

HIGH TREE ENDEMISM RECORDED IN KANANA KANDA ISOLATED FOREST FRAGMENT IN WET ZONE OF SRI LANKA

P.K.J. De Mel

Department of Agricultural and Plantation Engineering
Open University of Sri Lanka,
P.O. Box 21, Nawala, Nugegoda (10250), Sri Lanka
Email: pkmel@ou.ac.lk

K.A.J.M. Kuruppuarachchi

Department of Botany
Open University of Sri Lanka, P.O. Box 21,
Nawala, Nugegoda (10250), Sri Lanka
Email: kajmkuuruppu@gmail.com

ABSTRACT

Kanana Kanda is an isolated lowland hill with an altitude of 115m covered by natural forest with an extent of 13ha. The forest fragment located in wet zone of Sri Lanka where much species diversity and endemism is found. The forest is disappearing fast due to anthropogenic influences. Therefore the present study was carried out with the objective of assessment of existing tree flora. Reconnaissance survey was first conducted in the forest in order to gather basic information on vegetation types and floristic characteristics. Four transects with a size of 100m x 5m each were laid for sampling trees. A woody plant with a dbh equal or greater than 5cm considered as a tree. A total number of 464 trees were enumerated in the forest. Field identification of species performed with the consultation of personnel who have sufficient knowledge, skills and experience on similar vegetation. Herbarium specimens were prepared from each tree unidentified in the field and later identified those comparing with the specimens preserved in the National Herbarium. Present study, recorded a total number of 50 different species belongs to 29 families. One third (35%) of enumerated trees and nearly half (46%) of the species belongs to 16 families are endemic. Eleven endemic species are also rare. There are 13 threatened species where 12 are vulnerable and one is critically endangered. The critically endangered species and 10 out of 12 vulnerable are endemic. Three vulnerable species and the critically endangered species are also globally threatened. No clearly distinguishable vegetation communities in the forest. Existence of few trees belongs to family Dipterocarpaceae provide evidence for prevailed Dipterocarp community. No emergent trees found at all. Existence of few canopy and sub canopy trees provides evidence for similarity of community structure to the south western hill forests before degradation. Presence of light demanding pioneer trees, late successional dominants and late successional nondominants in some part of the forest indicates the regeneration of vegetation. The results revealed the importance of the forest fragment with respect to the endemism and conservation status of trees. All these species are in an isolated habitat. Therefore, preparation of a suitable management plan to arrest further degradation of this forest fragment is an urgent requirement. It helps for the conservation of high tree endemism of the forest and to prevent extinction of threatened species.

Key words: Sri Lankan forests, endemism, threatened tree species.

Introduction

The island Sri Lanka is a tropical country with a total land extent of 65,610km², located in Indian Ocean off the south east of southern tip of peninsular India (5° 53' and 9° 51' north and 79° 43' and 81° 53' east). It separates from southern tip of the India by 20m deep Polk Strait. The geological history of the country, its location in the tropical region, variations of topography and diverse climate especially the rain fall and temperature make the island into a most biologically diverse place. It creates variety of inland natural ecosystems with quite high diversity and endemism in flora and fauna.

Sri Lanka together with the Western Ghats recognized as one of the biodiversity hotspot (Myers *et al.*, 2000), out of 34 such hotspots identified with global importance (Mittermeier *et al.*, 2005). Biodiversity hotspot is a place where exceptional concentrations of endemic species are undergoing exceptional loss of habitat (Myers *et al.*, 2000). Sri Lanka Western Ghats region is also recognized as a hottest hotspot out of such 8 hottest hotspots identified based on high endemism, the ratio of endemic species to area and their habitat loss (Gunatilleke *et al.*, 2005). Further Sri Lanka has identified as a centre of plant diversity in the world out of such 234 centers after a comprehensive global analysis of specific taxonomic groups (Davis *et al.*, 1995).

There are about 3360 plant species both indigenous and naturalized representing 1070 genera and 180 families found in Sri Lanka and none of the families are confined to the country (Gunatilleke and Gunatilleke, 1990). There are 11 endemic genera and 830 endemic plant species (Peeris, 1975; Mabberley, 1987 in Gunatilleke and Gunatilleke, 1990). Dassanayake *et al.* (1980 - 2000) described 3044 indigenous flowering plant species out of which 919 species endemic to Sri Lanka. Senaratna (2001) has included 4143 species of different angiosperms (75% indigenous and 25% exotics) belongs to 214 families and 1522 genera in her check list of flowering plants of Sri Lanka and 27.53% out of indigenous species found endemic to the country. Herath (2007) has listed 1025 endemic angiosperms belongs to 98 families and 353 genera. More than 90% of endemic species and all

endemic genera are concentrated in the rain forests of wet zone encompassing 23% (15000km²) of the land area of the country (Gunatilleke and Gunatilleke, 1990).

