

RESEARCH ARTICLE

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PLANT DIVERSITY AND CONSERVATION STATUS OF THE KANNELIYA FOREST RESERVE, SRI LANKA

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ABSTRACT

Kanneliya Forest Reserve is a low land tropical rain forest located in the Galle District, Sri Lanka. The plant diversity of Kanneliya is considered richer, even compared to the Sinharaja World Heritage Rainforest. The Ceylon Plywood Corporation had been involved in the logging of the complex from 1968 until logging was suspended in 1988. A research was conducted to measure the diversity of plants at the Kanneliya Forest Reserve as well as to determine the recovery of the forest after logging was suspended. The fixed area method was used for sampling (trees: 500 m²/horizontal radius 12.6 m, saplings: 25 m²/horizontal radius 2.83 m and seedlings: 1 m²/horizontal radius 56.4 cm). The plant species and the number of individuals of each species within the radius of the circle were recorded. According to the observations 1802 trees were recorded belonging to 125 species, 326 saplings were recorded belonging to 63 species and 180 seedlings were recorded belonging to 43 species. In total, approximately 154 species were recorded in an area of 7500 m² covered. For the Simpson's Index and Shannon Diversity Index 0.9763/4.125, 0.9638/3.662 and 0.9482/3.325 were obtained for trees, saplings and seedlings respectively. The most common plants encountered within 15 plots sampled were *Diospyros insignis*, *Symplocos cochinchinensis* and *Fahreneitia zeylanica* where 118, 79 and 77 trees were encountered with relative abundances of 6.55%, 4.38% and 4.27% respectively. The species density and tree density were 0.075 individuals/m² and 0.240 individuals/m² respectively. The results from the *Alpha* Diversity Indices shows that the diversity of disturbed but a well-managed forest such as Kanneliya Forest Reserve supports a higher plant diversity than an un-disturbed or a disturbed forest. Furthermore, the increase in the species density and the tree density shows that there is rapid regeneration in the forest after the suspension of logging. Therefore, this study concludes that there is a high diversity of plants at Kanneliya and the diversity of a forest which is disturbed and well-managed is high. The presence of strong conservation priorities had helped to protect the Forest Reserve.

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INTRODUCTION

Tropical rainforests are typically found in the north and south of the equator, are home for large number of tree species and animals. In addition, it helps for the balance of the ecosystem. Rainforests are termed as 'lungs of the earth' as it absorbs large amounts of carbon dioxide and produce oxygen which helps the survival of humans and animals. More importantly, rainforests help to stabilize the climate as carbon dioxide is a huge contributor for the greenhouse effect, the absorption of

carbon dioxide minimizes the consequences of global warming. However, due to the rapid increase in the population, these forests are cleared for farming, fuel and for the development of settlements which has been a major concern. Sri Lanka also known as the 'Pearl of the Indian Ocean', has a forest cover of about 29.9%. However, over the past years Sri Lanka has lost 17.6% of its woodland habitat. In order to support conservation plans a study was designed to assess the plant diversity at the Kanneliya Forest Reserve. The Kanneliya Forest Reserve (5108.2ha) located in the Galle district, largest of the Kanneliya-Dediya-gala-Nakiyadeniya forest complex (Karunaratne, 2016).

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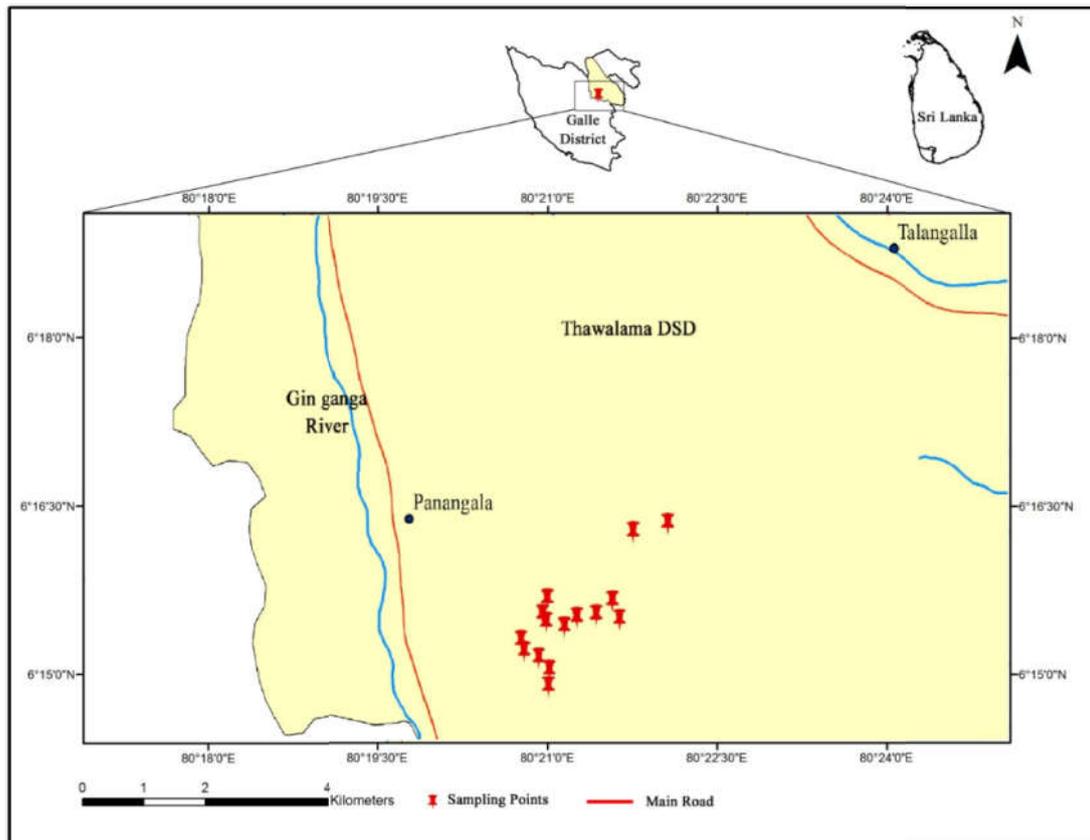


