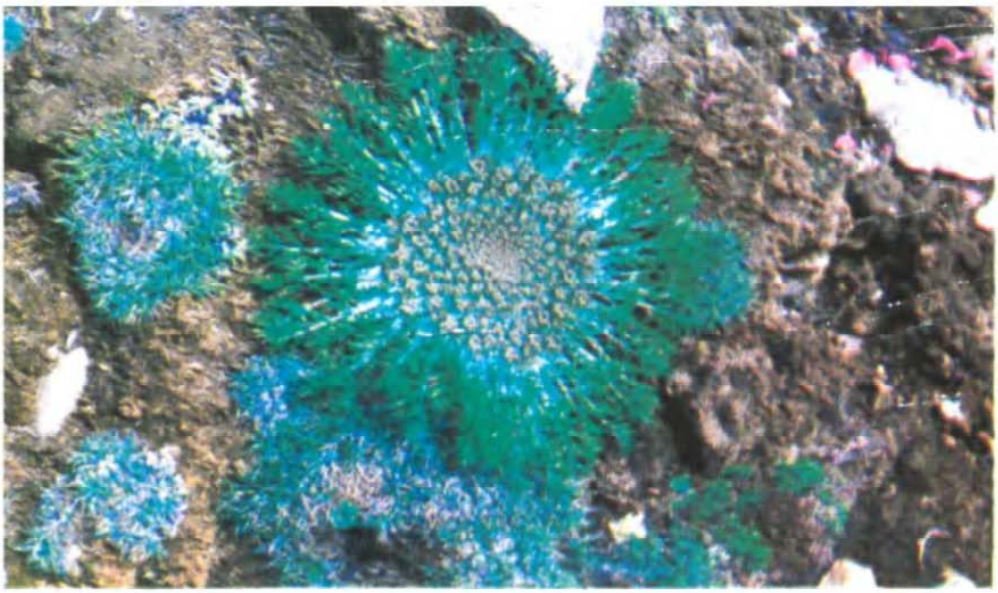
PLANT DIVERSITY HOTSPOTS IN INDIA

AN OVERVIEW



BOTANICAL SURVEY OF INDIA

MINISTRY OF ENVIRONMENT & FORESTS

Tropical forest : Lower storey in open places along the streams.
(Courtesy : H.J. Chowdhery)

Cortiella hookeri (C.B. Clarke) Norman-North
Sikkim, Sebula, alt. 5000 m.
(Courtesy : G.P. Sinha)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PLANT DIVERSITY HOTSPOTS IN INDIA - AN OVERVIEW

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Editors
P.K. Hajra
V. Mudgal

भारतीय वनस्पति सर्वेक्षण
BOTANICAL SURVEY OF INDIA

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MINISTRY OF ENVIRONMENT & FORESTS

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Foreword

Many small and large books have appeared on biodiversity in India in the last one decade.

This book deals with `Hotspots' of one major component of biodiversity, the plant resources in selected and critical areas in India. The work is authored by scientists who are researchers by profession and are well trained taxonomists of Botanical Survey of India, which is the main official agency of the Government for study of plant resources of the country.

Howsoever, one may wish to conserve the bioresource of a region, but needs of growing population and development limit the prospects. Prioritisation and selection of `Hotspots' is, therefore, necessary.

The data is based on life-time work and experience of the authors, and the contents can, therefore, be taken to be quite authentic and exhaustive.

The book covers various groups of the plant kingdom. At some places useful references are made to diversity in major animal groups also. The information in various chapters often covers economic aspects, ethnobotany, rare, endangered or endemic species, and biotic factors. The data in the book should provide ample material for utilisation and conservation of these bioresources, and also for further critical research, such as taxonomy, phytogeography, endemism, genetics, breeding, tissue culture, forestry, control of fungal or other diseases, etc.

This work will also help in the assessment of major gaps in our knowledge on any group of the plant kingdom in these critical geographic regions of the country.

The book will be a useful reference work and should be welcomed by researchers particularly in agriculture, forestry and botany.

The book is so profusely illustrated that it can be a collectors item even for photographers.

January 25, 1997 **S.K. Jain**

Preface

The convention on biological diversity has given momentum in realising the importance of biological resources as base materials for any country's economic growth and development. Speedy surveys and early inventorisation of these objects present an advantage in managing these resources. India with its varied geographical regions, changing topography, distinct seasons and an array of environmental situations supports diverse flora and fauna. Ths diversity is further compounded by the joining of three major biogeographic realms namely Indo-Malayan (the richest in the world), the Indo-Arctic (Eurasian) and the Afro-tropical. Appropriately, India is recognised as one of the 12 megadiversity centres of the world. Out of all the biogeographic regions, the Eastern Himalaya and the Western Ghats are comparatively botanically richer and not surprisingly, these are two of the 18 'Hotspot' areas recognised in the world. Hotspots generally refer to the areas rich in general diversity, high degree of endemism and higher incidence of rare and endangered species of the flora and fauna.

Survey and inventorisation are essentially the tasks of the Botanical Survey of India. It is undoubtedly a difficult task to explore the diversified plant wealth of such a vast country as India, but on the same hand, the significance of the inventorization and conservation of diversity cannot be overlooked for a longer time. In such a situation priorities are to be decided with regard to areas for exploration and inventorisation. The natural option under such circumstances is to work on botanically rich areas as this inventorisation follows evolving scientific methods of management for their conservation, thus safeguarding areas of rich diversity on priority basis.

The present publication is an earnest attempt to analyse the flora of five areas known for thier vast plant diversity. These areas are taken incidentaly from the two Hotspots the Eastern Himalaya (Sikkim, Namdapha and Dibang valley) and the Western Ghats (Agastyamalai and

Nilgiris). It is worth noting that the Nilgiris is the declared biosphere reserve while others represent identified sanctuaries or national parks partially or in total. The material presented focusses on general diversity levels, diversity in specific groups, percentage of endemism in the flora and threatened species. Specific ecological issues that are further related to sustainability of species and ecosystems in these areas, are also discusssed. The editors strongly feel the need of this publication as the information provided therein will serve as a baseline data in scheming methods for management and conservation of these biologically rich areas.

P.K. Hajra
V. Mudgal

Acknowledgements

The preparation of this publication is made possible by the prompt cooperation and involvement of the scientists of the Botanical Survey of India who had been actively engaged in exploration and survey in different hotspot areas of the country.

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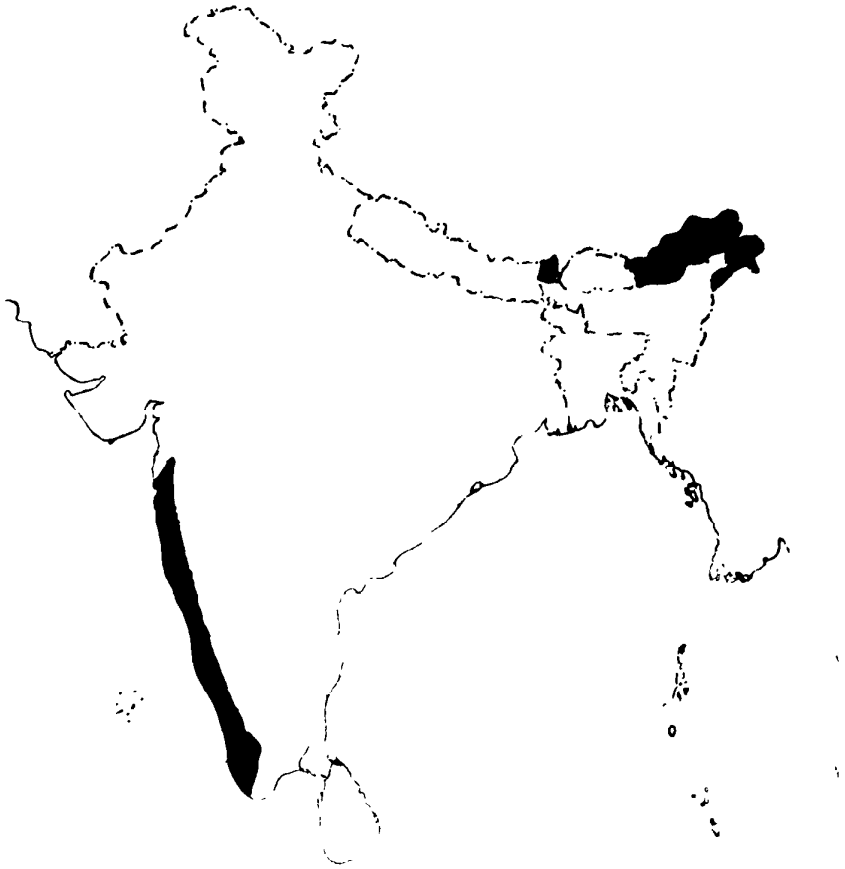

