

STRUCTURE AND COMPOSITION OF VEGETATION IN THE IFS -POPHAM ARBORETUM, DAMBULLA

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IFS - Popham Arboretum, Dambulla

ABSTRACT

The Dambulla Arboretum is a unique place, where a wasteland has been converted into a sanctuary of tropical trees by using a simple silvicultural method. The Arboretum consists of 3.6 ha arboretum along with a 10.8 ha woodland. The goal of the present survey was to document the abundance of dry zone key plant species and to update the checklist of plants in terms of seasons.

The abundance of plant species, which were naturally regenerated, was enumerated in six 20 m × 20 m experimental plots. The girth at breast height (gbh) of individuals over 10 cm was measured within main plots, while individuals below 10 cm gbh were counted in 20 m × 10 m sub plots within the main plots. Five random plots 2 m × 2 m quadrates were used to measure the cover value of ground vegetation. In addition, annuals and biannual during the wet and dry season and undocumented perennials were encountered in an ad hoc manner addition to the experimental plots.

A total of 101 plant species belonging to 91 genera and 42 families were identified. Among the taxa identified 45 had medicinal value, 14 timber value and 7 both timber and medicinal value. There were 45 tree spp., 27 shrub spp., 18 herbaceous spp. and 11 climber spp. Of them five were endemic viz., *Diospyros oppositifolia*, *Diplodiscus verrucosus*, *Cunarium zeylanicum*, *Cassine balae* and *Micromelum minutum*. The leading dominant species and families based on important value index (IVI) were *Syzygium cumini* and Myrtaceae (IVI = 29 & 32), *Grewia damine* and Tiliaceae (IVI = 23 & 28) and *Memecylon umbellatum* and Rubiaceae (IVI = 16 & 25) respectively.

In the ordination diagram, the plots in the arboretum and woodland are clearly separated by four distinguishable clusters and were assigned into plant communities. The species associated with cluster A were mainly trees viz., *Diplodiscus verrucosus*, *Diospyros ferrea*, *Lepisanthes tetraphylla* and *Sapindus emarginatu* along with a shrub. While Cluster C resulted in five tree species. The survey has shown that the arboretum provides refuge to many valuable timber trees, including endemic and endangered plant species.

INTRODUCTION

The dry zone forests of Sri Lanka have experienced a boost in large-scale depletion of forest land by slash and burn agriculture, illegal felling, fire, irrigation schemes and agricultural expansion resulting from a growing population (Samarasinghe, 1995). As a remedy reforestation and conservation have been carried out by the Forest Department on degraded lands of the dry zone. Mr. F. H. Popham introduced a sustainable silvicultural method namely the Popham method (Popham, 1993), which facilitates the natural regeneration of indigenous species. This leads to succession towards woodlands dominated by small trees and bushes managing the growth of creepers and thorny shrubs.

The IFS - Popham Arboretum in Dambulla is a typical example of natural regenerated forest. It has also contributed to rich biodiversity comprising 192 plant species (Cramer, 1993), 72 birds and 35 butterflies (Arboretum Newsletter, 1996). Research into the regeneration dynamics of silviculturally assisted scrub vegetation (Samarasinghe, 1995) in relation to different burning histories and regeneration

strategies of selected forest species (Weerawardane, 1999) has been carried out during the past decade.

The goals of this study are to document plant diversity of silviculturally treated vegetation in the IFS-Popham Arboretum and to update the checklist of plant species documented by Cramer (1993).

MATERIALS AND METHODS

The IFS - Popham Arboretum is located close to Dambulla, 2.9 km away from it on the Kandalama Dambulla road (Figure 1). The total extent of the IFS - Popham arboretum, is 14.4 ha comprising 3.6 ha in the arboretum and 10.8 ha of woodland ($7^{\circ} 51' 34''$ N and $80^{\circ} 40' 28''$ E).