Figure 2. Map of Location of the Kanneliya Forest Reserve

The Ceylon Plywood Corporation had been involved in the logging of the complex from 1968 until 1988 when logging was suspended (Singhakumara, 1996). However, Kanneliya is regarded as one of the most biologically diverse areas in the country and was designated as a Biosphere Reserve and World Heritage Site in 2004 by UNESCO (Weerakoon, *et al.*, 2016). The plant diversity of Kanneliya is considered richer, even compared to the world heritage rainforest “Sinharaja”. Plants were chosen for the research as plant diversity is a vital component of biodiversity in a dynamic ecosystem. The main objectives of this research were to measure the diversity of plants at several sites at the Kanneliya Forest Reserve and to compare the results obtained using Alpha Diversity Indices. The information on diversity and species richness of plant species provides support in planning and implementation of biodiversity conservation plans. Furthermore, plant species provide a suitable habitat and many resources for forest species (Suratman, 2012). Hence, by conserving plants other species could be protected as well. Therefore, a study was designed to assess the plant diversity at the Kanneliya Forest Reserve.

MATERIALS AND METHODS

Study Area

Kanneliya is a low land tropical rain forest in Sri Lanka that is situated in the Galle District – Thawalama Divisional Secretariat Division. Kanneliya Forest covers a total of about 5305.9 ha and the core unit of the Kanneliya Forest Reserve is about 5108.2 ha. Kanneliya lies between 6° 09' - 6° 18' N and 80° 19' - 80° 27' E. The average annual rainfall at Kanneliya is about 4445 mm (Karunaratne, 2016).

The fixed area method described by Singhakumara (1996) was used for sampling. This method was used since it yields data such as a species list, and estimates the stem density, frequency, diameter class-distribution, basal area and abundance. Several plots were laid on selected locations.

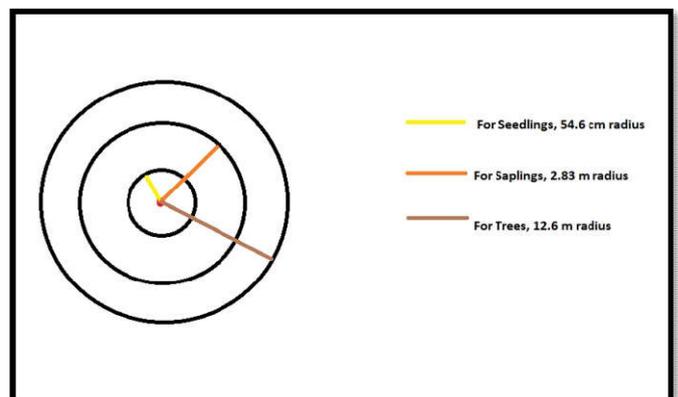


Figure 2. The Fixed Area Plot that was used for sampling

For trees a circle of radius 12.6 m with an area of 500 m² was used for sampling. Saplings were sampled in an area of 25 m² with a circle of 2.83 m of radius. Seedlings were sampled in a small area of 1 m² with a circle of radius 56.4 cm.

The following criteria were considered during sampling

Trees: dbh greater than 10 cm.

Saplings: dbh less than 10 cm and more than 1 m tall.

Seedlings: Less than 1 m tall.

The species and number of individuals were recorded at every site.