1
INTRODUCTION

Introduction

India with a geographical area of 329 million hectares exhibits a wide array of environmental conditions by virtue of its tropical location, varied physical features and climatic types. The widest variety of biomes exhibited by the country is owing to the confluence of three different biogeographic realms and a variety of environmental conditions. Considering the vastness of the country and variation pattern in different areas, the country is divided into ten botanical regions with distinct bioclimatic conditions. These include 1. Coromandel coast 2. Malabar 3. Indus plain(Indian desert) 4. Gangetic plain 5. Assam 6. Eastern Himalaya 7. Central Himalaya 8. Western Himalaya 9. Andaman and Nicobar Islands 10. Laccadive and Minicoy group of islands.

The flora of India is made up of well over ca 17000 species of flowering plants under ca 320 families. The ten dominant families in Indian flora include Orchidaceae, Fabaceae, Poaceae, Rubiaceae, Euphorbiaceae, Acanthaceae, Asteraceae, Cyperaceae, Lamiaceae and Urticaceae. Besides 17000 flowering plants, the floral diversity includes 64 Gymnosperms, 1200 Pterodophytes, 2850 Bryophytes, 13000 Fungi and 12500 Algae. Similarly, the faunal species comprise 372 mammals, 1228 birds, 428 reptiles, 204 amphibians, 2546 fishes, 5000 molluscs and about 57000 insects. At an aggregate level, India has about 48000 floral and 80000 faunal species.

Although India is connected by land with a number of other countries, it has a large proportion of endemic flora. In fact India harbours more endemic species of plants than any other region of the world except Australia. About 33% of flowering plants are endemic to this country. The reason for the presence of such a high percentage of endemic plants in India is the presence of lofty Himalayan mountain ranges on the north-east and north-west of the mainland and sea on three sides in the peninsular region. Further, the natural attributes coupled with diversity of cultures and lifestyles of the different population groups account for an equally rich

array of crop plants and domestic animals evolved through several centuries of selection and breeding, thus making both our natural and domesticated sectors rich and diverse. The country is also one of the 12 identified centres of origin of cultivated plants. The germplasm resources of India constitute 166 species of agri-horticultural crop plants and about 320 species of their wild relatives. Similarly, India has 27 breeds of cattle, 8 of camel, 6 of horses, 2 of donkeys, 40 of sheep, 22 of goats, 18 buffaloes and 18 types of poultry breed in addition to a variety of Yak, Mithun, Ducks and Geese.

Among different biogeographical zones, the Eastern Himalaya and the Western ghats are botanically rich areas of world significance. The humid tropical conditions met within these regions not only support an exceptionally rich vegetation, both in luxuriance and species diversity, but have also resulted in speciation in several genera, thus adding to the high endemicity of the flora (Nayar 1996).

Eastern Himalaya covering the states of Arunachal Pradesh, Sikkim and Darjeeling district of West Bengal is the richest of the phytogeographic regions of India affording the highest plant/animal diversity (Rao, 1993). The high rainfall, moist and cold climate coupled with factors like altitude, latitude and longitude have added to the multiplicity of habitats and thus provide varied microclimates and ecological niches both for plants and animals. The region supports different vegetational types from the cultivated plants to grasslands and meadows, marshes, swamps, scrub forests, temperate and alpine forests. About 8,000 species of flowering plants, out of which *ca* 3,500 are endemic, find representation in this region. Besides affording a high degree of diversity in orchids, rhododendrons, hedychiums, oaks and bamboos, the region also abounds in large number of plants of medicinal and ethnobotanical values. It is estimated that out of a total of 800 edible plants in India, more than 300 are found in this region. The region is also recognised as a centre of origin of several cultivated plants like Musa, Citrus, jackfruits and many others. The Eastern Himalaya, together with the north-eastern region, have about 200 wild relatives of cultivated plant species. Tables 1 indicates the general richness of some dominant families in north-eastern region in comparison to India and the rest of the

world while Table 2 shows the richness of wild relatives of crop plants in different phytogeographic zones of India.

Table 1. Approximate number of Genera and Species in some Dominant Families of Higher Plants. (R.R. Rao, 1993)

Name of family	North-eastern region	India	World
1. Poaceae	160/500	240/1100	620/10000
2. Orchidaceae	104/700	200/1500	735/20000
3. Fabaceae	50/200	100/750	482/12000
4. Caesalpiniaceae	11/42	23/80	152/2800
5. Mimosaceae	10/35	15/75	56/2800
6. Asteraceae	25/70	135/710	900/1300
7. Cyperaceae	14/175	21/350	90/4000
8. Lamiaceae	30/95	65/380	180/3500
9. Scrophulariaceae	15/35	60/350	220/3000
10. Acanthaceae	25/125	70/340	250/2500
11. Euphorbiaceae	55/160	65/340	300/5000
12. Rubiaceae	50/170	80/280	500/6000
13. Urticaceae	15/45	25/114	45/550
14. Zingiberaceae	18/73	20/115	46/850

Table 2. Wild Relative of Crop Plants in different Phytogeographical Zones of India

Phytogeographical Zone	Species of wild relatives of crop plants
1. Eastern Himalaya (including NE region)	190
2. Western Himalaya	113
3. North-Western plains	49
4. Gangetic plains	73
5. Deccan	96
6. Malabar	142

The Western Ghats is a narrow stretch running approximately for about 1500 km along the west coast of India, projecting a considerable gradient of climatic conditions. Also known as the Malabar province, it is one of the major tropical evergreen forested regions in India and exhibits enormous plant/animal diversity. Further, the climatic and altitudinal gradient has resulted in a variety of forest types ranging from evergreen to semievergreen, from moist deciduous to dry deciduous formations with sometimes stunted montane communities developing in higher hills. As many as 4000 species of flowering plants, of which more than 1600 are endemic, have already been recorded from this region. The narrow and closed valleys are also responsible for this high level of endemism. The region besides affording a high degree of diversity in valuable timber species of families like Clusiaceae, Dipterocarpaceae, Fabaceae, Bombacaceae and Lauraceae, the area is a major centre of diversity for bamboos, legumes and a variety of medicinal plants, spices and condiments. The Western Ghats is also a rich germplasm centre for a number of wild relatives of cultivated plants, having about 145 species of cereals, millets, pulses, vegetables, fruits, etc.

The rich biological diversity in these regions, however, is threatened largely due to various anthropogenic activities. In view of the richness of the biological and habitat diversity, high endemism and comparatively higher incidence of rare and threatened taxa in these two biogeographical areas, the International Union for the Conservation of Nature and Natural Resources (IUCN) has recognised these two regions as "Hotspots" amongst the 18 identified the world over.

