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Tree Flora in Eastern Ghats of Southern Peninsular India

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Abstract: Eastern Ghats are highly significant in terms of its Biodiversity. Extensive field and literature survey of trees in Eastern Ghats yielded 560 tree taxa under 262 genera belonging to 80 families out of the estimated 2500 species of flowering plants in Eastern Ghats. Euphorbiaceae (66) followed by Rubiaceae (38), Moraceae (31), Lauraceae (26), Mimosaceae (24), Rutaceae (21), Verbenaceae (17), Meliaceae (16), Cordiaceae, Fabaceae (14), Ebenaceae, Oleaceae (13), Tiliaceae (12) are the largest families based on the species number. The dominant genera include *Ficus* with 25 species, *Grewia*, *Acacia*, *Diospyros* with 12 and *Terminalia* 10. Endemic tree species distributed in different regions of Eastern Ghats are *Acacia donaldi*, *Actinodaphne madraspatana*, *Alphonsea madraspatana*, *Albizia thompsonii*, *Boswellia ovalifoliolata*, *Bridelia cinerascens*, *Cordia domestica*, *Croton scabiosus*, *Dimorphocalyx kurnoolensis*, *Eriolaena lushingtonii*, *Hildegardia populifolia*, *Lasiococca comberi*, *Premna hamiltonii*, *Pterocarpus santalinus*, *Shorea tumbuggaia*, *Syzigium alternifolium*, *Terminalia pallida*, *Wendlandia gambleii*, *Vernonia shevaroyensis*, *Toona ciliata* var. *brevipetiolata* etc. A brief account on topography, geology, climate, vegetation pattern, floristic analysis, distribution pattern of trees in various regions of Eastern Ghats are provided.

Key words: Eastern Ghats, trees, geography and topography, vegetation, statistical analysis, endemic trees

INTRODUCTION

The close bonding of humans with trees may be traced back to their arboreal ancestry. Reposing under a tree is like being cuddled by a mother-comfortable and secured. Trees are major components of forests. By sequestering carbon, releasing oxygen and losing a large amount of water vapor, trees profoundly influence the environment. Trees bind the soil, recycle minerals and regulate the course of rainwater. Unparalleled in the variety of useful products they give and the wide range of organisms they feed and shelter, trees are essential for maintaining the health of several ecosystems. Above all, trees are friendly, beautiful and invoke awe and admiration. They are the largest and longest-lived immobile organisms and often an amazing diversity of forms. Trees have come to symbolize benevolence, fertility and mobility.

Natural resources survey like floristic studies, play an important role in the economic development of developing country like India. The alarming rate at which this natural wealth is vanishing has become the compelling factor for a detailed botanical survey of all the plants, particularly in India. Trees have played an important role in the economy of the tribal population of Eastern Ghats

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area and are an asset to the nation. Besides meeting human needs like food, clothing, fuel, shelter and other basic products they aid in providing much needed wood fuel, timber, paper, rayon, soft wood, tannin, essential oils, perfumes, gums, resins, fibers, wax, coir and drugs. Trees serve as host for many animal products like lac, honey, silk tasar etc. and act as wind breakers and shelter belts, generate raw materials for feeding the small scale industries.

Eventhough, the tropics are known for their rich diversified Flora, there is not any reliable source, which provides full fledged information on a particular regions of the tropics and also tropics as a whole. Realizing that indispensability of floristic studies, taxonomists have undertaken the great task of preparing regional Floras. As a result many regional Floras have been worked out but all the same much remains to be done. Flora of Sylavatica for Eastern Ghats is one such work. Eventhough district Floras and State Flora do provide information on trees there is no single work which is solely dedicated to the trees of Eastern Ghats. The present study is taken up to fill this deficiency.

MATERIALS AND METHODS

Geo-climate and Location of Study Area

The Eastern Ghats, a rugged, hilly terrain running almost parallel to eastern coast of India, constitutes the watershed of many big rivers. The Eastern Ghats along the Peninsular India are divisible into three zones, the Northern Eastern Ghats, the Middle and the Southern Ghats (Rao,1998). Geography and Topography of different hill ranges are shown in Table 1.

