

FLORISTIC DIVERSITY IN WESTERN GHATS: DOCUMENTATION, CONSERVATION AND BIOPROSPECTION– A PRIORITY AGENDA FOR ACTION

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ABSTRACT

Western Ghats, being one of the global hotspots of biodiversity, supports an enormous vegetal wealth, which over the years is undergoing great stress due to anthropogenic disturbances. This region which forms the “Malabar Botanical Province” according to phytogeographers is a narrow stretch running from the hills south of Tapati river in the north to Kanyakumari in the south along the west coast of India covering the states of Goa, Maharashtra, Karnataka, Tamil Nadu and Kerala. The narrow stretch of Western Ghats running approximately 1500 km encompasses a considerable gradient of climatic conditions which have resulted in the development of diverse forest types ranging from the dry scrub types to the semi-evergreen and evergreen forests. Details of these forest types and their floristic composition are discussed. The development of the tropical rain forests in the southern Western Ghats and the ‘sholas’ in the Nilgiris region are the most outstanding features of Western Ghats. The entire Western Ghats biogeographic region is a major genetic estate with an enormous biodiversity of ancient lineage. Nearly 5800 species of flowering plants occur here of which 56 genera and 2100 species are endemic. Karnataka alone harbours 3900 species belonging to 1323 genera and 199 families while Nilgiris have 2611 species of flowering plants. Some dominant families are Poaceae, Leguminosae, Orchidaceae, Acanthaceae, Euphorbiaceae, Asteraceae, Lamiaceae and Rubiaceae. Analysis of endemic species reveals that Western Ghats being much older in age compared to Himalayan mountains, support a large majority of relict or palaeoendemics. Another unique feature of the endemic flora of Western Ghats is the prevalence of monotypic genera such as *Adenanthe*, *Calacanthus*, *Polyzygus*, *Erinocarpus*, *Frerea*, *Griffithella*, *Haplothismia*, *Jerdonia*, *Lamprochaenium*, *Nanothamnus*, *Wagatea* and *Willisia*. Some of the arborescent genera having maximum endemic taxa are *Memecylon* (16 spp.), *Litsea* (15 spp.), *Symplocos* (14 spp.), *Cinnamomum* (12 spp.), *Syzygium* (11 spp.), *Actinodaphne* (9 spp.), *Glochidion* (9 spp.), *Grewia* (9 spp.), *Diospyros* (8 spp.), *Dalbergia* (7 spp.), *Hopea* (6 spp.), *Drypetes* (6 spp.), *Poeciloneuron* (2 spp.), *Blepharistemma*, *Erinocarpus*, *Meteoromyrtus*, *Otonephelium* and *Pseudoglochidion*. The latter five genera are again monotypic. The flora of Western Ghats, particularly southern W. Ghats shows close affinity with the flora of Sri Lanka, supporting the view that Sri Lanka was connected to South India during the geologic past. Some important species common to both regions are listed. Agasthyamalai hills, Anamalai ranges, Nilgiris and the Palni hills are the hyperdiversity areas in Western Ghats which are also the

hotspots pockets. The Western Ghats region is also a rich germplasm center of number of wild relatives of our crop plants such as the cereals & millets, legumes, tropical & sub-tropical fruits, vegetables, spices & condiments and a few others. Species of *Piper*, *Oryza*, *Myristica*, *Elettaria*, *Amomum*, *Zingiber*, *Phaseolus*, *Vigna*, *Atylosia*, *Cinnamomum* and *Curcuma* show great variability in southern Western Ghats. The alarming rate of loss of biodiversity in Western Ghats is a major concern today. Shifting cultivation, grazing, indiscriminate lopping, extraction of timber and fuel wood, spread of invasive alien weeds, recurrent forest fires and selective removal of certain species such as the medicinal plants have all resulted in severe destruction of the virgin forests which now survive only as pockets in the mountains summit areas. The accelerated population growth followed by expansion of agriculture, introduction of plantation crops like tea, coffee, rubber have resulted in the extermination of many taxa, endangering a number of economically important timber and other species. Discussing the major strategies for conservation, the author prioritizes certain issues for urgent action. Inventory of base line data and development of computerized databases, assessment of genetic diversity at least in wide spread taxa, identifying and conserving and monitoring the hotspot pockets of biodiversity (19 such sites are identified by the author), protection of sacred forests and special habitats, establishment of gene bank/seed bank, conservation of critically endangered species are some issues suggested for action. Discussing the utilization and management of the bio resources of Western Ghats, the author outlines the immense opportunities for Bioprospection, particularly chemo- prospecting in wild medicinal and aromatic plants, which is much neglected. Recent developments in molecular biology and biotechnology have made it possible to scan the biodiversity for molecules with potential for commercial application. Problems and prospects associated with the bioprospection of the floristic diversity are discussed. Finally, the author calls for urgent attention for generating the trained manpower in taxonomy for shouldering this big responsibility of inventorization and conservation of the rich biodiversity of Western Ghats.

INTRODUCTION

Floristic diversity refers to the variety and variability of plants in a given region. It refers to the number of types or taxa in a given region or group. Floristic diversity can be measured at any level from overall global diversity to ecosystem, community, species, populations, individuals and even to genes within a single individual. The present write up deals with the floristic diversity of Western Ghats in the former sense, i.e., the number of individual species the region. India is one of the 12 mega diversity centers of the world where Western Ghats and the Eastern Himalayan region constitute 2 of the 25 biodiversity hotspots (Myers, 1988) representing a storehouse of several promising economically important plants. Western Ghats or 'Sahyadris' form a chain of mountains parallel to west coast almost stretching from Tapti River in the north to Kanyakumari in the south, covering a total area of about 160,000 km². It lies between 22° N to 8° N and covering western border of the states of south Gujarat,

Maharashtra, Karnataka, Tamil Nadu and Kerala. The Western Ghats, to a large extent, controls the ecology and biogeography of peninsular India. Phytogeographically, the Western Ghats is divided into four divisions on the basis of floristic composition i.e. (1) from river Tapti to Goa, (2) from Kalinadi to Coorg, (3) the Nilgiris and (4) the Anamalai, Palni and Cardamon hills (Rao, 1994). The Western Ghats rise up abruptly in the west to a highly dissected plateau up to 2900 m (Dodda Betta) in height and descend to the dry Deccan plains below 500 m in east. The climate is also extremely variable. The rainfall varies from 5000 mm per annum in windward areas to less than 600 mm in the leeward or rain shadow areas with prolonged dry season.

The present paper attempts to highlight the diversity of vast plant resources of Western Ghats region in a conservation perspective. However, no attempt is made to discuss the infra-specific diversity of taxa, which requires considerable amount of original research. Although the lower groups of plants (Pteridophytes, Lichens, Bryophytes) form a conspicuous feature of vegetation of Western Ghats and contribute significantly to the floristic diversity, these are also not dealt in the present discussion.

VEGETATION DIVERSITY

The climatic and altitudinal gradient has resulted in a variety of vegetation types, from evergreen to semi-evergreen; from moist deciduous to dry deciduous formations. In the higher hills stunted montane communities have also developed. Four major forest types and 23 different forest sub types have been recognized in Western Ghats based on ecological factors and floristic composition (Pascasl, 1982, 1988; Ramesh et al., 1997). In brief, the following forest types have developed in Western Ghats – (i) the dry scrub vegetation (ii) the dry deciduous forests (iii) moist deciduous forests (iv) the semi-evergreen forests (v) the evergreen forests (vi) the shoals and the (vii) the high altitude grasslands. Again, each of these forest types have numerous subtypes, formations or associations comprising of a variety of floristic composition. Only briefly the floristic composition of these forest types is discussed here.

The dry scrub vegetation occurs at the foothills, particularly along the eastern side of Western Ghats and these forests merge with the forests of Deccan region. The vegetation is mostly comprised of thorny species like *Barleria prionites*, *B. cristata*, *Eranthemum roseum*, *Hemigraphis latebrosa*, *Rungia repens*, *Dicliptera foetida*, *Aerva sanguinolenta*, *Mimosa pudica*, *Acacia spp.*, *Commiphora berryii*, *Dichrostachys cinerea*, *Scutia circumscissa*, *Pterolobium hexapetalum*, *Toddalia asiatica*, *Opuntia dillenii*,

Dicoma tomentosa, *Azima tetraacantha*, *Solanum trilobatum*, *Euphorbia antiquorum*, *Dodonaea viscosa*, *Capparis* spp, *Xeromphis spinosa*, *Carissa congesta*, *Rhus mysorensis*, *Erythroxylum monogynum*, *Balanites aegyptiaca* and a few others. The tree species are sparse and are stunted like *Anogeissus latifolia*, *Bauhinia racemosa*, *Cochlospermum religiosum*, *Cassia fistula*, *Careya arborea*, *Semecarpus anacardium*, *Albizzia lebbeck*, *Ixora brachiata*, *Radermachera xylocarpa*, etc. The climbers are few and are represented by *Hemedismus indicus*, *Ventilago maderaspatana*, *Smilax zeylanica* and *Argyrea* spp. The herbaceous flora in these forests can be observed only during monsoon and are represented by numerous grasses like *Apluda varia*, *Eragrostis unioloides*, *Heteropogon contortus*, *Setaria glauca* and others like *Polycarpaea aurea*, *Crotalaria* spp., *Indigofera* spp. and *Barleria buxifolia*.