Efforts are needed to conserve and maintain gene, species and ecosystems for the sustainable use and management of the biological resources. While the National Conservation Strategy, the National Forest Policy and the National Wildlife Action Plan lay down the policy framework and priorities in the area of biological diversity conservation, *in situ* protection of ecosystems and *ex situ* conservation of biological and genetic resources can help in using biological resources sustainably. A detailed floristic analysis of these 'Hotspot' areas will help in drawing practically feasible action oriented programmes keeping in view the potential benefits that the selected species/populations/ecosystems could provide to mankind in general and to the inhabitants of the area in particular.

In the present publication an attempt has been made to highlight the diverse floral resources, distribution of vegetation types and the enormous floristic diversity in the few selected primary target areas like Agastyamalai hills, Nilgiri Biosphere Reserve including Silent valley and Amarabalan reserve in the Western Ghats and Namdapha, Dibang valley and Sikkim in the Eastern Himalaya.

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2
AGASTYAMALAI HILLS

Plant Diversity in Agastyamalai Hills, Southern Western Ghats

R. GOPALAN

Agastyamalai, a towering range with a peak of 1868 m height is situated at the southern end of the Western Ghats. The area lying between 77°5' and 77°40' E longitude and 8°50' N latitude, falls within the hilly tracts of the Tirunelveli-Kattabomman and Kanniyakumari districts of Tamil Nadu, and Thiruvananthpuram district of Kerala. It has a forest cover of about 2,000 sq. km. with altitudes ranging from 67 to 1868 m. It harbours *ca* 2000 species of flowering plants which include 100 endemic and 50 rare and endangered species (Henry *et al.*, 1984). The inhospitable terrain of this region is still left with some of the pristine ecosystems and having evolved in the course of millions of years, still remains largely undisturbed. The floristic diversity and complexity make it a rich gene-pool region.

The area represents diverse ecosystems with almost all types of vegetation known to occur such as the southern tropical thorn forests, southern tropical moist deciduous forests, tropical semi-evergreen forests (this type corresponds to "Tirunelveli semi-evergreen forests" Champion & Seth, 1968), southern tropical wet evergreen (rain) forests, subtropical montane forests and grassy swards at high altitudes. A detailed account of the vegetation was provided by Henry and Subramanyam (1981), Henry *et al.*(1984) and, Mohanan and Henry (1994). As the tropical rain forests are a precious natural resource, these are confined to the developing countries and vanishing fast mostly due to over-exploitation. The Agastyamalai needs to be regarded as a prime example of this ecosystem in southern India requiring urgent conservational measures.

PLANT DIVERSITY

Agastyamalai and its environs are rich in floristic diversity so much so these represent the biota of the Western Ghats, particularly the

southern part. Its geographcal position is so unique that it has a profound effect which has been rightly considered as "an epitome of the whole Madras State" (Mudaliar & Sundararaj, 1954). Out of about 5,000 vascular plant species reported to occur in peninsular India, this region harbours about 2,000 species (Henry *et al.*, 1984; Nair & Daniel, 1986). The area being located at the southern end of peninsular India, the Indian Ocean, the Arabian sea and the Bay of Bengal act as barriers in south against migration of species from other countries. The natural barriers, varied altitudes, habitat, climate and rainfall resulted in the development of a rich and diverse flora. About 100 endemics occur which include tree species such as *Aglaia elaegnoidea* (Juss.) Benth. var. *bourdillonii* (Gamble) K.K.N. Nair, *Bentinckia condapanna* Berry ex Roxb., *Diospyros barberi* Ramas., *Elaeocarpus venustus* Bedd., *Eugenia floccosa* Bedd., *Nageia wallichiana* (Presl.) Kuntze, *Phyllanthus singampattiana* (Sebastine & A.N. Henry) Kumari & Chandrabose, *Pinanga dicksonii* (Roxb.) Blume, *Symplocos barberi* Gamble, *S. oligandra* Beddome and *Syzygium microphyllum* Gamble. Among the large number of endemic herbs, shrubs and climbers important are *Crotalaria scabra* Gamble, *Desmodium dolabriforme* Benth., *Exacum travancoricum* Bedd., *Grewia pandaica* Drumm., *Hedyotis villosostipulata* (Gamble) R. Rao & Hemadri, *Hetaeria ovalifolia* (Wight) Benth. *ex* Hook., *Malleola gracile* (Lindl.) Schltr., *Ochlandra wightii* C. Fischer, *Impatiens travancorica* Bedd., *Murdannia glauca* (Thw. ex C.B. Clarke) Bruckner, *Sonerila clarkei* Cogn., *Tainia bicornis* Benth., *Vernonia gossypina* Gamble and *Zenkeria sebastinei* A.N. Henry & Chandrabose.

Species such as *Hedyotis travancorica* Bedd., *H. barberi* (Gamble) A.N. Henry & Subram., *H. villosostipulata* (Gamble) R. Rao & Hemadri, *Euphorbia santapaui* A.N. Henry, *Knoxia linearis* Gamble, *Paphiopedilum druryi* (Bedd.) Stein, *Popowia beddomeana* Hook.f. & Thoms., *Piper barberi* Gamble and *Thottea barberi* (Gamble) Ding Hou are considered under rare and endangered.

As the area is floristically rich with genetically diverse populations, more than 30 new taxa have been discovered from here in recent years. These include *Amorphophallus smithsonianus* Sivadasan, *Bulbop-*

hyllum agastyamalayanum Gopalan & A.N. Henry, *Dendrobium diodon* Reichb.f. subsp. *kodayarensis* Gopalan & A.N. Henry, *D. panduratum* Lindl. subsp. *villosum* Gopalan & A.N. Henry, *Euphorbia santapaui* A.N. Henry, *Homalium jainii* A.N. Henry & Swamin., *Indotristicha tirunelveliana* B. Sharma *et al.*, *Ixora agastyamalayana* Sivad. & N. Mohanan, *Marsdenia tirunelvelica* A.N. Henry & Subram., *Memecylon subramanii* A.N. Henry, *Oberonia agastyamalayana* Sathish Kumar, *Peucedanum josephianum* Wadhwa & H. Chowdhery, *Phyllanthus singampattiana* (Sebastine & A.N. Henry) Kumari & Chandrabose, *Pothos crassipedunculata* Sivadasan *et al.*, *Premna balakrishnanii* Rajendran & P. Daniel, *P. mundanthuraiensis* Rajendran & P. Daniel, *Rhynchosia jacobii* Chandrabose & Shetty, *Sonerila kanniyakumariana* Gopalan & A.N. Henry, *Syzygium parameswaranii* M. Mohanan & A.N. Henry, *Tylophora subramanii* A.N. Henry, *Vernonia peninsularis* C.B. Clarke ex Hook.*f.* var. *kodayarensis* Henry & Gopalan. *Aenhenrya agastyamalayana* Gopalan and *Janakia arayalpathra* J. Joseph & V. Chandras. are the two new genera discovered here. Agastyamalai hills are, therefore, very important not only for the conservation of "the finest remaining example of tropical wet evergreen forests (rain forests) on the Western Ghats" (Henry *et al.*, 1984), but also for their varied and unique flora of biogeographical interest. Undoubtedly, the floristic diversity of this region is of an ancient lineage (Subramanyam & Nayar, 1974; Nair & Daniel, 1986; Nair, 1991). Out of the 179 families dealt with for the then Madras state as many as 157 families are represented. The details of the genera and species represented are given in Table 1. The predominant families with the largest number of species are arranged in Table 2.