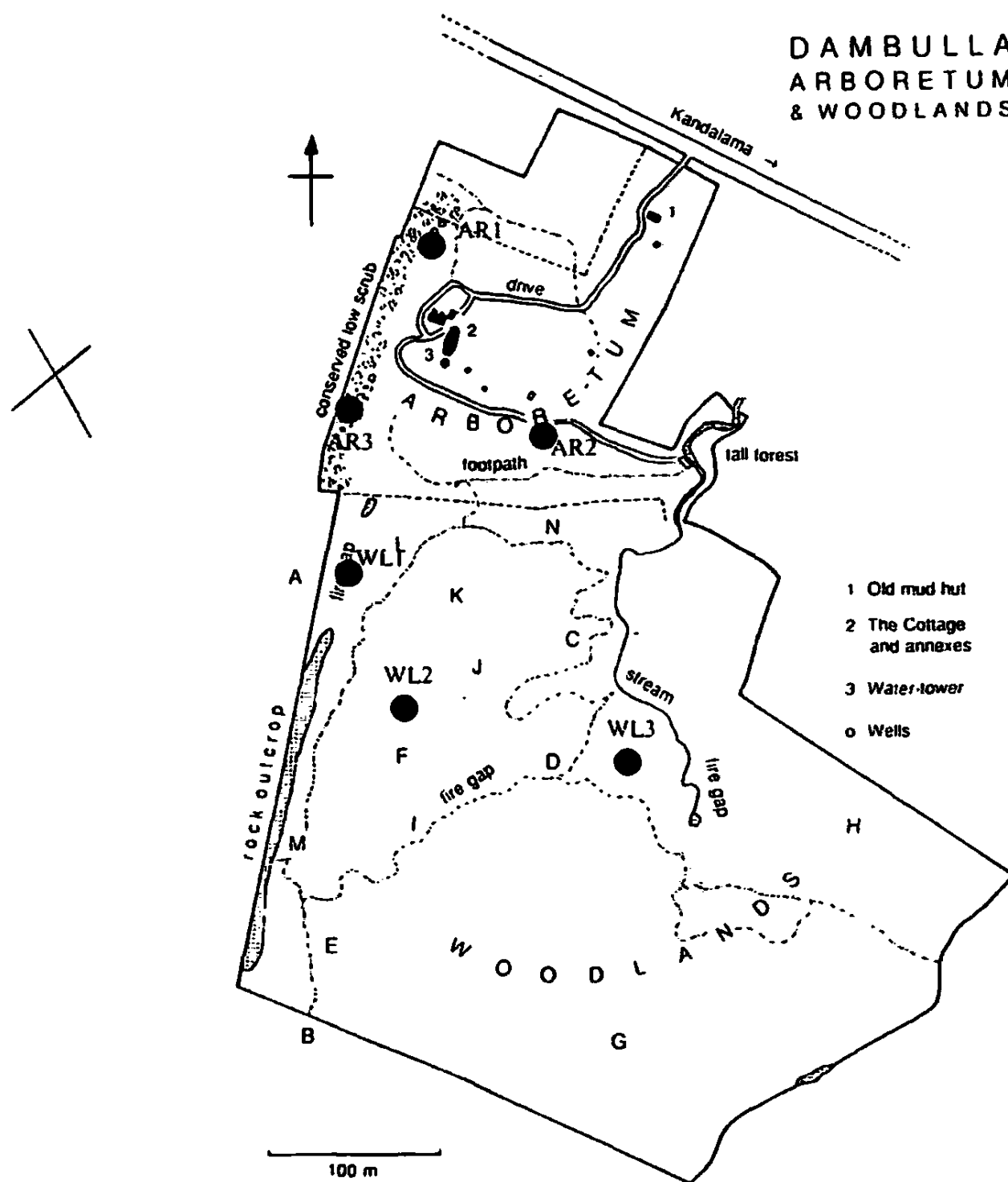


Figure 1. Location of the IFS - Popham Arboretum. Colored circles indicate the sampling plots. Plots in the arboretum = AR; and woodland = WL.

The permanent plot method was used for sampling in this study. Six plots, each 20 m 20 m were demarcated within the woodland and arboretum. Three plots each

from the woodland and arboretum were selected and each plot was divided into 20 m × 10 m sub plots to facilitate sampling. Individuals over 10 cm girth at breast height (1.3 m above the ground) in the main plots (20 m × 20 m) were enumerated and were marked with numbered aluminum tags. Sub plots of size 20 m × 10 m were demarcated within the main plot to enumerate individuals below 10 cm gbh and above 1 m in height. Individuals less than 1 m in height were enumerated by 2 m × 2 m quadrat sampling.

A number of characteristics of the vegetation, *viz.*, density and gbh of all woody species were recorded. The Importance Value Indices (IVI) of all the species were calculated using relative basal area and relative density for individuals over 1 m in height. Relative cover value was used for individuals less than 1 m in height.

The flora of the arboretum documented by Cramer (1993) was revised by collecting plants in an ad hoc manner representing all vegetation types and microhabitats during the dry and wet season as shown in appendix 1.

Herbarium specimens were prepared from the plant material collected in the field. Each individual sampled was identified as to its species as far as possible with help from the National Herbarium, Peradeniya, use of the Hand Book to the Flora of Ceylon by Dassanayake and Fosberg (1990-1991), Dassanayake *et al.* (1994-1995) and Dassanayake and Clayton (1996-2000).

An ordination of the vegetation gradients in the dataset that could be compared against their spatial distribution on the ground was carried out using multivariate analysis (Detrended Correspondence Analysis) with the help of PCORD4 software.

RESULTS

Structure of vegetation

The density, over 1 m height and basal area greater than 10 cm gbh, of trees and shrubs in the arboretum are shown in Table 1.

The total density of individuals was 2208/ha and the basal area was 93.2 m²/ha. However, the density and basal area of twenty leading tree and shrub species were 1795/ha and 74.8 m²/ha respectively.

The highest density of trees was recorded in *Grewia damine* and followed by *Diospyros ferrea*, *Pterospermum suberifolium* and *Chloroxylon swietenia* etc. The highest contribution of basal area was recorded of *Syzygium cumini* followed by *G. damine* and *Mitragyna parvifolia* etc. *Memecylon umbellatum* showed the highest density and basal area and *Phyllanthus polyphyllus* and *Allophylus serratus* followed respectively.

Table 1. List of first ten leading tree and shrub species represented in the vegetation size class above 10 cm gbh with their basal areas, density and IVI values.

Species	IVI Value	BA m ² /ha	Den/ha
Tree species			
<i>Syzygium cumini</i>	29	24.90 ± 4.36	46 ± 0.51
<i>Grewia damine</i>	23	13.11 ± 0.23	192 ± 0.20
<i>Chloroxylon swietenia</i>	14	8.30 ± 0.34	113 ± 0.81
<i>Mitragyna parvifolia</i>	11	9.14 ± 3.31	25 ± 0.03
<i>Pterospermum suberifolium</i>	9	3.44 ± 0.17	117 ± 1.28
<i>Diospyros ferrea</i>	8	2.20 ± 0.09	129 ± 0.42
<i>Bauhinia racemosa</i>	7	4.05 ± 0.31	50 ± 0.23
<i>Diplodiscus verrucosus</i>	6	2.20 ± 0.13	88 ± 0.71
<i>Lepisanthes tetraphylla</i>	5	1.41 ± 0.05	83 ± 0.62
<i>Pleurostylia opposita</i>	5	0.70 ± 0.05	92 ± 1.85
Total		69.45 ± 2.65	935 ± 41.35
Shrub species			
<i>Memecylon umbellatum</i>	16	1.51 ± 0.01	321 ± 3.0
<i>Phyllanthus polyphyllus</i>	8	0.89 ± 0.03	163 ± 2.62
<i>Allophylus serratus</i>	6	0.88 ± 0.03	108 ± 1.22
<i>Flueggea leucopyrus</i>	5	0.76 ± 0.01	96 ± 0.73
<i>Eugenia bracteata</i>	3	0.34 ± 0.02	54 ± 0.60
<i>Ochna obtusata</i>	2	0.03 ± 0.00	54 ± 1.82
<i>Dichrostachys cinerea</i>	1	0.45 ± 0.05	17 ± 0.06
<i>Catunaregam spinosa</i>	1	0.25 ± 0.05	17 ± 0.12
<i>Flacourtia indica</i>	1	0.18 ± 0.02	13 ± 0.07
<i>Capparis brevispina</i>	1	0.09 ± 0.03	17 ± 0.58
Total		5.38 ± 1.62	860 ± 26.32
Total individuals above 1m height		93.2	2208
Total twenty dominant species		74.8	1795