Even within a locality in wet zone the diversity of flora and endemism are very high. There were 426 different species (319 identified and 107 have not) found from Kanneliya, Dediyaigala – Nakiadeniya forest complex (a natural forest in the south–west lowland hills with an extent of 12050ha) belongs to 194 genera and 75 families where 159 species (only from the identified species) and 9 genera are endemic to Sri Lanka (Singhakumara, 1996). Further the diversity and endemism change with the altitude of the locality. Floristic survey carried out in Adam’s Peak Wilderness sanctuary revealed that the lowland forest formation of the sanctuary is most diverse than mountain forest formation while endemism increase from lowland to mountain forests (Singhakumara, 1995).

Most of the threatened angiosperms in Sri Lanka also concentrated in wet zone where threats to the biodiversity also high due to anthropogenic activities. Phytosociological survey carried out in nine rain forests in wet zone revealed that 93% of the recorded 184 woody endemics were either endangered, vulnerable or rare (Gunatilleke and Gunatilleke, 1990).

The present study site too located in wet zone of the country within the geographic coordinate 6° 26′ – 48° 17′ N and 80° 05′ - 48° 68′ E and 7m amsl in a village called Kanana in Walallawita divisional secretariat division in Kalutara district in Western province. Kanana Kanda is an isolated lowland hill with an altitude of 115m covered with a natural forest with an extent of 13ha. The forest patch surrounded at the base by Paddy fields, home gardens and small holdings of Tea and Rubber cultivations. The natural forest is fast disappearing due to anthropogenic activities. Therefore it has a greater importance of ecological assessment of natural forest taking note on endemism and conservation status of tree flora of Kanana Kanda. Gathering base line data and recording the present status of floral structure and composition of the site is necessary to understand the changes in vegetation. This data may also useful for the preparation and adoption of environment management plan for conservation purposes. Therefore the present study was carried out with the objectives of assessment of tree flora in Kanana Kanda.

Methods

A reconnaissance survey was first conducted in the site in order to gather basic information about the vegetation and floristic characteristics of different vegetation types. Personal communication was established with villagers around Kanana Kanda during the period of field works in order to gather background information about the area, values of the surrounding floral community and identify the human threats associated with the vegetation. Further the remote sensed image maps, land use planning maps and relevant 1: 50,000 topographic maps were used to identify the land use types and locations of the sampling site.

Sampling was carried out to ensure proper representation of entire terrestrial floral communities in the sampling site. Transect method was used for sampling since this method is a time saving, less expensive and less labor consuming technique as well as a technique which could be use in sites where the vegetation shows gradient changes (Moore and Chapmen, 1986). Four transects were laid in order to ensure the maximum representation of the site. Each transect consisted of one plot with a size of 100m x 5m. A woody plant with a dbh equal or greater than 5cm, considered as a tree in this survey.

Field identification of species performed with the consultation of personnel those who have sufficient knowledge, skills and field experience on similar vegetation. Literature review, dichotomous keys also made use for the identification of species. The 2007 Red list of threatened fauna and flora of Sri Lanka and other relevant publications were used to categorize the threatened and endemic species. Herbarium specimens were prepared from each tree unidentified in the field and later identified those comparing with the specimens preserved in the National Herbarium in Royal Botanical Garden, Peradeniya, Sri Lanka.

A general survey too was carried out around the plots in order to encounter any additional species that was not found in the plots. Profile diagram of vegetation types were drawn on a scale in separate sheets for more accurate representation.

Results

A total number of 464 trees are enumerated in the site. Nineteen herbarium specimens collected during enumeration and all samples identified. There were 50 tree species belongs to 45 genera and 29 families. No additional species found out of the plots during the general survey. The species found in the site with their local names and families are shown in table 1.