The striking peculiarity of this area lies in the preponderance of several Sri Lankan species such as *Abarema subcoriacea* (Thw.) Kosterm., *Biophytum nudum* (Arn.) Wight, *Chrysoglossum maculatum* (Thw.) Airy-Shaw, *Pavetta zeylanica* (Hook.f.) Gamble and *Rubus micropetalus* Gardn. Besides, *Andrographis zeylanica* Nees, *Antidesma walkeri* (Tul.) Pax and Hoffm., *Eugenia mabaeoides* Wight and *Neanotis nummularia* (Arn.) Lewis, which were so far considered endemic to Sri Lanka, have also been collected in these forests.

Table 1 : Comparative Account of Genera and Species.

	Madras District	Tirunelveli
Total number of species	4516	2105
Total number of genera	1305	872
Percentage of species represented		47.9
Percentage of genera represented		69.4

Table 2 : Analysis of Predominent Families

	Number of species in Fl. Pres. Madras	Number of species in Tirunelveli Dist.
Leguminosae	433	201
Gramineae	386	145
Rubiaceae	214	128
Euphorbiaceae	194	115
Acanthaceae	200	87
Compositae	186	82
Cyperaceae	171	50
Orchidaceae	194	47

(Mudaliar & Sundararaj, 1954)

Agastyamalai abounds in some economically and medicinally important plants. The area is associated with the ancient sage, Agastya who is said to have lived here on leaves, tubers, fruits and sap of local

wild plants. The region is known for its rare plants that are still widely used in ayurvedic medicines. These include species of *Aristolochia, Cardiospermum, Ceropegia, Dioscorea, Ficus, Gloriosa, Gymnema, Janakia, Knema, Leucas, Naregamia, Rauvolfia, Smilax, Solanum, Stephania, Strychnos, Trichopus, Tylophora*, etc. The more important non-conventional timber species include *Canarium strictum* Roxb., *Cullenia exarillata* Robyns, *Elaeocarpus* spp., *Gluta travancorica* Bedd., *Hydnocarpus* spp., *Litsea* spp., *Mesua nagassarium* (Burm.f.) Kosterm., *Myristica* spp., etc. A number of edible fruit-yielding species occurring are : *Antidesma* spp., *Baccaurea courtallensis* Muell.-Arg., *Calamus rotang* L., *Canthium travancoricum* (Beddome) Hook.f., *Carissa carandas* L., *Emblica officinalis* Gaertn., *Ficus* spp., *Mangifera indica* L., *Solanum* spp. and *Syzygium* spp.

The occurrence of a large number of wild relatives of cultivated plants such as species of *Amomum, Amorphophallus, Atylosia, Canavalia, Cinnamomum, Coffea, Dioscorea, Elettaria, Garcinia, Mangifera, Musa, Myristica, Oryza, Piper* and *Rauvolfia* indicates this area to be a genetic reservoir of wild species.

ECONOMIC ASSESSMENT

The current value of resources and services which the area provides to the national economy on a sustainable basis are yet to be fully assessed. Besides valuable timber trees, revenue is being collected from the sale of minor forest produce like *Acacia concinna* DC., *Alpinia galanga* (L.) Sw., *Anamirta cocculus* Wight & Arn., *Aphanamixis polystachya* (Wall.) Parker, *Bambusa arundinacea* (Retz.) Willd., *Dendrocalamus strictus* (Roxb.) Nees, *Dioscorea* spp., *Diospyros* spp., *Garcinia* spp., *Ochlandra travancorica* (Bedd.) Benth. ex Gamble *Calamus rotang* L., etc. In these forests some of the trees which yield resins and gums are Kanis, the hill tribe inhabiting these forests, mainly collect honey, cinnamomum bark, resin of white dammer, black dammer, bark for red dye from *Morinda tinctoria* Roxb. and fruits of *Garcinia* spp. On the hill slopes commercial cash crops such as coffee, tea, rubber, pepper and cardamom are grown on a large scale.

HUMAN ACTIVITIES AND THEIR IMPACT

The various factors affecting the loss of biodiversity of the area are yet to be fully studied. Several settlements in the existing hydel and irrigation projects (Upper Thambraparani, Servalar, Papanasam Lower, Manimuthar, Kodayar and Neyyar) have caused much ecological disturbance. These hydel/irrigation projects have been instrumental in bringing about changes in the forest types, particularly in the Mundanthurai plateau, from moist deciduous to dry-deciduous indicating a shift in soil hydrology. The tropical wet evergreen forests interspersed by grassy swards at Muthukuzhivayal which was once a botanists' paradise has since been cleared for the construction of the Kodayar Hydroelectric Project.

The Singampatti Reserve Forest has been considerably disturbed due to cultivation of tea and other plantation crops. The increase in the number of pilgrims to the "Pothigaimudi" or "Agastyakudam" the highest peak in the range, has brought about in its wake undesirable developments such as widening of the foot/bridle paths. Accidental as well as intentional fire to the seasonal dry forests by the visitors has had disastrous effects on the habitats of rare and endangered plant species.

The area is well protected by natural barriers both by land and sea. The core region is remotely located and completely free from human activities. The western slope in Kerala has an area of 180 sq km with two wildlife sanctuaries, *viz.*, Neyyar Wildlife Sanctuary (128 sq. km) and Peppara Wildlife Sanctuary (53 sq. km). The animal populations also constitute a complexity of fauna in this region. Among the number of rare and threatened plants and amimals tiger is the apex of the complex biotype. The threatened animal species include Tiger, Lion-tailed macaque, Great pied hornbill, Malabar pied hornbill other more prominent animal species found here are Bison, Black-faced langur, Bonnet macaque, Chamaleon, Chital, Cobra, Crocodile, Elephant, Indian Giat squirrel, Indian monitor lizard, Indian rock python, Indian porcupine, Jackal, King cobra, Leopard, Russells viper, Saw-scaled

viper, Slender lorris, Sloth bear, Wipe snake, Wild boar, Wild dog, and wood pecker. Hunters and poachers who kill the animals for their skins, horns, etc. are the threat to the fauna. However, a number of human activities go on unhindered in the buffer zone. The sanctuaries also attract tourists not only to witness the wildlife but also to experience life in wilderness. The tourists are also enchanted by the scenic beauty provided by several cascades and other water courses, *viz.*, Banathirtham, Agastyar falls and Tiger falls. The 'Pothigaimudi' or 'Agastyakudam' is not only a place of pilgrimage to the numerous devotees of Agastya Maharishi but also offers a spectacular scenery to scale the summit trail. Caused by a large number of tourists/piligrims are required to be assessed properly. About 1000 forest coverage is protected by the existing sanctuaries and tiger reserve.

There are settlements of 'Kanis' of 'Kanikar' the local tribes, on the hills. They live partly on leaves, tubers and fruits of wild plants and wild herbivores. In recent years some of them are employed in hydroeletric projects, private estates and the Forest Department.

Several river valley projects of this area provide economic benefits to the local people. These also offer enormous opportunity for various impact studies in environmental as well as restorative research designed to study ways of rehabilitating degraded ecosystems. The social and environmental values as well as the current value of resources and services, the area provides to the local people/national economy on sustainable basis are yet to be fully assessed.