The Eastern Ghats are located between 11° 30' and 22° N latitude and 76° 50' and 86° 30' E longitude in a North- East to South-West strike (Fig. 1). The Ghats cover an area of about 75,000 km² with an average width to 200 km in the North and 100 km in the South. They are extended over a length of 1750 km between the rivers Mahanadi and Vaigainal. The average elevation of the Eastern Ghats is about 750 m, though peaks rise to heights of 1672 m.

Table 1: Geography and topography of different hill ranges of Eastern Ghats

Region	Name of the hills/districts	Altitudes of the hills
Northern Eastern Ghats	Districts of Sambalpur and Bolangir (Gandhamardan hills), Mayurbhanj and Kalahandi (Khondmal hills) Phulbani and Koraput -Orissa Srikakulam (Palakonda-Antikonda-Burra Konda ranges), Vizianagaram, Visakapatnam (Madgole hills- Anantagiri-Chintapalli-Sapparla- Gudem- Marripakalau hill ranges), East Godavari (Gurteedu-Addateegala-Rampachodavaram-Maredumilli ranges) and West Godavari (Polavaram-Papikonda ranges)- Andhra Pradesh districts	Altitude of above 400 m, few peaks with above 1100 m, Mahendragiri 1501 m, Debmali Parbat 1672 m, (Koraput district), Koraput 1515 m, SingarajuParbar 1516 m, Devagiri 1381.2 m, Turiakionda 1598 m, Hatimali 1391 m, Chandragiri 1269 m, Armakonada 1680 m, Dharakonda 1365 m Sambarikonda near Gudem village 1527 m, Galikonda 1643 m, Average elevation 750 m, Nallamalais 800 m, Seshachalam hills 850 m
Middle Eastern Ghats	Districts of Krishna (Kondapalli ranges), Kurnool, Mahaboob nagar, Prakasam (Nallamalai ranges), Anantapur, Cuddapah, Chittoor and Prakasam (Palakonga-Seshachalam-Lankamala- Nagari hills and Nellore (Veligonda range)-Andhra Pradesh	
Southern Eastern Ghats	North Arcot (Javadi hills), South Arcot (Gingee hills), Salem (Hills of Shevaroy, Kollimalai hills, Kalrayan and Bodamalai) Dhamapuri (Melahiri hills) Tiruchirapalli (Pachamalai hills)	Javadi hills up to 1375 m, Pachamalais hills up to 1000 m, Shervaroy hill 400-1600 m, Kolli hills 1000-1500 m

