Ecology of woody plants of the undergrowth of Oliyagankele Forest Reserve - a tropical rainforest in Southern Sri Lanka

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Abstract

Soil fertility status and ecology (floristic richness, girth-class distribution, complexity-index, importance value index, and species area curve) of the understorey vegetation were studied in a tropical rainforest in southern Sri Lanka. At three spatially separated areas, (sites A, B, and C) sixteen contiguous plots per site, each 25 x 25 m were established along a strip of vegetation spanning across the entire altitudinal range.

Overall floristic and phytosociological heterogeneity within the forest was associated with the combined effects of the variations of topography, aspect and relief, altitudinal gradients, and accompanied differences in surface run-off, erosion and other edaphic conditions. Compared with the sites A and C, the soils of Site-B were of relatively at higher fertility status (lesser amounts of larger particles, better water holding capacity, higher pH and phosphorus concentration). A total of 131 undergrowth woody species (below 30 cm stem circumference) belonging to 95 genera and 43 families waere enumerated from a sampling area of 3 ha, comprising 1 ha from each sampling site. About 38% of the species collected were endemic to Sri Lanka. Of all the species, about 70% were tree species, and the balance, were typical undergrowth species.

The species area curve indicated that a sampling area of 25x100 m is sufficient to obtain the maximum number of species in any natural community of this forest. Based on the relative frequency, and basal area, the most dominant species of the forest was *Macaranga digyna*. However, *Polyalthia korinti* is the dominant species based on relative density. Based on the IVI of the undergrowth species, three sampling sites represented different plant communities *viz.*, (site A) *M. digyna* dominated plant community, (site B) *M. digyna, Aporosa lindleyana*, and *Axinadra zeylanica* co-dominated plant community, and (site C) *Semecarpus gardneri, A. zeylanica*, and *Gyrinops walla* co-dominated plant community. Euphorbiaceae (IVI= 69.9) was the most dominant family of the undergrowth followed by Dipterocarpaceae, Anacardiaceae, Annonaceae and Dilleniaceae with IVI of 37.6, 29.0, 20.4 and 20.3, respectively.

On average, the density of woody stems of the undergrowth vegetation of the forest was 3,500 stems/ha. Majority of the individuals was represented by a very few common species. Approximately, 59% of the total number of species and 44% of the endemic species were represented by less than 25 individuals/ha. The proportions of stems of the three stem circumference classes (2-9.4, 9.5-19.4, and 19.5-29.4) at three sites appeared to show a consistent ratio of 6:5:3.

Key words: soil fertility, floristic richness, girth-class distribution, importance value index, undergrowth species and species area curve.

Introduction

In ecological studies of the lowland tropical rainforests, large sized individuals of tree species have received much attention, and so phytosociological data are collected from them (e.g. Peeris 1975 Pemadasa 1986), and relatively little is known about the individuals less than 30 cm gbh. These species are generally not regarded as trees and referred to as understorey, or undergrowth vegetation to distinguish them from the apparently more dominant and economically more important large trees (Richards 1948). Shrubs, herbaceous plants, and a vast number of saplings and seedlings of trees are the members of the undergrowth community of a rainforest (Richards 1948). It's woody component can be categorized into two groups of plants, the juveniles of the species which have the potential of growing up to trees over 30 cm gbh and the individuals of the species never attain above 30 cm gbh. Mitchell and Tilakeratne (1980) made an attempt to study the understorey of Sinharaja tropical rainforest of Sri Lanka. They have sampled a total area of 300 m^2 (0.03ha) at twelve study sites using 25 sample plots of the size 20x50 cm at each site; they have recorded 79 woody and herbaceous species. From their data it appears that the species with highest cover and frequency values were *Shorea trapezifolia, Palaquium petiolare, Mesua nagassarium, Lindsaya trapaziformis, Garnetia raginus, Lasianthus oliganthus,* and *Syzygium lissophyllum*. De Zoysa *et al.* (1988) also have studied the undergrowth of the same forest but have used

a much larger area (2-ha) and sampled the plants between 10-30 cm gbh. Plants less than 10 cm gbh were separated into two classes as (a) those of more than 1-m and (b) those of less than 1-m tall, and sampled 0.2 ha for the former and 0.02 ha for the latter. Under such conditions they have recorded a total of 259 species of which 156 were endemic.

A preliminary investigation on the ecology and phytosociology of Oliyagankele rainforest (Samarakoon 1994, Dissanayake and Samarakoon 1994) indicated that the structure, composition, and phytosociology of its undergrowth vegetation are not in consistence with the information mentioned above.

