging would exhibit more diversity due to an increased openness in canopy cover and ground cover gaps from tree-fall impact. Ultimately, it was expected that these conditions would be ideal for increased competition for light as well as more nutrients. From this study, the data collected was not shown to be significant enough to fail to reject the hypothesis, therefore, the hypothesis was rejected likely on the terms of not having logged areas that were recently impacted by logging activity. It is likely that rainforest structure begins to repair itself after a certain number of years, which is what was ultimately exhibited in this study of logs that were deforested up to 40 years ago.

Literature Cited

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