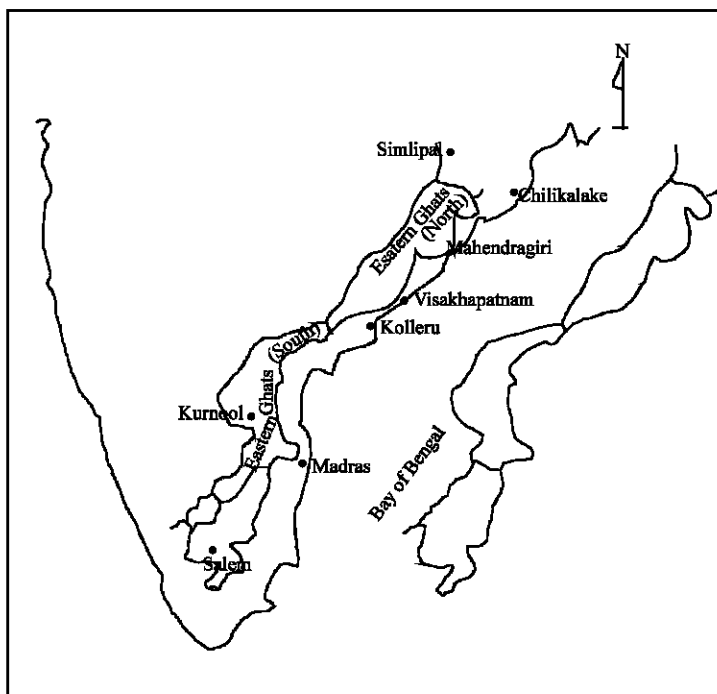


Fig. 1: Study area showing Eastern Ghats of Southern Peninsular, India

The region falls under tropical monsoon climate receiving rainfall from both South-West monsoon and North-East retreating monsoon. In the northern part, the annual rainfall Ranges from 1150 (rainfall recorded at Gopalpur Meteorological Station, Orissa)-1660 mm (Sambalpur Station, Orissa) indicating sub humid climate, whereas in the central and southern parts the mean annual rainfall ranges from 600-1050 mm (in between Machilipatnam and Tiruchirapalli Stations) exhibiting semi-arid climate except in the hilly peaks. Heavy winter rains coupled with cyclonic storms are the characteristics of the eastern portion, especially in the Coastal plain. The mean temperature in January ranges between 20-40°C indicating a north-south increasing trend. The maximum temperature shoots up to 41°C during hot season and night temperature goes down even up to 2°C during winter. Winter is cool but frost is normally absent. During rainy season relative humidity is quite high (70-75%)

Vegetation

Biodiversity is fully expressed in the flora, fauna and vegetation. Tree flora is rich and varied and distributed under the following types of vegetation:

Tropical Evergreen Forests

This type of vegetation is seen in very few valleys of Shevaroy hills of southern Eastern Ghats, small patch of forests in Laksmipuram of Visakhapatnam in Northern Eastern Ghats. The common trees are *Cinnamomum zeylanicum*, *Elaeocarpus serratus*, *Ixora notoniana*, *Meliosma microcarpa*, *Symplocos laurina*, *Toona ciliata* etc.

Tropical Semi-evergreen Forests (Moist Deciduous Forests and Mixed with Evergreen Elements)

These are prevalent in moist valleys of Simlipal forests, Atai, Mahendragiri, Banguru forests and parts of Ganjam and Koraput districts, Sapparla, Dharakonda, Galikonda, Tanjavanam, Minumuluru,

some areas near Anantagiri, Nulakamaddi, Maredumilli of Northern Eastern Ghats and Shervaroy hills of southern Eastern Ghats. Trees such as *Michelia champaca*, *Mangifera indica*, *Artocarpus lakoocha*, *Dillenia pentagyna*, *Firmiana colorata*, *Bridelia tomentosa*, *Xylia xylocarpa*, *Mesua nagassarium*, *Polyalthia cerasoides*, *Macaranga peltata*, *Pittosporum napaulense*, *Phoebe lanceolata*, *Murraya koenigii* etc. are the dominant elements of semi evergreen forests.

Tropical Moist Deciduous Forests

Sub divided for convenience into:

Northern Sub Tropical Deciduous Forests (Sal Forests)

This type of forest is found in parts of the districts of Kalahandi, Pulbani, Ganjam, Koraput and Srikakulam and North-eastern border area of Vizianagaram district. In the Sal forests *Shorea robusta* predominates and is associated with *Syzigium cumini*, *Xylia xylocarpa*, *Haldinia cordifolia*, *Terminalia coriacea*, *Pterocarpus marsupium*, *Anogeissus latifolia*, *Albizia procera*, *Madhuca longifolia*, *Phyllanthus emblica*, *Lagerstroemia parviflora*, *Schleichera oleosa*, *Cleistanthus collinus*, *Buchanania lanzan*, *Dillenia pentagyna*, *Diospyros melanoxylon*, *Mallotus philippinensis*, *Careya arborea*, *Litsea glutinosa*, *Syzigium operculatum* etc. In certain areas adjoining these pockets in Ganjam district, an elastic species like *Shorea robusta* (Sal) attains very large dimensions due to favourable edaphic and climatic conditions. These are called Coastal Sal forests. The associates of Sal are *Elaeocarpus tectorius*, *E. robustus*, *Aphanamixis polystachya* etc.