Oliyagankele Forest Reserve (latitude 6^0 10' N and longitude 80^0 32' E) is situated near Kamburupitiya, approximately 15 km north of Matara town and covers about 500 ha. Topographically, the forest reserve is moderately hilly, and the altitude varies from 30-100 m (Figure 1). Geologically, the forest reserve is underlain by charnokites and charnokitik rocks of the southwestern group (Cooray 1967) with localized recent and sub-recent gravel, sands and clays especially in the valleys. The soils especially in the upper catena belong to the red-yellow podzolic group of Panabokke (1976). Generally the soils of the valleys between the hills are made up of a mixture of alluvial sand, clay and gravel. The soils of the area are generally more than one meter deep and its water holding capacity is around 250 mm per meter depth (Weerasinghe and Alwis 1985). Alluvial valleys separate the hills having moderate slopes; the lowest valley lies around the Hali-ela Tank. Climatically, Oliyagankele forest lies in the wet zone (WL2) of Sri Lanka. At Mapalana, about 1-km from the forest, the mean annual rainfall is 2,354 mm (Weerasinghe 1989). It ranges from a minimum of 1,342 mm (approximating mean rainfall of the typical dry zone) to maximum of 3,548 mm (approximating the mean annual rainfall of typical wet zone). It is evident that the mean monthly rainfall is bimodally distributed with maxima in May and October – November (Figure 2) mainly due to southwest and northeast monsoons. February, the driest month of the year, averages only 97.4 mm of rainfall. According to the rainfall data more than 43% of the years, the months of January, February and July are dry (<100 mm of rainfall). The mean air temperature is 28 ^{0}C, which fluctuates only between 27 ^{0}C –29 ^{0}C (Figure 2). The present paper is one of the series of papers designed to report the results of a study of ecology and phytosociology of this forest. Much attention is given to the soil fertility status, floristic richness, girth-class distribution, complexity index, importance value index, and species area curve of the understorey vegetation.

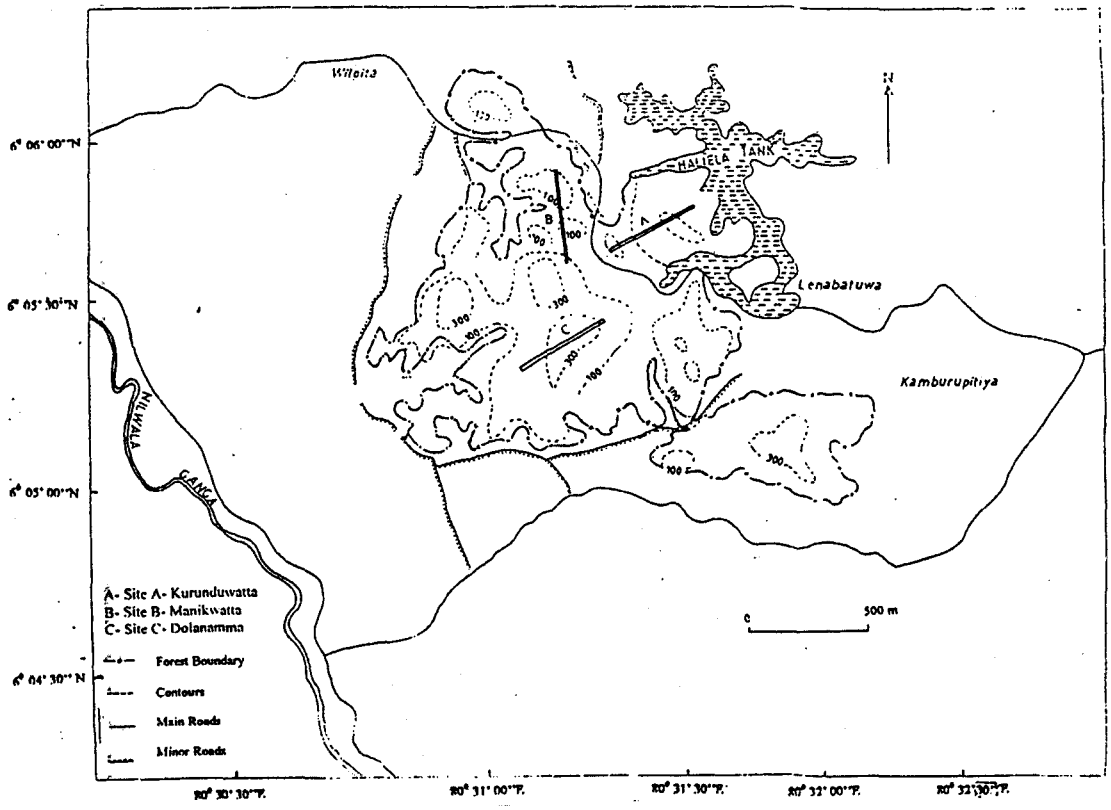

Figure 1. Map showing the Oliyagankele Forest Reserve in Matara District.

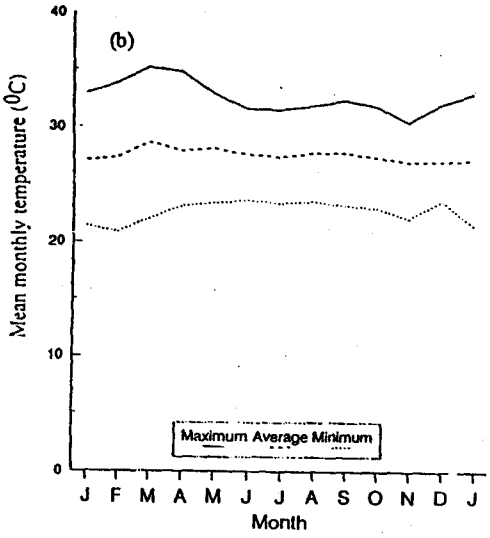

Figure 2. Mean monthly maximum and minimum temperature at Mapalana Meteorological Station in Matara District