Table 1 Species found in the site

Species	Local name	Family
<i>Adenanthera paronia</i>	Madatiya	Leguminosae
<i>Alstonia macrophylla</i>	Hawarinuga	Apocynaceae
<i>Anisophyllea cinnamomoides</i>	Welipiyanna	Anisophylleaceae
<i>Aporusa cardiosperma</i>	Kampotta	Euphorbiaceae
<i>Aporusa lindleyana</i>	Kebella	Euphorbiaceae
<i>Artocarpus nobilis</i>	Waldel	Moraceae

<i>Atalantia ceylanica</i>	Yaknaran	Rutaceae
<i>Bridelia moonii</i>	Pathkela	Euphorbiaceae
<i>Bridelia retusa</i>	Ketakella	Euphorbiaceae
<i>Calophyllum bracteatum</i>	Walukeena	Clusiaceae
<i>Canarium zeylanicum</i>	Kekuna	Euphorbiaceae
<i>Caryota urens</i>	Kitul	Arecaceae
<i>Chaetocarpus castanocarpus</i>	Hedawaka	Euphorbiaceae
<i>Cinnamomum verum</i>	Kurundu	Lauraceae
<i>Clerodendrum infortunatum</i>	Pinna	Verbanaceae
<i>Crotolaria retusa</i>	Keppetiya	Fabaceae
<i>Croton lacciferus</i>	Keppetiya	Euphorbiaceae
<i>Cullenia rosayroana</i>	Katumoda	Bombacaceae
<i>Desmos elegans</i>	Kudumirissa	Annonaceae
<i>Dillenia retusa</i>	Godapara	Dilleniaceae
<i>Dimocarpus longan</i>	Mora	Sapindaceae
<i>Diospyros insignis</i>	Porowamara	Ebenaceae
<i>Erythroxylum moonii</i>	Batakirilla	Erythroxylaceae
<i>Euodia lunu - ankenda</i>	Unkenda	Rutaceae
<i>Ficus benghalensis</i>	Nuga	Moraceae
<i>Foniculum vulgare</i>	Dividuru	Umbelifera
<i>Gaertnera vaginans</i>	Peratambala	Rubiaceae
<i>Garcinia quaesita</i>	Goraka	Clusiaceae
<i>Gardenia cramari</i>	Galis	Rubiaceae
<i>Gyrinops walla</i>	Walla	Thymelaeaceae
<i>Hopea jucunda</i>	Rat Beraliya	Dipterocarpaceae
<i>Humboldtia laurifolia</i>	Galkaranda	Fabaceae
<i>Hydnocarpus octandra</i>	Waldivul	Flacourtiaceae
<i>Mangifera zeylanica</i>	Etamba	Anacardiaceae
<i>Neolitsea cassia</i>	Kududaula	Lauraceae
<i>Ochna jabodapita</i>	Bokera	Ochnaceae
<i>Palaquium grande</i>	Kirihimbiliya	Sapotaceae
<i>Rejoua dichotoma</i>	Divikaduru	Apocynaceae
<i>Scolopia acuminata</i>	Katukenda	Flacourtiaceae
<i>Shorea affinis</i>	Beraliya Dun	Dipterocarpaceae
<i>Strombosia ceylanica</i>	Pubberiya	Olacaceae
<i>Symplocos cochinchinensis</i>	Bombu	Symplocaceae
<i>Syzygium caryophyllatum</i>	Dan	Myrtaceae
<i>Syzygium firum</i>	Wal Jambu	Myrtaceae
<i>Syzygium lanceolatum</i>		Myrtaceae
<i>Syzygium makul</i>	Alubo	Myrtaceae
<i>Tarenna asiatica</i>	Tharana	Rubiaceae
<i>Vitex pinnata</i>	Milla	Verbanaceae
<i>Xanthium indicum</i>	Wal Rambutan	Asteraceae
<i>Xylopia parvifolia</i>	Athuketiya	Annonaceae

There are 23 endemic species belongs to 22 genera and 16 families (Table 2).