The dry deciduous hill forests are found on the eastern side at elevations of 500-1000 m. The rainfall varies from 800-2000 mm. Typically species like *Diospyros montana*, *D. sylvatica*, *Eriolaena quinquelocularis*, *Sterculia urens*, *Anogeissus latifolia*, *Butea monosperma*, *Emblica officinalis*, *Grewia tiliaefolia*, *Pterocarpus marsupium*, *Terminalia* spp, *Albizzia amara*, *Bombax ceiba*, *Mitragyna parvifolia*, *Givotia moluccana*, *Melia composita*, *Cassia fistula* and a few others. At comparatively higher rainfall areas bamboo species like *Dendrocalamus strictus* and *Bambusa arundinacea* also appear. The shrubby species in these forests are represented by *Flacourtia indica*, *Securinega leucopyrus*, *Carissa congesta*, *Callicarpa tomentosa*, *Xeromphis spinosa*, *Meyna laxiflora*, *Ziziphus* spp and the invasive *Lantana camara*. Often climbers like *Asparagus racemosus*, *Cryptolepis buchmanii*, *Cayratia pedata*, *Canavalia gladiata*, *Glycine wightii*, *Dregea volubilis*, *Calycopteris floribunda* and Convolvulaceae members cover the vegetation.

Moist deciduous forests mostly occur between 600-1000 m elevation at windward side where rainfall is comparatively higher. Important timber species like *Terminalia crenulata*, *Dalbergia latifolia*, *Lagerstroemia microcarpa*, *Pterocarpus marsupium*, *Pterygota alata*, *Schleichera oleosa*, *Tectona grandis* grow luxuriantly here. Other tree species are *Haldina cordifolia*, *Dillenia pentagyna*, *Miliusa tomentosa*, *Terminalia alata*, *T. paniculata*, *T. chebula*, *Shorea roxburghii*, *Xylia xylocarpa*, *Stereospermum colais*, *Vitex altissima* and smaller trees like *Trema orientalis*, *Cassia fistula*, *Kydia calycina*, *Clausena heterophylla*, *Oroxylum indicum*, *Grewia tiliaefolia* and others. *Bambusa arundinacea* forms huge clumps in exposed places. During monsoon, these forests resemble an evergreen forest with dense canopies over topped by large climbers like *Gouania microcarpa*, *Ichnocarpus frutescens*, *Diploclisia glaucescens*, *Dioscorea* spp., *Ventilago maderaspatana*, *Teramnus labialis*, *Derris heyneana*, *Naravelia zeylanica*, *Hiptage benghalensis*, *Mucuna* spp. and the gigantic *Entada purseatha*. The

epiphytic flora- ferns, orchids, mosses are also rich and often completely cover the tree trunks. The diversity of herbaceous flora is also quite rich and are represented by diverse families.

The semi-evergreen and evergreen forests appear at higher elevations usually along the windward side where rainfall is very heavy (2000-35000 m). The evergreen forests are supposed to be the climax type of forests also termed 'wet evergreen forests', 'montane subtropical evergreen forests' by some authors. The forests are storied with distinct species composition. The dominant species of the upper storey are *Artocarpus hirsutus*, *Euphoria longan*, *Elaeocarpus tuberculatus*, *Hopea parviflora*, *Mangifera indica*, *Sterculia guttata*, *Holoptelia integrifolia*, *Hydnocarpus pentandra*, *Fagraea ceilanica*, *Knema attenuata*, *Diospyros ebenum*, *Canarium strictum*, *Neolitsea cassia*, *Myristica dactyloides*, *M. malabarica*, *Palaquium ellipticum*, *Calophyllum polyanthus*, *Litsea floribunda*, *Vateria indica*, *Cullenia exarillata*, *Garcinia gummigutta*, *Lophopetalum wightianum* and numerous others. The endemic genus *Poeciloneuron* with two species, *P. indicum*, *P. pauciflorum* occur only in evergreen forests from Mysore southwards. The typical tropical family, Dipterocarpaceae is well represented here. *Dipterocarpus*, *Hopea*, *Shorea*, *Vatica*, *Vateria* are the important genera. About nine species are restricted to southern Western Ghats.

The second storey trees are medium sized and belong to *Aporosa lindleyana*, *Antidesma menasu*, *Carallia brachiata*, *Acrocarpus fraxinifolium*, *Beccaurea courtallensis*, *Elaeocarpus glandulosus*, *Holigarna ferruginea*, *H. beddomei*, *Persea macrantha*, *Pterospermum xylocarpum*, *Macaranga tomentosa*, *Sapindus laurifolius*, *Meliosma simplicifolia* and a host of others. The ground flora is composed of a number of shrubs and herbs belonging to *Strobilanthes*, *Psychotria*, *Begonia*, *Elatostema*, *Ophiorhiza*, *Impatiens*, *Scutellaria*, and many Zingiberaceae members. Ground orchids like *Habenaria*, *Zeuxine*, *Pectelis*, *Nervelia*, *Malaxis* are also common. Along ravines and marshy areas the prickly *Calamus*, *Angiopteris*, *Cyathea* are remarkable. The epiphytic flora in these forests is also very dense and belong to diverse angiosperms, ferns, lichens, and mosses.

The Silent Valley forests in Western Ghats are the true surviving Tropical Rain forests in India and is really a store house of plant wealth. The forests abound in orchids, timber trees, spices, medicinal plants and so on. Manilal (1988, 1995) reports ca 1000 angiosperms belonging to 134 families and 23 rare or new species from Silent Valley alone. Some of the typical trees of this region are *Palaquium ellipticum*, *Cullenia exarillata*, *Myristica dactyloides*, *Elaeocarpus glandulosus*, *Litsea floribunda*, *Mesua nagassarium*, *Cinnamomum malabaricum* *Calophyllum polyanthum*, *Garcinia morella*, *Actinodaphne campanulata* and numerous lianas and climbers, shrubs and herbs.

The Shola forests (in Nilgiris) are characteristically seen along the folds of rolling downs at a height of 1600 m, where moisture content is very high. These forests are isolated compact evergreen patches composed of stunted trees with crooked braches. Shola forests in western Ghats are a highly threatened community today. The species diversity is remarkably very high. Some dominant species are *Hydnocarpus alpina* (Dipterocarpaceae), *Michelia nilagirica* (Magnoliaceae), *Mahonia leschenaultii* (Berberidaceae), *Gardenia obtusa* (Rubiaceae), *Cinnamomum wightii* (Lauraceae, *Atalantia wightii* (Rutaceae), *Garcinia cambogia* (Clusiaceae), *Ilex denticulata* (Aquifoliaceae), *Microtropis ramiflora* (Leguminaceae), *Meliosma wightii* (Sabiaceae), *Acronychia pedunculata* (Rutaceae), *Eurya nitida* (Theaceae), *Igustrum robustum* (Oleaceae), *Ternstroemia gymnanthera* (Ternstroemiaceae) and the tree *Compositae* , *Vernonia arborea*.

The open meadow bordering the shoal forests support a variety of colorful herbs like *Anemone rivularis*, *Ranunculus reniformis*, *Cardamine hirsuta*, *Hypericum mysorensense*, *Impatiens nilagirica*, *Parnassia chinensis* and shrubs like *Osbeckia cupularis*, *Gaultheria fragrantissima*, *Symplocos laurina*, *Rhodomyrtus tomentosus*, etc. *Rhododendron arboreum* (nilagiricum ?) is a Pleistocene relict that survives in the Nilgiris hills. The flora here show close affinity with the flora of Khasi & Jaintia hills of Meghalaya.

The Grasslands in Western Ghats usually occur at higher elevations (above 1800 m) in the Nilgiris, Anaimali, Palnis, Bababudangiris, and Caradomum hill ranges, and are composed of *Saccharum spontaneum*, *Imperata cylindrica*, *Arundinella setosa*, *Chrysopogon hackelii*, *Eulalia trispicata*, *Themeda triandra*, and *Jansenella griffithiana*. Nuamorous colourful angiospermic herbs and shrubs like *Hypericum japonicum*, *Osbeckia leschenaultiana*, *Gaultheria fragrantissima*, *Rhus fairholmianus*, *Phlebophyllum kunthianus*, *Anaphalis aristata*, *Strobilanthes kunthianus*, *Rumex nepalensis*, *Exacum bicolor*, *Lilium neilgherrense*, *Lobelia nicotianaefolia* *Polygala siberica*, *Striga asiatica*, *Walhenbergia gracilis*, *Crotolaria notonii*, *Knoxia mollis*, *Indigofera pedicellata* and several Acanthaceae and Lamiaceae members. *Phoenix humilis* is another characteristic species on the hill slopes.

Some of the Outstanding features of Vegetation of Western Ghats are Development of tropical rain forests (with fair representation of typically tropical families like Dipterocarpaceae, Myrsticaceae, Clusiaceae), presence of tall trees with buttresses, Occurrence of lianas, canes and profuse epiphytes, development of cauliflory, ground layer and tree trunks with a carpet of mosses, ferns, orchids and lichens and absence of dominance of any one species. Development of *Myristica* swamp is another unique feature. *Myristica* swamps in the southern Western Ghats occur in the bottom of valleys

inundated during a greater part of the year. The floor of the swamps is traversed by the characteristic, looped knee roots of *Myristica* spp. The commonly encountered species are *Myristica dactyloides*, *M. fatua*, *M. malabarica*, *Knema attenuata*, and other species like *Hydnocarpus alpina* and *Lophopetalum wightianum*. *Myristica* swamps in Western Ghats are a threatened community today (Krishnamoorthy, 1960, Nair & Daniel, 1986).