Methods

After a preliminary reconnaissance survey, it was decided to select three spatially widely separated area (sites A, B, and C) for detailed study (Figure 1). At each site 16 contiguous plots, each 25x25 m in size, were located along a strip of vegetation spanning across the entire altitudinal range. Every major plot was divided into four 12.5x12.5 m sub-plots, and each sub-plot was again divided into four smaller plots each sized 6.25x6.25 m. Soil samples, collected from top 10 cm of the ground in each of these plots, were analyzed to test for their fertility status. Floristic data were collected from plants between 2-30 cm stem-circumference approximately at 25 cm above the ground.

The assessment of dominance of species and families was based on the Importance Value Index (Curtis and McIntosh 1950), where basal area was calculated using the stem circumference. For species area curve, the basic plot size (Block-size 1) used was 6.25x6.25 m, where the number of species present was noted; the Block-size 2 was constructed by combining two adjacent basic plots; similarly, the subsequent block-sizes were constructed. Similarity Coefficient (Sorensen 1948) of each site was computed using the following equation:

$$\text{Similarity Coefficient} = \{2c/(a+b)\}*100,$$

where, a is the number of species in one site, b is the number of species of the other site (being compared for similarity), and c is the number of species common to both sites. Identification of the specimens collected was made with the help of reference specimens at the National Herbarium in Peradeniya, and the available taxonomic literature (e.g. Trimen 1895-1900; Dassanayeke and Fosberg 1980 *et seq.*).

Results

Overall floristic and phytosociological heterogeneity within the Oliyagankele Forest Reserve appears to be associated with the combined effects of the variations of topography, aspect and relief, altitudinal gradients, and accompanied differences in surface run-off, erosion and other edaphic conditions. Of the three sites, whole of site B and a majority of the plots of Site-A represent habitats of the leeward side of the hills that are protected from the southwest monsoon winds. In contrast, majority of the Site-C plots represents habitats oriented towards southwest direction facing southwest monsoon winds.

Soil fertility status

The soils of Site-B are of relatively higher in fertility status (lesser amounts of larger particles, better water holding capacity, higher pH, higher phosphorus concentration) compared with the sites A and C (Tables 1 and 2).

Floristics

A total of 131 undergrowth woody species (>30 cm stem circumference) belonging to 95 genera and 43 families was enumerated from a sampling area of 3-ha representing all three sampling sites (Table 3). It appears that only about 38% of these species are endemic to Sri Lanka (Appendix I). Approximately, 70% of these species has the potential of attaining the size of trees and the rest (30%) is considered as typical undergrowth species. As it is normally expected, the numbers specie, genera, and families were relatively low at each study site simply because the area sampled was only 1-ha. In general, although Site-C has relatively higher number of species compared with the other two sites, the floristic richness appears to be more or less similar in all three sites. When all three sites are taken together, while the number of families showed only a marginal increase in comparison to that of a single site, the number of genera and species were increased by about 32% (Table 3).

Species Area Curve

The number of species per block consistently increased in all three sites with the increase in the size of the block up to the Block-size-7, corresponding to an area of 25x100-m rectangle. It appears that for the enumeration of woody undergrowth species a sampling area of 25x100-m rectangle would be sufficient to obtain the maximum number of species in a given community of this forest. It is evident from the results that on average between 90 and 100 woody species are found in any natural plant community at the Oliyagankele Forest Reserve.

Importance value ndex

The results indicated (Appendix-1) that the hierarchies of leading species based on the relative (a) frequency, (b) density, and (c) basal area respectively of the three study sites of undergrowth of Oliyagankele Forest Reserve are as follows:

1. *Macaranga digyna, Semecarpus gardneri, Aporosa lindleyana, Axinadra zeylanica, Gyrinops walla*, and *Strombosia zeylanica.*
2. *Polyalthia korinti, Macaranga digyna, Axinadra zeylanica, Aporosa lindleyana, Diospyros insignis*, and *Strombosia zeylanica.*
3. *Macaranga digyna, Semecarpus gardneri, Hopea jucunda, Axinadra zeylanica, Aporosa lindleyana*, and *Strombosia zeylanica.*

Table 1. Mean percent soil particle size (mm), organic carbon (OC) and water holding capacity (WHC) with standard errors (SE) of mean and standard deviations (SD) of the soils of three study sites (A, B, and C) of Oliyagankele Forest Reserve.