Table 2 Endemic tree species found in the site

Species	Family
<i>Anisophyllea cinnamomoides</i> #	Anisophylleaceae
<i>Aporusa cardiosperma</i> *#	Euphorbiaceae
<i>Artocarpus nobillis</i> *^#	Moraceae
<i>Bridelia moonii</i> *	Euphorbiaceae
<i>Calophyllum bracteatum</i> *	Clusiaceae
<i>He siteCanarium zeylanicum</i> *	Euphorbiaceae
<i>Cinnamomum verum</i>	Lauraceae
<i>Cullenia rosayroana</i> #	Bombacaceae
<i>Desmos elegans</i>	Annonaceae
<i>Dillenia retusa</i> #	Dilleniaceae
<i>Diospyros insignis</i>	Ebenaceae
<i>Garcinia quaesita</i> *	Clusiaceae
<i>Gardenia cramari</i> *	Rubiaceae
<i>Hopea jucunda</i> #	Dipterocarpaceae
<i>Hydnocarpus octandra</i> #	Flacourtiaceae
<i>Mangifera zeylanica</i> #	Anacardiaceae
<i>Neolitsea cassia</i>	Lauraceae
<i>Ochna jabodapita</i> +^	Ochnaceae
<i>Palaquium grande</i> *^#	Sapotaceae
<i>Scolopia acuminata</i>	Flacourtiaceae
<i>Shorea affinis</i> #	Dipterocarpaceae
<i>Syzygium firum</i> #	Myrtaceae
<i>Syzygium makul</i> *	Myrtaceae

*vulnerable +critically endangered ^globally threatened #rare

Percentage endemic species and endemic individuals in the site are 46% and 35%. No endemic genera found in the sampling site. Out of 23 endemic species 9 are vulnerable and one species is critically endangered as well as globally threatened. There are 2 globally threatened species within the 9 vulnerable species (Table 3). Another 11 endemic species are rare (Table 4).

Table 3Threatened endemic species found in site and their conservation status

Species	Conservation status
<i>Aporusa cardiosperma</i>	Vulnarable
<i>Artocarpus nobilis</i>	Vulnarable/Globally threatened
<i>Bridelia moonii</i>	Vulnarable
<i>Calophyllum bracteatum</i>	Vulnarable
<i>Canarium zeylanicum</i>	Vulnarable
<i>Garcinia quaesita</i>	Vulnarable
<i>Gardenia cramari</i>	Vulnarable
<i>Ochna jabodapita</i>	Critically endangered/Globally threatened
<i>Palaquium grande</i>	Vulnarable/Globally threatened

Syzygium makul

Vulnerable

Table 4 Rare endemic species found in site their local names and families

Species	Local name	Family
<i>Anisophyllea cinnamomoides</i>	Welipiyanna	Anisophylleaceae
<i>Aporusa cardiosperma</i>	Kampotta	Euphorbiaceae
<i>Artocarpus nobilis</i>	Wal-del	Moraceae
<i>Cullenia rosayroana</i>	Katumoda	Bombacaceae
<i>Dillenia retusa</i>	Godapara	Dilleniaceae
<i>Hopea jucunda</i>	Rat Beraliya	Dipterocarpaceae
<i>Hydnocarpus octandra</i>	Waldivul	Flacourtiaceae
<i>Mangifera zeylanica</i>	Etamba	Anacardiaceae
<i>Palaquium grande</i>	Kirihimbiliya	Sapotaceae
<i>Shorea affinis</i>	Beraliya Dun	Dipterocarpaceae
<i>Syzygium firum</i>	Wal Jambu	Myrtaceae

There are 13 threatened species in the site, out of which 4 species are also globally threatened tree species according to 2007 Red list of threatened fauna and flora of Sri Lanka (IUCN Red list). The species are shown in table 5. Out of 13 threatened species 10 are endemic.

Table 5 Threatened species found in site , their conservation status and endemismity

Species	Conservation status	Endemismity
<i>Aporusa cardiosperma</i>	Vulnerable	Endemic
<i>Aporusa lindleyana</i>	Vulnerable	-
<i>Artocarpus nobilis</i> (Globally threatened)	Vulnerable	Endemic
<i>Bridelia moonii</i>	Vulnerable	Endemic
<i>Calophyllum bracteatum</i>	Vulnerable	Endemic
<i>Canarium zeylanicum</i>	Vulnerable	Endemic
<i>Garcinia quaesita</i>	Vulnerable	Endemic
<i>Gardenia cramari</i>	Vulnerable	Endemic
<i>Humboldtia laurifolia</i> (Globally threatened)	Vulnerable	-
<i>Ochna jabodapita</i> (Globally threatened)	Critically enangered	Endemic
<i>Palaquium grande</i> (Globally threatened)	Vulnerable	Endemic
<i>Syzygium lanceolatum</i>	Vulnerable	-
<i>Syzygium makul</i>	Vulnerable	Endemic

Profile diagram of Kanana Kanda natural forest is shown in figure 1.

