PART I

THE BOTANY AND ECOLOGY OF NORTH KALABA DISTRICT

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SOIL STUDIES IN THE HUMID TROPICS
PART I

THE BOTANY AND ECOLOGY OF NORTH KAHARA
DISTRICT
GENERAL
North Kanara is one of the most fascinating botanical regions of India, situated along the Western Ghats between latitude 13° 55' N and 15° 31' N and longitude 74° 9' E and 75° 10' E, with an area of about 3910 square miles. The district stretches to the maximum length of about 110 miles from north to south and has a width of roughly from 10 to 60 miles in the east-west direction.

The district is bounded on the north by Belgaum, while on its east lies Dharwar, with its open lands and dry scrubby jungles, where thorny species of Carissa congesta, Flacourtia indica, Gymnosporia montana, Ixora parviflora, Randia brandisii, Zizyphus oenoplia, Zizyphus xylopyra and a few others usually predominate. Its southern boundaries are formed by Shimoga and South Kanara districts of the Mysore State where evergreen high forests of Eugenias, Dipterocarpus, Hopeas, Calophyllum, Mesua, Palaquium and others are commonly observed while on its west runs a coastal belt for a distance of about 76 miles. The coastal strip apart from its variety of scenery and picturesqueness, offers a rich mangrove vegetation of Rhizophora mucronata, Rhizophora conjugata, Avicennia officinalis and Acanthus ilicifolius. On the bare raised flats near the sea shore Coconut and Areca plantations are in abundance, while Casuarina equisetifolia in these areas has been extensively planted both on seaward and in inland localities.

North Kanara is mostly hilly and its broken and irregular range of central hills divides the district into three parts; the central uplands, with an area of 3,000 sq. miles and the two lowlands about 1,800 sq. miles on its west and northeast.
The lowlands on the north support a scrubby type of vegetation. The climax attained here is a Teak and/or Bamboo type forest with variable associates i.e., Adina cordifolia, Emblica officinalis, Grewia tiliaefolia, Terminalia tomentosa and others. The uplands bear along the slopes merging with the lowlands, moist deciduous bamboo-type communities in initial stages, which change over to semievergreen and evergreen types with rise of altitude and increase of precipitation. Such areas are chiefly located along the west - the coastal ghat forests, and along the central and southern parts of the uplands which get a rainfall of over 500 cms. at places. The characteristic vegetation of tropical evergreen type dominates here with species like, Artocarpus hirsuta, Diospyros microphylla, Garcinia spp., Hopea wightiana, Holigarna spp., Knema attenuata; many Lauraceae, with climbers like Gnetum ula, Ancistrocladus heynanus, Diplolisia glaucescens, Cyclea, Artabotrys zeylanicus, Anami-та coocculus and others.

Near the coast, small raised flat topped blocks mostly of laterite varying from 100 - 300 feet in elevation are present. In general, the hills vary between an altitude of 1,000 - 3,000 feet and some of the highest peaks in the district are:

Darshaniguda, - 3,400 feet,
Kaltiguda - 2,500 feet, and
Bhedasgava - 2,500 feet.

The district is drained by four large rivers, Kalanadi, Bedi, Tadri and Garsappa, which rise from north, east or south, and after following a zigzag course fall into the Arabian Sea. The wide mouthed estuaries of these rivers form a conspicuous feature of physiography along the coastal belt. Besides these rivers
small streams and many water courses traverse the district.
In the west of longitude 75°, the water channels flow westwards into the Arabian Sea, while east of long. 75°, they follow an easterly course.

Along the banks of these streams, rivulets and rivers, riverain vegetation of Pongamia pinnata, Lagerstroemia speciosa, Mangifera indica, Syzygium cumini, Schleichera oleosa, Terminalia arjuna and Salix tetrasperma, with shrubby growth of Homonaria spp., Phyllanthus lawii, Polygonum spp., Memecylon, Tamarix (occasionally seen) and ferns like Gymnopteris is usually met with.

Botanically, the area has not been explored extensively so far. The major contribution on the flora of this district is that of Talbot (1909, 1911), which includes a detailed account of trees and shrubs from this area. Rest of the contributions on this district is mainly confined to the general study of the forests (Davis, 1927; Dhareshwar 1939, 41; Mirchandani, 1941; Mathunga 1945; Kaikaini 1945, 52; Mavinkarve, 1955; Coelho 1956 and others) from the economic point of view. A patchy reference to the plants met within the district is also confined to forest reports, and in the 'Flora of British India', but no consolidated account of the total floristic wealth of the area has been attempted so far.

