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A QUANTITATIVE STUDY OF PIGMY FOREST AT 2000 M IN HAKGALA STRICT NATURAL RESERVE

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Abstract

A study was made in 1996 of the composition, abundance, and density of the flora of this type of pigmy forest. In the overstorey (≥ 8 cm girth at 20 cm above ground level) there were recorded 18 species of 13 genera and 8 families, and in the understorey (non-woody species and woody species < 8 cm) 41 species of 35 genera and 25 families; 16 species (39%) were common to both. Syzygium sclerophyllum *was the most dominant species in both storeys. Many species were endemics.*

Introduction

Pigmy forest is a physiognomically distinctive formation, consisting mainly of broad-leaved tropical species, dwarfed to an extreme degree (Richards, 1952; de Rosayro, 1958; Whitmore, 1984). These forests are generally remarkable for the small, hard and shiny leaves that dominate their foliage (Brunig, 1974; Grubb, 1980). Soil infertility, strong winds, and water deficits can cause their formation (de Rosayro, 1958; Turner et al., 1995). Their ecological interest is that they prevent soil erosion, provide shelter and space for the forest fauna, and facilitate nutrient cycling.

In Sri Lanka the upper montane rain forest (1500-2524 m) covers about 300 km^2 (Werner, 1982). The extent of the pigmy forest community included in this figure is not separately recorded. It is confined to the higher altitudes, above 1800 m (de Rosayro, 1958; Wijesundara, 1991). Pigmy forest is classified as such on the basis of floristic composition and physiognomic features (de Rosayro, 1958). In Sri Lanka it is a climax formation. It contains genera that are representative of the montane rain forest, but the height of the trees is uniformly reduced to 60-90 cm (de Rosayro, 1958).

The characteristic tree species are of the genera *Eugenia*, *Syzygium* and *Calophyllum*. Among the shrubs, species of Rubiaceae, including the genera *Hedyotis* and *Osbeckia* are dominant. The ground layer consists of small herbaceous plants (eg *Indocalamus debilis* and *Biophytum proliferum*). According to de Rosayro (1958) and Wijesundara (1991) the pigmy forests that are found in the lowland montane rain forests are different from those of the upper montane rain forests in species composition.

Study site, materials and methods

The study site is in Hakgala Strict Natural Reserve, 6 km south-east of Nuwara Eliya, at about 2000 m.

For the study of species composition, plant specimens were collected from the overstorey (trees and shrubs > 8 cm girth at 20 cm above ground level) and understorey vegetation. Herbarium specimens were prepared by the techniques given in Mitra (1974). They were identified in the National Herbarium, Peradeniya, and from specimens in the Hakgala Botanic Garden. The identifications were confirmed by referring to Dassanayake & Fosberg (1980-87) and Wijesinghe (1994). The endemicity of plant species and their medicinal importance were studied by consulting these reference books, and also Jayaweera (1981-82).

For the quantitative survey a representative undisturbed area of about one ha was selected, in which 25 plots of 4 × 4 m were located at random, and demarcated. Each plot was subdivided into four. For each species, percentage frequency and density were estimated on the basis of its occurrence in these plots (Greig-Smith, 1957). Dominance (in terms of basal area) was estimated only for the overstorey flora.

Results

Table 1 shows the species composition. In the overstorey, 18 species of 13 genera and 8 families were recorded, of which 11 species (61%) were endemic and 3 (17%) medicinally important. In the understorey there were 41 species of 35 genera and 25 families, of which 12 species (29%) were endemic and 5 (12%) medicinally important. The understorey, therefore, was floristically much richer than the overstorey. The overstorey consisted of 11 tree (61%) and 7 shrub (39%) species; the understorey of 11 tree species (27%), 13 shrubs (32%), 4 herbs (10%), 1 creeper (2%), and 2 climbers (5%). The herb *Eupatorium riparium* was the only exotic. Sixteen species were common to both storeys. Except for *Daphniphyllum neilgherrense* and *Callophyllum walkeri* all the species of the overstorey were also found in the understorey.

Table 2 shows the frequency, density, and dominance of each species. In the overstorey the most frequent species were *Syzygium sclerophyllum*, 73%; *S. revolutum*, 44%; and *Hedyotis trimenii*, 23% of plots, (relative frequency 25%, 15% & 8%). *Syzygium sclerophyllum* and *S. revolutum* were also the densest and most dominant species. In the understorey the most frequent species were *Syzygium sclerophyllum*, 63%; *Indocalamus debilis*, 41%; and *Actinodaphne ambigua*, 39% of plots (relative frequency 9%, 6% and 6%) but the densest were *Anotis nummularia*, *Blumea hieracifolia* and *Syzygium sclerophyllum*.