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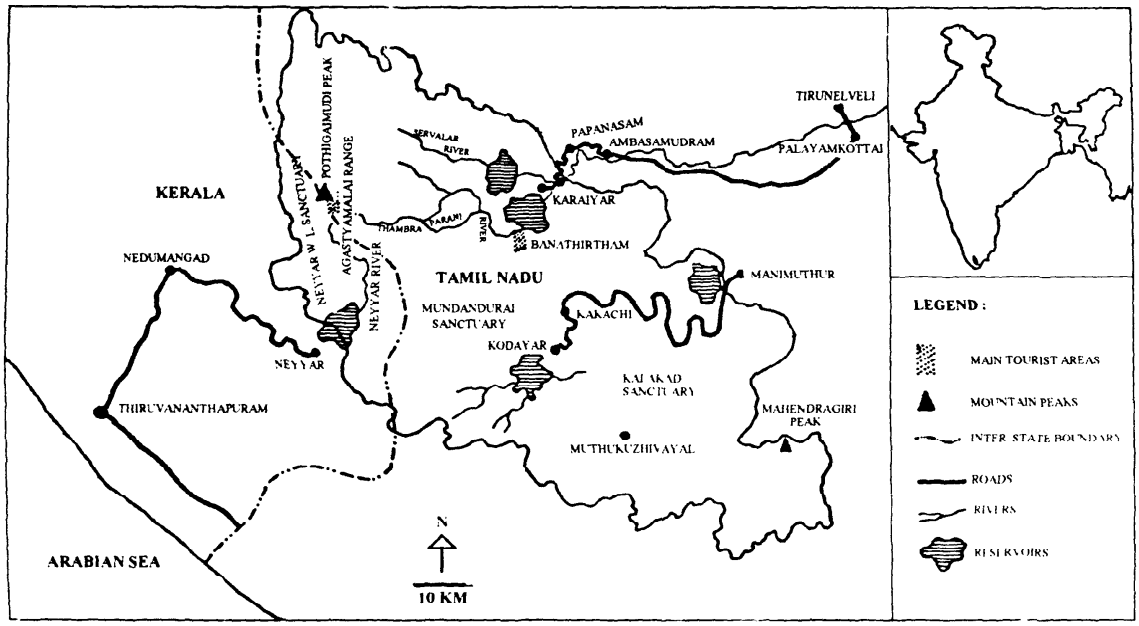
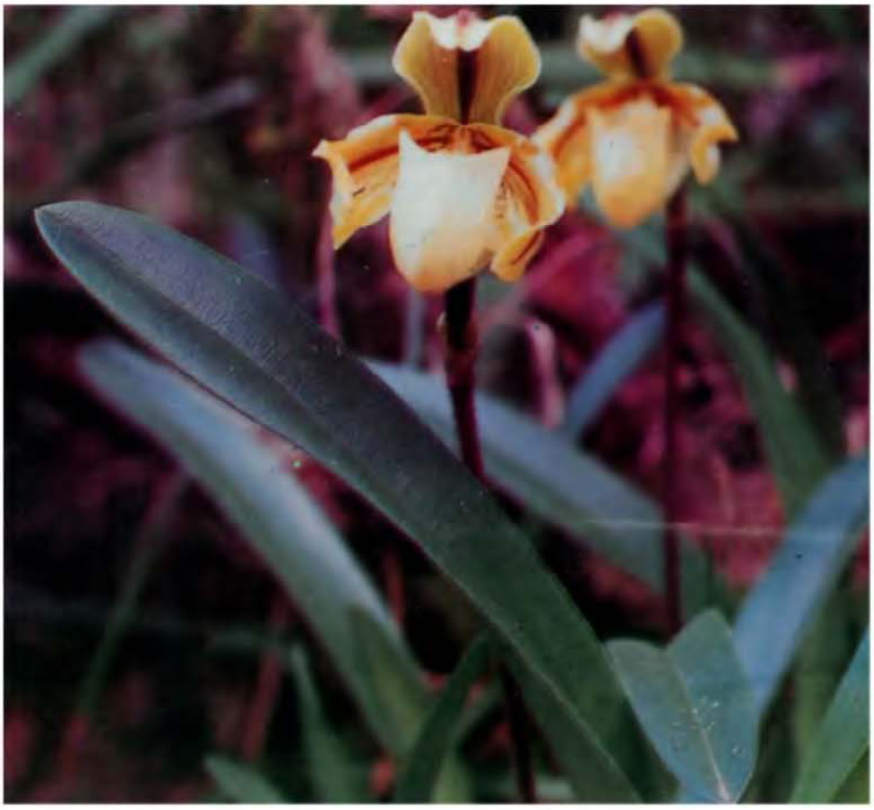


AGASTYAMALAI HILLS, SOUTHERN WESTERN GHATS; INSET SHOWING LOCATION OF AGASTYAMALAI HILLS IN INDIA

A view of Ainthuthalaipothigai from Agastyarpeedam showing sholas and grassland.
(Courtesy : Southern Circle, Botanical Survey of India)

Canopy of an evergreen forest - Agastyamalai.
(Courtesy : Southern Circle, Botanical Survey of India)

Musa acuminata Colla - a rare wild banana.
(Courtesy : Southern Circle, Botanical Survey of India)



Paphiopedilum druryi (Bedd.) Pfitz. - the only lady's slipper orchid of the Western Ghats.
(Courtesy : R. Gopalan)

The rare and endemic *Piper barberi* Gamble.
(Courtesy : Southern Circle, Botanical Survey of India)

3
NILGIRI BIOSPHERE RESERVE

Plant Diversity in Nilgiri Biosphere Reserve

K. VIVEKANANTHAN
P. DANIEL
R.K. PREMANATH

India lies at the junction of the 3 major biogeographic realms, namely, the Indo-Malayan, the Eurasian and the Afro-tropical. As a result, it has a rich biological heritage that qualifies it as one of the 12 megadiversity nations in the world. Three richest areas, *viz.*, the north-eastern Himalaya, the Western Ghats and the Andaman and Nicobar islands, have been marked for the overall national strategy of protecting the representative primary benchmark ecosystems and safeguarding the genetic diversity. The Western and Eastern Ghats are the two potential areas in Peninsular India for biodiversity conservation. The Western Ghats to a large extent preside over the biogeography, ecology and biodiversity of Peninsular India as the Himalaya in the north. Their geographical history adds new dimensions to their richness. They form the backbone of the economy of the states of Gujarat, Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu and support a population of over 35 million people. Blanford (1901), and Udvardy (1975) classified this zone as the most significant biogeographical zone in Peninsular India. On the basus of Flora Phytogeographers like Hooker and Thomson (1855), Clarke (1898), Hooker (1904), Chatterjee (1939, 1962), Razi (1955), and Puri (1960) considered "Malabar" as the richest wet tropical forests harbouring a large number of species and ecosystems. In the strategy for the preservation of the biological diversity of the Western Ghats, the Nilgiris and Agastyamalai would form the backbone.

As the Western Ghats or the Malabar rainforests are one of the richest biogeographic provinces of the Indian subcontinent, the Nilgiri tract was the first choice for the constitution of a biosphere reserve in India. It embraces the sanctuary complex of Wynad, Nagarhole, Bandipur and Mudumalai, the entire forested hill slopes of Nilambur

and Nilgiris, the upper Nilgiri Plateau, the Silent Valley and the Siruvani hills. The total area of the biosphere reserve is around 5670 sq km of which 2020 sq km is the core zone, 2290 sq km the manipulation zone (forestry) and it has around 1330 sq km as manipulation zone (agriculture) and 30 km^2 as restoration zone. It includes substantial unspoilt areas of natural vegetation types with several dry scrub, dry and moist deciduous, semievergreen and wet evergreen forests, evergreen sholas, grassy downs and swamps. The Attapadi Plateau, Moyar Valley and parts of Wynad would provide the entire diversity of cultivated plants covering the spectrum from millets of very dry tracts to rice and plantation crops of very humid tracts. The region includes the largest known population of two endangered animal species, namely, the Nilgiri tahr and the lion-tailed macaque, and probably the largest south Indian population of elephant, tiger, gaur, sambar and chital as well as many less known groups of plants including a good number of endemic and endangered speces of plants. It is the habitat of a number of tribal groups remarkable for their traditional modes of harmonious use of the environment (Anonymous., 1980).