Southern Indian Tropical Moist Deciduous Forests (Non- Sal Forests)

These are found in parts of the Rampa agency, Maredumilli areas of East Godavari district, parts of West Godavari district, small patches of Nallamalais, Talakona and some parts of Seshachalam hill ranges of Middle Eastern Ghats and parts of Southern Eastern Ghats. Dominant tree elements are *Terminalia alata*, *Xylia xylocarpa*, *Anogeissus latifolia*, *Dillenia pentagyna*, *Pterocarpus marsupium*, *Mangifera indica*, *Dalbergia latifolia*, *Terminalia chebula*, *Sterculia urens*, *Mitragyna parviflora*, *Albizia odoratissima*, *Bridelia airyshawii*, *Schrebera swieteniodes*, *Careya arborea*, *Grewia tilifolia*, *Polyalthia cerasoides*, *Kydia calycina*, *Semecarpus anacardium* etc.

Southern Tropical Moist Deciduous Riverian Forests

These are spread in very limited areas along banks and the dried river beds, represent a distinct eco-type comprising tree species of *Terminalia arjuna*, *Pongamia pinnata*, *Tamarindus indica*, *Anogeissus acuminata*, *Barringtonia acutangula* and also mixed with characteristic species on the sandy and rocky bouldered river beds such as *Homonoia riparia*, *Tamarix ericoides* and *Syzygium heyneanum*.

Tropical Dry Deciduous Forests

These forests are found in almost all regions of Eastern Ghats. These are divided into Teak bearing forest and non Teak-bearing forests.

Teak Bearing Forest

These are distributed Northern and middle Eastern Ghats of Andhra Pradesh and dominated by valuable timber tree species i.e., *Tectona grandis*. Associating elements are *Anogeissus latifolia*, *Pterocarpus marsupium*, *Terminalia chebula*, *Terminalia bellirica*, *Garuga pinnata*, *Bridelia airyshawii*, *Cassia fistula* etc.

Non Teak Bearing Forests

These are distributed along the Seshachalam hill ranges of middle Eastern Ghats and North Arcot of Southern Eastern Ghats. Interestingly these forests having important and very valuable endemic tree such as *Pterocarpus santalinus* and also *Shorea tumbuggaia*, *Syzigium alternifolium*, *Boswellia ovalifoliolata*, prominent in some areas and mixed up with other species like *Terminalia pallida*, *Shorea roxburghii*, *Phyllanthus emblica*, *Anogeissus latifolia*, *Terminalia paniculata*, *Terminalia alata*, *Chloroxylon swietenia*, *Dolichandrone arcuata*, *Wrightia tinctoria*, *Vitex altissima* etc.,

Mixed Dry Deciduous Forests

Northern Mixed Dry Deciduous Forests

These are distributed in restricted areas in Sukinda-Rebna, Keonjhar area, Nigirda-Llung area (Mayurbhanj district) and parts of Angul Division, Kalahandi, Ganjam and Koraput districts of Orissa. *Shorea robusta* may or may not be present but *Boswellia serrata* is normally common and associated with *Terminalia alata*, *Bombax ceiba*, *Hymenodictyon excelsum*, *Pterocarpus marsupium*, *Sterculia urens*, *Alangium salivifolium*, *Mallotus philippinensis*, *Cassia fistula* etc.

Southern Mixed Dry Deciduous Forests

These are found in drier areas of all regions of Eastern Ghats. Dominant tree elements are *Anogeissus latifolia*, *Chloroxylon swietenia*, *Diospyros melanoxylon*, *Gardenia gummifera*, *Albizia odoratissima*, *Hardwickia binata*, *Pterospermum xylocarpum*, *Helicteres isora*, *Xeromphis spinosa*, *Flacourtia ramontchi* etc.

Dry Savannah Forests

These, formed mostly as a result of biotic interference, are scattered throughout the area, covered with stunted tree species of *Phyllanthus emblica*, *Terminalia chebula*, *Pterocarpus marsupium* etc.

Scrub Forests

These are considered to be as a result of intensive biotic interference. These are seen all along the Eastern Ghats in larger or smaller areas. These are dominated by thorny species of *Acacias*, *Capparis septaria*, *Ziziphus mauritiana*, *Ziziphus oenoplia*, *Ziziphus xylopyrus*, *Euphorbia antiquorum*, *E. tirucalli*, *Flacourtia septaria*, *Xeromphis spinosa* and also associated with non thorny drought resistant species like *Dolichandrone falcata*, *Wrightia tinctoria*, *Dodonaea viscosa*, *Cassia fistula* etc.