Girth class distribution in relation to percentage individuals are given in Figure 2. The girth size class 10- 20 showed the highest number of species along with the highest species richness. Species richness of first and third gbh size class is more or less similar, while the proportion of individuals is quite high in the gbh size class 20-30.

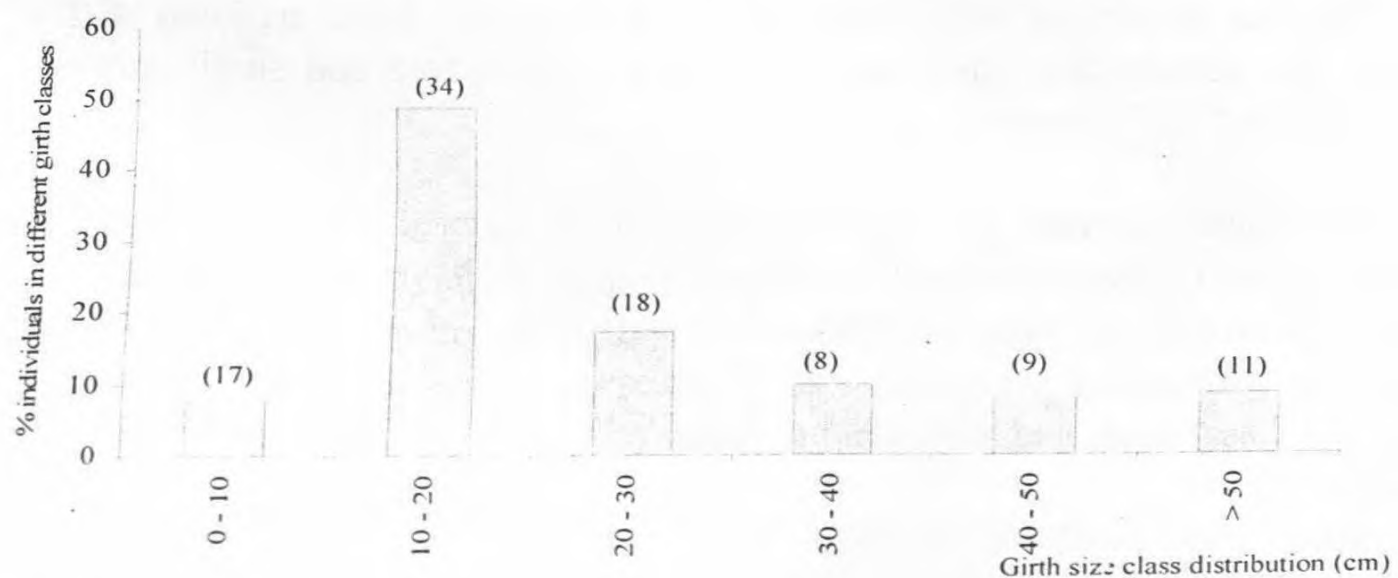


Figure 2. Girth class distribution of individuals greater than 10 cm gbh (trees and shrubs) in the Popham Arboretum in Dambulla. The number of species that were present in each size class is given in parentheses.

Floristic composition of vegetation

A total of 101 species belonging to 91 genera and 42 families were identified. Among the taxa identified 45 had medicinal value, 14 timber value and 7 both timber and medicinal value. There were 45 tree spp., 27 shrub spp., 18 herbaceous spp. and 11 climber spp. comprising 5 endemics (*Diospyros oppositifolia*, *Diplodiscus verrucosus*, *Canarium zeylanicum*, *Cassine balae* and *Micromelum minutum*) were recorded.

Species and family dominance

On the basis of IVI values, the leading dominant in the vegetation size class >10 cm gbh were *S. cumini*, *G. damine* and *M. umbellatum* etc (Figure 3). The contribution of basal area and density of those species showed alternative variation. Compared to basal area density of constitute species showed more or less similar among the leading species.