Attribute	Site	Mean	SE	SD
Particle-size				
>2.00	A	59	1.9	7.8
	B	18	2.8	11.0
	C	49	2.7	10.6
	Overall	42	2.9	20.0
2.00-0.48	A	20	1.4	5.6
	B	22	1.4	5.4
	C	25	1.4	5.5
	Overall	23	0.8	5.8
0.48-0.42	A	11	1.1	4.4
	B	31	1.6	6.2
	C	17	1.3	5.3
	Overall	19	1.4	9.9
0.42-0.25	A	4	0.24	0.95
	B	14	1.1	4.4
	C	5	0.33	1.33
	Overall	7.6	0.79	5.4
0.25-0.17	A	3.4	0.33	1.31
	B	10.3	0.82	3.3
	C	3.4	0.26	1.0
	Overall	5.7	0.56	3.9
<0.17	A	2.5	0.29	1.15
	B	3.9	0.34	1.3
	C	1.9	0.14	0.6
	Overall	2.0	0.21	1.42
OC	A	8.3	0.38	1.52
	B	5.5	0.33	1.73
	C	9.3	0.44	1.7
	Overall	7.7	0.32	2.21
WHC	A	36	1.3	5.0
	B	44	0.88	3.5
	C	38	2.38	9.5
	Overall	39	1.05	7.29

Table 2. Mean pH and concentrations of nitrogen, phosphorus, potassium, sodium and calcium of the soils of three study sites (A, B, and C) of Oliyagankele Forest Reserve.

Attribute	Site	Mean	SE	SD
pH	A	5.0	0.12	0.50
	B	6.2	0.06	0.24
	C	4.8	0.05	0.82
	Overall	5.3	0.1	0.71
Nitrogen	A	1.9	0.16	0.63
	B	2.2	0.12	0.42
	C	2.6	0.14	0.56
	Overall	2.2	0.08	0.61
Phosphorus	A	38.4	0.22	0.88
	B	42.8	1.62	6.47
	C	26.2	0.53	2.13
	Overall	35.8	1.37	6.18
Potassium	A	10.8	0.42	1.69
	B	7.3	0.83	3.30
	C	8.6	0.57	2.28
	Overall	8.9	0.41	2.85
Sodium	A	35.0	2.99	12.0
	B	20.9	2.35	9.42
	C	45.1	3.37	13.47
	Overall	33.7	2.20	15.26
Calcium	A	188	13.5	4.07
	B	92	9.18	36.74
	C	108	7.16	28.63
	Overall	130	8.45	58.53

Table 3. Numbers of families, genera and species of woody undergrowth at three study-sites (A, B, and C) and for the entire sampling area (sites A+B+C) of Oliyagankele Forest Reserve

Study Area	Families	Genera	Species
Site-A (1-ha)	40	70	90
Site-B (1-ha)	37	73	94
Site-C (1-ha)	41	73	99
Mean/site	39	72	94
Sites A+B+C(3-ha)	43	95	121

Table 4. Importance value index of leading species of the undergrowth at three study sites (A, B, and C) of Oliyagankele Forest Reserve

Species	Site-A	Site-B	Site-C
Macaranga digyna	7.1	5.5	4.0
Semecarpus gardneri	3.6	3.0	7.3
Aporosa lindleyana	2.8	4.1	4.8
Axinadra zeylanica	2.8	3.7	5.9
Gyrinops walla	2.8	2.1	5.6
Anisophyllea cinnamomoides	2.6	1.7	5.2
Calophyllum soulattri	2.4	2.0	1.4

For the undergrowth of entire forest reserve the highest importance value (16.6) was estimated for *Macaranga digyna,* followed by *Semecarpus gardneri, Hopea jucunda, Axinadra zeylanica, Aporosa lindleyana,* and *Polyalthia korinti* (Appendix-1). These leading species appear to be co-dominating the undergrowth community of this forest having IVIs above 10. Among the families, Euphorbiaceae (IVI=69.9) is the most dominant family, followed by Dipterocarpaceae, Anacardiaceae, Annonaceae, and Dilleniaceae with IVIs of 37.6, 29, 20.4, and 20.3 respectively (Appendix-2). *Macaranga digyna,* with an IVI of 7.1 showed dominance over the other species in the Site-A. This species is clearly co-dominating with *Aporosa lindleyana* and *Axinadra zeylanica* at the Site-B (Table 4). Its importance has dropped down to the sixth position at the Site-C, where the hierarchy of the leading species is *Semecarpus gardneri, Axinadra zeylanica,* and *Gyrinops walla.* Based on the IVIs of the species, the plant communities of the three sites may be conveniently summarized as follows:

Site-A: *Macaranga digyna* dominated plant community
The other leading species of this community include by *Semecarpus gardneri, Axinadra zeylanica,* and *Aporosa lindleyana.* (This community is almost a *Macaranga digyna* Consociation.)
Site-B: *Macaranga digyna, Aporosa lindleyana* and *Axinadra zeylanica* co-dominated plant-community. (This community is an Association of *Macaranga digyna-Aporosa lindleyana- Axinadra zeylanica.*)
Site-C: by *Semecarpus gardneri, Axinadra zeylanica,* and *Gyrinops walla* co-dominated plant Community (This community is an Association of *Semecarpus gardneri-Axinadra zeylanica- Gyrinops walla.*)

Girth-Class distribution

On average the density of the woody stems of the undergrowth vegetation of Oliyagankele Forest Reserve is 3,500 stems/ha (Table 5). Despite a slight increase at sit-C, the environmental differences apparently are not significantly affecting the stem density. The proportions of stems represented by the three stem circumference classes (2-9.4, 9.5-19.4, and 19.5-29.4 cm) at three sites appear to show a consistent ratio of 6:5:3.