The ecological aspect of the problem has not been considered at all, and there is not even a single publication that could speak about the 'Succession of forest communities' for this area. Even the structure of forest types has not been described except Santapau's (1954) preliminary efforts.
Thus, to understand the behaviour of plant communities, and to know the details of floristics, the work on this district was undertaken in hand in 1957. The work is based on field surveys carried on during 1957-60, mainly in the areas of:

Northern lowlands: Holiyal, Bhagwatti, Danieli, Mundgod.
Uplands: Sirsi, Siddapur, Malimane, Garsappa, Katgal, Deiimane ghat.
Western lowlands: Kounta, Karwar, Ankola.

The areas explored are shown in the map.

GEOLOGY

Geologically, North Kanara is formed of unclassified crystalline rocks mainly, Granites, Gneiss and laterite, clay slate, chlorite slate, talc, limestone, mica schists, also occur at various places, more commonly along the northern lowlands.

The granites are hard rocks and do not weather with ease. Under the wet conditions of North Kanara, they have given rise to soils which are coarser and reddish in colour and bear an evergreen vegetation of tropical rain forest type.

Laterites are hard on surface, decompose slightly, and so, the soils formed from these are generally shallow; vegetation is not deep rooted, mostly scrubby, unless it has an expected soil deposit on its top. On this deep red soil, then an evergreen forest gets established. Laterite plateaus are prominent in Sirsi-Katgal and Sirsi-Siddapur regions.

Gneisses are comparatively softer, decompose easily to give a greyish black - reddish brown soil, which too supports
Certain geological formations are hidden over by alluvial soils. This alluvium which is a deposition from various rivers, bears generally a good growth of deciduous vegetation attaining a climax of Teak and/or Bamboo types at different places in the district.

Granite and laterite provide the building stones to the district and are extensively quarried thereby disturbing the development of vegetation.

SOILS

Considering the soil features in relation to vegetation, two main types of soil series have been recognised:

The Red Soil Series
The Black Soil Series.

These, not only differ from each other in their morphological and chemical nature, but also, support altogether different types of forests.

RED SOIL SERIES:

These are mainly conspicuous by the red colour of the soils, which with more of humus, turn to dark brownish. These are derived chiefly from the disintegration of granite/gneiss or laterite, and bear a vegetation of *Myristica* - *Diospyros* - *Cinnamomum* and other related types. The red soils from laterite, usually support either a scrub of an evergreen type with associates like *Syzygium*, *Gardenia*, *Glochidium*, *Ixora* type (on hard shallow soil) or else a forest growth of *Cinnamomum-xylie* mixed, *Kylie* - *Tabernaemontana* mixed types with species like *Actinodaphne*,

an evergreen forest
Approsa lindleyana, Callicarpa tomentosa, Macaranga peltata and Symplocos beddomei (on moderately deep soils).

These soils are mainly distributed in the uplands of the district, where temperature remains moderate, and precipitation is quite high (upto 550 cms).

BLACK SOIL SERIES

These are mainly characterised by black, humus mixed, moist-greyish coarser soils, which generally support a deciduous or an evergreen vegetation.

The hard shallow coarser soils in the northern low-lands bear a mixed-deciduous scrub with associates like Carissa congesta, Flacourtia indica, Fluessea, Gymnosporia montana, Ixora parviflora, Lantana, Zizyphus and others, with malformed, crooked and stunted tree growth of Bauhinia racemosa, Buchanania lanzan, Fitea, Cassia fistula, Cordia, Diospyros melanos, Xylon and Lagerstroemia parviflora.

The deep black alluvial soils which form the fertile group of soils for the district, support a Teak or Teak/Bamboo types with species like Adina cordifolia, Anogeissus latifolia, Bambusa bambos, Dalbergia latifolia, Dillenia pentagyna, Dendrocalamus strictus, Emblica officinalis, Grewia tiliacefolia, Kydia Calycina, Lagerstroemia lanceolata, Terminalia tomentosa and T. paniculata. On maturity these soils change to the red types which support Bamboo - Xylia mixed types. The red soils on leaching may further develop brownish deep soils, which generally in North Kanara, bear a vegetation of species like Litsea, Olea dioica, Symlocos sp., Tabernaemontana heynnea, Terminalia paniculata and Xylia xylocarpa.
In general, the black soil types are located in the lowlands of the district, in areas which get low-moderate amounts of precipitation.