FLORISTIC DIVERSITY

The Western Ghats is one of the major tropical evergreen-forested regions in India and possess enormous plant diversity. The richness of floristic diversity of the region has been brought out by Gamble, 1915-1936; Fyson, 1932; Nair & Daniel, 1986; Rao, 1994; Nayar, 1996. Further, several State and District floras (Cooke, 1901-1908; Fyson, 1932; Gamble, 1915-1936; Ahuja & Singh, 1963; Manilal, 1988; Matthew, 1981-1984 & 1999; Mohanan & Henry, 1994; Nayar, 1996; Ramachandran & Nair, 1988; Rao, 1985-86; Sasidharan & Sivarajan, 1996; Rao & Razi, 1981; Saldanha & Nicolson, 1976; Saldanha, 1984, 1996; Keshava Murthy & Yoganarashiman, 1990 and Yoganarashiman *et al.*, 1981) also highlight the diversity and richness of the flora of the region. About 12000 species from lower groups to flowering plants are estimated to occur here. About 2100 endemic flowering plants have been reported from out of 5800 flowering plant species in this mega endemic area (Rao, 1994, Yoganarasimhan, 2000, Nair & Henry, 1983). This constitutes approximately 27 % of the total Indian flora. Agasthyamalai (200 km²) support 2000 species; The Nilgiris support *ca* 2611 species while Silent Valley (90 Sq Km) supports 1300 species. Most of the District floras published in recent years reveal that most of them have more than 1200 species. (Rao & Razi, 1981; Keshava Murthy & Yoganarasimhan, 1990; Saldanha, 1984; Saldanha & Nicolson, 1976; Yoganarasimhan *et al.*, 1981; Manilal, 1988; Ramachandran & Nair, 1988; Chandrabose *et al.*, 1988; Mohanan & Henry, 1994; Mohanan & Sivadasan, 2002; Ramaswamy *et al.*, 2001). There are about 1215 species of arborescent taxa in the Western Ghats flora. Again, several genera have more than 5 endemic species (Table- 1). Presence of about 60 endemic genera including 49 monotypic genera makes the region floristically unique and significant. There are about 1286 endemic species in southern Western Ghats alone (Nayar, 1996). The flora of Western Ghats reveals close affinity with E. Africa, Malaysian and Sri Lankan flora. W. Ghat flora supports Gondwana origin of landmass comprising S. America, Madagascar, India, Malaysia islands, Sri Lanka, Australia and Antarctica. Past connection of peninsular India with surrounding continents explains the distribution of certain genera like *Hernandia*, *Lindenbergia*, *Pittosporum*, *Acrotrema*, *Gomphandra*, *Nothopodytes*, *Sarcostigma*, *Hydnocarpus*, etc. in Western Ghats, Africa and some in S. America. The endemic genus

Poeciloneuron (Bonnetiaceae) in Western Ghats has allied genera in S. America. Similarly 10 genera of Orchidaceae and 52 species of Andropogoneae (Poaceae) of Western Ghats also occur in Africa. In fact, grasses are very well represented in Western Ghats. It is estimated that about 400 species of grasses occur in Kerala alone. According to Mehrotra & Jain (1982) of the 329 species of Andropogoneae about 250 species occur in Western Ghats and in plains of south India. Similarly, the genus *Isachne* is represented by 20 species in the region out of the total of 29 species in India. Again, of the 12 species of *Garnotia* in India, 9 species occur in Western Ghats (Prakash & Jain, 1979). Bamboos are also well represented in Western Ghats. Out of the ca. 100 species in India 25 species belonging to 8 genera occur here.

Orchids are a fascinating group which are popular among plant lovers mainly because of the long lasting and attractive flowers. The group includes both epiphytic and terrestrial species. Of the ca 1230 species in India more than 300 species are expected to occur in Western Ghats. Some of the ornamental species are *Acanthephippium bicolor*, *Pectelis gigantea*, *Rhynchostylis retusa*, *Vanda spp.*, *Dendrobium spp.*, *Aerides spp.*, *Eulophia spp.*, and *Paphiopedilum druryi*. However, new taxa and new reports of orchids are being constantly made from this region indicating the need for further exploration in various under explored regions in Western Ghats.

Acanthaceae, Leguminosae and Asteraceae are other families well represented in Western Ghats. Out of the 500 species of Acanthaceae in India, Santapau (1951) has recorded 38 genera and 130 species from Bombay & Khandala region alone. The genus *Strobilanthes (sensu lato)* of the family Acanthaceae is remarkable in having nearly 46 species in the rain forests of Western Ghats (Naair & Daniel, 1986). The family Leguminosae exhibits extra ordinary lifeform diversity ranging from lofty trees of the rain forests to shrubs and herbs in the grasslands; from lianas to tender climbers/creepers along the fringes of forests. Several economically important timber species, medicinal plants, wild relatives of cultivated plants belong to this family. Asteraceae with about 800 species in the country is represented by nearly 50% of the total in Western Ghats. The genus *Vernonia* again has all lifeforms like herbs, shrubs, climbers and even trees (*Vernonia monosis* & *V. travancorica*). According to Rau & Narayana (1985), of the 50 species of tribe Vernonieae from south India, nearly 45 species occur in Western Ghats.

The family Asclepiadaceae with 57 genera and 260 species in India is remarkably well represented in Western Ghats. More than 95 species ((30%) occur in Western Ghats which include 7 endemic genera

and 50 endemic species. Of the 45 species of *Ceropegia*, 35 species are from Western Ghats which include 26 endemics (Ansari, 1984).

Among monocots, Araceae, Commelinaceae, Arecaceae and Zingiberaceae are richly represented in Western Ghats. The family Araceae with 29 genera and 126 species in India is represented by more than 30 % in Western Ghats. Of the 42 species of *Arisaema* in India 13 species occur in Western Ghats. Commelinaceae with 90 species in India is represented by ca. 50 species in Western Ghats, of which about 17 species are endemic to southern Western Ghats (Kammathy, 1983).

Similarly, Western Ghats supports a good diversity of biologically interesting plants like the insectivorous species (Droseraceae, Lentibulariaceae,) parasitic plants (Lauraceae, Cuscutaceae, Orobanchaceae, Scrophulariaceae, Viscaceae), saprophytes (Burmanniaceae, some orchids). It is certainly not possible to highlight the enormous floristic diversity in each of the groups of Western Ghats and only certain peaks that stand out conspicuously are touched in this article. Diversity in certain important taxa of Western Ghats is provided in Table- 2 & 3. Yet, the floristic diversity of Western Ghats is incompletely known. Also, constantly new taxa, new reports from Western Ghats are being made by taxonomists. Therefore, Systematic survey, documentation, and evaluation of the rich floristic diversity and Bioprospection of the rich flora of Western Ghats is now an urgent task. Keeping in view, the threats operating in this region and also the importance attached to the biodiversity of the region under the National Biodiversity Action Plan, this task has become all the more important. Bioprospection of the flora and identifying better genes/molecules/species in different groups of economic plants would be highly rewarding.

Table - 1 **Some arborescent genera of Western Ghats having more than 5 endemic species**

Genera	No. of species	Genera	No. of species
<i>Memecylon</i>	16	<i>Litsea</i>	15
<i>Symplocos</i>	14	<i>Cinnamomum</i>	13
<i>Syzygium</i>	11	<i>Actinodaphne</i>	9
<i>Glochidion</i>	9	<i>Grewia</i>	9
<i>Diospyros</i>	8	<i>Dalbergia</i>	7
<i>Jambosa</i>	7	<i>Hopea</i>	6
<i>Drypetes</i>	6	<i>Mallotus</i>	6
<i>Aglaia</i>	5	<i>Cryptocarya</i>	5
<i>Garcinia</i>	5	<i>Holigarna</i>	5
<i>Terminalia</i>	5	<i>Humboldtia</i>	5
<i>Euonymus</i>	5		

Table 2: Some taxa of Western Ghats having high diversity in them

Taxa	Number of genera & species (Approximate)
Poaceae	120 genera; 430 species
Leguminosae	85 genera; 350 species
Orchidaceae	60 genera; 285 species
Acanthaceae	45 genera; 125 species
Cyperaceae	21 genera; 170 species
Euphorbiaceae	55 genera; 150 species
Asteraceae	58 genera; 150 species
Lamiaceae	25 genera; 120 species
Rubiaceae	40 genera; 110 species
Asclepiadaceae	30 genera; 95 species

Table - 3 : Diversity of some taxa of Western ghats vis a vis Indian region

Taxa	No. of species in India	Species in Western Ghats
<i>Ceropegia</i>	44	35 (26 endemics)
<i>Arisaema</i>	42	13
<i>Commelinaceae</i>	81	45 (17 endemics)
<i>Impatiens</i>	223 (incl. 23 vars.)	88 (most are endemics)
<i>Orchids</i>	1000	250
<i>Palms</i>	--	21
<i>Andropogoneae</i>	329	250
<i>Isaachne</i>	29	20
<i>Asclepiadaceae</i>	280	90
<i>Vernonieae</i>	--	45
<i>Pittosporum</i>	11	7
<i>Piper</i>	--	15
<i>Cinnamomum</i>	--	15
<i>Litsea</i>	--	16
<i>Calophyllum</i>	--	5
<i>Garcinia</i>	--	12
<i>Myristica</i>	--	4
<i>Dioscorea</i>	--	21 species; 27 varieties

Diversity in wild relatives of crop plants/economically important species:

Western Ghats is a major genetic estate of wild relatives of crop plants with an enormous biodiversity of ancient lineage. The region is a store house of wild relatives of **cereals and millets** (*Panicum psilopodium*, *Oryza coaractata*, *Pennisetum glaucum*, *Chionachne koenigii*, *C. semiteres*, *Coix gigantea* and *Trilobachne cookie*); **legumes** (*Atylosia albicans*, *A. goenisis*, *A. trinervia*, *A. elongata*, *A. platycarpa*, *A. graniflora*, *A. mollis*, *A. nivea*, *A. scarabaeoides*, *A. sericea*, *A. villosa* (all wild relatives of cultivated *Cajanus*), *Canavalia virosa*, *C. maritime*, *Macrotyloma uniflorum*, *Sphenostylis bracteata*, *Mucuna pruriens*, *Vigna sublobata*, *V. vexillata*, *V. pilosa*, *V. umbellata*, *V. dalzelliana*, and *V. khandalensis*; **Tropical and subtropical fruits** (*Artocarpus heterophyllus*, *A.lacucha*, *Garcinia indica*, *Diospyros spp.*, *Ensete superbum*, *Mangifera indica*, *Mimosops elengii*, *Spondias pinnata*, *Ziziphus oenoplea*, *Z. rugosa*, *Rubus ellepticus*, *R. niveus*, *R. alceifolius* ; **Vegetables** (*Abelmoschus angulosus*, *A. moschatus*, *A. manihot*, *A. ficulneus*, *Amorphophalus paeonifolius*, *Cucumis setosus*, *Luffa graveolens*, *Momordica cochinchinensis*, *M. subangulata*, *Solanum indicum*, *Trichosanthes anamalaiensis*, *T. bracteata*, *T. cuspidata*, *T. perrottetiana* and *T. villosula*; **Oil seeds** (*Sesamum laaciniatum*, *S. prostratum*); **Spices and Condiments** (*Cinnamomum zeylanicum*, *Myrstica dactyloides* *M. malabarica*, *Piper nigrum*, *P. schmidtii*, *P. longum*, *Zingiber purpureum*, *Z. officinale*, *Z. zerumbet*, *Costus speciosus* and *Elettaria caradomum* . In addition wild relatives of Coffee and sugarcane are also well represented.