Species richness, Basel area and Stand height

The undergrowth of Site-C possessed the highest number of species, mean basal area and the mean stand height of Oliyagankele Forest Reserve. The lowest figures were obtained for the Site-A, and the site-B held medium values for the three parameters of importance (Table 6).

Table 5. Stem density (number of stems/ha) of stem circumference classes (2-9.4, 9.5-19.4, and 19.5-29.4 cm) of the woody undergrowth (between 2-30 cm stem circumference) of Oliyagankele Forest Reserve

SCC	Site-A	Site-B	Site-C	Mean Ratio
2-9.4	1394 (b)	1504 (a)	1543 (a)	1480 (a) 6
9.5-19.4	1275 (b)	1278 (b)	1218 (b)	1257 (b) 5
19.5-29.4	805 (c)	701 (c)	789 (c)	765 (c) 3
Mean	3474 (d)	3483 (d)	3550 (d)	3502 (d)

SCC: Stem Circumference Class
Dissimilar lower case letters (a-d in parentheses) indicate significant difference between the means.

Table 6. Species richness (number of species), basal area, and mean stand height of the undergrowth of Oliyagankele Forest Reserve

Study site	No. Species	Basal Area (m^2/ha)	Mean Stand-Height (m)
A	90 (a)	9.94 (d)	4.7 (f)
B	94 (b)	10.72 (d)	5.9 (g)
C	99 (c)	13.49 (e)	9.4 (h)
Mean	94	11.38	6.7

Dissimilar lower case letters (a-d in parentheses) indicate significant difference between the means.

Population density

The density of each species was computed as the number of stems/ha and the whole series was divided into density rank-classes, so that each class contains a range of 25 densities (Table 7).
Majority of the individuals, for example >100 stems/ha are represented by a very few common species (Figure 5). About 59% of the total number of species and 44% of the endemic species possess less than 25 individuals/ha. The plot of class-of-species (Y-axis) and total- number-of-individuals/species (X-axis) is a typical scree-plot characterized by a steep slope and a break between 3-12 of the Y-axis followed by a gradual trailing thereafter. There is a slight increase at the end of the plot due to the accumulation of all the density rank classes (401 and above). It appears that the density of the percent number of endemic species also follows exactly a similar pattern.

Discussion

A comprehensive knowledge of the differential behavior of the individual species is an essential prerequisite to causal interpretation of vegetational heterogeneity of any ecosystem. Of the key attributes affecting the vegetational variation, floristic-composition, species richness, standing crop and species preponderance are the most important. Whereas all four parameters are essential for characterizing phytosociological differences of complex vegetation such as Oliyagankele Forest Reserve standing crop and species preponderance are more informative than the other two in elucidating the vegetational heterogeneity. The enumeration of the basal are and the mean height enable quantification of biomass and productivity of the undergrowth, which could be regarded as an indirect rough estimation of the standing crop of the undergrowth of the forest.

Table 7. The percent numbers of total and endemic species in each density-rank class of the woody undergrowth of Oliyagankele Forest Reserve

Density-rank Class	Percent No. Total species	Percent No. Endemic species
1-25	59.0	44.0
26-50	11.0	15.0
51-75	4.0	7.4
76-100	1.6	1.9
101-125	7.1	9.3
126-150	0.8	1.9
151-175	0.8	1.9
176-200	1.6	1.9
201-225	2.4	3.7
226-250	2.4	3.7
251-275	0.8	1.9
276-300	1.6	1.9
301-325	0.8	0.8
326-350	1.6	0.0
351-375	0.0	0.0
376-400	1.6	0.0
401 and over	3.2	3.7

Analysis of the soils revealed that the fertility status of the soils of different areas of the forest is heterogeneous. The relationship between the vegetational heterogeneity and altitudinal gradients of Oliyagankele Forest Reserve appears to be similar to most other lowland forests in Sri Lanka (e.g. Peeris 1975, Gunatilleke and Gunatilleke 1980, Pemadasa and Gunatilleke 1981, Pemadasa 1986). Generally, the steeper hillsides are much eroded, truncated and denuded than the hillsides with more-gentler slopes. The surface runoff is much stronger in the former where the erosion is relatively less. It can be expected that the surface erosion causes not only removal of soluble nutrients leading to the impoverishment and deficiency of nutrients in the soil, but also remobilization of soil particles creating differences in soil mechanical composition, texture and water holding capacity. The outcome of the totality of all these effects is to create chemical, mechanical, and textural diversity within the forest. It is generally believed that the soils of Sri Lanka are typically poor in mineral nutrients (Abeywickrama 1956; Panabokke 1967). This is particularly so in the wet zone habitats with perennially high rainfalls, hence the soils undergo impoverishment due to surface runoff and the leaching losses of the soluble nutrients. Notwithstandingly, it appears that the soils of Oliyagankele Forest Reserve show relatively higher overall concentrations of nutrients than those reported for the lowland rainforests of the other countries (e.g. Poels 1987, Eden 1974). The results of the present work show parallelism with the results reported by Chandrasena (1994) who also obtained comparable mineral nutrient concentrations for soil samples collected from number of forest patches in Matara district of Sri Lanka.