The correlation of soil features with climate and the type of vegetation has been brought out (Table, [14]). A few general conclusions may thus be drawn.

1) The black soil series are associated with a climax of moist deciduous types.

.......... Rainfall low-moderate, temperature shows more extremes.

2) The red soil series are associated with a climax of rain forest type, with variable evergreen components.

.......... Rainfall high, temperature remains moderate.

CLIMATE

The climate of North Kanara is typically monsoonic since rains fall by the Arabian Sea branch of the summer monsoon. Most of the areas especially in the coastal side and uplands, receive high rainfall (above 350 cms. annually). The lowlands on the north however, get a low rainfall which hardly exceeds 200 cms. p.m. The rainfall patterns of the important towns of the district are given. From the study of these patterns, North Kanara can broadly be divided into three rainfall zones. The first rainfall zone is represented by the patterns of towns like Ankola, Bhatgal and others, and has high evergreen forests. The second rainfall zone has chiefly both evergreen and semi-evergreen forests, (Yellapur, Siddapur and others) and the third, has only deciduous vegetation. This zone lies in the north east of the district and is represented by Haliyal and
<table>
<thead>
<tr>
<th>Place</th>
<th>Rainfall in cms.</th>
<th>Vegetation</th>
<th>Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mundgod</td>
<td>106</td>
<td>Scrub forest Butea type, Gymnosporia-Ixora type.</td>
<td>Hard, shallow, greyish.</td>
</tr>
<tr>
<td>Supa</td>
<td>220</td>
<td>Moist deciduous forests (Teak/Bamboo types)</td>
<td>Black alluvial</td>
</tr>
<tr>
<td>Sirsi</td>
<td>235.5</td>
<td>Semievergreen/evergreen moist deciduous types</td>
<td>Black or red; laterite exposes at places.</td>
</tr>
<tr>
<td>Yella-pur</td>
<td>270</td>
<td>Laterite scrub; evergreen forests</td>
<td>Laterite exposed hill-schist; deep red soils from granite/gneiss.</td>
</tr>
<tr>
<td>Siddapur</td>
<td>296</td>
<td>Coastal scrub; semievergreen-wet evergreen types.</td>
<td>Coastal sand; deep ferruginous clay.</td>
</tr>
<tr>
<td>Karwar</td>
<td>309</td>
<td></td>
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<tr>
<td>Ankola</td>
<td>332</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Honavar</td>
<td>362</td>
<td></td>
<td></td>
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<tr>
<td>Kumta</td>
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<td></td>
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<tr>
<td>Bhatgal</td>
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</table>
Mundgod towns.

The number of rainy days in every month along with monthly and yearly rainfall averages of ten towns is given. The second line against each station gives the number of rainy days in a particular month (Table 1).

There being no observatory centre anywhere in the district, temperature variations and their effect cannot be studied. In general temperature remains moderate, going up to about 55°F in winter and 45°F in summer months.

The moisture content of the atmosphere is mainly governed by the rainfall and temperature and is measured in terms of Relative Humidity and Vapour pressure, the figures of which are given for Marmagaon, this being the only data available for a place nearest to North Kanara. Together with these, data on clouds, thunder, hail, fog, etc. which are rare in the district, is given (Table II).

The climograph for Marmagaon on the above data has been plotted.

FOREST RAIN

A very unusual feature noted in these forests is the presence of falling of the forest rain. On account of the climatic conditions water transpired by vegetation rises up the crown of trees and condenses in the form of dew, and falls from the trees as continuous drops during night. In some areas, this instability rainfall assumes some importance in the development of ground flora species.

The instability rainfall does not occur in areas which are maltreated or where the trees have been removed and only
scrub and grassy vegetation prevails. Incidentally, North Kanara provides interesting evidence of usefulness of the forest, for ameliorating climatic conditions of the area, especially the rainfall.