Figure 1 Profile diagram of Kanana Kanda natural forest



- | | | |
|---------------------------------------|--------------------------------------|---------------------------------|
| ● - <i>Humboldtia laurifolia</i> | ● - <i>Neolitsea cassia</i> | ● - <i>Cinnamomum verum</i> |
| ● - <i>Aporosa cardiosperma</i> | ● - <i>Shorea affinis</i> | ● - <i>Hopea jucunda</i> |
| ● - <i>Dilinia retusa</i> | ● - <i>Ochna jabodapita</i> | ● - <i>Garcinia quaesita</i> |
| ● - <i>Strombosia ceylanica</i> | ● - <i>Aporosa lindleyana</i> | ● - <i>Diospyros insignis</i> |
| ● - <i>Chaetocarpus castanocarpus</i> | ● - <i>Caryota urens</i> | ● - <i>Plaquium grande</i> |
| ● - <i>Artocarpus nobilis</i> | ● - <i>Clerodendrum infortunatum</i> | ● - <i>Tarenna asiatica</i> |
| ● - <i>Gyrinops walla</i> | | ● - <i>Gardenia cramari</i> |
| ● - <i>Symplocos cochinchinensis</i> | | ● - <i>Syzygium lanceolatum</i> |

Discussion

Present field observations revealed that Kanana Kanda is an isolated lowland hill with an altitude of 115m covered with a natural forest surrounded at the base by paddy fields, home gardens and small holdings of tea and rubber cultivations.

The natural forest is disappearing due to expanded anthropogenic activities. Encroachment of the forest with the intension of expansion of the existing home gardens surrounding the forest patch, illicit felling of trees for fire wood are the major threats to survival of the flora in Kanana Kanda.

Difficult to identify the community structures and stratification of the tree flora due to degradation of the primary forest species in various degrees in various locations in the forest. No emergent trees found at all. Presence of a few number of trees of *Cullenia rosayroana* (2 trees in 2 plots) and *Hydnocarpus octandra* (1 tree in 1 plot) which were also found as canopy trees in KDN complex (Singhakumara, 1996) and other south-western hill forests of Tibbottagala, Suriyakanda (Gunatilleke *et al.*, 2005) provide evidence for the similarity of community structure of Kanana Kanda to community structures of above south-western hill forests before degradation. The fact further proves the presence of *Anisophyllea cinnamomoides* (one tree), *Shorea affinis* and *Chaetocarpus castanocarpus* which were found in Hinidumakanda and Singhagala as canopy and sub canopy dominants (Gunatilleke *et al.*, 2005) and the presence of *Gyrinops walla*, *Humboldtia laurifolia*, *Diospyros insignis* found in Hinidumakanda, Suriyakanda and Singhagala (Gunatilleke *et al.*, 2005).

Presence of *Alstonia macrophylla* a light demanding pioneer tree species which establish after formation of a gap, late successional dominants (*S. affinis*) and late successional nondominants (*Mangifera zeylanica*) in some part of the forest indicates the regeneration of the vegetation in such areas of the forest. Same time some part of the forest consists of late successional understory species like *H. laurifolia* and *G. walla* which indicates the mature phase of the forest.

No clearly distinguishable vegetation communities in the forest. Presence of few species of *C. castanocarpus*, *A. cinnamomoides* and *G. walla* provide evidence for prevailed such vegetation communities (*eg.* Dipterocarp community) before the degradation took place.

There were 13 threatened species (12 vulnerable and 1 critically endangered species) found during the present survey. Out of 13 threatened species 10 are endemic including the critically endangered species (Table 5). All these species are in an isolated habitat. Isolated species are susceptible to extinction due to deleterious environmental effects and genetic deterioration. The fact further demands the requirement of adoption of intensive management plan for the forest in order to protect the species.

Forests in the wet zone are rich in endemic floral species. Over 90% of endemic flowering plants including all endemic genera are concentrated in the south-west wet zone of the Sri Lanka where 9 of the 13 terrestrial floristic regions are located (Gunatilleke and Gunatilleke, 1990). The present study revealed that one third (35%) of the enumerated trees and half (46%) of the species found in the site are endemic. Comparison of percentage endemic species and percentage endemic individuals in Kanana Kanda with the above values found in Kanneliya, Dediyaigala – Nkiyadeniya (KDN) forest complex (Singhakumara, 1996) and Adam's Peak Wilderness sanctuary (Singhakumara, 1995) are shown in table 6. It is clear the percentage endemic species present in Kanana Kanda is closer to the percentage endemic species present in three different forest formations in Adam's Peak Wilderness sanctuary. It is also close to the percentage endemic species in Kanneliya, Dediyaigala and Nakiyadeniya. Percentage endemic individuals found in Kanana Kanda are similar to the percentage endemic individuals in Dediyaigala. Priority should be given to the conservation of this forest patch since the degree of endemism of an area is often

cited as a measure of the uniqueness of the flora and consequently is important for prioritizing site for conservation (Myers *et al.*, 2000).