This picturesque mountain range is situated in southern India mainly in the north-western corner of Tamil Nadu. It is bounded in the north by the state of Karnataka and in the west and south-west by Kerala and lies between 11°15'-12°15' N and 7°60' 76°45' E. It is the meeting ground or nexus of three mountain systems of Peninsular India, the Sahyadri joining opposite the Makurti peak, the Southern Ghats across the Palghat gap in the south, and the Eastern Ghats in the north-eastern corner (Chatterjee, 1965). The abrupt rise of the Nilgiris from the surrounding areas is very striking. Doddabetta (2,637 m) is the second highest peak in India south of the Himalayas while Makurti, Nilgiri peak, Pichal Betta and Devar Betta, Naraidu Betta, Kundikadu Betta, Kalari Betta are over 2,500 m. Udhagamandalam (Ootacamund), the most popular hill station in south India, is situated in a broad undulating valley at the foot of Doddabetta. Doddabetta is the culminating point of a range of hills running north-south dividing the Nilgiri Plateau into two climatically dissimilar halves, situated in the east and west of it. The south-western part of the Nilgiri Plateau is formed by a high range of hills called the Kundhas or the Upper Nilgiri Plateau. This range rises steeply from the Silent Valley, the Nilambur Valley and the

Ouchterlony Valley forming a continuous hill range broken only by the Sispara Pass. The Nilgiri-Wynad Plateau situated in the north-west has an average elevation of 1000 m. This undulating plateau is characterized by the prevalence of swampy low-lying areas (Wyals or hadlus). The well-known Mudumalai wildlife sanctuary is situated here. The Sigur Plateau, situated in the north with an average elevation of 900 m is the land lying between the foot of the Nilgiris and the Moyar river. The south-eastern and eastern slopes of the Nilgiris confronting the plains of the Coimbatore District are less precipitous showing altitudinal zonation. The panorama of landscapes at different places in the Nilgiris and their scenic grandeur outstrip every other part in south India. The Nilgiris are drained by several small perennial streams which join to form six major river systems, viz., Pykara (called Moyar from Gudalur), Billithada Hall, Kundah, Coonoor river, Sigur river and Kedar Halla.

The verdant Silent Valley covering an area of about 8,952 ha is situated at the south-western corner of the Nilgiris (on the lower side of the Nilgiri Plateau) in the Palghat District of Kerala. It has high and continuous ridges all over 2,000 m altitude along the entire northern, north-eastern and eastern borders and somewhat lower ridges over 1,200 m altitude along the entire western and southern borders. Due to the presence of high ridges all around, the whole plateau is shielded from extremes of climate and has developed its own special microclimate (Manilal, 1988). It is protected on all sides by high hills and, therefore, the vegetation of the area is relatively not exposed to external influences (Nair, 1981). Kunthipuzha, a perennial river and a tributary of Bharathapuzha, originating at an altitude of 1,861 m near the Kozhipara Peak in the north, flows down the entire length of the valley. The main stream is relatively gentle flowing compared to other rivers in the Western Ghats. The western slopes of the Nilgiris are drained by Punnapuzha, Talipuzha, Karimpuzha and Cherupuzha all the tributaries of the Chaliyar constitute a huge, deeply dissected valley and sharp westerly ridges. The slope-forests are the New Amarambalam Reserve Forest (26,572 ha) and a part of the valley is the Karimpuzha Reserve Forest. All the the Nilgiri-Wynad Plateau and Kerala-Wynad meeting there is a high north-south ridge known as the Nilambur vested forest. The extensive forests in Karnataka, north of river Kabini and east of Brahmagiri hill, constitute the Nagarhole Wildlife Sanctuary

and it is also known as Coorg-Wynad. The Mysore Plateau (north) is a flat plateau whereas the South Mysore Plateau is about 800 m high. Bandipur Tiger Reserve lies south of the Mysore Plateau. The Ataapadi Plateau and Siruvani hills in Coimbatore district, Tamil Nadu in the southern (lower) side are considered as spurs of the Nilgiris.

ECOSYSTEM DIVERSITY

A good amount of biodiversity occurs here. This may be attributed to the significant geographical location (trijunction of the Western Ghats), the proximity of the triseas (the Arabian sea, the Bay of Bengal and the Indian Ocean) to these hills as compared to other hills of India, wide range of topographic features having altitudes varying from 300 to 2,637 m, the marked difference in rainfall received from the south-west as well as the northeast monsoons ranging from 700 to 7,629 mm, the high intensity of solar radiation with significant diurnal range of temperature with tropical montane climate, and the presence of a large number of perennial streams and tributaries of river systems.

All the important forest types in southern India from scrub jungles to wet evergreen forests as well as others that are peculiar to the area occur here. Tropical thorn forests, Tropical dry deciduous forests, Tropical moist deciduous forests, Tropical semievergreen forests, Subtropical broad-leaved forests, Tropical wet evergreen forests, Southern montane wet temperate forests popularly known as "sholas" interspersed with Southern montane wet grasslands (savannas), Subtropical hill savannas and fresh water swamps (low and high level) are encountered on these hills. These include their seral and edaphic modifications having variations in floristic composition. The finest remaining examples of tropical evergreen forests or tropical rain forests known as `Malabar rainforest' of the Western Ghats and the original climax formation of the Western Ghats locally known as `sholas' are some of the non-renewable natural resources that occur here. These have developed in course of million years of evolution. In representativeness, ecosystem diversity, naturalness and effectiveness as a conservation unit this tract surpasses any other tract in the country and hence it was declared as the first biosphere reserve.

UNIQUE ECOSYSTEMS AND COMMUNITIES

Southern montane wet temperate forests (locally known as sholas) interspersed with large tracts of southern montane wet grasslands (Shrub-savannas) are the main vegetation type in the high plateaux of the Nilgiris above 1,600 m. The sholas are compact, sharply well-defined small woods confined to sheltered valleys, glens, hollows and depressions where there is adequate moisture and good drainage. They occur all over the range but their composition and size and height of trees vary according to altitude and velocity of wind. Though the sholas show fundamental affinity to the various types of tropical rain forests to the category they belong, but they, however, show marked differences in detail from the main group in structure and floristic composition. The tree species inhabiting the sholas are all predominantly of tropical stock and evergreen represented mostly by members of the families Celastraceae, Claeocarpaceae, Myrtaceae, Symplocaceae and Ternstroemiaceae. However, the total absence of representation of families like Anacardiaceae, Annonaceae, Bixaceae, Connaraceae, Datiscaceae, Dipterocarpaceae, Ebenaceae, Mimosaceae, Sterculiaceae etc. which are characteristic of the tropical rain forests of the adjacent regions is striking. The undergrowth consists of a large number of species of the Acanthaceae (*Strobilanthes* spp. *s.l.*) and Rubiaceae. The ground floor consists of a great wealth of ferns, mosses and fungi. The epiphytic flora is abundant and consists of orchids, ferns, lichens and bryophytes.

'Shola' forests are the most interesting ecosystem and remnants of the original climax formations of the Western Ghats and the montane variation of the wet evergreen forests. According to Bor (1938) the shola forest is a relict of an evergreen climax forest which has been pushed back to its last stronghold by fire and grazing. Theagarajan (1964-74) remarked, "The helpless shola vegetation is indeed an anachronism in this tract having a precarious existence. It is therefore a relict vegetation" This non-regenerating and fast-receding forest is almost a dying community and deserves to be more appropriately called a 'living fossil community' (Vishnu Mittre & Gupta, 1968). Hence, sholas are relicts of extinct vegetation and are now confined to a few pockets in the world (Figs. 1-4).