The **medicinal plant diversity** in Western Ghats is also of a very high order. The region is known as the 'Emporium of medicinal Plants.' Due to varied physiographic and physiognomic factors, medicinal plant diversity is very high both in terms of species diversity as well as infra specific diversity. Roughly, 1500 species of medicinal plants from out of the total of 5000 species of Western ghats are reported (Yoganarasimhan, 1996, 2000). A few important ones in this category are listed (Table- 4) The floristic diversity of **wild aromatic plants** in Western Ghats is also incompletely known. While medicinal plants have received some attention, other groups such as the essential oil yielding plants of the region are least studied. There are more than 200 such aromatic species in different ecosystems of Western Ghats and are predominantly spread among Lamiaceae, Asteraceae, Rutaceae, Zingiberaceae, Lauraceae, Oleaceae and Poaceae (table-5 & 6). While species diversity is assessed to some extent, infra specific diversity in these aromatic species is least known. Nevertheless, many species like *Hyptis suaveolens*, *Blumea lacera*, *B. hieracifolia*, *B. membranacea*, *Cymbopogon flexuosus*, *Ocimum basilicum*, *Plectranthus mollis* exhibit remarkable morphological variations in the region. Western Ghats with a wide variety of ecological habitats certainly provides for numerous ecotypes / chemotypes in some of

Table 4: Medicinal Plant species diversity in Western Ghats

Species	Family
<i>Trichopus zeylanicus</i>	Trichopodaceae
<i>Utleria salicifolia</i>	Periplocaceae
<i>Janakia arayalpathra</i>	Periplocaceae
<i>Myristica malabarica</i>	Myristicaceae
<i>Adenia hondala</i>	Passifloraceae
<i>Artocarpus hirsutus</i>	Moraceae
<i>Cinnamomum travancoricum</i>	Lauraceae
<i>Cinnamomum wightii</i>	Lauraceae
<i>Piper barberi</i>	Piperaceae
<i>Vateria indica</i>	Dipterocarpaceae
<i>Ochreinauclea missionis</i>	Rubiaceae
<i>Syzygium travancoricum</i>	Myrtaceae
<i>Hydnocarpus alpina</i>	Dipterocarpaceae
<i>Michelia nilagirica</i>	Magnoliaceae
<i>Mahonia leschenaultii</i>	Berberidaceae
<i>Gardenia obtusa</i>	Rubiaceae
<i>Cinnamomum wightii</i>	Lauraceae
<i>Atalantia wightii</i>	Rutaceae
<i>Garcinia cambogia</i>	Clusiaceae
<i>Ilex denticulata</i>	Aquifoliaceae
<i>Microtropis ramiflora</i>	Leguminaceae
<i>Gymnosporia montana</i>	Celastraceae
<i>Rhus mysorensis</i>	Anacardiaceae
<i>Scutia circumscissa</i>	Rhamnaceae
<i>Plecosperrum spinosum</i>	Ulmaceae
<i>Pterolobium hexapetalum</i>	Caesalpiniaceae
<i>Xeromphis spinosa</i>	Rubiaceae
<i>Toddalia asiatica</i>	Rutaceae
<i>Ziziphus spp.</i>	Rhamnaceae
<i>Acacia spp.</i>	Mimosaceae
<i>Sagearaea dalzelli</i>	Annonaceae
<i>Dysoxylum malabaricum</i>	Meliaceae
<i>Holigarna arnottiana</i>	Anacardiaceae
<i>Syzygium mungudam</i>	Myrtaceae
<i>Memeylon malabaricum</i>	Melastomaceae
<i>Diospyros paniculata</i>	Ebenaceae
<i>Humboldtia vahliana</i>	Leguminosae

<i>Buchanania lanceolata</i>	Anacardiaceae
<i>Myrstica malabarica</i>	Myristicaceae
<i>Nothapodytes foetida</i>	Icacinaceae
<i>Maesua nagassarium</i>	Clusiaceae
<i>Aphanamyxis polystachya</i>	Meliaceae
<i>Semecarpus anacardium</i>	Anacardiaceae
<i>Butea monosperma</i>	Papilionaceae
<i>Hymenodictyon orixense</i>	Rubiaceae
<i>Phyllanthus amarus</i>	Euphorbiaceae
<i>Mucuna pruriens</i>	Papilionaceae
<i>Asclepias curassavica</i>	Asclepiadaceae
<i>Celastrus paniculatus</i>	Celastraceae
<i>Abrus precatorius</i>	Papilionaceae
<i>Cissus quadrangularis</i>	Vitaceae
<i>Plumbago zeylanica</i>	Plumbaginaceae
<i>Tylophora indica</i>	Asclepiadaceae
<i>Gymnema sylvestre</i>	-do-
<i>Withania somnifera</i>	Solanaceae
<i>Centella asiatica</i>	Apiaceae
<i>Ocimum sanctum</i>	Lamiaceae
<i>Boerhavia diffusa</i>	Nyctaginaceae
<i>Tinospora cordifolia</i>	Menispermaceae
<i>Bacopa monnieri</i>	Scrophulariaceae
<i>Wrightia tinctoria</i>	Apocynaceae
<i>Strychnos spp</i>	Loganiaceae
<i>Pterocarpus marsupium</i>	Fabaceae
<i>Mallotus philippensis</i>	Euphorbiaceae
<i>Knema attenuata</i>	Myristicaceae
<i>Dioscorea spp.</i>	Dioscoreaceae
<i>Anamirta cocculus</i>	Menispermaceae
<i>Alangium salviifolium</i>	Alangiaceae
<i>Gmelina arborea</i>	Verbenaceae
<i>Ichnocarpus frutescens</i>	Apocynaceae
<i>Helicteres isora</i>	Sterculiaceae
<i>Entada purseatha</i>	Mimosaceae
<i>Aristolochia indica</i>	Aristolochiaceae
<i>Alstonia scholaris</i>	Apocynaceae
<i>Zanthoxylum rhetusa</i>	Rutaceae
<i>Acrocarpus fraxinifolius</i>	Caesalpiniaceae
<i>Gluta travancorica</i>	Anacardiaceae
<i>Stephania japonica</i>	Menispermaceae
<i>Elaeocarpus spp.</i>	Elaeocarpaceae
<i>Narenga alata</i>	Rutaceae
<i>Murraya paniculata</i>	Rutaceae

Table 5: Diversity of aromatic species in Western Ghats

Family	Genus	Species
Rutaceae	10	18
Asteraceae	7	10
Zingiberaceae	6	12
Lauraceae	2	5
Lamiaceae	17	47
Myrtaceae	1	3
Oleaceae	1	9
Geraniaceae	2	2
Verbenaceae	1	1
Lamiaceae	1	2
Ericaceae	1	1
Flindersiaceae	1	1
Chenopodiaceae	1	1
Burseraceae	2	2
Euphorbiaceae	1	1
Apiaceae	1	1
Poaceae	1	3
Total	56	120

Table 6: Diversity of Wild Aromatic species of Western Ghats

S.No.	Name of the species	Family
1	<i>Acalypha fruticosa</i> *	Euphorbiaceae
2	<i>Acronychia pedunculata</i>	Rutaceae
3	<i>Alpinia calcarata</i> *	Zingiberaceae
4	<i>Alpinia malaccensis</i> *	Zingiberaceae
5	<i>Amomum masticatorium</i> *	Zingiberaceae
6	<i>Anisochilus carnosus</i>	Lamiaceae

7	<i>Anisochilus paniculatus</i> *	Lamiaceae
8	<i>Anisochilus robustus</i> *	Lamiaceae
9	<i>Anisomeles heyneana</i> *	Lamiaceae
10	<i>Anisomeles indica</i> *	Lamiaceae
11	<i>Anisomeles malabarica</i> *	Lamiaceae
12	<i>Artemisia nilagirica</i> var. <i>nilagirica</i> *	Asteraceae
13	<i>Atalantia monophylla</i>	Rutaceae
14	<i>Atalantia racemosa</i>	Rutaceae
15	<i>Becium filamentosum</i>	Lamiaceae
16	<i>Blumea lacera</i> *	Asteraceae
17	<i>Blumea lanceolaria</i> *	Asteraceae
18	<i>Blumea mollis</i> *	Asteraceae
19	<i>Boswellia serrata</i> *	Burseraceae
20	<i>Calamintha umbrosa</i> *	Lamiaceae
21	<i>Centratherum punctatum</i> *	Asteraceae
22	<i>Chenopodium ambrosioides</i> *	Chenopodiaceae
23	<i>Chloroxylon swietenia</i> *	Flindersiaceae
24	<i>Cinnamomum gracile</i>	Lauraceae
26	<i>Cinnamomum sulphuratum</i> *	Lauraceae
27	<i>Cinnamomum verum</i>	Lauraceae
28	<i>Clausena dentata</i> *	Rutaceae
29	<i>Clausena heptaphylla</i>	Rutaceae
30	<i>Clausena willdenovii</i> *	Rutaceae
31	<i>Commiphora caudata</i> *	Burseraceae
32	<i>Curcuma aeruginosa</i> *	Zingiberaceae
33	<i>Curcuma aromatica</i> *	Zingiberaceae
34	<i>Curcuma neilgherrensis</i> *	Zingiberaceae
35	<i>Cymbopogon coloratus</i> *	Poaceae
36	<i>Cymbopogon flexuosus</i> *	Poaceae
37	<i>Cymbopogon martinii</i> *	Poaceae