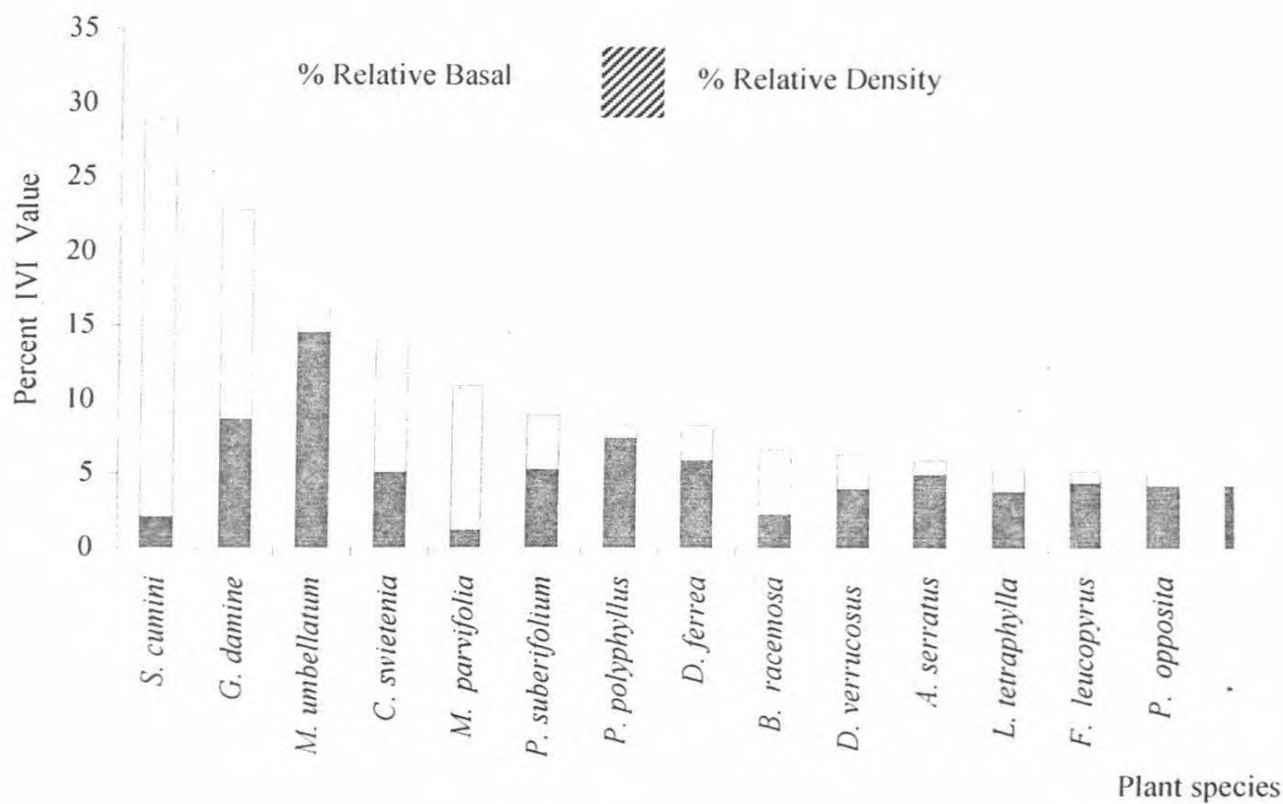


Figure 3. Variation in IVI values of the first ten leading species in Popham Arboretum in Dambulla.

The most dominant family based on IVI value was Myrtaceae followed by Tiliaceae and Rubiaceae. However the two leading families constitute only two species, while Rutaceae, Fabaceae, Euphorbiaceae and Rubiaceae contribute higher species richness (Figure 4).

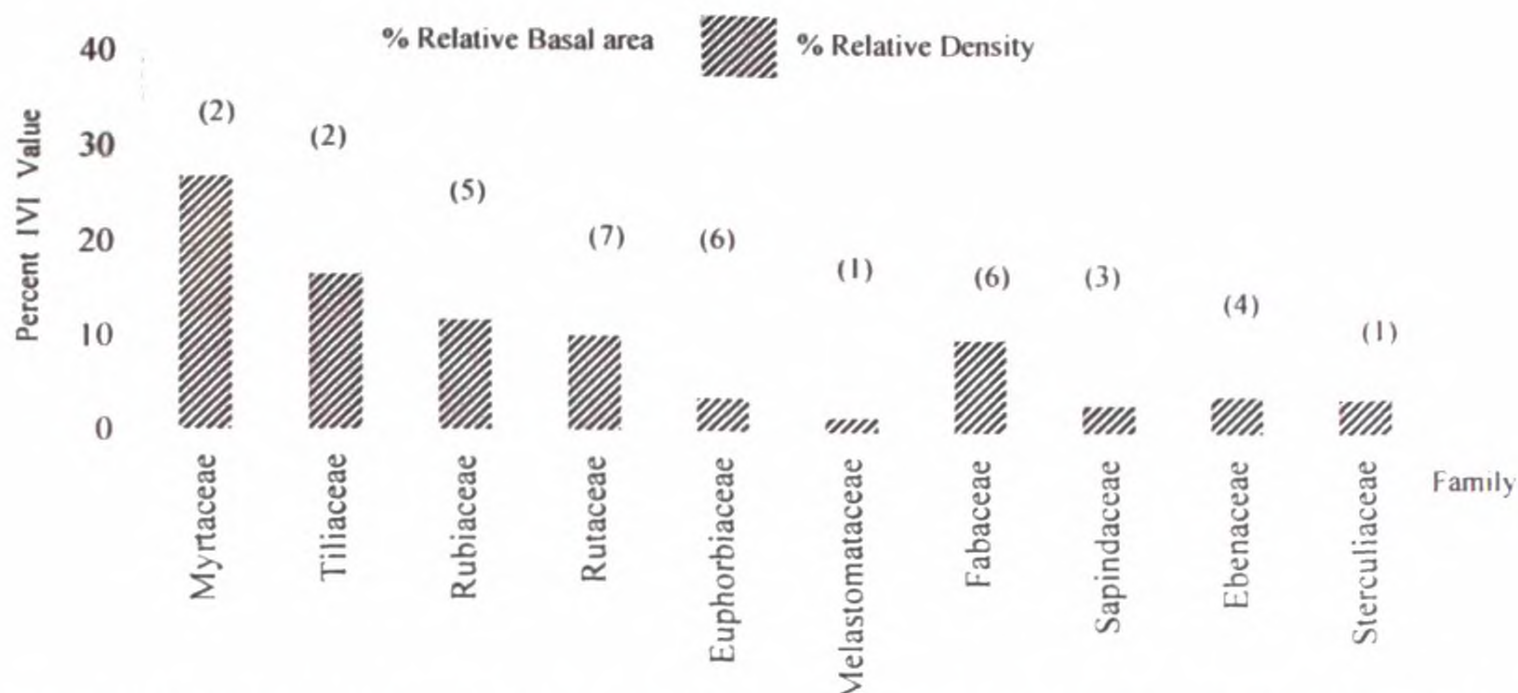


Figure 4. Variation in IVI values of the first ten leading families in Popham Arboretum in Dambulla. Number of species in a given family is given in parenthesis.

