Diversity and Abundance of Rattan in Logged and Unlogged Forest

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ABSTRACT
A study on the effects of logging on rattan species diversity, abundance, and composition in mixed dipterocarp forest in Malaysia, Borneo. Data was collected from belt transects which were placed along skid trails in logged forest and hiking trails in unlogged forest. In addition to diversity, abundance, and composition measurements, the number of stems per individual and the life stage of each individual were also recorded. No statistically-significant differences were found between the logged and unlogged forest. Unlogged-forest transects did not cluster together on the basis of species composition, and neither did logged-forest transects. However, four logged-forest transects were omitted because no rattans were found, as was one unlogged forest transect. Because all four of these logged-forest transects were located along flooded, swampy skid trails, and because the one unlogged-forest transect was located along a river, the authors believe that logging may negatively affect the establishment of rattans due to the poor drainage of skid trails.

INTRODUCTION

Rattans, a specialized group of scaly fruited palms (subfamiliy Lepidocaryoideae), have their headquarters in South-east Asia, and Malaya lies at the very hub. Rattans are versatile plants. They can grow in a wide range of light-levels and soil types. Some rattans are pioneer species, while others require shade to mature (especially forest-floor and understorey rattans). Some rattans are extremely important non-wood forest products; being used for furniture and the global trade. Rattan species diversity in Southeast Asia varies among forest types, with mixed dipterocarp forest exhibiting the highest diversity, followed by lower montane forest, alluvial forest, and finally peat swamp. Rattan species diversity strongly correlates with the floral diversity of the surround forest, but this is probably a non-causal relationship. High rattan species diversity may have be facilitated by a wide range of host tree heights, which would allow climbing rattans to exhibit a wide range of climbing heights as well. Since there may be a trade-off between climbing height and seed recruitment, a wide range of climbing heights would allow for the existence of a variety of life strategies, and thus for the coexistence of a variety of species. (Watanabe & Suzuki, 2008)

Because conventional logging greatly changes the physical structure of the forest, it would be expected to change the species diversity and composition of rattans as well. Studies on rattan species richness in logged forest, or in unlogged forest, suggest that logging may decrease rattan species richness. For example, Nasi (1993) in Watanabe & Suzuki (2008) found a total of 19 rattan species with 881 individuals within 5 ha of logged-over forest in Sabah, Malaysia. Van Valkenburg (1997) did a similar study in primary forest, and he found 20 species with 269 plants, but his sample area was only 0.51 ha. However, studies comparing rattan diversity and abundance between logged and unlogged mixed dipterocarp forest are virtually absent from the literature.

The principal objective of this study is to explore whether there are any differences in rattan species diversity, abundance, or composition between logged and unlogged forest of Southeast Asia. Additionally, this study also seeks to address the question of whether logging adversely affects the establishment of juvenile rattan, or if it adversely affects the growth of existing rattan.

METHODS

This study was conducted in Maliau Basin Conservation area, Malaysia. A total of 7 genera and 28 species of rattan can be found at Maliau. The Rattan species were recorded from 50 X 10 m transects. Data was collected from 10 transects, 5 from the logged forest and 5 from the unlogged forest. The transects in the logged forest were placed in the middle of old skid trails, while the transects in the unlogged forest were placed in middle of walking trails. It would have been preferable to lay the transects off the trail, but the understory was too dense in the logged forest to go off the trail. The width of each trail was also measured, using a point on the trail that was judged by the researchers to be a good average of the widest and the narrowest part of the trail. In each transect, each rattan specimen with its roots within the transect boundaries was identified to species level and added to a species count. The life form of each rattan (climbing, not yet climbing or not climbing, adult or juvenile, solitary or cluster), the number of stems of each individual, and position of each rattan in the transect (using x and y coordinates) were also recorded.

For the analysis, a Shannon-Wiener diversity index was calculated for each transect, and a t-test was used to compare the five logged-forest diversity indices with the five unlogged-forest diversity indices. The same was done for rattan abundance, where the total number of individuals regardless of species was added up for each transect, and then the five logged-forest total abundances were compared with the five unlogged-forest total abundances using a t-test. The exact same method was used to compare the total number of stems between the logged and unlogged forest, and also to compare the total number of juveniles between logged and unlogged forest. Two dendograms, both based on species composition, were created to observe whether the logged forest transects and the unlogged forest transects clustered away from each other. The first dendogram used the total number of individuals of each species in each transect, while the second dendogram used the relative abundance of each species in each transect. Lastly, dominant species were identified by observing if any species constituted 50% or more of the relative abundance of a single transect.

RESULTS

The Shannon-Weiner diversity indices for the logged forest ranged from 0 – 1.213, and for the unlogged forest ranged from 0 – 1.386 (Table 1). The t-test comparing the five logged forest diversity indices with the five unlogged forest diversity indices resulted in a statistically non-significant $p = 0.5275$. The t-tests for abundance and total number of stems resulted in statistically non-significant p-values. The t-test comparing the number of juveniles for logged vs. unlogged forest resulted in a p-value of 0.07405. This is almost statistically significant, but not quite. As the data shows, there are more juveniles per transect in the unlogged forest (Table 2). The first dendogram, based on number of specimens of each species, resulted in a tree with no clustering of logged or unlogged forests (Fig 1). The second dendogram, based on relative abundances, also resulted in a non-clustered tree (Fig 2). The dominant species of both the logged and unlogged forest was clearly *Korthalsia furtadoana*, which consisted of at least 50% of the individuals in 4 out of 5 of the unlogged transects, and 4 out of 5 of the logged transects.