Table 6 Comparison of percentage endemic species and percentage endemic individuals in Kanana Kanda with few other wet lowland, submountain and mountain forest formations

Contribution made by endemic species	KDN complex			Adam's Peak Wilderness sanctuary			Kanana Kanda
	Kanneliya	Dediyagala	Nakiadeniya	Lowland	Submountain	Mountain	
% endemic species	52	55	51	42.7	45.6	46.8	46
% endemic individuals	63.15	34.7	60	47.8	60.6	64.2	35

Conclusions and recommendations

Kanana Kanda is an isolated forest patch. The structure and composition of the tree flora in Kanana Kanda is similar to the tree flora of south western hill forests. Endemism of tree flora are high in Kanana Kanda and it provides habitat for threatened species as well as rare species. The natural forest is disappearing due to expanded anthropogenic activities. However some part of the forest is regenerating.

It is clear the importance of this site with respect to the endemism and conservation status of trees. Therefore priority should be given to the conservation of this forest patch.

Preparation of a suitable management plan to arrest further degradation of this forest fragment is highly recommended.

References

- Dassanayake, M.D., & Fosberg, F.R. (1980–1991) *A revised hand book to the flora of Ceylon* (Vols. 1 - 7) Amerind Publishing Co., New Delhi.
- Dassanayake, M.D., Fosberg, F.R. & Clayton, W.D. (1994 - 1995) *A revised hand book to the flora of Ceylon* (Vols. 8 - 9) Amerind Publishing Co., New Delhi.
- Dassanayake, M.D., & Clayton, W.D. (1996 – 2000) *A revised hand book to the flora of Ceylon* (Vols. 10 – 14) Oxford and IBH publication company., New Delhi.
- Davis, S.D., Heywood, V.H. & Hamilton, A.C. (eds.) (1995) *Centers of plant diversity: A guide and strategy for their conservation*. Vol. 2: *Asia, Australasia and Pacific*. IUCN Publications, Cambridge.
- Gunatilleke, I.A.U.N. & Gunatilleke, C.V.S. (1990). *Threatened woody endemics of the wet lowlands of Sri Lanka and their conservation*. Biological conservation. 55, 17-36.
- Gunatilleke, I.A.U.N., Gunatilleke, C.V.S. & Dilhan, M.A.A.B. (2005) *Plant biogeography and conservation of the south-western hill forests of Sri Lanka*. The Raffles Bulletin of Zoology 2005 Supplement No. 12: 9-22.
- Heart, T.R. (2007) *Endemic flowering plants of Sri Lanka. Part IIA Index to the distribution of plants within localities*. Biodiversity secretariat of the ministry of Environment and Natural Resources.
- Heart, T.R. (2007) *Endemic flowering plants of Sri Lanka. Part IIB Index to the distribution within agro ecological zones*. Biodiversity secretariat of the ministry of Environment and Natural Resources.
- Mittermeier, R.A., Gil, P.R., Hoffman, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J. & da Fonseca, G.A.B. (2005). *Hotspots revisited: Earths biologically richest and most threatened terrestrial ecoregions*. Conservation International, Washington D.C. 392 pp.
- Moore, P.D. & Chapman, S.B. (1986). *Methods in plant ecology*. Blackwell Science Inc; 2 Sub edition (May 1986).
- Myers, N., Mittermeier, R.A., Mittermeier, C.G., Gustavo, A.B., da Fonseca & Kent, J. (2000) *Biodiversity hotspots for conservation priorities*. Nature: Vol. 403, 24th February 2000.
- Senarathna, L.K. (2007) *A check list of the flowering plants of Sri Lanka*. National Science Foundation of Sri Lanka.
- Singhakumara, B.M.P. (1995) *Floristic survey of Adam's Peak Wilderness*. Forestry information service, Sri Lanka Forest Department.
- Singhakumara, B.M.P. (1996). *Ecological assessment of Kanneliya, Dediyagala, Nakiadeniya (KDN) forest complex*. Proceedings of the second annual forestry symposium 1996, University of Sri Jayawardenapura.