38	<i>Endostemon viscosus</i> *	Lamiaceae
39	<i>Eryngium foetidum</i> *	Apiaceae
40	<i>Gaultheria fragrantissima</i>	Ericaceae
41	<i>Geranium nepalense</i>	Geraniaceae
42	<i>Globba ophioglossa</i>	Zingiberaceae
43	<i>Glycosmis pentaphylla</i> *	Rutaceae
44	<i>Gomphostemma eriocarpon</i> *	Lamiaceae
45	<i>Hedychium coronarium</i> *	Zingiberaceae
46	<i>Hedychium flavescens</i> *	Zingiberaceae
47	<i>Hyptis suaveolens</i> *	Lamiaceae
48	<i>Isodon coetsa</i>	Lamiaceae
49	<i>Isodon wightii</i>	Lamiaceae
50	<i>Janakia arayalpathra</i>	Asclepiadaceae
51	<i>Jasminum auriculatum</i> *	Oleaceae
52	<i>Jasminum azoricum</i> var. <i>travancorense</i> *	Oleaceae
53	<i>Jasminum cordifolium</i>	Oleaceae
54	<i>Jasminum malabaricum</i> *	Oleaceae
55	<i>Jasminum rigidum</i>	Oleaceae
56	<i>Jasminum ritchiei</i>	Oleaceae
57	<i>Jasminum sambac</i>	Oleaceae
58	<i>Jasminum scandens</i>	Oleaceae
59	<i>Jasminum sessiliflorum</i>	Oleaceae
60	<i>Kaempferia galanga</i> *	Zingiberaceae
61	<i>Kaempferia rotunda</i> *	Zingiberaceae
62	<i>Laggera crispata</i> *	Asteraceae
63	<i>Lavandula gibsoni</i>	Labiataea
64	<i>Lavandula bipinnata</i>	Labiataea
65	<i>Cyathocline purpurea</i>	Asteraceae
66	<i>Pimpinella adscendens</i>	Asteraceae

67	<i>Leonotis nepetiifolia</i> *	Lamiaceae
68	<i>Leucas ciliata</i> *	Lamiaceae
69	<i>Leucas lavandulifolia</i> *	Lamiaceae
70	<i>Leucas marrubioides</i>	Lamiaceae
71	<i>Leucas stelligera</i> *	Lamiaceae
72	<i>Leucas vestita</i> var. <i>vestita</i> *	Lamiaceae
73	<i>Limonia acidissima</i> *	Rutaceae
74	<i>Limonia crenulata</i>	Rutaceae
75	<i>Mentha arvensis</i> *	Lamiaceae
76	<i>Mentha spicata</i> *	Lamiaceae
77	<i>Murraya indica</i> *	Rutaceae
78	<i>Murraya koenigii</i> *	Rutaceae
79	<i>Murraya paniculata</i> *	Rutaceae
80	<i>Neolitsia zeylanica</i>	Lauraceae
81	<i>Ocimum americanum</i>	Lamiaceae
82	<i>Ocimum basilicum</i> *	Lamiaceae
83	<i>Ocimum gratissimum</i> *	Lamiaceae
84	<i>Ocimum kilimandscharicum</i> *	Lamiaceae
85	<i>Ocimum tenuiflorum</i> *	Lamiaceae
86	<i>Orthosiphon diffuses</i> *	Lamiaceae
87	<i>Orthosiphon thymiflorus</i> *	Lamiaceae
88	<i>Paramignya monophylla</i>	Rutaceae
89	<i>Pelargonium graveolens</i>	Geraniaceae
90	<i>Plectranthus amboinicus</i> *	Lamiaceae
91	<i>Plectranthus aromaticus</i>	Lamiaceae
92	<i>Plectranthus barbatus</i> *	Lamiaceae
93	<i>Plectranthus coleoides</i> *	Lamiaceae
94	<i>Plectranthus deccanicus</i>	Lamiaceae
95	<i>Plectranthus malabaricus</i> *	Lamiaceae
96	<i>Plectranthus mollis</i> *	Lamiaceae
97	<i>Plectranthus subincisus</i>	Lamiaceae
98	<i>Plectranthus zeylanicus</i> *	Lamiaceae
99	<i>Pleiospermum alatum</i>	Rutaceae

100	<i>Pluchea tomentosa</i> *	Asteraceae
101	<i>Pogostemon benghalensis</i> *	Lamiaceae
102	<i>Pogostemon heyneanus</i>	Lamiaceae
103	<i>Pogostemon mollis</i>	Lamiaceae
104	<i>Pogostemon paniculatus</i> *	Lamiaceae
105	<i>Salvia coccinea</i> *	Lamiaceae
106	<i>Salvia leucantha</i> *	Lamiaceae
107	<i>Salvia plebeia</i>	Lamiaceae
108	<i>Scutellaria violacea</i> *	Lamiaceae
109	<i>Scutellaria wightiana</i> *	Lamiaceae
110	<i>Sphaeranthus indicus</i>	Asteraceae
111	<i>Syzygium aromaticum</i> *	Myrtaceae
112	<i>Syzygium cuminii</i>	Myrtaceae
113	<i>Syzygium lineare</i>	Myrtaceae
114	<i>Thymus vulgaris</i> *	Lamiaceae
115	<i>Toddalia asiatica</i> var. <i>floribunda</i> *	Rutaceae
116	<i>Toddalis asiatica</i> var. <i>gracile</i>	Rutaceae
117	<i>Vitex trifolia</i> *	Verbenaceae
118	<i>Zanthoxylum ovalifolium</i> *	Rutaceae
119	<i>Zanthoxylum tetraspermum</i>	Rutaceae
120	<i>Zingiber zerumbet</i> *	Zingiberaceae

these wild aromatic species. Species-specific surveys followed by interdisciplinary investigations by Taxonomists, Molecular biologists, Geneticists, Phytochemists and Ecologists must be undertaken to assess the extent of total diversity and also the 'elite' populations in the wild aromatic plants.

The life support species which offer very valuable subsidiary food are also very numerous. Several wild plants are consumed as vegetables, as fruits or as seeds. Only a few important ones are listed here. *Alangium salviifolium*, *Antidesma acidum*, *A. menasu*, *Artocarpus* sp., *Baccaurea courtallensis*, *Calamus rotung*, *Canthium travancoricum*, *Embllica officinalis*, *Flacourtia indica*, *Mangifera indica*, *Dioscorea* spp.,

Phoenix humilis, *Physalis* spp., *Rubus* spp., *Syzygium cuminii*, *Caryota urens* and several *Colocasia* and *Alocasia* spp.

ENDEMIC AND MONOTYPIC TAXA OF WESTERN GHATS

The issue of endemism in Western Ghats has been discussed by many botanists from time to time (Chatterjee, 1940, 1962; Maheshwaari, 1976; Nayar, 1980, 82; Rao, 1972; Subramanyam & Nayar, 1974; Aahmedulla & Nayar, 1987; Nair & Daniel, 1986; Nayar & Ahmedulla, 1984; Ramesh & Pascal, 1981). Western Ghats are only next to Himalaya in having high number of endemic plants. Although Western Ghats are a part of the continental area, they are protected by vast sea along the western side, Vindhya and Satpura ranges on the northern side, semi-arid Deccan plateau on the eastern side and Indian Ocean on the south which act as barriers for plant migration and hence act as a kind of oceanic island in supporting a large number of endemic plants. According to Subramanyam & Nayar, 1974; Blasco, 1970, 1971, the high summits of Western Ghats with their characteristic climate are comparable to islands as regards the distribution of endemic species. According to Nayar (1982) there are 56 (now 60) endemic genera and 2100 (38 %) species in the Peninsular India. Among these 49 genera are monotypic. Unlike Himalayas, most of the endemics in the Western Ghats are palaeo-endemics. Southern Western Ghats, particularly Agasthyamalai hills are the richest in endemics followed by Wynad and Annamalai hill ranges (Table -7). Further, an analysis of endemism in various taxa reveals that Poaceae with 13 genera and 155 species is the largest among endemics. The family Orchidaceae has approximately 100 endemic species in Western Ghats. Acanthaceae with 8 genera (*Kanjarum*, *Carvia*, *Gantelbua*, *Nilgirianthus*, *Phlebophyllum*, *Pleocaulus*, *Taeniandra* and *Xenacanthus*); Asclepiadaceae with 7 genera (*Baeolepis*, *Decalepis*, *Frerea*, *Janakia*, *Oianthus*, *Seshagiria* and *Utleria*) and 35 species are other large families as regards endemic plants are concerned. There are also 21 aroborescent genera having more than 5 endemic species in Western Ghats (Table 1). Among the evergreen tree species ca. 352 species (56 % of the total evergreen species) are reported to be endemic to Western Ghats (Ramesh & Pascal, 1997).

Table – 7: Distribution of endemic species in Western Ghats

Center/ Region	Area (km ²)	Endemics
Agasthyamalai	2450	189
Anamalai high range	8000	94
Palni hills	2068	43
Wyanad – Kodagu	12800	150
Shimoga – Kanara	12000	58

Mahabaleshwar -Khandala	11000	63
Konkan – Raigad	20000	50
Marathwada – Satpuda	100000	27

Similarly, the large genus *Crotalaria* has ca.30 % of the species endemic to the region. Some of the other genera having high concentration of endemic species are *Nilgiranthus* and *Phlebophyllum* ca. 27 species; *Ceropegia* 26 species ; *Habenaria* 17 species ; *Isachne* 14 species; *Dichanthium* 11 species. Some of the arborescent endemic genera are *Blepharistemma*, *Erinocarpus*, *Meteoromyrtus*, *Otonophelium*, *Poeciloneuron*, *Pseudoglochidion* (except *Poeciloneuron* all other genera are monotypic). Another unique feature of the endemism in Western Ghats is the prevalence of high endemic species among arborescent genera (Table - 1).