It is clear that the number of undergrowth woody species (131) and the endemics (38%) recorded in the sampling areas (3-ha) of this forest were much lower than the results obtained by de Zoysa *et al.* (1988). They have sampled an area of 2-ha at Sinharaja Forest Reserve and recorded a total number of 259 species of which 60% were endemics. Presumably, the low numbers of total species and endemic species recorded in the present study is associated with the exclusion of herbs from the study coupled with differences in climatic (low rainfall) and topographical heterogeneity (relatively more homogeneous) of the Oliyagankele Forest Reserve, compared with those of Sinharaja Forest Reserve, and the degree of disturbance. It should be noted that the total number of all the species of plants present in the forest must include non-woody species including epiphytes, ferns and grasses, and herbs as well as plants which are not found in the sampling plots. Although, certain woody species (e.g. *Ochlandra stridula*, *Coscinium fenestratum*, *Asparagus* sp., and *Calamus* spp.) are relatively common, they were not found in the sampling plots. Relatively higher number of species in the Site-C in relation to the other two sites may be attributable to its steeper slopes and topographic heterogeneity.

Apparently, that the individuals encountered as undergrowth plants represent not only typical undergrowth species but also the young plants of the typical tree species, and so the list of species recorded is also a list of woody species (Appendix 1). The number of species per block consistently increased in all three sites with the increase in size of the block up to the Block-size-7, corresponding to an area of 25x100-m rectangle. This area (about quarter of a hectare) is just a fraction of the minimal area (about 3-ha) recommended for Sinharaja (Gunatilleke and Gunatilleke 1980 and 1981), and therefore the applicability of the method to other forests is questionable and should be tested. It is evident from the results that on average between 90 and 100 woody species are found in any natural plant community at the Oliyagankele Forest Reserve.

It was found that in general, the most dominant species of the undergrowth of this forest is *Macaranga digyna*; in some areas (e.g. Site-A) it forms more or less a consociation (see Appendix 1). The other important determinants of the undergrowth community are *Semecarpus gardneri* (the most dominant species in some areas, e.g. Site-C), *Hopea jucunda*, *Axinadra zeylanica*, *Aporosa lindleyana*, *Polyalthia korinti*, and *Gyrinops walla*. These leading species appear to be co-dominating the plant communities of most areas of the undergrowth of this forest. Of the families, Euphorbiaceae is the most dominant family of the undergrowth, indicating what could be called a single-family dominance in the undergrowth. The other important families of the undergrowth include Dipterocarpaceae, Anacardiaceae, and Annonaceae (see Appendix 2). Based on the results the three hillsides are different in their composition and structure reflecting habitat and community heterogeneity of the undergrowth vegetation.

The density of 3,500 stems/ha of woody undergrowth of Oliyagankele Forest Reserve indicates that each of these stems occupy approximately 3-m^2 (a square of nearly 1.7x1.7m). It appears that most of this space (approximately 80%) is occupied by the individuals less than 20 cm stem circumference (Table 5). Despite a slight increase in the 2-9.4 cm class at Site-C, probably due to increased light penetration, the environmental differences apparently are not significantly affecting the stem density of different communities.

Of the three communities, the undergrowth of Site-C has the highest basal area, the mean stand height, and the number of species. It is very clear that if less than 25 individuals/ha is considered as rare for undergrowth species, nearly 59% of the total number of species, and 44% of the endemic species are rare in this forest. Only less than 5% of the species (including endemics) appears to be very common.

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Appendix -1. The importance value index (IVI) calculated by the method of Curtis and McIntosh (1950) and the relative (a) frequency (RF), (b) density (RD), and (c) basal area (RBA) of the relatively common species of undergrowth (2-30 cm gbh) recorded in forty-eight 25x25 m sampling plots. (The endemic species are marked with an star.)