Population size

Considering the population size classes, species richness was high in the vegetation size class over 10 cm gbh (Figure 5). The population between 2 -10 recorded the highest number of species for both vegetation size classes.

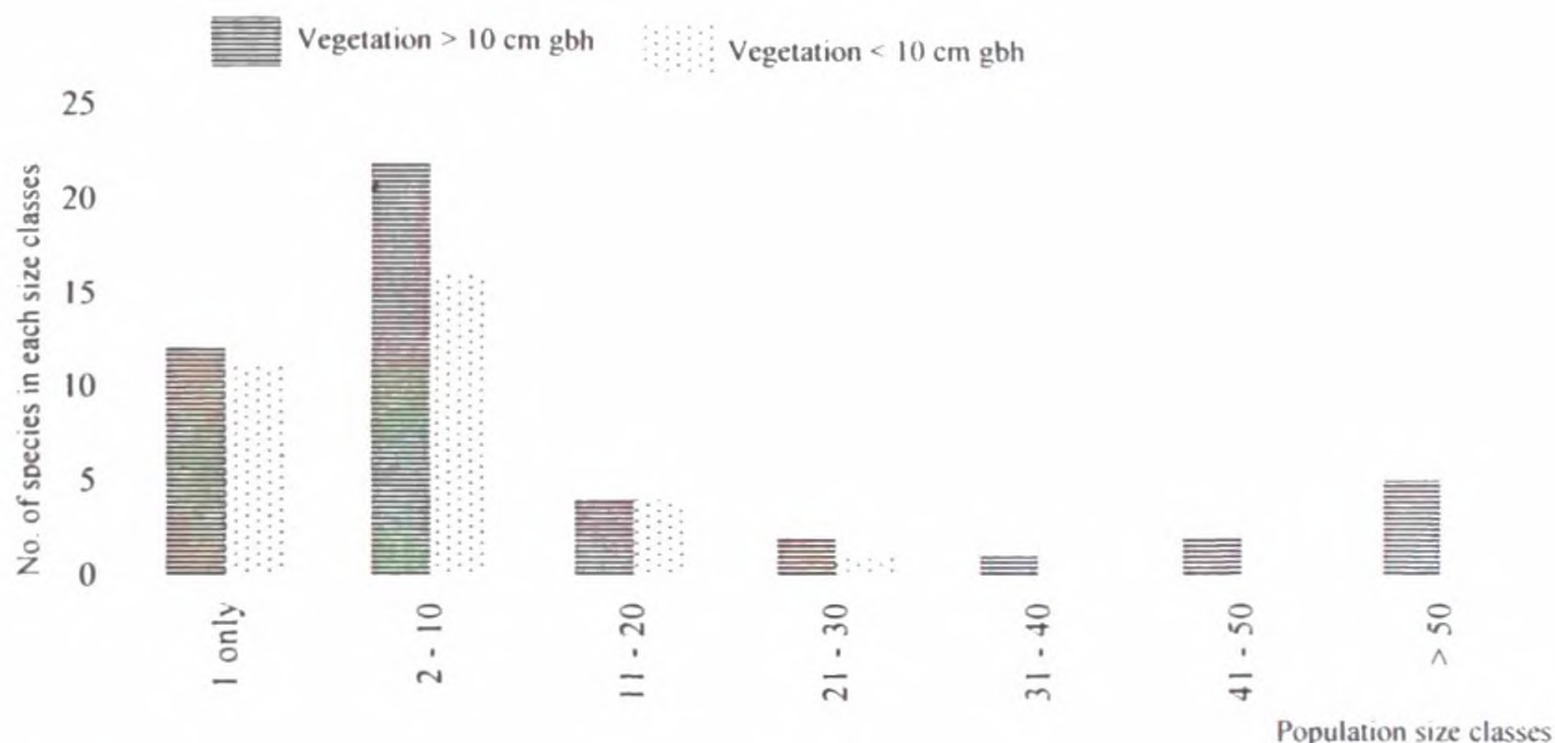


Figure 5. Number of species in each of the population size classes in the vegetation of the Popham Arboretum in Dambulla.

Trends and relationships

Figure 6 gives the species association in terms of their occurrence in the arboretum and woodland. Cluster A and B associated with nine species including one species of borderline negative (Meum), while cluster C and D associated with eleven species including one species of borderline positive (Phpo). In the TWINSpan diagram WL3 and WL1 formed a single distinguishable cluster, while AR1, AR2 and AR3 formed a single distinguishable cluster along with WL1 cluster. Therefore, species very common to both arboretum and woodland occur at the WL1 plot.