Tropical Dry Evergreen Forests

This type of forest found in South Cuddapah, Sriharikota and Mamandur valley in Seshachalam hill ranges. Tree species like *Manilkara hexandra*, *Memecylon umbellatum*, *Syzygium cumini*, *Albizia amara*, *Albizia lebeck*, *Strychnos nux-vomica*, *Sapindus emarginatus*, *Drypetes septaria*, *Pterospermum canescens*, *Drypetes ferrea*, *Garcinia spicata*, *Cordia dichotoma*, *Flacourtia indica* etc.

Tropical Dry Evergreen Scrub

It is found in Saidapet division and Madurantakam in Tamil Nadu. *Memecylon edule*, *Dichrostachys cinerea*, *Catunaregum spinosa*, *Diospyros ferrea* are the dominant tree elements.

RESULTS AND DISCUSSION

An extensive field study was conducted during 1993-2006 in different hills of Eastern Ghats. Analysis of the tree diversity available within the Eastern Ghats and literature (Gamble and Fishcher, 1915-1935; Haines, 1921; Hookers, 1872-1897; Nair and Henry, 1983; Nayar *et al.*, 1984; Raju *et al.*, 1987; Pullaiah and Chennaiah, 1997; Pullaiah and Moulali, 1997; Pullaiah, 1997; Pullaiah and Rani, 1999; Matthew, 1983; Henry *et al.*, 1987; Saxena and Brahmam, 1994; Pullaiah and Murthy, 2001; Pullaiah and Rao, 2002; Rao and Kumari, 2003; Rani *et al.*, 2003; Rani *et al.*, 2006) revealed altogether 565 taxa includes 560 species, 5 varieties under 262 genera belonging to 80 families. The details of the number of species, genera and families under each plant group are shown in the Table 2.

It is evident from the data that the ratio of species belonging to Monocotyledons and Dicotyledons is 1:70. Dominant families with 13 or more tree species are Euphorbiaceae, Rubiaceae, Moraceae, Lauraceae, Mimosaceae, Rutaceae, Verbenaceae, Meliaceae, Tiliaceae, Oleaceae, Cordiaceae, Fabaceae, Ebenaceae, Annonaceae (Table 3).

It is interesting that Euphorbiaceae occupies the first position; this indicates the wide range of growth adaptability and distribution of the various members of the family (Table 3). 21 out of 80 families are represented by single genus with one species each.

Some of the arborescent genera having more than 3 arborescent species occurring in Eastern Ghats are *Ficus* with 25 species, *Grewia* 12, *Acacia* 12, *Diospyros* 12, *Syzigium* 12, *Terminalia* 10, *Cordia* 8, *Mallotus* 8, *Wendlandia*, *Vitex*, *Litsea* 7 each, *Antidesma*, *Bridelia*, *Euphorbia*, *Glochidion* 6 each, *Bauhinia*, *Maytenus*, *Premna* and *Chionanthus* 5 each and *Zanthoxylum*, *Aglaia*, *Memecylon*, *Cinnamomum* 4 species each. In this it is interesting to observe woody character in few species in an other wise predominantly herbaceous genus like *Vernonia* (*V. shevaroyensis*) of family Asteraceae in the mountains of Southern Eastern Ghats.

Phytogeographical Distributional Pattern of Tree Taxa

Eastern Ghats are the storehouse of 560 tree species (Table 4). Of these 253 tree species are commonly seen throughout Eastern Ghats like *Sterculia urens*, *Azadirachata indica*, *Boswellia serrata*, *Pterocarpus marsupium*, *Dalbergia* sp., *Diospyros melanoxylon*, *Haldinia cordifolia*, *Gyrocarpus americanus*, *Tectona grandis*, etc. Apart from above common species Northern Eastern Ghats, Middle Eastern and Southern Eastern Ghats having 156, 90 and 152 species, respectively. Northern and Southern Eastern Ghats are rich in tree diversity having 409 and 404 species, respectively. Middle Eastern Ghats having less diversity with 343 species. A comparison of the distribution pattern of tree taxa in Northern Eastern Ghats, Middle and Southern Eastern Ghats brings out some noticeable phytogeographic facts. Though all these three regions are the part of the same Eastern Ghats chain, yet differ in the absence/presence of some species and number of species. This is due to the fact that Northern and Southern Eastern Ghats are having most humid zone and high altitude (up to 1501) than Middle Eastern Ghats.