Monotypic genera are those which are represented by only one species having no closely related genomes anywhere else in the world and hence have conservation significance. There are about 236 monotypic genera in India of which 49 genera are monotypic in Western Ghats. Rana & Ranade (2009) have provided a detailed account of monotypic genera in India and according them Poaceae with 32 monotypic genera is the largest family in India followed by Leguminosae (15 monotypic genera) and Asteraceae (with 12 monotypic genera) in Indian flora. A few important monotypic genera which are also endemics in Western Ghats are listed in Table -8.

Table – 8: Some monotypic endemic genera in Western Ghats

<i>Acrotrema arnotttianum</i> Wight	Dilleniaceae
<i>Adenoon indicum</i> Dalz.	Asteraceae
<i>Chandrasekharaniakeralensis</i> Nair,Ramachandran & Sree Kumar	Poaceae
<i>Hubbardia heptaneuron</i> Bor	Poaceae
<i>Indobanalia thyrsoflora</i> (Moq.) Henry & B. Roy	Amaranthaceae
<i>Indopoa paupercula</i> (Stapf) Bor	Poaceae
<i>Janakia arayalpathra</i> Joseph & Chandrasekaran	Asclepiadaceae
<i>Kanjarum palghatense</i> Ramamurthy	Acanthaceae
<i>Kingiodendron pinnatum</i> (Roxb. ex Dc.)	Leguminosae
<i>Kunstleria keralensis</i> Mohanan & Nair	“do”
<i>Lamprachaenium microcephalum</i> (Dalz.)Benth.	Asteraceae
<i>Limnopoia meeboldii</i> (Fischer) Hubb.	Poaceae
<i>Moullava spicata</i> (Dalz.)Nicolson	Leguminosae
<i>Nanothamnus sericeus</i> Thoms.	Asteraceae

<i>Otonephelium stipulaceum</i> (Bedd.) Radlk.	Sapindaceae
<i>Paracautleya bhatii</i> R.M.Smith	Zingiberaceae
<i>Polyzygus tuberosus</i> Dalz.	Apiaceae
<i>Proteroceras holtumii</i> Joseph & Vajravelu	Orchidaceae
<i>Pseudodichanthium serrafalcoides</i> (Cooke & Stapf) Bor	Poaceae
<i>Santapaua madurensis</i> Balak. ex Subr.	Acanthaceae
<i>Seshagiria sahyadrica</i> Ansari & Hemadri	Asclepiadaceae
<i>Silentvaleyia nairii</i> Nair & Bhargavan	Poaceae
<i>Solenocarpus indica</i> Wight & Arn.	Anacardiaceae
<i>Trilobanche cookie</i> (Stapf) Sch. ex Henr.	Poaceae
<i>Triplopogon romasissimus</i> (Hack.) Bor	Poaceae

DIVERSITY OF AQUATIC AND MARSH PLANTS

The aquatic and marsh vegetation of India is quite rich and diverse. Approximately the world's half of the aquatic plants occur in Indian region and again more than 50% of the total aquatic flora of India occur in Western Ghat region. There are 10 dicotyledonous and 11 monocotyledonous purely aquatic families. Podostemaceae, Hydrocharitaceae are some of the dominant families. A number of aquatic plants are also endemic, of which Podostemaceae with about 20 species tops the list (Nagendran & Arekal, 1981). There are various forms of aquatic plants in Western Ghats like **Free floating forms** (*Eichhornia crassipes*, *Pistia stratiotes*, *Spirodela polyrrhiza*, *Lemna* spp., and Pteridophytes like *Azolla pinnata*, *Salvinia* spp., and some algal members), **Rooted aquatics with their foliage floating** (*Nelumbo nucifera*, *Nymphaea nouchalii*, *Nymphoides indica*), **Submerged aquatics** (*Vallisneria spiralis*, *Ottelia alismoides*, *Nechamandra alternifolia*, *Hydrilla verticillata*, *Najas graminea*, *Limnophila indica*, *Potamogeton pectinatus* and *Ceratophyllum demersum*) **Emergent hydrophytes** (*Scirpus maritimus*, *S. articulatus*, *Elaeocharis palustris*, *Phragmites karka*, *Sacciolepis interrupta*, *Lymnophyton obtusifolium*, *Monochoria vaginalis*, *Sagittaria* spp., *Butomos umbellatus*, *Rorippa nasturtium-aquaticum* and a few more). In addition to the pure aquatic plant species, there are diverse varieties of marsh or wetland plants, which are too numerous to list.

BIOPROSPECTION AND HUMAN WELFARE

The bio resources of Western Ghats are quite rich. Almost all groups of economically significant plants grow here which include numerous life saving drug plants, nutraceuticals, life support species, wild aromatic species, ornamental species, metal tolerant species, wild genetic resources and so on. While many species await discoveries, the flora is getting depleted in an alarming rate. Therefore, not just conservation of these bio-resources in the region but also their sustainable utilization for human welfare is the priority agenda. Today, with advancements in molecular biology and biotechnology, Bioprospection of the flora for better genes, better molecules, better medicinal plants has become easier and faster. But this involves the active collaboration of field botanists, taxonomists, ecologists, molecular biologists and biotechnologists, which unfortunately almost non-existent in India. The prospects for Bioprospection on Western Ghat flora is quite high. The enormous floristic diversity, enormous habitat variation resulting in vast infra-specific variation, chemo-prospecting in wild aromatic plants, wild food plants, Bioprospection of flora for better genotypes in bio-fuel plants (*Jatropha*, *Caralluma*, *Pongamia*, *Boswellia* and many others. Bioprospection of the flora for metal tolerant genes for environmental bioremediation - in members of Caryophyllaceae, Ceratophyllaceae, Portulacaceae, Tamaricaceae, Salvadoraceae, Thymeleaceae and Fabaceae are certain challenging areas. Added to this, there are excellent taxonomists (who can scan the entire biodiversity and short list species for Bioprospection), and biotechnologists with excellent laboratory facilities in the country. What is needed is the actual collaboration and joint programmes on Bioprospection so that product development at global level (based on wild flora of Western Ghats) becomes a reality for the ultimate human welfare.

Bioprospection in medicinal and aromatic plants

Western Ghats, as an emporium of several wild aromatic plant species with an enormous diversity in them offers an immense scope for Bioprospection, particularly chemo-prospecting in wild aromatic plants. Some short listed aromatic species like *Acronychia pedunculata*, *Chloroxylon swietenia*, *Cymbopogon flexuosus*, *Blumea lanceolaria*, *Artemisia nilagirica* var. *nilagirica*, *Ocimum gratissimum*, *Curcuma pseudomontana*, *Clausena dentata* and *Limonia acidissima* have already shown prospects for their development and popularization in the region. Although the quality and quantity of the required compounds is not satisfactory, the existing diversity can be used to improve and develop these crops. Molecular biologists, Biotechnologists and Geneticists can also play a lead role in genetic improvement of some of these short listed species. There is also an urgent need for bioprospection of

medicinal flora of Western Ghats, particularly tree flora which to some extent are neglected. There are ca.490 arborescent medicinal taxa in Western Ghats of which 308 (62.8%) are endemic and medicinally important for various diseases from cancer to rheumatism. Intensive phytochemical screening are essential for identifying active compounds from all populations within a taxa as tropical trees are well known for their variability. *Nothapodites foetida* (Icacaceae) – an evergreen tree of Western Ghats is found to contain camptothecine, an antileukaemia and antitumoral compound. Camptothecine (0.005%) was earlier found only in *Camptotheca acuminata* (Nyssaceae) occurring in China, whereas the species from Western Ghats contains 0.1%, promising for treatment of cancer. Ethnopharmacological studies are also required for fully understanding their therapeutic value.

MAJOR THREATS AND CONSERVATION OF DIVERSITY

The Western Ghats being on the threshold of development and with increased population pressure has already lost much of its prime forests and unique habitats. The whole area has already been listed as one of the world's 'hottest hotspot' areas (Myers, 1988, Myers et al., 2000). There are several threats operating in the region, which have not only destroyed many unique habitats of flora but also favoring the spread of many invasive, alien species, which are further deteriorating the plant wealth of the region. In brief, ever increasing population growth, selective removal of specific groups of plants, extensive practice of shifting agriculture by local people, extension of townships , road construction on Hills creating accessibility of remote areas, degradation and fragmentation of forests for various plantation crops such as coffee, fruits, vegetables, spices (Pepper, cardomum, nutmeg, areca nut, etc.), 'modernisation' leading to change of llife style and cultural values of local tribals, free access and unregulated exploitation of bioresources in the region, tourists influx and their greed for collection of specific groups of ornamental plants (orchids, begonias, *Impatiens* spp., etc.), dependence of plant based industries solely on wild resources of biodiversity, wrong policies of the government that allow unregulated export of timber, bamboos and other forest products impoverishing the biodiversity sink of the region, unplanned economic upliftment of the people, spread of certain alien invasive weeds such as *Eupatorium*, *Mikania*, *Parthenium* and others endangering the native flora are some noticeable threats in Western Ghats. Nearly 40 % of natural forest vegetation in Western Ghats has disappeared during the past 8-10 decades (Menon & Bawa, 1997).Already the low elevation evergreen forests dominated by *Dipterocarpus* spp. have become