Figure 3. GPS locations of the Sampling Points

Table 1. Recorded species & Individuals of Seedlings, Sapling & Trees

	Total Area Covered	No. of Species Recorded	No. of individuals Recorded
Seedlings	15 m ²	43	180
Saplings	375 m ²	63	326
Trees	7500 m ²	125	1802

Table 2. Dominant Tree Species recorded at sampling locations

Family	Species	Sinhala Name	No. of Individuals	Percentage Abundance
Ebenaceae	<i>Diospyros insignis</i>	Porowa mara	118	6.55%
Symlocaceae	<i>Symplocos cochinchinensis</i>	Wal-bombu	79	4.38%
Euphorbiaceae	<i>Fahrenheitia zeylanica</i>	Otha	77	4.27%
Annonaceae	<i>Xylopia championii</i>	Athu ketiya	76	4.21%
Clusiaceae	<i>Garcinia echinocarpa</i>	Madol	74	4.10%

In addition, the dbh of trees were recorded at each location. The Published Field Guides Ashton S. Mark *et al.* (1997) and Senarathna, L.K. (2001) were used as reference books for species identification at sampling locations. In addition samples and photographs were taken of unidentified species for further clarification.

Data was collected at 15 sites using the fixed area method. When choosing the sites the distance from the water body, the elevation and the amount of leaf litter was considered. The 15 plots were taken as follows:

1. 6 plots – Entrance Gate to Anagimala Ella Falls
2. 2 plots – Nevada Tree Region
3. 2 plots – Kunakattu Kanda Trail
4. 5 plots – Peak Road

The Collected data was analyzed using Alpha Diversity Indices:

1. Shanon Weiner Index (SWI)

$$\sum P_i \ln P$$

2. Simpson’s Index (SI)

$$1 - \frac{\sum n(n-1)}{N(N-1)}$$

N = total number of individual records.
 n_i = number of individuals in ith species.
 P_i = the proportional abundance of the ith species

RESULTS AND DISCUSSION

In total sampling was conducted in 15 locations. A total area of 15m² for seedling was covered it included 180 individuals in total belonging to 43 species. For saplings the total area covered was 375m² which included 326 individuals belonging to 63 species. There were 1802 trees belonging to 125 species in a total area of 7500m². The most dominant species recorded was *Diospyros insignis* with a total number of 118 individuals and an abundance of 6.55%. The rest included *Symplocos cochinchinensis* (4.38%), *Fahrenheitia zeylanica* (4.27%), *Xylopia championii* (4.21%) and *Garcinia echinocarpa* (4.10%) respectively.

Table 3. Simpsons and Shanon Weiner Index values

	Simpsons Index	Shanon Weiner Index
Seedlings	0.9482	3.325
Saplings	0.9638	3.662
Trees	0.9763	4.125

The values of the Simpson Index were all over 0.9 with trees being the highest with a value of 0.9763. Furthermore, the values of Shanon Weiner Index were all over 3.325 with the highest for trees with a value 4.125. Usually, the values of Shanon Weiner Index lies between 1.5 to 3.5 and is rarely over 4. However, the diversity of tree species has a value over 4. This shows that there is a high diversity of plants at Kanneliya Forest Reserve. The results from the *Alpha* Diversity Indices shows that the diversity of disturbed but a well-managed forest such as Kanneliya Forest Reserve supports a higher plant diversity than an un-disturbed or a disturbed forests. This is because of the presence of plant species which grow in un-disturbed forests as well as disturbed forests. This proves that a high diversity could be obtained if forests are disturbed in a well-managed manner without harming it. A similar study had been conducted Sinhakumara (1999) at the Kanneliya Forest Reserve, which have recorded 1773 individual trees belonging to 144 species within an area of 23500m². In the present study, within an area of 7500m², 1802 individual trees were recorded belonging to 125 species. In 1999 the tree density was 0.075 individuals/m² and at present tree density is 0.240 individuals/m². This considerable difference in tree density may be due to the heavy logging practiced until 1988. Therefore, during the past 30 years rapid regeneration had occurred. Sinhakumara also has stated that even 10 years after logging has been suspended there have been a fast forest recovery. The species density in 1999 was 0.0061 species/m² (Sinhakumara, 1999). According to this study, the species density is 0.0167 species/m², which showed an increase in species density in the study area. Therefore, both the tree density and species density has been increased during the past 2 to 3 decades at Kanneliya Forest Reserve, which demonstrates the increase in plant diversity (species richness and abundance) in partially disturbed forests due to the rapid regeneration rate. This study, reveals that the diversity of plants can be higher in disturbed primary forests than the undisturbed primary forests.

However, to maintain such diversity proper conservation methods must be applied to ensure other threats such as forest fragmentation and invasive species. Restricting logging in 1988 and demarcating it as a protected area in 2004 must have resulted in good conservation and management of the Kanneliya Forest Reserve.

Conclusion

According to the study, plant diversity of trees, saplings and seedlings are very high in the study area which indicates that the high biodiversity at Kanneliya is mainly due to high plant diversity. Proper conservation and management practices at Kanneliya during the past few decades can be observed which had help to preserve the high biodiversity. Therefore, these practices must be maintained and significant conservation priorities must be applied to ensure the future biodiversity management as well, at the Kanneliya Forest Reserve.

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