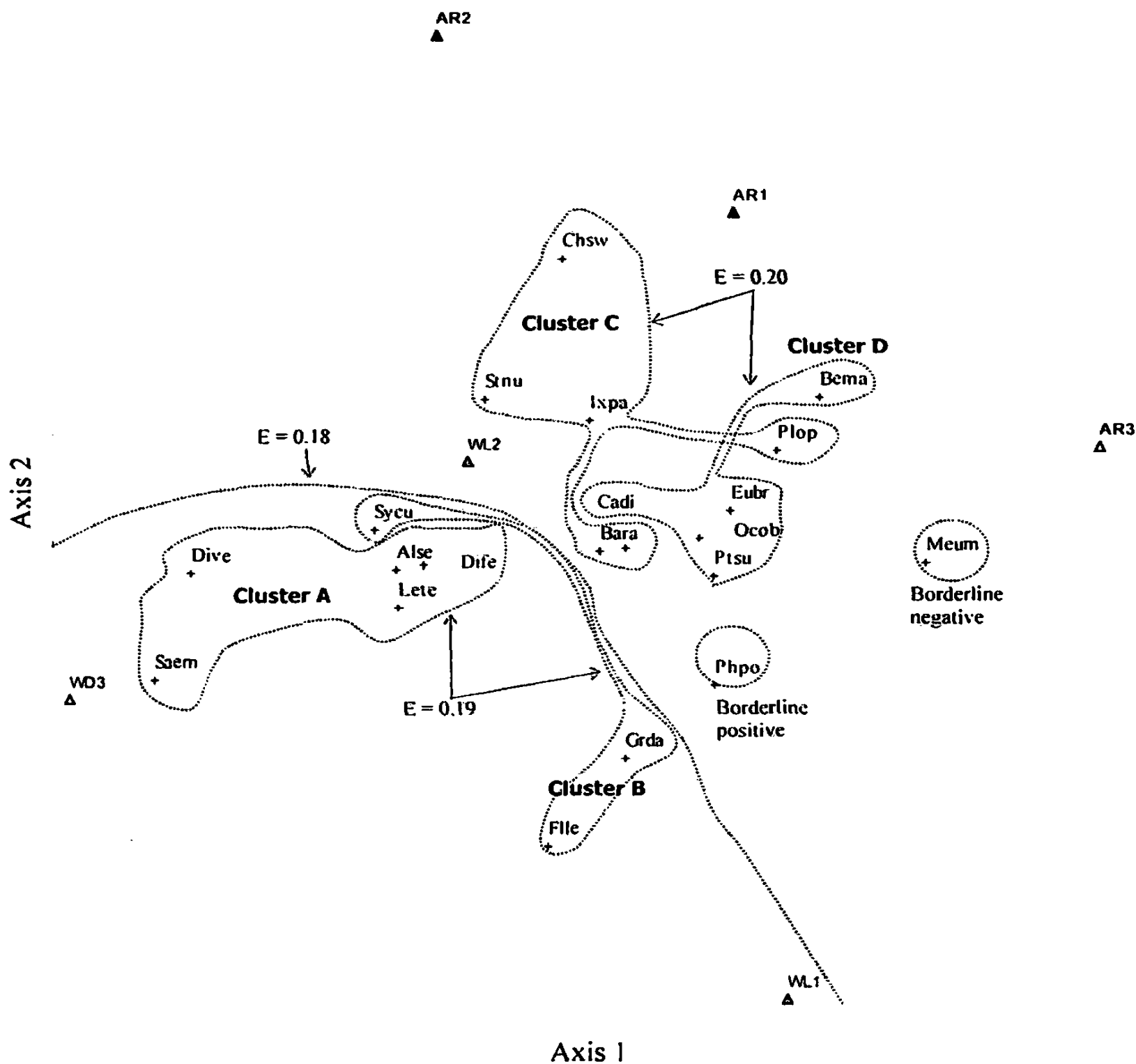


Figure 6. The ordination diagram based on species abundance in terms of plots. Species are denoted by four letters (two letters from generic name of particular species and two letters from species name) and plots are denoted by two letters and numerical number referring to arboretum (AR) and woodland (WL). Four clusters identified by TWINSpan were subjectively marked in the ordination diagram, where cluster A and B denoted the positive branch of the cluster, while cluster C and D denoted the negative branch of the cluster. Letter E indicates the eigen value of each cluster.

Cluster A was composed of four typical dry zone tree species such as *D. verrucosus*, *D. ferrea*, *L. tetraphylla* and *S. emarginata* with typical shrub viz., *A. serratus*. All species associated in cluster C (Plots of AR1 and AR2) were trees such as *C. swietenia*, *P. opposita*, *S. nux-vomica*, *Bauhinia racemosa* and *Ixora pavetta*. Cluster D were associated with mostly shrub species such as *P. polyphyllus*, *Ochna obtusata*, *Benkara malabarica* and *Eugenia bracteata* and trees such as *P. suberifolium* and *Canthium dicoccum* var. *umbellatum*.

DISCUSSION

Perera (1998) carried out a vegetational survey at Sigiriya sanctuary and recorded over 5,000 individuals of trees and 5,000 individuals of shrubs per hectare. This was quite a high density compared to density of trees and shrubs at the arboretum. This is because of the contribution of immature seedlings and sapling in the Sigiriya sanctuary. Furthermore, size class distribution of individuals at Sigiriya sanctuary showed very few large trees and the majority have smaller diameters. But in the Dambulla arboretum, the predominance of mature trees indicates that the forest in Dambulla arboretum is higher in its regeneration state.

Samarasinghe 1995 showed that *Chloroxylon swietenia* was the most dominant tree based on its relative density (RD = 3.4 in year 1993) followed by *Grewia damine* (RD = 0.1), *Diospyros ferrea* (RD = 0.1) and *Pterospermum suberifolium* (RD = 0.5). The present survey found that these are the leading tree species however, their dominance within the survey was altered. On the other hand, Samarasinghe recorded *Phyllanthus polyphyllus* was the leading dominant, whereas it was the second dominant species in the present survey.

Relatively high stem densities, particularly stems in the smaller girth size classes is due to a dominance of species of typically small size i.e. *Diospyros ferrea*, *Memecylon umbellatum* and *Ixora pavetta* and coppicing of shrubs.

Cramer in 1993 documented 192 plant species of which 88 species were trees composed of rare, endemic and endangered species. The vegetation in the arboretum, when compared with primary forests in the dry zone have climax species in the canopy layer.