the most threatened community. (Pascal, 1982; Ramesh et. Al., 1997). Similarly, the other low elevation species like *Buchanania barberi*, *Cynometra beddomei*, *Dialium travancoricum*, *Hopea Jacobi*, *Inga cynometroides*, *Syzygium chavaran*, *Buchanania lanceolata* have almost reached the stage of extinction. As a consequence of the deforestation, many groups of plants (ornamental plants, medicinal plants(table 10), biologically interesting plants, aromatic species) have already become critically endangered or even presumed to be extinct (Table -11) and several species have not been recollected after their Types (Table-12) and are also facing the threat of extinction. Aromatic plant species like *Pogostemon nilagiricus*, *P. travancoricus*, *P. wightii*, *Plectranthus nilgherricus*, *P. wightii*, *P. walkeri*, *Moonia heterophylla*, *Ocimum adscendens*, *Cinnamomum travancoricum* and *C. wightii*, which were at one time abundant on the hill slopes have now become scarce. Further, Infestation of alien weeds like *Parthenium hysterophorus*, *Mikania micrantha*, *Eupatorium odoratum*, *Mimosa invisa*, etc., have taken a heavy toll of native and naturalized species (Table -9). In fact, Invasive alien species are considered as the second major threat to native flora only after habitat destruction. Extinction of local populations due to spread of alien weeds was recognized as early as 1872 by Darwin. Invasive aliens severely compete with native flora for space, light, nutrients and water. The density and competitive ability of weeds and native species play a crucial role in the outcome of competition between them. Although clear cut assessments on biodiversity erosion in native taxa are not available, the very presence of these invasive species over extensive areas, indicates the elimination of diversity in native flora. Again, although clear cut species extinctions are not observed, fragmentation of native species/populations has pushed many native herbaceous species on road to extinction. Loss of species due to invasive weeds from an area can attract the attention of botanists but loss of genetic variability (due to population extinction) goes unnoticed, which is the case in many native flora. Assessment of such fragmented species in different biogeographic zones including Western Ghats is a challenging but priority agenda. Erosion of diversity has been observed in several taxa (Table -9) since the introduction of *Parthenium* in south India , at a time when Flora of Mysore district was just published (Rao & Razi, 1981). Therefore, it is an urgent task to initiate collaborative programmes aiming at conservation of the rich flora of Western Ghats. While *in situ* conservation of these species is partly taken care of by the establishment of several protected areas like the Nilgiris Biosphere Reserve, Agasthyamalai Biosphere Reserve, Kalakad-Mundandurai Tiger Reserve, Indra Gandhi National Park, Silent Valley National Park, Bandipur National Park, Kudremukha National Park, Nagarahole National Park, Giant Squirrel Wildlife Sanctuary, Idukki Wildlife Sanctuary, Eravikulam Wildlife Sanctuary,

Wayanad Wildlife Sanctuary, Periyar Wildlife Sanctuary, Parimbikulam Wildlife Sanctuary, Shendurney Wildlife Sanctuary, Peppara Wildlife Sanctuary, etc., many species outside the reserve do not find a place in any *in situ* programmes. Even within the protected Biosphere Reserve areas there is always a severe threat by the invasive weeds. Experience has shown that entry of even one single invasive species can eliminate hundreds of local species in just a short period of time. Therefore, regular monitoring of the population of these species is necessary. It is also advisable to identify certain pockets rich in aromatic species within the larger protected areas and give extra protection, so that these species are freely multiplied in nature.

Table -9: Distribution of native / naturalized species affected by invasive weeds

Species	Family
<i>Abutilon indicum</i>	Malvaceae
<i>Acalypha indica</i>	Euphorbiaceae
<i>Alternanthera echinata</i>	Amaranthaceae
<i>Alysicarpus vaginalis</i>	Papilionaceae
<i>Amaranthus spinosus</i>	Amaranthaceae
<i>Andrographis paniculata</i>	Acanthaceae
<i>Anisomeles indica</i>	Lamiaceae
<i>Asystasia dalzelliana</i>	Acanthaceae
<i>Boerhaavia diffusa</i>	Nyctaginaceae
<i>Cassia occidentalis</i>	Caesalpiaceae
<i>Chenopodium album</i>	Chenopodiaceae
<i>Indigofera cordifolia</i>	Papilionaceae
<i>Indigofera linifolia</i>	Papilionaceae
<i>Indigofera trita</i>	Papilionaceae
<i>Chenopodium ambrosioides</i>	Chenopodiaceae
<i>Cleome viscosa</i>	Capparidaceae

<i>Convolvulus arvensis</i>	Convolvulaceae
<i>Corchorus tridens</i>	Tiliaceae
<i>Crotalaria medicaginea</i>	Papilionaceae
<i>Croton bonplandianum</i>	Euphorbiaceae
<i>Cucumis callosus</i>	Cucurbitaceae
<i>Digera alternifolia</i>	Amaranthaceae
<i>Euphorbia hirta</i>	Euphorbiaceae
<i>Euphorbia orbiculata</i>	Euphorbiaceae
<i>Euphorbia prostrata</i>	Euphorbiaceae
<i>Evolvulus alsinoides</i>	Convolvulaceae
<i>Gomphrena serrata</i>	Amaranthaceae
<i>Hedyotis aspera</i>	Rubiaceae
<i>Hybanthus enneaspermus</i>	Violaceae
<i>Tribulus terrestris</i>	Zygophyllaceae
<i>Polycarpon prostratum</i>	Caryophyllaceae
<i>Polygala chinensis</i>	Polygalaceae
<i>Portulacca oleracea</i>	Portulacaceae
<i>Rungia repens</i>	Acanthaceae
<i>Scoparia dulcis</i>	Scrophulariaceae
<i>Solanum nigrum</i>	Solanaceae
<i>Tephrosia purpurea</i>	Papilionaceae
<i>Trianthema portulacastrum</i>	Aizoaceae
<i>Ipomoea muricata</i>	Convolvulaceae
<i>Mollugo cerviana</i>	Molluginaceae
<i>Physalis minima</i>	Solanaceae

<i>Polycarpaea corymbosa</i>	Caryophyllaceae
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Table 10: **Some Endemic and Endangered medicinal plant species of Western Ghats**

<i>Trichopus zeylanicus</i>	Trichopodaceae
<i>Utleria salicifolia</i>	Periplocaceae
<i>Janakia arayalpathra</i>	Periplocaceae
<i>Myristica malabarica</i>	Myristicaceae
<i>Adenia hondala</i>	Passifloraceae
<i>Artocarpus hirsutus</i>	Moraceae
<i>Cinnamomum travancoricum</i>	Lauraceae
<i>Cinnamomum wightii</i>	Lauraceae
<i>Piper barberi</i>	Piperaceae
<i>Vateria indica</i>	Dipterocarpaceae
<i>Ochreinauclea missionis</i>	Rubiaceae
<i>Syzygium travancoricum</i>	Myrtaceae

Table 11 : **Some extremely rare taxa of Western Ghats (presumed to be extinct ?)**

<i>Neuracanthus neesianus</i>	Acanthaceae	N. Arcot dist., Tamil Nadu
<i>Bunium nothum</i>	Apiaceae	Nilgiri hills; Sri Lanka
<i>Pimpinella pulneyensis</i>	Apiaceae	Kodaikanal Sholas, T.N

<i>Ceropegia maculata</i>	Asclepiadaceae	T. N; Kerala: Sri Lanka
<i>Oianthus deccanensis</i>	Asclepiadaceae	Chaturringhi hills, Pune, Maharashtra
<i>Vernonia recurva</i>	Asteraceae	Annamalai hills, T. Nadu
<i>Impatiens anaimudica</i>	Balsaminaceae	Anaimudi slopes, Idukki district, Kerala
l. <i>johnii</i>	Balsaminaceae	Kalar valley, Idukki dist., Kerala
<i>Ilex gardneriana</i>	Aquifoliaceae	Nilgiri hills
<i>Begonia canarana</i>	Begoniaceae	Western Ghats
<i>Salacia malabarica</i>	Elastraceae	Coorg, Karnataka & Travancore hills, Kerala
<i>Euonymus serratifolius</i>	Celastraceae	Annamalai & Nilgiri hills, T. N
<i>Dipcadi concanense</i>	Liliaceae	South India
<i>Urginea poyphylla</i>	Liliaceae	Deccan peninsula
<i>Abutilon ranadei</i>	Malvaceae	Ambaghat, Maharashtra
<i>Eugenia argentea</i>	Myrtaceae	Wynad forest, Kerala
<i>E. singampattiana</i>	Myrtaceae	Tirunelveli dist., T. N
<i>Syzygium bourdillonii</i>	Myrtaceae	South India
<i>S. palaghatense</i>	Myrtaceae	Palaghat hills, Kerala
<i>Anoectochilus rotundifolius</i>	Orchidaceae	Madurai dist. T.N.
<i>Vanda wightii</i>	Orchidaceae	Nilgiris hills, T.N
<i>Eragrostis rottleri</i>	Poaceae	E. Coast of Tranquebar, S. India
<i>Eriochrysis rangacharii</i>	Poaceae	Paikara in Nilgiri district, T. Nadu
<i>Hedyotis hirsutissim</i>	Rubiaceae	Nilgiri dist. T.N

<i>Opercularia ocolytantha</i>	Rubiaceae	Karnataka , Kerala
<i>Ophiorrhiza barnesii</i>	Rubiaceae	Travancore, Kerala
<i>O. brunonis</i>	Rubiaceae	Hills of Kerala, T. N , Karnataka
<i>Ophiorrhiza radicans</i>	Rubiaceae	Kerala: Sri Lanka
<i>Pavetta oblanceolata</i>	Rubiaceae	Kerala
<i>P.wightii</i>	Rubiaceae	Nilgiri hills, Coonoor, T.N
<i>Wendlandia angustifolia</i>	Rubiaceae	Courtallum & Tirunelveli, T.N
<i>Madhuca bourdillonii</i>	Sapotaceae	Quilon dist., Kerala
<i>M. insignis</i>	Sapotaceae	Mangalore, Karnatka
<i>Carex christii</i>	Cyperaceae	Nilgiri hills, T. N
<i>Isoetes dixitii</i>	Isoetaceae	Maharashtra
<i>Isoetes sampathkumarnii</i>	Isoetaceae	Karnataka
<i>Plectranthus bishopianus</i>	Lamiaceae	Palni hills, T.N
<i>Ophiorrhiza caudata</i>	Rubiaceae	Kerala
<i>O.pykarensis</i>	Rubiaceae	Nilgiri hills

Table 12: **Some Western Ghats taxa not collected after their Types**

Species	Family	Locality
<i>Sageraea grandiflora</i>	Annonaceae	Quilon, Kerala 1894.
<i>Vernonia multibracteata</i>	"do"	Idduki, Kerala, 1880.