Table 2: Statistical analysis of trees of Eastern Ghats

Groups	Species		Genera		Families	
	Total	Percentage	Total	Percentage	Total	Percentage
Dicots						
Polypetalae	269	48.04	136	51.91	49	61.25
Gamopetalae	144	25.71	66	25.19	17	21.25
Monochlamydae	140	25.00	53	20.23	12	15.00
Monocots	7	1.25	7	2.67	2	2.50
Total	560	100.00	262	100.00	80	100.00

Table 3: A perusal of the list of the species distributed in the Eastern Ghats reveals the following families in the order of dominance

Family	Genera	Species
Euphorbiaceae	25	68
Rubiaceae	20	38
Moraceae	4	31
Lauraceae	10	26
Mimosaceae	7	24
Rutaceae	13	21
Verbenaceae	5	17
Meliaceae	11	16
Tiliaceae	1	12
Oleaceae	5	14
Cordiaceae	2	14
Fabaceae	7	13
Ebenaceae	2	13
Annonaceae	7	13

Table 4: Phytogeographical distributional pattern of tree taxa in various regions

Region	No.	Percentage
Throughout Eastern Ghats	253	45.18
Northern Eastern Ghats	112	20.00
Middle Eastern Ghats	17	3.04
Southern Eastern Ghats	88	15.71
Northern to Middle Eastern Ghats	27	4.82
Middle to Southern Eastern Ghats	46	8.21
Northern and Southern Eastern Ghats	17	3.04
Total	560	100.00

Endemic Trees in Eastern Ghats

Of the estimated 17,000 species of angiosperms in India, about 1932 taxa are endemic to Peninsular India (Ahmedulla and Nayar, 1987). As many as 77 taxa are endemic to Eastern Ghats of which 21 are tree taxa. The taxonomically and phytogeographically interesting endemic tree species occurring in Eastern Ghats are given below.

Acacia donaldi Haines (Mimosaceae). Small tree; leaves pinnate, rachis with very small weak prickles on the lower rounded surface, flower heads white or cream, pods grey when mature, found in Sambalpur district of Orissa up to 1250 m altitude.

Actinodaphne madraspatana Bedd. (Lauraceae). Small to medium sized tree, leaves simple, glaucous beneath, flowers yellow, dioecious, fruit ellipsoid, distributed in Seshachalam hill ranges (Cuddapah-Chittoor districts), Chingleput district of Tamil Nadu at 600-800 m altitude.

Aglaia haslettiana Haines (Meliaceae) Evergreen tree, leaves pinnate, flowers fragrant, occurring in semi evergreen forests of Angul, Mals of Puri up to 1650 m altitude.

Alphonsea madraspatana Bedd. (Lauraceae). Middle sized tree, flowers yellow found throughout Eastern Ghats but rare in distribution at 700-1000 m altitude.

Boswellia ovalifoliolata Balakr. & Henry (Burseraceae). Deciduous tree, leaves imparipinnate, flowers greenish white, drupe 3-gonous, seeds winged, distribution is confined to Seshachalam hills (in Cuddapah, Chittoor districts) at 600-900 m altitude.

Bridelia cinerascens Gehrm. (Euphorbiaceae) Moderate sized tree, leaves simple, flowers greenish-yellow, drupe globose, purple, Occurring in Middle and Southern Eastern Ghats (Chingleput) 650 m altitude above

Cordia domestica Roth. (Cordiaceae). Small tree, leaves simple, flowers yellowish- white, drupe ellipsoid, yellowish or pinkish yellow, found in Guvvalacheruvu of Cuddapah district, Kambakam hills of Chingleput at about 1000 m altitude.