Reverse J shaped curve observed in the vegetation of the arboretum indicates that these are in the late regenerating phase of secondary vegetation. The vegetation of the arboretum was regenerated via silvicultural management since 1963 and therefore it harbors mature trees, while the vegetation of the woodlands declared for conservation since 1989 by the Institute of Fundamental Studies has both mature and immature trees.

Bauhinia racemosa, *G. damine* and *P. suberifolium* that play an important role in the damana forest, adapted to withstand fire can be seen here. On the other hand, *M. hexandra*, *C. swietenia*, *Drypetes sepiaria* and *Diospyros ebenum* are climax forest species in the dry zone. The occurrence of fire tolerant species as well as climax forest species indicates that the forest is in a late succession stage of regeneration.

The IVI values of *C. swietenia* is fairly good. This tree species was considered as the key species in monsoon forests, which in the past, was classified as *M. hexandra* - *D. sepiaria* - *C. swietenia* association based on their abundance in the forest. However, the present survey recorded that these species in the arboretum still provide refuge for remarkably rare species such as *Diospyros ebenum*, *Diospyros malabarica* and *Diospyros oppositifolia*.

Of the shrub species *M. umbellatum* recorded the highest importance value. Fernando (1996) has suggested that the very high relative importance value of these species in forests of Maduru Oya national park indicate that there has been minimal

disturbance. This is further confirmed because the arboretum was initiated in the year 1963 and disturbance has not taken place since and therefore an abundance of this species is obvious and to be expected.

The three most dominant families by number of species in the arboretum and woodland were Rutaceae, Fabaceae and Euphorbiaceae. Plants in these families are adapted to grow under dry and stressful environmental conditions. Some members of the Euphorbiaceae and Rutaceae have thorns, latex, cladodes and/or relatively small leaves to conserve water and escape herbivory. Some members of Fabaceae can fix Nitrogen and therefore, they can perform well in the dry zone forests. The present results further confirm Samarasinghe's findings of diverse families *viz.*, Euphorbiaceae, Rubiaceae and Rutaceae.

The ordination diagram clearly shows that the plots of the arboretum and woodland are divided into two because of different regeneration stages. The species inhabitants in the arboretum are mainly trees and shrubs typically found in the primary dry zone forests. Cluster A resulted in basically dominant species in the woodland. On the other hand, Cluster C dominated by valuable timber such as *Chloroxylon swietenia* and *Pleurostyliia opposita* and mainly inhabit the arboretum.

CONCLUSIONS

The study proves the importance of the arboretum with regard to its fairly rich flowering plants including endemics, valuable timber trees and plentiful medicinal plants. Furthermore, arboretum provides refuge for typical dry zone key plant species through natural regeneration from the soil seed bank. Application of Popham method is recommended for degraded land to convert the land into productive ecosystems.

ACKNOWLEDGEMENTS

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Appendix 1

Species list of the vegetation in the IFS Popham Arboretum
(T = Tree, S = Shrub, H = Herb, C = Climber).

Species/Family	Code	Local Name	Medicine-M/ Timber-T	Life form
Acanthaceae				
<i>Andrographis paniculata*</i>	Anpa	Heen-bin-kohomba	M	H
<i>Justicia procumbens</i>	Jupr	Mayani		H
Amaranthaceae				
<i>Aerva lanata*</i>	Aela	Pol pala	M	H
Amaryllidaceae				
<i>Crinum sp.*</i>	Crin			H
Apocynaceae				
<i>Aganosma cymosa*</i>	Agcy			H
<i>Carissa spinarum</i>	Casp	Heen-Karamba	M	S
<i>Ichnocarpus frutescens</i>	Icfr	Kiri-wel		H
Araceae				
<i>Amorphophallus paeoniifolius*</i>	Ampa	Kidaran		H
Arecaceae				
<i>Borassus flabellifer*</i>	Bofl	Tal		T
Asclepiadaceae				
<i>Wattakaka volubilis*</i>	Wavo	Anguna	M	C
Asteraceae				
<i>Elephantopus scaber</i>	Epsc	Et-adi		H
<i>Eupatorium odoratum</i>	Euod	Podisinghomaran		S
Boraginaceae				
<i>Carmona retusa</i>	Care	Heen-tambala		S
<i>Cordia dichotoma</i>	Codi	Lolu		T
<i>Ehretia laevis</i>	Ehle	Walangasal	M	T
Burseraceae				
<i>Canarium zeylanicum*</i>	Caze	Dik-kekuna		T
Capparaceae				
<i>Capparis brevispina</i>	Cabr	Wellangiriya	M	S
Celastraceae				
<i>Cassine balae*</i>	Caba	Neraloo	M	T
<i>Pleurostylia opposita</i>	Plop	Panakka	T	T
Clusaceae				
<i>Garcinia morella*</i>	Gamo	Gokatu		T
Convolvulaceae				
<i>Ipomoea littoralis*</i>	Ipli	Tel-kola		C
Dioscoreaceae				
<i>Dioscorea alata*</i>	Dial	Hingurala		C
Dracaenaceae				
<i>Sansevieria zelanica*</i>	Saze	Niyanda		H
Ebenaceae				
<i>Diospyros ebenum</i>	Dieb	Kaluwara	T	T
<i>Diospyros ferrea</i>	Dife	Kalu habarala		T
<i>Diospyros malabarica</i>	Dima	Timbiri	M	T
<i>Diospyros oppositifolia</i>	Diop	Kalu-mediriya	T	T
<i>Diospyros ovalifolia*</i>	Diov	Kunumella		T
Euphorbiaceae				
<i>Bridelia retusa</i>	Brre	Katakala	M/T	T
<i>Croton officinalis*</i>	Crof			S
<i>Dimorphocalyx glabellus</i>	Digl	Weli wenna		S
<i>Drypetes sepiaria</i>	Drse	Wira		T
<i>Euphorbia antiquorum*</i>	Euan	Daluk	M	T
<i>Euphorbia heterophylla*</i>	Euhe			H
<i>Flueggea leucopyrus</i>	Flle	Heen-katu-pila	M	S