**BIOTIC INFLUENCES**

There is no evidence of a large scale forest destruction. Grazing is of common practice only in the lowlands, where the established vegetation now consists of a scrub forest. Due to trampling, the soil has hardened in these areas, thus hampering the growth of tree species.

The village being scanty populated the forests are most covered and undisturbed providing a home for the wild life i.e., tigers, elephants, jackals, black bear, deer and bisons which do some harm to the forest areas. Especially bisons and elephants cause a considerable damage. Bamboos form the favourite feed for the elephants.

Fires are in no way a menace to these forests; and perhaps the most operating factor seems to be man himself. Lately, forest lands at suitable sites in the lowlands, as well as in the uplands have been cleared for plantations of Areca, Banana, Coconut, Anacardium, Piper and betle, and for the cultivation of paddy and other cereals. The forest areas along such sites have resulted into scrubby, grassy regions where useless hardy, thorny components only survive.

The practice of selective felling is being carried on modern management systems and so, does not effect the existing vegetation to a considerable extent.
GENERAL ACCOUNT OF THE VEGETATION

Four vegetation types are met with in the district of North Kanara i.e. Evergreen, Deciduous, Scrub, and Grasslands. Of these, grasslands cover a very small area of the district and most of the forest land supports rich deciduous or evergreen vegetation.

Apart from these types, palm forests are met with near the coastal strip on spurs and slopes of the Western ghats. These support a vegetation of evergreen species of both hardwood and softwood varieties, with certain deciduous trees like Dillenia pentagyna, Schleichera oleosa, Terminalia paniculata, Trewia nudiflora, and at few places Terminalia tomentosa. Softwood evergreen species have more percentage here and are since they find use in Matchwood and Plywood industries.

There are also some Sandal areas in the district, one being at Sirsi, and the other at Siddapur. Sandle wood (Santalum album) is found in these forests to varying degrees, and is occasionally present in the evergreen areas at places which are rather open. It is comparatively better in moist deciduous, while fairly well represented in the deciduous forests, where it grows in plenty, covered over by Lantana bushes.

GRASSLANDS

Grasslands are not a feature of the botany of North Kanara. These are found only in small patches at places where the forests are rather open and well subjected to biotic influences. The main grass species met with are:-
( in uplands )

Apluda aristata
Bothriochloa pertusa
Dicanthium sp.
Eremopoeon foveolatus
Heteropogon contortus
Iscilema laxum
Panicum spp.
Pseudanthistiria hispida
Themeda quadrivalvis

( in lowlands )

Apluda aristata
Arundinella avenacea
Cenchrus ciliaris
Cynodon dactylon
Digitaria marginata
Eleusine indica
Heteropogon contortus
Ischaemum rugosum
Paspalum spp.
Sporobolus spp.

Arundinella tenella
Capillipedium sp.
Eragrostis spp.
Fulalla spp.
Ischaemum ciliare
Opismaenus compositus
Phragmites karka
Themeda triandra

The herbaceous element interspersed in these grasslands mostly contains leguminous plants; and often, a good number of weeds. Amongst them, the following species are seen to be more common:

Achyranthes aspera, Alysicarpus spp., Ammannia baccifera, Argyemone mexicana, Atylosia sp., Blumea sp., Boerhaavia repens, Cassia auriculata, C. tora, Celosia argentea, Chlorophytum sp., Corchorus sp., Crotalaria spp., Cyanosis sp.,
Cyperus spp., Desmodium triflorum, Euphorbia hirta, Indigofera spp.,
Justicia diffusa, Leucas spp., Mimosa pudica, Rangia parviflora,
Polygononum spp., Phyllanthus urenaria, Tridax procumbens, Urena
lobata, Vernonia cinerea.

SCRUBS

The scrub forests are located in the district, in the
north eastern lowlands, the central uplands and in the coastal
(western) lowlands. The types are developed either on black or
red soils, and accordingly support a deciduous or evergreen type
of vegetation. The red soil scrub or the laterite scrub, has
developed along coastal sides, and extends into the plateaux of
Sirsi-Siddapur regions. The lowland north types on black soils,
are found in the east and north-east of the district, extending
further to Dharwar where they constitute the representative type
of vegetation covering large open lands on alluvial type of soils.
Such types support species like,

Carissa congesta, Gymnosporia, Lantana, Flacourtia indica,
Flueggea, Ixora arborea, Zizyphus with stunted trees of Castia
fistula, Diospyros melanoxylon, Lagerstroemia lanceolata, Termi-
nalia tomentosa and Tectona grandis.