Discussion

Pigmy forest (within the upper montane rain forest) is found very close to the summit of Hakgala Strict Natural Reserve (Wijesundara, 1991). It is physiognomically similar to the pigmy forest of the Knuckles Range (lowland montane rain forest), although the floristic similarity ends at generic level. From the present study, it is evident that the overstorey and

understorey are both dominated by the families Myrtaceae, Symplocaceae, Rubiaceae and Bambusaceae. The presence of 32% of endemic species and 12% of medicinally important species indicate the importance of the pigmy forest. The average number of individuals per square metre is one in the overstorey and three in the understorey. Categorization of the overstorey flora on a girth limit (8 cm at 20 cm above ground level) was meaningful; branching starts at this height among many of the woody species. The physiognomy of pigmy forest is related to the harsh environmental conditions prevailing there, ie high light intensity, high wind velocity, poor supply of water and nutrients (de Rosayro, 1958). The overstorey experiences harsh environmental conditions directly, and the presence of only 18 species shows that few can adapt to these conditions (de Rosayro, 1958). The exotic species *Eupatorium riparium* was introduced in 1905 from Mexico (Willis, 1908). It is wind dispersed, and is one of the most serious invaders in the montane zone of Sri Lanka (Bond, 1952). It has been spread into this pigmy forest by both wind and human transport. Endemism of species is high in the pigmy forest; according to Willis (1908) and de Rosayro (1958) it is mainly due to the isolation of each mountain.

Table 1 : Floristic composition

T – tree, S –shrub, H – herb, C – climber, Cr – creeper
*endemic, #exotic, +medicinally important

Families and species	Life form
Acanthaceae	S
Strobilanthes diandra (Nees) Alston	
Aquifoliaceae	T
Ilex walkeri Wight & Gardn. ex Thw.	
Asteraceae	
Blumea hieracifolia (D. Don) DC. in Wight	H
Emilia zeylanica C.B. Clarke	H
Eupatorium riparium Regel	H#
Bambusaceae (Gramineae)	
Indocalamus debilis (Thw.) Alston	S
Clusiaceae	
Calophyllum walkeri Wight	T*+
Commelinaceae	
Anotis nummularia Hk..f.	H
Cyanotis cristata (L.) D. Don	H
Cyperaceae	
Carex longicruris Nees	H
Daphniphyllaceae	
Daphniphyllum neilgherrense (Wight) Thw.	T

Ericaceae	
Vaccinium symplocifolium (G. Don) Alston	S
Euphorbiaceae	
Phyllanthus sp.	H
Flacourtiaceae	
Caesaria thwaitesii Briq.	T*
Lamiaceae	
Pogostemon sp.	H
Lauraceae	
Actinodaphne ambigua (Meisn.) Hook.f.	T*
Cinnamomum ovalifolium Wight	T*+
Liliaceae	
Asparagus zeylanicus (Baker) Hook.f.	Cr
Melastomataceae	
Osbeckia walkeri Arn.	S*
Myrtaceae	
Eugenia mabaeoides Wight	S*
Rhodomyrtus tomentosa (Alt.) Hassk..	S
Syzygium revolutum Walp.	T
Syzygium rotundifolium Arn.	T*
Syzygium sclerophyllum Thw.	T*
Piperaceae	
Piper zeylanicum Miq.	C
Poaceae	
Cyrtococcum sp.	H
Pteridaceae	
Asplenium sp.	H
Rhamnaceae	
Rhamnus wightii Wight & Arn.	S+
Rosaceae	
Rubus indicus Thunb.	S
Rubiaceae	
Hedyotis trimenii Deb. & Dutta	S*
Hedyotis lessertiana Arn.	S*
Lasianthus gardneri (Thw.) Hook.f.	S*
Lasianthus varians (Thw.) Thw.	S*

Neurocalyx gardneri Thw.	H
Psychotria zeylanica Sohmer	T
Rutaceae	
Toddalia asiatica (L.) Lam.	C^+
Symplocaceae	
Symplocos bractealis Thw.	S*
Symplocos cochinchinensis (Lour.) S. Moore	T
Symplocos sp.	T
Umbelliferae	
Centella asiatica (L.) Urb.	H^+
Violaceae	
Viola serpens Wall.	H

Table 2 : Frequency, density, and dominance (each value is a mean of 25 replicates)