- Croton scabiosus* Bedd. (Euphorbiaceae) Small to medium sized tree, leaves simple, lepidote on both surfaces, flowers yellow, capsules globose, golden yellow, common in hills of Cuddapah district, rare in Veligonda hill ranges at above 400 m altitude.
- Dimorphocalyx kurnoolensis* Venkataraju & Pullaiah (Euphorbiaceae) Dioceous small tree, leaves simple, shiny, flowers white, capsular fruit subglobose, found rare along the sides of the streams at the foot hills of Erramalai hills of middle Eastern Ghats at 500-700 m altitude.
- Eriolaena lushingtonii* Dunn (Sterculiaceae) Small tree, flowers yellow, fruits capsular, woody and rare in open slopes of moist deciduous forests of Nallamalais, Northern Circars, between 350-900 m altitude.
- Hildegardia populifolia* (Roxb.) Schott & Endl. (Sterculiaceae). Tree, leaves simple, flowers scarlet, fruit follicular, winged, wings flat, inflated, found in middle (few patches of Anantapur and Chittoor districts of Andhra Pradesh) and Southern Eastern Ghats (N. Arcot district of Tamil Nadu) above 250 m altitude.
- Lasiococca comberi* Haines (Euphorbiaceae) Small tree, often buttressed, leaves simple, panduri-form or obovate, flowers in racemes, capsule 3-lobed, tuberculate, found in northern circars of Andhra Pradesh at 700 m altitude.
- Premna hamiltonii* (Buch.- Ham.) Ellis (Verbenaceae). Tree, leaves simple, ovate, yellow gland dotted, flowers pale green, drupe globose, black, occurring in Northern Eastern Ghats of Andhra Pradesh, Nallamalais of Middle Eastern Ghats at 600-1000 m altitude
- Pterocarpus santalinus* Linn. (Papilionaceae) Moderate sized tree, leaves 3 rarely 5-foliolate, flowers yellow, fruit samara, common on the hill slopes at 300-700 m altitude, endemic to the southern-middle Eastern Ghats.
- Shorea tumbuggaia* Roxb. (Dipterocarpaceae) Large resinous tree, flowers white, fruits winged, occurring in Seshchalam hill ranges of Middle Eastern Ghats, North Arcot and Chingleput of Southern Eastern Ghats at 700-1000 m.
- Syzigium alternifolium* (Wt.) Walp. (Myrtaceae) Deciduous middle-sized tree, leaves thick coriaceous, simple, flowers cream or yellowish white, sweet scented, berry globose, dark purple, occurring in Middle Eastern Ghats at 600-850 m altitude.
- Terminalia pallida* Brandis (Combretaceae) Small to medium sized tree, leaves simple, thick coriaceous, flowers pale yellow, drupe ovoid, faintly ridged, distribution is restricted to Cuddapah and Chittoor districts of Andhra Pradesh at an altitude of 600-800 m altitude.
- Toona ciliata* Roem var. *brevipetiolata* (Hains) Mishra & Panigr. (Meliaceae). Small tree, leaves pinnate, flowers white, fruit capsular, found in Mals of Orissa, up to 1340 m altitude
- Vernonia shevaroyensis* Gamble (Asteraceae). Salem district in Tamil Nadu above 1000m altitude
- Wendlandia gamblei* Cowan (Rubiaceae). Small tree, leaves simple, flowers yellowish, in panicles, capsule globose found in Mahendragiri hills, Ganjam of Orissa, Rampa hills of East Godavari district at 1000-1500 m altitude.

Endemic Trees of Peninsular India Occurring in Eastern Ghats

Annonaceae: *Alphonsea madraspatana* Bedd ; *Goniothalamus cardiopetalus* (Dalz.) Hook. f. & Thoms; *Miliusa eriocarpa* Dunn ex Gamble; *Miliusa montana* Gard. ex Hook.f. et Thoms; *Miliusa wightiana* Hook. f. et Thoms.

Dilleniaceae: *Dillenia bracteata* Wt.