DISCUSSION

The fact that there was no significant difference in species diversity or abundance between the logged and unlogged forest suggests that rattans are resilient to conventional logging. We did not observe any rattans climbing up large trees, but this may have been caused by the fact that all our transects were along trails or somewhat open patches of forest. The logged transects experienced much higher light levels than the unlogged transects, but this does not seem to affect species diversity, composition, or abundance. However, the lower numbers of juveniles in the logged transects may suggest that it is more difficult for rattan seedlings to establish themselves in logged forest. This could be from increased competition in the logged forest, which exhibited a much thicker understorey full of pioneer species. The dominant species, *Korthalsia furtadoana*, must also be able to adapt to wide ranging light levels, because it was highly prevalent in both the logged and unlogged transects. However, one aspect of our research which should be discussed is that we omitted four transects from the logged forest, because we could not find any rattan there. All four of these skid trails were extremely muddy and swampy, whereas none of the unlogged trails were muddy. According to Dransfield (1992) in Watanabe and Suzuki, it is rare for rattan species to be able to survive in areas that are water-logged or experience prolonged flooding . Watanabe and Suzuki conclude from their own data that "poor drainage conditions should inhibit the growth of rattans as well as many plants." We also omitted one unlogged transect because there were no rattan there, and this transect was the only transect that was on a hiking trail right next to a river. Therefore, it seems possible that skid trails inhibit the growth of rattans because of erosion and poor drainage, which causes them to become easily flooded when it rains. This may also contribute to the lower number of rattan juveniles in the logged forest. However, further research would have to be done in which some measure of swampiness or poor drainage is measured as the independent variable and rattan diversity or abundance is the dependent variable.

ACKNOWLEDGMENTS

We would like to thank Ms. Heni Mangangantung and Santiago Ramirez for accompanying us in the field, and professor Shawn Lum for his help in identifying rattan species.

LITERATURE CITED

Watanabe, N. M. & Suzuki, E. (2008), Species diversity, abundance, and vertical size structure of rattans in Borneo and Java, *BIODIVERSITY AND CONSERVATION* **17**(3), 523-538.

Appendix

Table 1. Shannon-Weiner indices for logged forest transects. Values of 0 indicate the dominance of a single species.

Transect No.	Shannon-Weiner
Logged 1	0.5623351
Logged 2	1.2130076
Logged 3	0.0000000
Logged 4	0.6365142
Logged 5	0.0000000
Unlogged 1	0.5623351
Unlogged 2	0.0000000
Unlogged 3	1.3862944
Unlogged 4	0.5091373
Unlogged 5	1.0397208

Table 2. Abundance, no. of juveniles, and no. of stems for logged and unlogged forest transects.

	No. of Juveniles
Logged 1	1
Logged 2	1
Logged 3	0
Logged 4	0
Logged 5	0
Unlogged 1	2
Unlogged 2	1
Unlogged 3	3
Unlogged 4	0
Unlogged 5	3

Figure 1. Dendogram of species composition, based on abundance

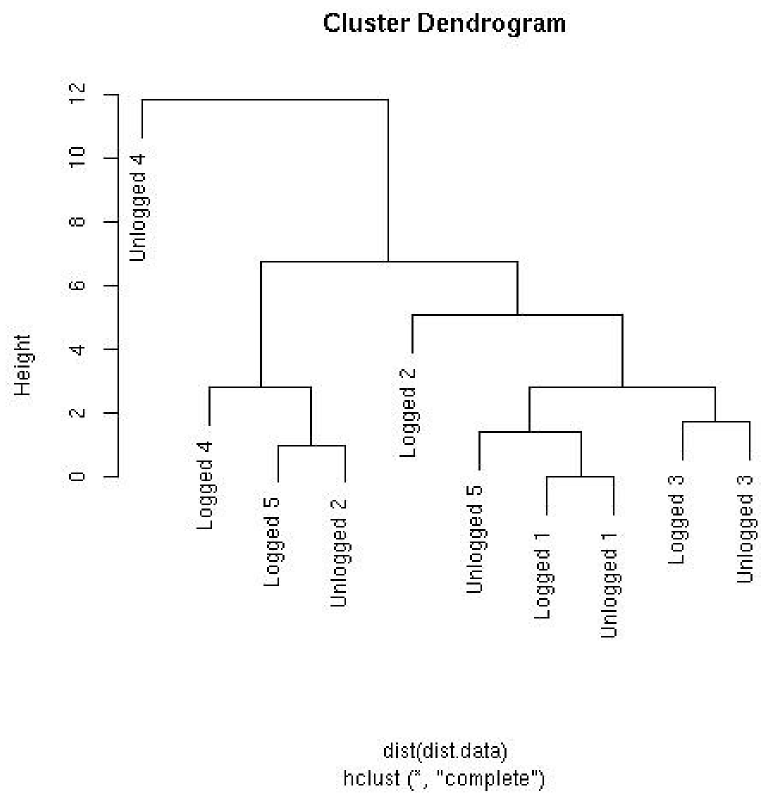

Figure 2. Dendogram of species composition, based on relative abundance