<i>V. recurva</i>	"do"	Annamalai hills, Tamil Nadu, 1957
<i>Eugenia singampattiana</i>	Myrtaceae	Tirunelveli, Tamil Nadu, 1864-74.
<i>Syzygium palghatense</i>	"do"	Palghat, Kerala
<i>Neuracanthus neesianus</i>	Acanthaceae	N.Arcot, Tamil Nadu, 1850.
<i>Nothopegia aureo-fulva</i>	Anacardiaceae	Tirunelveli hills, T. N
<i>Crotolaria fysonii</i>	Fabaceae	Palani hills, Madurai, 1899
<i>Actinodaphne bourneae</i>	Lauraceae	Pulneys, T.N., 1897
<i>Actinodaphne lanata</i>	"do"	Nilgiris , T. N. 1889
<i>Begonia anamalayana</i>	Begoniaceae	Anamalai hills, 1864
<i>B. canarana</i>	"do"	Mangalore, 1851
<i>Neanotis carnosa</i>	Rubiaceae	Kulhatti, Kadur, 1897
<i>Pavetta travancorica</i>	Rubiaceae	Courtallum hills
<i>Eugenia argentea</i>	Myrtaceae	Wynaad,1892
<i>Syzygium kanarensis</i>	"do"	N.Canara
<i>Memecylon sisparens</i>	Melastomataceae	Sispara
<i>Euonymus serratifolius</i>	Celastraceae	Wynaad,1864
<i>Salacia malabarica</i>	"do"	Travancore hills
<i>Ostodes integrifolius</i>	Euphorbiaceae	Wynaad
<i>Humboldtia bourdilloni</i>	Fabaceae	Kerala
<i>Dialium travancorium</i>	"do"	Ponmudi forest
<i>Phyllanthus megacarpa</i>	Euphorbiaceae	Nilgiri hills
<i>Syzygium courtallense</i>	Myrtaceae	Courtallum hills
<i>Wendlandia angustifolia</i>	Rubiaceae	Courtallum hills

<i>Abutilon ransdei</i>	Malvaceae	Ratnagiri,
<i>Achyranthus coynei</i>	Amaranthaceae	Khandala
<i>Barleria gibsonioides</i>	Acanthaceae	Maharashtra
<i>B. sepalosa</i>	“do”	Concan
<i>Caralluma truncato-coronata</i>	Asclepiadaceae	N. Canara
<i>Cryptocoryne cognata</i>	Araceae	Concan
<i>Cynoglossum ritchiei</i>	Boraginaceae	Belgaum
<i>Dysophylla stocksii</i>	Lamiaceae	Concan
<i>Leea talbotii</i>	Leeaceae	Yellapur & Karwar
<i>Neanotis ritchiei</i>	Rubiaceae	Belgaum
<i>Maba micrantha</i>	Ebenaceae	Western Ghats
<i>Viscum mysorensense</i>	Loranthaceae	Arasikere (Karnataka)

Conservation of such species which are not covered by protected areas under *ex-situ* conditions, in botanical gardens and other germplasm preservation centers is another aspect that is strongly recommended. The institutes like Central Institute of Medicinal and Aromatic Plants, Lucknow, which primarily deals with medicinal and aromatic plants has already several collections of medicinal and aromatic species in their gene bank. The collections should be further strengthened. The author at CIMAP Resource Centre at Bangalore initiated a programme of introduction, evaluation and multiplication of as many medicinal and aromatic species of Western Ghats as possible. So far, 70 species are being grown and conserved in the conservatory. While *ex-situ* conservation helps in conservation of the selected rare and endangered species, such centers also provide for the study of their chemistry, reproductive biology, their agro technology and even multiplication. Constant supply of required quantity of material for evaluation of medicinal and aromatic plants is also assured through such germplasm conservation. The pharmaceutical industries and others dealing with the large scale use of medicinal and aromatic plants must also come forward to identify the locally available such species, introduce them in their collection centers and multiply them so that these are not only conserved, but

also help in identifying the elite populations for further investigations and adopting them as future aromatic crops.

India's efforts towards conservation of biodiversity is also praiseworthy. Among the several steps taken for conservation of the biodiversity, the following are important (a) India is a signatory to all International conventions on biodiversity (b) Biological diversity Bill (2000) and National and State Biodiversity Boards for all states established (c) Forty seven plant species from India are included in CITES and Scientific and Management Authorities designated (d) Under Man and Biosphere Reserve programme 15 Biosphere Reserves declared (e) Prepared project documents for all Biosphere Reserves (f) Eighty nine National Parks, 496 Wildlife Sanctuaries, 27 Tiger Reserves, 25 Ramsar Sites, 17 Wetlands areas, 15 Mangrove areas, 6 World Heritage Sites and 4 Coral Reef areas declared (g) Establishment of National Gene banks at different places (h) Publications of Red Data Books by the Botanical Survey of India under the Ministry of Environment and Forests (i) Funding research programmes through DBT, DST and Ministry of Environment and Forests aiming at conservation of rare species and their habitat recovery (j) Financial support for establishment of Botanic Gardens and *ex situ* conservatories for rare and endangered species by Ministry of Environment and Forests. Recently efforts are also on to declare the whole of Western Ghats as a World heritage site. As many as 39 sites scattered in States of Karnataka, Kerala and Tamil Nadu in the Western Ghats are in the UNESCO list of natural world heritage sites and the author hopes that the tag of world heritage site attached to these hills certainly helps in *in situ* conservation of the flora and fauna of the region.

SOME URGENT TASK FOR FUTURE

Studies on assessment of the floristic diversity in the country are still incomplete. It is said that nearly 30% of the country still remains under explored. There is an urgent need to systematically survey and document all the economically important species in the wild for future bioprospection work. Taxonomists and Ecologists should take up studies on assessment of infra specific variations in wild species and develop databases. Bioprospection of the medicinal and aromatic species involving Taxonomists, Ecologists, Phytochemists, Molecular biologists, Geneticists, Plant Breeders is also strongly recommended. As the flora is fast dwindling due to several anthropogenic factors, priority must be attached to the study of all wild flora. As a first step in this direction, it is necessary to establish a chain of conservatories of wild plants, particularly of rare, endangered, endemic and other economically important species. The author strongly urges to develop coordinated programmes on all

major groups for stock taking and identifying gaps, avoiding duplication of efforts, develop expertise for all groups through training programmes, strengthen biodiversity collection centers (herbaria), identify areas needing further exploration and attempt once for all following co-ordinated multidisciplinary programmes, attempt assessment of infra-specific diversity in at least few economically important species, develop consolidated National Biodiversity database and distribution maps for all species under central supervision with networking of information among different regional centers. However, the constraints in this direction are also too many, such as, lack of much required cooperation between Taxonomists and Phytochemists, biotechnologists; dearth of required number of good taxonomists / field botanists, vast array of flora with enormous infra-specific variation in taxa spread over vast extension of the geographical boundaries of Western Ghats, incomplete knowledge of our flora and huge cost involved in bioprospection work, etc. are some constraints. Serious and meaningful efforts should be initiated to overcome these constraints. Complete inventorization of flora (including infra specific diversity), training and generation of devoted field botanists and taxonomists, close interaction of taxonomists with phytochemists, biotechnologists for successful bioprospection programmes are certain priority agenda suggested with regard to the development of wild plant resources of Western Ghats.

CONCLUDING REMARKS

Western Ghats region is very rich in biological resources, which have not been satisfactorily documented and utilized. The opportunities for inventorization and bioprospection of our flora though limitless, several constraints like lack of trained field botanists/ ethno-botanists, lack of much needed cooperation between field botanists and biotechnologists, apathy towards field oriented studies have become the limiting factors. There is an urgent need to generate adequate number of taxonomists and field botanists who have become endangered. The limited number of existing agriculture crops may not sustain the ever increasing population in the coming decades and therefore search for alternate/additional crops is a must. Documentation of all life support species and life saving species in different zones of the country and their utilization can certainly help in our fight against hunger and ailments in coming years. Therefore serious efforts are needed to initiate truly collaborative programmes involving taxonomists and biotechnologists for Bioprospection of our resources and product development. Conservation of our biological resources is another challenging task needing the attention of all biological scientists. The National Biodiversity strategy and Action Plan (Singh, 2002) rightly summarizes the course of action to be pursued for conservation of the rich flora of India. These

are outlined below which should also apply to the conservation of the rich floristic diversity of Western Ghats

- i. Strengthening and increasing the effectiveness of present Protected Areas
- ii. Survey, catalogue and study the threatened ecosystems and develop conservation strategies,
- iii. Identify and map large forest fragments and develop methodology for management of biodiversity
- iv. Identify, catalogue and study the hyper-diversity areas and develop strategies for their conservation
- v. Identify over exploited species and reduce anthropogenic pressure by cultivating them
- vi. Develop strategies that involve indigenous people and in benefit sharing
- vii. Develop regional and national biodiversity database
- viii. Incorporate biodiversity concerns in Environmental Impact Assessments and in Forest Working Plans
- ix. Identify and map grassland/savanna areas and develop management strategies
- x. Mount a multi-tier education system for public awareness. Lastly establishment of ex-situ conservatories and wilderness areas in every village, town, schools and colleges to accommodate the unique flora of Western Ghats is strongly advocated for which liberal government subsidies be made available.

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