Species	Family	RF	RD	RBA	IVI	
Acronychia pedunculata	Rubiaceae	0.2	0.1	0.1	0.4	
Adenanthera pavonina	Leguminosae	0.1	0.0	0.0	0.1	
Agrostistachis coriacea	Euphorbiaceae	0.4	1.1	1.3	2.8	
Allophyllus cobbe	Sapindaceae	0.1	0.0	0.0	0.1	
Alstonia macrophylla	Apocynaceae	1.3	0.9	1.0	3.2	
Anisophyllea cinnamomoides	Euphorbiaceae	2.9	3.6	2.9	9.4	
*Aporosa cardiosperma**	Euphorbiaceae	1.7	1.1	1.1	3.9	
Aporosa lindleyana	Euphorbiaceae	3.2	4.2	4.3	11.7	
Ardisia humilis	Myrsinaceae	0.1	0.0	0.0	0.1	
*Artocarpus nobilis**	Moraceae	2.1	0.5	0.5	3.1	
*Axinadra zeylanica**	Melastomaceae	3.1	4.5	4.8	12.4	
*Calophyllum bracteatum**	*Clusiaceae*	*0.1*	*0.0*	*0.0*	*0.1*	
*Calophyllum calaba**	Clusiaceae	0.8	0.2	0.4	1.4	
*Calophyllum cuneifolium**	Clusiaceae	0.3	0.1	0.1	0.5	
Calophyllum inophyllum	Clusiaceae	0.1	0.0	0.0	0.1	
Calophyllum soulattri	Clusiaceae	2.9	0.0	2.9	5.8	
*Calophyllum thwaitesii**	Clusiaceae	0.6	0.1	0.3	1.0	
*Campnosperma zeylanica**	Anacardiaceae	0.4	0.2	0.2	0.8	
*Canarium zeylanicum**	Burseraceae	0.5	0.9	0.2	1.6	
Carallia brachiata	Rhizophoraceae	0.5	0.2	0.3	1.0	
*Carallia calycina**	Rhizophoraceae	0.5	0.2	0.1	1.3	
Chaetocarpus coriaceus	Euphorbiaceae	2.4	2.9	2.4	7.7	
*Cryptocarya membranacea**	Lauraceae	0.2	0.1	0.1	0.4	
*Cullenia zeylanica**	Bombacaceae	1.8	0.0	1.1	2.9	
*Cyathocalyx zeylanicus**	Annonaceae	1.4	1.0	0.8	3.2	
*Dillenia retusa**	Dilleniaceae	2.4	2.5	2.0	6.9	
Diospyros insignis	Ebenaceae	2.4	4.0	2.6	9.0	
Diospyros racemosa	Ebenaceae	0.1	0.0	0.0	0.1	
Diospyros sylvatica	Ebenaceae	0.9	0.4	0.5	1.8	
*Dipterocarpus hispidus**	Dipterocarpaceae	0.5	0.3	0.3	1.1	
*Dipterocarpus insignis**	Dipterocarpaceae	0.2	0.1	0.1	0.4	
*Dipterocarpus zeylanicus**	Dipterocarpaceae	2.0	1.3	1.3	4.6	
*Enicosanthum acuminatum**	Annonaceae	0.1	0.0	0.0	0.2	
Elaeocarpus subvillosus	Elaeocarpaceae	0.2	0.1	0.1	0.4	
*Garcinia cambogia**	Clusiaceae	0.2	0.1	0.1	0.4	
Garcinia morella	Clusiaceae	0.3	0.1	0.1	0.5	
Glochiodion zeylanicum	Euphorbiaceae	0.6	0.3	0.4	1.3	
Gyrinops walla	Thymelaeaceae	3.1	3.7	3.7	10.5	
Hopea discolor*	Disterocarpaceae	0.5	0.7	0.4	1.6	
Homelium zeylanicum	Flacourtaceae	0.2	0.1	0.1	0.4	
Horsfieldia irya	Myristicaceae	0.3	0.1	0.2	0.6	
*Horsfieldia iryaghedhi**	Myristicaceae	0.1	0.0	0.0	0.1	
*Hopea jucunda**	Dipterocarpaceae	2.3	3.8	6.4	12.5	
Hunteria zeylanica	Apocynaceae	1.0	1.1	0.3	2.4	
*Hydnocarpus octandra**	Flacourtaceae	1.4	3.0	2.1	6.5	
Kokoona zeylanica	Celastraceae	2.4	0.5	2.3	5.2	
Lannea coromandelica	Anacardiaceae	0.2	0.0	0.0	0.2	
Leea indica	Leeaceae	0.2	0.1	0.1	0.4	
Macaranga digyna	Euphorbiaceae	3.7	4.8	8.1	16.6	
*Madhuca fulva**	Sapotaceae	0.7	0.2	0.3	1.2	
*Mangifera zeylanica**	Anacardiaceae	1.8	2.6	2.1	6.5	
Mastixia thwaitesii	Cornaceae	0.2	0.0	0.0	0.2	
*Memecylon angustifolium**	Melastomaceae	1.2	0.2	1.0	2.4	
*Memecylon capitellatum**	Melastomaceae	1.9	0.6	1.5	4.0	

Appendix -1. Contd.