	Overstorey			Understorey	
	Percentage and (relative) frequency	**Density/ 100 m^2 and (relative density)**	**Dominance/1 0^5 and (relative dominance)**	**Percentage and (relative) frequency**	**Density/ 100 m^2 and (relative density)**
Syzygium sclerophyllum	73 (24.6)	23 (25.0)	39 (22.3)	63 (8.9)	20 (6.8)
Syzygium revolutum	44 (14.8)	13 (14.1)	40 (22.9)	38 (5.4)	10 (3.4)
Hedyotis trimenii	23 (7.7)	7 (7.6)	7.8 (4.5)	19 (2.7)	5 (1.7)
Indocalamus debilis	-	-	-	41 (5.8)	12 (4.1)
Actinodaphne ambigua	22 (7.4)	8 (8.7)	13.7 (7.8)	39 (5.5)	10 (3.4)
Syzygium rotundifolium	21 (7.1)	8 (8.7)	18 (10.3)	21 (2.9)	8 (2.7)
Rhodomyrtus tomentosa	20 (6.7)	6 (6.5)	6.5 (3.7)	12 (1.7)	4 (1.4)
Eugenia mabaeoides	19 (6.4)	5 (5.4)	4.6 (2.6)	19 (2.7)	6 (1.9)

Osbeckia walkeri	18 (6.1)	6 (6.5)	7.5 (4.3)	26 (3.7)	8 (2.7)
Caesaria thwaitesii	13 (4.4)	5 (5.4)	15 (8.6)	27 (3.8)	8 (2.7)
Cinnamomum ovalifolium	10 (3.4)	2 (2.2)	1.7 (0.9)	24 (3.4)	6 (1.9)
Symplocos bractealis	10 (3.4)	3 (3.3)	3.7 (2.1)	21 (2.9)	5 (1.7)
Symplocos sp.	8 (2.7)	2 (2.2)	15 (8.6)	16 (2.2)	4 (1.4)
Calophyllum walkeri	5 (1.7)	1 (1.1)	0.1 (0.1)	-	-
Hedyotis lessertiana	4 (1.3)	1 (1.1)	0.9 (0.5)	6 (0.8)	2 (0.7)
Symplocos cochinchinensis	3 (1.0)	1 (1.1)	0.4 (0.2)	16 (2.2)	4 (1.4)
Psychotria zeylanica	2 (0.7)	0.5 (0.5)	0.3 (0.1)	21 (2.9)	8 (2.7)
Rhamnus wightii	1 (0.3)	0.3 (0.3)	0.1 (0.7)	14 (1.9)	6 (1.9)
Daphniphyllum neilgherrense	1 (0.3)	0.3 (0.3)	0.2 (0.1)	-	-
Phyllanthus sp.	-	-	-	34 (4.8)	8 (2.7)
Anotis nummularia	-	-	-	27 (3.8)	30 (10.3)
Blumea hieracifolia	-	-	-	24 (3.4)	2 (0.7)
Ilex walkeri	-	-	-	23 (3.3)	6 (1.9)
Eupatorium riparium	-	-	-	22 (3.1)	14 (4.8)
Cyanotis cristata	-	-	-	20 (2.8)	5 (1.7)
Lasianthus gardneri	-	-	-	16 (2.3)	4 (1.4)
Carex longiccruris	-	-	-	13 (1.8)	3 (1.3)
Strobilanthes diandra	-	-	-	12 (1.7)	5 (1.7)
Centella asiatica	-	-	-	10 (1.4)	15 (5.1)
Asparagus zeylanicus	-	-	-	9 (1.3)	2 (0.7)
Piper zeylanicum	-	-	-	9 (1.3)	4 (1.4)

Toddalia asiatica	-	-	-	9 (1.3)	2 (0.7)
Emilia zeylanica	-	-	-	8 (1.1)	1 (0.3)
Lasianthus varians	-	-	-	8 (1.1)	2 (0.7)
Pogostemon sp.	-	-	-	8 (1.1)	12 (4.1)
Biophytum proliferum	-	-	-	7 (0.9)	4 (1.4)
Neurocalyx gardneri	-	-	-	6 (0.8)	3 (1.3)
Rubus indicus	-	-	-	6 (0.8)	1 (0.3)
Asplenium sp.	-	-	-	4 (0.4)	20 (0.7)
Vaccinium symplocifolium	-	-	-	3 (0.4)	1 (0.3)
Viola serpens	-	-	-	3 (0.4)	40 (13.6)
Unidentified species	-	-	-	1 (0.1)	5 (1.6)

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