The lateritic scrub consists mostly of evergreen armed
or unarmed shrubs, with few small trees. The following plants
are met with;

Canthium parviflorum   Carissa congesta
Gardenia gummifera     Glochidion sp.
Gymnosporia rothiana   Ixora coccinea
Ixora nigricans        Lantana camara
Meynea laxiflora       Randia brandisii
Trees of Syzygium spp., Terminalia tomentosa and Careya arborea are often observed.

The ground flora consists of grasses like; Auluda aristata, Dimeria ornithopoda, Eragrostis unioloides, Eulalia fimbriata, Heteropogon contortus and Ischaemum ciliare, with few saplings of the above species.

The hills at certain places are more or less undulating and are open to grazing. The soil is coarse gravelly and shallow.

Biotic interferences and shallow soils are mainly responsible for the formation of these scrubby forests.

DECIDUOUS FORESTS

The deciduous forests are distributed in the low rainfall areas of the district mainly in the northern lowlands. The characteristic vegetation here is of Teak and/or Bamboo types, which with the increase of rainfall progresses into semi-evergreen communities. A change from black to red type of soil may also bring about a similar effect. Thus, in these areas, at higher elevations on laterite, evergreen vegetation has stabilised showing that the deciduous forests are also related to the alluvial type of soils.

Much of the studies on deciduous and moist deciduous forests have been done by the Forest Department (Garland, 1937; Kesarcodi, 1934; Kaikini, 1945; Coelho, 1956; Brito, 1956), mainly concerning the production and quality of teak. It has
been observed that teak flourishes best in the deciduous forests, with high rainfall and perhaps moisture conditions are more suitable to its growth. Here, teak is chiefly associated with *Xylica xylocarpa* (occurring mostly on laterite), while in the low rainfall areas its co-dominant is mainly *Anogeissus latifolia*. In the moist sites *Terminalia tomentosa* and in dry situations *Dalbergia latifolia* and *Pterocarpus marsupium* are often present.

These forests are usually teak-bearing, but sometimes teak may be absent, perhaps due to some biotic interferences or edaphic differences.

The forests are rather open, less dense and are penetrable as there is no dense growth of lianes and other climbers characteristic of evergreen forests. They also differ in their physiognomy from the evergreen forests and do not show any well marked stratification.

The forests are chiefly composed of the following plant species.

**TREES**

<table>
<thead>
<tr>
<th>Adina cordifolia</th>
<th>Albizzia lebbek</th>
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<tbody>
<tr>
<td>Albizia procera</td>
<td>Bauhinia racemosa</td>
</tr>
<tr>
<td>Bridelia squamosa</td>
<td>Butea monosperma</td>
</tr>
<tr>
<td>Dalbergia latifolia</td>
<td>Dalbergia paniculata</td>
</tr>
<tr>
<td>Dillenia pentagyina</td>
<td>Diospyros montana</td>
</tr>
<tr>
<td>Ethretia laevis</td>
<td>Emblica officinalis</td>
</tr>
<tr>
<td>Erinocarpus nimmonii</td>
<td>Erythrina indica</td>
</tr>
<tr>
<td>Ficus arnottiana</td>
<td>Ficus asperrima</td>
</tr>
<tr>
<td>Ficus glomerata</td>
<td>Garuga pinnata</td>
</tr>
<tr>
<td>Gmelina arborea</td>
<td>Grewia tillaefolia</td>
</tr>
</tbody>
</table>
Kydia calycina
Lannea grandis
Miliusa tomentosa
Schleichera oleosa
Sterculia spp.
Terminalia tomentosa
Terminalia chebula
Xylicia xylocarpa

Small trees and shrubs are:

Adhatoda vasica
Carissa congesta
Colebrookia oppositifolia
Hymenoxis laxiflora
Lantana camara
Randia brandisii
Woodfordia fruticosa
Zizyphus rugosa

CLIMBERS

Asparagus racemosus
Cissus sp. (commonest being Cissus discolor)
Diploclisia glaucescens
Smilax zeylanica

The undergrowth consists of:

Carvia callosa
Desmodium trifloratum
Moghania strobilifera
Urena lobata
With a few grasses like *Themeda triandra*, *Apluda aristata*, *Eragrostis* species and the seedlings of the above trees and shrubs.