Capparaceae: *Maerua apetala* (Roth) Jacob

Pittosporaceae: *Pittosporum dasycaulon* Miq.

Dipterocarpaceae: *Shorea roxburghii* G. Don

Ochnaceae: *Ochna obtusata* DC. var. *gamblei* (King ex Brandis) Kanis

- Rutaceae:** *Pamburus missionis* (Wt.) Swingle
Meliaceae: *Aglaiia elaeagnoidea* (Juss.) Benth var. *courtallensis* (Gamble) K.K.N. Nair
Icacinaceae: *Apodytes dimidiata* E. Meyer ex Arn
Aquifoliaceae: *Ilex malabarica* Bedd.
Celastraceae: *Eunoymus indicus* Heyne ex Roxb.; *Maytenus bailadillana* (Swamy & Mooney) Raju & Biswas
Anacardiaceae: *Nothopegia heyneana* (Hook.f.) Gamble
Celastraceae: *Kingiodendron pinnatum* (Roxb. ex DC.) Harm
Mimosaceae: *Acacia campbelli* Arn.
Melastomataceae: *Memecylon lushingtonii* Gamble
Rubiaceae: *Hymenodictyon obovatum* Wall.; *Wendlandia angustifolia* Wt.; *Randia candolleana* Wt. & Arn.,
Vacciniaceae: *Vaccinium neilgherrense* Wt.
Myrsinaceae: *Myrsine capitellata* Wall. ex Roxb
Ebenaceae: *Diospyros assamensis* Bedd.
Sapotaceae: *Isonandra villosa* Wt, *Manilkara roxburghiana* (Wt.) Dubard
Cordiaceae: *Cordia evolutor* Gamble
Bignoniaceae: *Dolichandrone arcuata* Clarke.; *Dolichandrone atrovirens* (Heyne ex Roth) Sprague
Myristicaceae: *Knema attenuata* (Hook.f. et Thoms.) Warb.
Lauraceae: *Actinodaphne bourdillonii* Gamble; *Cinnamomum macrocarpum* Hook.f., *Cinnamomum malabaricum* (Burm. f.) Bl.; *Cryptocarya neilgherrensis* Meissn., *Litsea oleoides* Hook.; *Litsea wightiana* (Nees) Hook.f.; *Neolitsea foliosa* Gamble; *Neolitsea scrobiculata* Gamble
Euphorbiaceae: *Bridelia cremulata* Roxb.; *Glochidion ellipticum* Wt.; *Glochidion neilgherrense* Wt; *Glochidion tomentosum* Dalz.; *Mallotus aureopunctatus* Murell.-Arg; *Mallotus muricatius* Bedd; *Mallotus stenanthus* Muell.-Arg.; *Trewia polycarpa* Benth. ex Hook.f.
Moraceae: *Ficus beddomei* King; *Ficus dalhousiae* Miq

Causes for Depletion of Tree Species and its Conservation

The natural forest all over the Eastern Ghats are under great pressure. Over grazing, over-exploitation of trees for timber, fuel wood, fodder etc., forest fires, encroachment of forest for agriculture, urbanization and construction of reservoirs, plantation of exotic trees for shade or at forestation have decreased the tree and other Biodiversity. Rich biodiversity has been thereby lost in Eastern Ghats. Plantations favoured only few valuable species thus natural are dwindling and shrinking. The biotic interference has a marked effect on the vegetation leading to the extinction of valuable and rare species. However, due to various anthropogenic factors and natural catastrophes, there is perceptible decline in the population of many valuable trees, making them rare and threatened.

Illegal felling of trees is a problem to reckon with in most reserve forest and the best way to solve it is legally and with the full involvement of the local communities living in the area. Forest fires should be prevented at any cost. Frequent fire has reduced the moist forest into drier forest. Grazing should be restricted to carrying capacity of forests and degraded grasslands should be planted up with improved fodder grass and legumes to increase the productivity of the area and to meet the present fodder demand. Enrichment plantations could be taken in degraded forestlands to introduce valuable species and a mixture of species having multipurpose characters. Appropriate conservation measures will not only stop further depletion of trees, but will also help in improving tree diversity in Eastern Ghats.

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