The Silent Valley harbours the only comparatively undisturbed patch of tropical evergreen forests with a rich flora and a valuable gene pool. Tropical wet evergreen forests, the most magnificent among forests, are still plentiful here making it the best remaining evergreen forests in the southern Western Ghats (Figs. 5-8-Silent Valley; 9, 10 Siruvani hills). The impenetrable New Amarambalam and the Silent Valley still retain some of the original forests in magnitude and grandeur. Another unique feature in the Kunthipuzha, Karimpuzha and Tekkamalayar in the New Amarambalam forests is the presence of a well-preserved riparian vegetation (Anonymous, 1982). Studies Plant diversity in the Silent Valley indicate that the mesic upland forests are comparable to extremely species-rich rain forests. Species-richness in the riparian forests is also high. The high alpha and beta diversities in species composition may indicate that this valley possesses virgin forests (Singh *et al.*, 1983).

High rainfall savannas (Southern montane wet grasslands) are encountered in the southern and western parts of the Nilgiris in places like the western catchment area, Upper Bhavani and Sispara (Kundah Range) which are extremely windy and rainy during the south-western monsoon. The altitude here is about 2,400 m and in places like Upper Bhavani and Arikayampuzha the mean annual rainfall exceeds 5,000 mm. Monsoonal rainfall of 2,000 to 4,000 mm in the month of July or August is not rare, here. In these places the 'monsoon flora' is very interesting with a number of ephemerals and a great profusion of *Impatiens* spp. Swamps and marshes in grasslands filled with peat deposits are noteworthy features in the Kundah Range. The curious plant *Pleiocraterium verticillare* L. (Rubiaceae) appears to be a characteristic of these bogs. The surface of these bogs is covered by herbaceous vegetation with species of *Carex, Eriocaulon, Juncus, Isachne, Utricularia* and *Xyris*. The grass *Eriochrysis rangacharii* C. Fischer is an indicator of the peaty undrained soils of the Nilgiris (Chinnamani, 1983). That it is an extinct grass of a unique but extinct ecosystem may not be an exaggeration. Hooker (1904) pointed out the occurrence of peat bogs on the Nilgiris as a rare instance in India. The Wynad tract with low level swamps is another biogeographically valuable area extensively forested till recently. Another rare ecosystem which is very characteristic of the Sigur Plateau of the Nilgiri is the open sandal bearing scrub.

FLOWERING PLANT WEALTH

The diversity of the vegetation of the Nilgiri Biosphere Reserve has resulted in teaming of plant life in all its variety and complexity. Floristically, the southern Western Ghats are one of the richest areas in the country harbouring not less than 3,500 species representing 27% of the flowering plants of India. There is an equal, if not more, proportion of lower plants (Nair, 1991). Western Ghats cover about 5% of the total land area of the country but they harbour an estimated 4000 species of flowering plants (Sastry & Sharma, 1991). About 80% of the flowering plants reported from the Western Ghats appear to occur in the Nilgiri Biosphere Reserve (Table 1). An analysis of the eight dominant families of flowering plants may indicate the floristic diversity of the biosphere reserve (Table 2). The area contains a relatively large number of species (Table 3) as compared to other adjoining areas. Intensive surveys in New Amarambalam reserve forest and Nilambur vested forests which still remain unexplored would certainly increase the number of known species in the areas concerned.

Table 1: Number of genera and species of flowering plants in the Nilgiri Biosphere Reserve and Certain areas therein

Name of group	No. of species in the Nilgiri Biosphere Reserve	No. of genera and species in Nilgiri Dist., Tamil Nadu	No. of species in the Western Ghats
(1)	(2)	(3)	(4)
1. Angiosperms	3187 spp. (Balakrishnan & Ansari, 1990)	942 genera and 2611 spp. (163 families) (Sharma *et al.*, 1977)	4000 spp. (Sastry & Sharma,1991) Southern Western Ghats-3500 (Nair, 1991)
	Boluvampatty forest, Siruvani, Coimbatore Dist., Tamil Nadu	Pakasura Hills, Hulichal Drug R.F. Nilgiri Dt., Tamil Nadu	

205 genera & 248 species (Subramanyam, 1959) 152 genera & 194 species (Subramanian, 1966)	123 genera & 154 species (Sebastine, 1960)
Boluvampatty R.F., Coimbatore Dist. 357 genera & 549 species (Sreemadhavan, 1965); 435 genera & 702 species (Viswanathan, 1972) Vellingiri and Maruthamalai, Coimbatore Dist. 247 genera & 373 species (Sebastine, 1959)	Mudumalai Wildlife Sanctuary, Nilgiri Dist. 539 genera & 1015 species (Stephen, 1994)
Bandipur R.F., Mysore Karnataka 309 genera & 439 species (Naithani, 1966)	

Table 2: Analysis of the flora of dominant families

Family	No. of genera & species in India	No. of species in Nilgiri Biosphere Reserve	No. of genera & species in Nilgiri Dist.	No. of genera & species in Silent Valley
(1)	(2)	(3)	(4)	(5)
Fabaceae	123/775	333	90/325	26/55
Poaceae	255/1225	243	98/192	32/56

(1)	(2)	(3)	(4)	(5)
Orchidaceae	145/990	175	46/113	49/108
Asteraceae	161/754	154	61/145	25/45
Rubiaceae	90/495	144	39/116	276/49
Acanthaceae	84 /379	134	34/104	18/31
Euphorbiaeae	74/419	122	37/93	23/38
Cyperaceae	24/449	108	11/87	10/22
	(Jain, 1983)	(Balakrishnan & Ansari, 1990)	(Sharma *et al.* 1977	(Manilal, 1987)

Table 3: Number of species reported from different regions

Area	No. of species of flowering plants	No. of genera	Families	Reference
(1)	(2)	(3)	(4)	(5)
Madras Presidency	4,516*	1,305	179	Gamble & Fischer, 1915-1936
Tamil Nadu	5,640* (incl. cult. plants)	---	---	Nair & Henry, 1983; Henry *et al.*, 1987, 1989
Karnataka	3,294	1,323	189	Sharma *et al.*, 1984
Tamil Nadu Carnatic	2,037	990	180	Matthew, 1983
Nilgiri Biosphere Reserve	3,187 (incl. cult. plants)	---	---	Balakrishnan & Ansari, 1990

*incl. gymnosperms

(1)	(2)	(3)	(4)	(5)
Areas in W. Ghats Nilgiri Dist., Tamil Nadu	2,611 (excl. cult. plants)	942	163	Sharma *et al.*, 1977
Tirunelveli Dist., Tamil Nadu	2,105	872	157	Mudaliar & Sundararaj, 1954
Palghat Dist., Kerala	1,270	710	163	Vajravelu, 1990
Thiruvananthapuram Dist., Kerala	1,325	751	195	Mohanan & Henry, 1994
Cannanore Dist., Kerala	1,132	658	157	Ramachandran & Nair, 1988
Hassan Dist., Karnataka	1,700	—	—	Saldanha & Nicolson, 1976
Chikmaglur Dist., Karnataka	616	—	—	Yoganarasimhan *et al.*, 1981
Coorg (Kodagu) Karnataka	1,332	717	160	Keshava Murthy Yoganarasimhan, 1990

ENDEMIC GENERA/SPECIES

The genus *Baeolepis* Decne. ex Moq. (Periplocaceae) is exclusively endemic to the Nilgiris whereas *Ascopholis* C. Fischer (Cyperaceae) is endemic to the Nilgiris and Hassan (Karnataka). *Silentvalleya* V.J. Nair *et al.* is the other genus endemic to the Silent Valley, an integral part of the biosphere reserve. All are unispecific. The following endemic genera of the Western Ghats also occur in the biosphere reserve.