The most deciduous types, are prominent by a rich growth of bamboos, which may also be observed along stream beds. The following species are found: -

- *Bambusa bambos*
- *Dendrocalamus strictus*
- *Oxytenanthera monostigma*
- *Ochlandra talboti*

Humidity and moisture conditions are low in these forests. The epiphytic flora is less prominent and is chiefly observed on trees of *Careva arborea*, *Mangifera indica* and *Terminalia tomentosa*. In some hidden and shady pouches of the trees *Drynaria quercifolia* comes up along with numerous mosses. Fungal flora too has a poor growth here.

The ground is less moist, almost dry in certain forests; and is covered with decomposed or decomposing leaves, mostly of *Tectona grandis* and other deciduous tree species.

**EVERGREEN FORESTS**

The evergreen forests are distributed mainly in the uplands of the district in high rainfall tracts. The Garsappa ghats, Malamani, Yellapur and Devimane Ghat, all of these are areas possessing a typical wet evergreen type of vegetation with lofty tall trees reaching to a height of 100 - 150'. At Katgal, Sirsi and Siddapur the forests are comparatively poorer in general aspect and top-storey is smaller, generally keeping itself to 100'. Trees above 150' have been recorded from the forests at Gund which are perhaps of the best height growth in North Kanara. The author has also observed tree growth at its best at Teligiri Kan, Sahasrahalli.
Kan, Malamani and Yesle Forests, where most of the work has been done. The characteristic feature of the evergreen forests is their stratification. Depending on the type of forest, top-layer exhibits a good deal of variation in the average height of its trees. Thus certain variations in the different storeys are met with and possibly they are governed by the length of the top canopy. In the forest with top layer upto 100' or so, the following layers can be demarked.

a) First storey or the top layer.

b) Second storey or the middle layer, composed of moderate sized as well as tall trees, the latter having a tendency to go into the first storey.

c) Small trees.

d) Shrubs and climbers, followed by the ground flora species.

In other evergreen forests where the trees are comparatively not so tall and their height is almost equal to that of the second storey pointed above, following composition can be observed.

a) Top layer; (b) middle layer; (c) shrubs and woody climbers; followed by the ground flora species.

The forests are composed of three or more co-dominants. A detailed ecological account of these will be taken up later on, while here only the floristic notes on general basis may be presented.

**Top layer or First storey** - variable in height; 80 - 150'; in others 50 - 75'. Tree species met with are:-
<table>
<thead>
<tr>
<th>Species</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alseodaphne semecarpifolia</td>
<td>Artocarpus incisa</td>
</tr>
<tr>
<td>Artocarpus hirsuta</td>
<td>Beilschmiedia fagifolia</td>
</tr>
<tr>
<td>Caryota urens</td>
<td>Celtis cinnamomea</td>
</tr>
<tr>
<td>Cinnamomum zeylanicum</td>
<td>Dillenia pentagyna</td>
</tr>
<tr>
<td>Diospyros micropyllla</td>
<td>Dipterocarpus indicus</td>
</tr>
<tr>
<td>Dysopyllum binecarifera</td>
<td>Elaeocarpus tuberculatus</td>
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<tr>
<td>Euphoria longana</td>
<td>Garcinia cambogia</td>
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<tr>
<td>Garcinia morella</td>
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</tr>
<tr>
<td>Holigarna grahimi</td>
<td>Hopea wightiana</td>
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<tr>
<td>Knema attenuata</td>
<td>Lagerstroemia speciosa</td>
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<tr>
<td>Lepisanthes tetraphylla</td>
<td>Litsea stockii</td>
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<tr>
<td>Lophopetalum wightianum</td>
<td>Macaranga peltata</td>
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<td>Machilus macrantha</td>
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<td>Mesua ferrea</td>
<td>Myristica beddomei</td>
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<tr>
<td>Pithecolobium bigenimum</td>
<td>Polyalithia fragrans</td>
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<tr>
<td>Pouteria tomentosa</td>
<td>Pterygota alata</td>
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<tr>
<td>Sapindus marginatus</td>
<td>Strychnos rux-vomica</td>
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<tr>
<td>Terminalia bellerica</td>
<td>Vateria indica</td>
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<tr>
<td>Vitex altissima</td>
<td></td>
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</tbody>
</table>