<i>Givotia moluccana</i> *	Gimo			H
<i>Margaritaria indicus</i>	Main	Karawu		T
<i>Phyllanthus amarus</i>	Pham	Pita-wakka	M	H
<i>Phyllanthus polyphyllus</i>	Phpo	Kuratiya		S
Fabaceae				
<i>Bauhinia racemosa</i>	Bara	Maila	M	T
<i>Cassia fistula</i>	Cafi	Ehela	M/T	T
<i>Cassia roxburghii</i>	Caro	Ratu-wa		T
<i>Derris benthamii</i>	Disc	Kala-wel		C
<i>Dichrostachys cinerea</i>	Dici	Andara	M	S
<i>Mimosa pudica</i>	Mipu	Nidi-kumba	M	H
<i>Tamarindus indica</i>	Tain	Siyambala	M/T	T
Flacourtiaceae				
<i>Flacourtia indica</i>	Flin	Uguressa		S
Lamiaceae				
<i>Ocimum americanum</i> *	Ocam	Heen-tala		H
Lauraceae				
<i>Alseodaphne semecarpifolia</i>	Alss	Wewarani	T	T
<i>Litsea glutinosa</i>	Ligl	Bomee	M	T
Linaceae				
<i>Hugonia mystax</i> *	Humy	Bu-getiya	M	C
Loganaceae				
<i>Strychnos potatorum</i> *	Stop	Ingin	M	T
<i>Strychnos nux-vomica</i>	Stnu	Goda kaduru	M	T
Melastomataceae				
<i>Memecylon umbellatum</i>	Meum	Kora-kaha	M	T
<i>Osbeckia sp.</i>	Osbe	Bowitiya		S
Meliaceae				
<i>Azadirachta indica</i>	Azin	Kohomba	M/T	T
<i>Chukrasia tabularis</i>	Chta	Hulan-hik	M/T	T
Moraceae				
<i>Streblus asper</i>	Stas	Geta-netul		T
Myrtaceae				
<i>Eugenia bracteata</i>	Eubr	Daeduwa		T
<i>Syzygium cumini</i>	Sycu	Madan	M/T	T
Ochnaceae				
<i>Ochna obtusata</i>	Ocob	Galkera		S
Oleaceae				
<i>Chionantus zeylanica</i> *	Chze	Geratiya		H
<i>Jasminum angustifolium</i>	Jaan	Wal-pichcha	M	C
Periplocaceae				
<i>Hemidesmus indicus</i>	Hein	Heen-iramusu	M	H
Poaceae				
<i>Setaria sp.</i>	Seta			H
Rhamnaceae				
<i>Scutia myrtina</i> *	Scmy			S
<i>Ziziphus oenoplia</i>	Zioe	Heen-eraminiya	M	S
Rhizophoraceae				
<i>Cassipourea ceylanica</i> *	Cace	Pana		S
Rubiaceae				
<i>Benkara malabarica</i>	Bema	Getakula		S
<i>Canthium coromandelicum</i>	Caco	Kara	M	S
<i>Canthium dicoccum var. umbellatum</i>	Cadi	Bokutu	M	T
<i>Catunaregam spinosa</i>	Cats	Kukurman	M	S
<i>Ixora pavetta</i>	Ixpa	Goda ratmal	M	T
<i>Mitragyna parvifolia</i>	Mipa	Helamba	M/T	T
<i>Morinda umbellata</i> *	Moum	Maha-kiri-wel		C
<i>Oldenlandia corymbosa</i> *	Olco	Wal-patpadagam		H
<i>Tarenna asiatica</i>	Taas	Tarana	M	T
Rutaceae				

<i>Acronychia pedunculata</i>	Acpe	Ankenda	M	T
<i>Atalantia ceylanica</i>	Atce	Yakinaran	M	S
<i>Chloroxylon swietenia</i>	Chsw	Buruta	T	T
<i>Clausena indica</i> *	Clin	Migon-karapincha		S
<i>Glycosmis mauritiana</i>	Glma	Bol-pana		S
<i>Limonia acidissima</i>	Liac	Divul	M	T
<i>Micromelum minutum</i>	Mimi	Wal-karapincha	M	S
<i>Pleiospermium alatum</i>	Plal	Tumpat-kurundu	M	T
<i>Toddalia asiatica</i>	Toas	Kudu-miris	M	C
Sapindaceae				
<i>Allophylus serratus</i>	Alse	Kobbe	M	S
<i>Cardiospermum halicacabum</i> *	Caha	Penala-wel	M	C
<i>Lepisanthes tetraphylla</i>	Lete	Dambu		T
<i>Sapindus emarginata</i>	Saem	Penela		T
Sapotaceae				
<i>Manilkara hexandra</i>	Mahe	Palu	T	T
Sterculiaceae				
<i>Helicteres isora</i> *	Heis	liniya		S
<i>Pterospermum suberifolium</i>	Ptsu	Welan		T
Tiliaceae				
<i>Diplodiscus verrucosus</i>	Dive	Dik-wenna		T
<i>Grewia damine</i>	Grda	Daminiya		T
<i>Microcos paniculata</i> *	Mipa	Keliya		S
Verbenaceae				
<i>Gmelina asiatica</i>	Gmas	Demata	M	S
<i>Lantana camara</i>	Laca		M	S
<i>Vitex altissima</i>	Vial	Milla	T	T
Vitaceae				
<i>Cissus quadrangularis</i> *	Ciqu	Hiressa	M	C
<i>Cissus vitiginea</i>	Civi	Wal-niviti		C

Plants, which are not documented in Cramer's checklist in the arboretum. Endemic species are in bold.
Source: Jayaweera (1982), Cramer (1963) and Senaratna (2001).