Campbellia	(Orobanchaceae)	unispecific
Helicanthes	(Loranthaceae)	"
Indobanalia	(Amaranthaceae)	"
Jerdonia	(Gesneriaceae)	"
Kanjaram	(Acanthaceae)	"
Meteoromyrtus	(Myrtaceae)	"
Nilgirianthus	(Acanthaceae)	
Phlebophyllum	(")	
Pleocaulus	(")	
Poeciloneuron	(Bonnetiaceae)	
Taeniandra	(Acanthaceae)	
Xenacanthus	(")	

Blasco's (1971) enumeration of the dicotyledonous endemic taxa that occur in the southern Western Ghats may indicate that the Nilgiris is an important centre of speciation and 82 endemic species are exclusively confined to the Nilgiris. Out of the 1932 taxa of flowering plants endemic to Peninsular India (Ahmedullah & Nayar, 1987) about 818 are found in the Nilgiris and adjoining areas which account for about 25% (Mohanan & Balakrishnan, 1991). A recent analysis (Balakrishnan & Ansari, 1990) shows that there are about 135 species endemic to the Nilgiris and the adjoining areas alone. The endemic species of the biosphere reserve (Table 4) may throw light on the biogeography, centres of speciation, areas of extinction, variance and adaptive evolution.

Table 4: Endemic plants of the Nilgiri Biosphere Reserve

1. *Acacia hohenackeri* Craib Mimosaceae
2. *Agrostis schmidtii* (Hook. *f.*) Bor Poaceae
3. *Alchemilla harae* Purohit & Panigr. Rosaceae
4. *A. parijae* Panigr. & Purohit Rosaceae
5. *Anaphalis notoniana* DC. Asteraceae
6. *Andrographis lobeloides* Wt. Acanthaceae

7. *Arisaema translucens* C. Fischer Araceae
8. *A. tuberculatum* C. Fischer Araceae
9. *A. tylophorum* C. Fischer Araceae
10. *Arundinaria wightiana* Nees var. *hispida* Gamble Poaceae
11. *Arundinella setosa* Trin. var. *nilagiriana* Subba Rao & Kumari Poaceae
12. *Baeolepis nervosa* (Wight & Arn.) Decne. ex Moq.- Periplocaceae
13. *Berberis nilghiriensis* Ahrendt Berberidaceae
14. *Biophytum polyphyllum* Munro Oxalidaceae
15. *Bulbophyllum acutiflorum* A. Rich. Orchidaceae
16. *B. elegantulum* (Rolfe) J.J. Smith Orchidaceae
17. *Capparis nilagiriensis* Subba Rao *et al.* Capparaceae
18. *Caralluma nilagiriana* Kumari & Subba Rao Asclepiadacea
19. *Carex pseudo-aperta* Boeck. Cyperaceae
20. *Cayratia pedata* (Lam.) Juss. ex Gagnepain var. *glabra* Gamble Vitaceae
21 *Cinnamomum perrottetii* Meissn Lauraceae
22. *Coelogyne odoratissima* Lindl var. *angustifolia* Lindley Orchidaceae
23. *Crotalaria barbata* Graham Fabaceae
24. *C. candicans* Wight & Arn. Fabaceae
25. *C. formosa* J. Graham ex Wight & Arn. Fabaceae
26. *Cucumella silentvalleyii* Manilal *et al.* Cucurbitaceae
27. *Dalbergia gardneriana* Benth. Fabaceae
28. *Dichanthium pallidum* (Hook. *f.*) Stapf ex C. Fischer Poaceae
29. *Embelia gardneriana* Wight Myrsinaceae
*30. *Eria tiagii* Manilal *et al.* Orchidaceae
31. *Eriochrysis rangacharii* C. Fischer Poaceae

32. *Eriocaulon pectinatum* Ruhl. Eriocaulaceae
33. *E. robustum* Steud. Eriocaulaceae
34. *Fimbristylis latinucifera* Govindar. Cyperaceae
35. *Garnotia schmidii* Hook. *f.* Poaceae
*36. *G. puchiparensis* Bor Poaceae
37. *Glochidion sisparense* Gamble Euphorbiaceae
38. *Habenaria denticulata* Reichb. *f.* Orchidaceae
39. *Habenaria polyodon* Hook. *f.*
40. *Hedyotis hirsutissima* Bedd.- Rubiaceae
*41. *H. silent-valleyensis* Vajravelu *et al.* Rubiaceae
42. *H. sisparensis* Gage Rubiaceae
43. *Helichrysum wightii* C.B. Clarke *ex* Hook. *f.* Asteraceae
44. *Helictotrichon polyneurum* (Hook. *f.*) Henrard Poaceae
45. *Heracleum hookerianum* Wight & Arn. Apiaceae
*46. *Hydnocarpus pendulus* Manilal *et al.* Bixaceae
47. *Ilex gardneriana* Wight Aquifoliaceae
48. *Impatiens clavicornu* Turcz. Balsaminaceae
49. *I. cuspidata* Wight Balsaminaceae
50. *I. debilis* Turcz. Balsaminaceae
51. *I. denisonii* Bedd.- Balsaminaceae
52. *I. gardneriana* Wight Balsaminaceae
53. *I. laticornis* C. E.C. Fisch.- Balsaminaceae
54. *I. lawsonii* Hook. *f.* Balsaminaceae
55. *I. lenta* Hook. *f.* Balsaminaceae
56. *I. levingei* Gamble ex Hook. *f.* Balsaminaceae
57. *I. munronii* Wight Balsaminaceae
58. *I. neo-barnesii* C. E.C. Fischer Balsaminaceae

59. *I. nilgirica* C. E.C. Fischer Balsaminaceae
60. *I. orchioides* Bedd. Balsaminaceae
61. *I. trichocarpa* Hook. *f.* Balsaminaceae
62. *Isachne deccanensis* Bor Poaceae
63. *I. oreades* (Domin) Bor Poaceae
*64. *Ipsea malabarica* (Reichb. *f.*) Hook. *f.* Orchidaceae
65. *Lasianthus ciliatus* Wight Rubiaceae
66. *Leucas rosmarinifolia* Benth. Lamiaceae
67. *Liparis biloba* Wight Orchidaceae
*68. *L. indiraii* Manilal *et al.* Orchidaceae
69. *Mackenziea violacea* (Beddome) Bremek. Acanthaceae
70. *Microtropis densiflora* Wight Celastraceae
71. *M. microcarpa* Wight Celastraceae
72. *Memecylon flavescens* Gamble Melastomataceae
73. *M. sisparense* Gamble Melastomataceae
74. *Myriactis wightii* DC. var. *bellidioides* Hook. *f.* Acanthaceae
75. *Nilgirianthus papillosus* (T. Anderson) Bremek. Acanthaceae
76. *Oberonia bisaccata* Manilal *et al.* Orchidaceae
77. *O. wightiana* Lindley var. *arnottiana* (Wight) R. Ansari *et al.* Orchidaceae
78. *O. wightiana* Lindley var. *nilgirensis* R. Ansari *et al.* Orchidaceae
79. *Ophiorrhiza incarnata* C. Fischer Rubiaceae
80. *O. pykarensis* Gamble Rubiaceae
81. *Orthosiphon rubicundus* Benth. var. *hohenackeri* Hook. *f.* Lamiaceae
82. *Pavetta breviflora* DC. var. *ciliolata* Gamble ex Bremek. Rubiaceae
83. *P. hohenackeri* Bremek. Rubiaceae