**Second storey:** Usually less prominent; with species like:

<table>
<thead>
<tr>
<th>Species</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actinodaphne hookeri</td>
<td>Alstonia scholaris</td>
</tr>
<tr>
<td>Anopora lindleyana</td>
<td>Careya arborea</td>
</tr>
<tr>
<td>Cinnamomum zeylanicum</td>
<td>Diospyros crumenata</td>
</tr>
<tr>
<td>Diospyros micropyllla</td>
<td>Flacourtia montana</td>
</tr>
<tr>
<td>Holigarna arnottiana</td>
<td>Hydnocarpus laurifolia</td>
</tr>
<tr>
<td>Knema attenuata</td>
<td>Linociera malabarica</td>
</tr>
<tr>
<td>Mimusosa elengi</td>
<td>Mimusosa hexandra</td>
</tr>
<tr>
<td>Olea diotica</td>
<td>Pterospermum acerifolium</td>
</tr>
<tr>
<td>Pterospermum hexeanum</td>
<td>Strychnos rux-vomica</td>
</tr>
<tr>
<td>Terminalia chebula</td>
<td>Terminalia paniculata</td>
</tr>
</tbody>
</table>
Xylia xylocarpa

Third storey is composed of:

Callicarpa tomentosa  Canthium dicoccum
Flacourtia montana  Ixora brachiatia
Ixora nigricans  Ixora polyantha
Leea indica  Psychotria dalzellii
Psychotria truncata  Randia sp.
Unona lawii

Shrubs, Climbers: grow in abundance in these forests and almost make them impenetrable at certain places.

Allonhylus serratus  Anamirta cocculus
Ancistrocladus hevneanus  Artabotrys zeylanicus
Asparagus racemosus  Calamus pseudo-tenuis
Calycoperis floribunda  Chasalia curviflora
Cissus spp.  Clematis spp.
Clerodendron infortunatum  Cyclea bmmanni
Diolodisia glaucescens  Entada phaseoloides
Erythronium populifolium  Gnetum ula
Goniothalamus cardipetalus  Hemidesmus indicus
Ixora nigricans  Jasminum rottlerianum
Melanthesia turbinata  Murraya koenigii
Naravelia zeylanica  Piper nigrum
Pothos scandens  Rubia cordifolia
Schefflera venulosa  Smilax zeylanica
Solanum ferox  Toddalia aculeata
Uvaria narum  Wagatea spicata
Zizyphus rugosa  Zizyphus xylopyra
Zizyphus xylocarpa
The ground flora species are chiefly composed of saplings of the above trees, shrubs, etc. Amongst other plants, Curcuma spp., Costus speciosus, Ophiopogon harrisi, Leucas aspera, Melanthesia turbinata, Murraya koenigii, and ferns (Pteris quadriaurita) are seen. In the undergrowth Lese indica, Costus speciosus, some members of Zingiberaceae are generally more common, and at certain open places, Pteris quadriaurita forms almost pure patches.

On the forest fringes, especially in clearings, Lantana camara is abundant. Careya arborea is also frequently noted along forest edges.

The characteristic features of the forests are:-

i) The trees of top storey are very tall.
ii) Number of trees are within a clean bole upto 60' with a girth of 8' or more.
iii) The trees develop buttressed bases, i.e. Alstonia scholaris, Polyalthia fragrans, Dipterocarpus, Elaeocarpus tuberculatus.
iv) Rich growth of climbers, especially the lianes, like Gnatum ula and Ancistrocladus heyneanus.

Excess of moisture and humid conditions are favourable for the growth of Cryptogamic flora. Amongst the fungi, generally Agarics and Polypores are noted. Agarics are generally abundant on the moist, decayed, fallen twigs. Of the mosses the commonest are Bryum, Polytrichum spp., often firmly adjusted to the barks of trees, especially near the field layer. Certain foliose Jungermanniales also grow in association with mosses, while thalloid liverworts are noted on the edges along roadsides at shady places.
Drynaria quercifolia and Pleopeltis spp., seem to be the common epiphytic ferns. The common epiphytic orchids are Acamphe wightiana, Aerides radicosum, Bulbophyllum spp., Dendrobium macrostachyum, Liparis & Pholidota imbricata.