Species	Family	RF	RD	RBA	IVI
Meliosma arnottiana	Sabiaceae	0.3	0.1	0.2	0.6
Mesua nagassarium	Clusiaceae	0.8	1.4	1.1	3.3
Murraya paniculata	Rutaceae	0.2	0.1	0.1	0.4
Myristica dactyloides	Myristicaceae	1.4	0.9	1.1	3.4
Neolitsea cassia	Lauraceae	1.0	0.8	0.9	2.7
Ochna lanceolata	Ochnaceae	0.7	0.3	0.4	1.4
*Ochna squarrosa**	Ochnaceae	0.5	0.2	0.3	1.0
*Palaquium grande**	Sapotaceae	2.5	1.4	2.0	5.9
Polyalthia korinti	Annonaceae	2.4	5.0	3.2	10.6
Prunus walkeri	Rosaceae	2.5	2.3	1.9	6.7
Pterospermum canescens	Sterculiaceae	0.3	0.9	0.1	1.3
*Putranjiva zeylanica**	Euphorbiaceae	2.0	0.9	1.9	4.8
Schumacheria castaneifolia	Dilleniaceae	1.6	2.7	2.7	7.0
Semecarpus gardneri	Anacardiaceae	3.6	2.9	7.3	13.8
*Semecarpus obovata**	Anacardiaceae	2.3	3.1	2.3	7.7
Shorea congestiflora	Dipterocarpaceae 1.6	1.8	1.9	5.3	
*Shorea dyeri**	Dipterocarpaceae 1.9	2.0	1.6	5.5	
Shorea trapezifolia	Dipterocarpaceae 0.1	0.0	0.0	0.1	
Stereospermum personatum	Bignoniaceae	0.1	0.0	0.0	0.1
Strombosia zeylanica	Olacaceae	3.1	3.9	3.3	10.3
Swietenia mahogony	Meliaceae	1.9	1.7	1.2	4.8
*Syzygium aqueum**	Myrtaceae	1.0	0.6	0.6	2.2
*Syzygium makul**	Myrtaceae	0.8	0.2	0.5	1.5
Syzygium operculatum	Myrtaceae	0.2	0.0	0.0	0.2
Tarenna asiatica	Rubiaceae	0.2	0.1	0.1	0.4
*Trichadenia zeylanica**	Flacourtaceae	1.0	0.2	0.6	1.8
Turpinia malabarica	Staphyleaceae	0.2	0.1	0.1	0.4
Unona elegans	Annonaceae	0.8	0.3	0.5	1.6
*Urandra apicalis**	Icacinaceae	0.1	0.1	0.1	0.3
*Vateria copallifera**	Dipterocarpaceae 2.5	1.8	2.2	6.5	
Vitex pinnata	Verbinaceae	0.2	0.1	0.1	0.4
Wormia triquetra*	Dilleniaceae	1.7	2.7	2.0	6.4
Xylopia parvifolia	Annonaceae	2.0	1.0	1.8	4.8

Appendix -1. Contd. List of rare species, which are not included in the computation of Importance Value Index:

Acacia mearnsii, Adenanthera aglaosperma, Bridelia retusa, Caryota urens, Chaetocarpus castanocarpus, Cinnamomum vernum, Diospyros moonii*, Elaeocarpus serratus,*
Erythrina variegata, Ficus benghalensis, Ficus hispida, Flacourtia inermis, Gmelina arborea, Goniothalamus gardneri*, Hopea discolor, Humboldtia laurifolia*
Kurrimia zeylanica, Litsea glutinosa, Madhuca neriifolia , Mimusops elengi*
Mussaenda frondosa, Ochlandra stridula, Olax zeylanica, Pericopsis mooniana*
Petchia ceylanica, Pleurostylia opposita, Pongamia pinnata, Psidium guajava,*
Rejoua dichotoma, Scyphostachys coffaeoides, Scolopia acuminata*, Shorea gardneri*, Shorea congestiflora*, Shorea dyeri*, Shumacharia castaneifolia*, Symplocos loha*
Syzygium caryophyllatum*, Syzygium cordifolium, *Terminalia arjuna, Terminalia parvifolia*, Trema orientale, Petchia zeylanica, Xylopia championii**

Appendix 2. List of thirty-eight plant families of undergrowth (2-30 cm gbh) which occurred in forty-eight 25x25 m sampling plots with their importance value indices (IVIs) calculated for the entire forest reserve.

FAMILY	IVI	FAMILY	IVI	FAMILY	IV
Anacardiaceae	29.0	Euphorbiaceae	69.9	Ochnaceae	2.4
Annonaceae	20.4	Flacourtaceae	10.5	Olacaceae	2.3
Apocynaceae	5.6	Icacinaceae	0.3	Rosaceae	6.7
Bignoniaceae	0.1	Lauraceae	3.1	Rubiaceae	0.4
Bombacaceae	2.9	Leeaceae	0.4	Rutaceae	0.8
Burseraceae	1.6	Leguminosae	0.1	Sabiaceae	0.6
Celastraceae	5.2	Melastomaceae	18.8	Sapindaceae	0.1
Clusiaceae	13.1	Meliaceae	4.8	Sapotaceae	7.1
Cornaceae	0.2	Moraceae	3.1	Staphyleaceae	0.4
Dilleniaceae	20.3	Myristicaceae	0.7	Sterculiaceae	1.3
Dipterocarpaceae	37.6	Myrsinaceae	3.5	Thymelaeaceae	10.5
Ebenaceae	10.9	Myrtaceae	3.9	Verbinaceae	0.4
Elaeocarpaceae	0.4				

Oliyagankele Forest Reserve (latitude 6^0 10' N and longitude 80^0 32' E) is situated near Kamburupitiya, approximately 15 km north of Matara town and covers about 500 ha. Topographically, the forest reserve is moderately hilly, and the altitude varies from 30-100 m (Figure 1).

It is evident that the mean monthly rainfall is bimodally distributed with maxima in May and October – November (Figure 2) mainly due to southwest and northeast monsoons. For species area curve, the basic plot size (Block-size 1) used was 6.25x6.25 m, where the number of species present was noted; the Block-size 2 was constructed by combining two adjacent basic plots; similarly, the subsequent block-sizes were constructed.