TAXONOMIC AND ETHNOBOTANIC STUDIES OF ENDEMIC ANGIOSPERMS OF KERALA

THESIS SUBMITTED TO THE
UNIVERSITY OF CALICUT

IN PART-FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN BOTANY

BY
T SHAJU

SUPERVISING TEACHER
Prof. Dr. M. SIVADASAN

DEPARTMENT OF BOTANY
UNIVERSITY OF CALICUT
KERALA, INDIA

SEPTEMBER 2010

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KERALA, INDIA

SEPTEMBER 2010

Dedicated to my Teachers

Prof. N Ravi

and

Late Prof. (Dr) V V Sivarajan

who set the foundation on which
this piece of work is based

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SEPTEMBER 2010

DEPARTMENT OF BOTANY AND MICROBIOLOGY
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P. O. Box 2455, Riyadh - 11451, Kingdom of Saudi Arabia

Dr. M. Sivadasan
Professor

27.09.2010

CERTIFICATE

This is to certify that the thesis entitled **TAXONOMIC AND ETHNOBOTANIC STUDIES OF ENDEMIC ANGIOSPERMS OF KERALA** submitted by Mr. T. Shaju in part-fulfilment of the requirements for the degree of **Doctor of Philosophy** in Botany of the **University of Calicut** is a record of *bonafide* research work carried out by him during the period of his study under my supervision, and that the thesis has not previously formed the basis for award of any degree, diploma, associateship, fellowship or other similar titles or recognition.

Mr. T. Shaju has successfully completed the Qualifying examination prescribed by the University of Calicut as part of the Ph. D. programme.

(M. Sivadasan)

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DECLARATION

I hereby declare that the thesis entitled **TAXONOMIC AND ETHNOBOTANIC STUDIES OF ENDEMIC ANGIOSPERMS OF KERALA** submitted by me in part-fulfilment of the requirements for the degree of **Doctor of Philosophy** in Botany of the **University of Calicut** has not been submitted by me for the award of any other degree or diploma, and it represents the original work done by me.

Calicut University,
27. 09. 2010

(T Shaju)

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"Come forth into the Light of things,
Let Nature be your Teacher"

William Wordsworth

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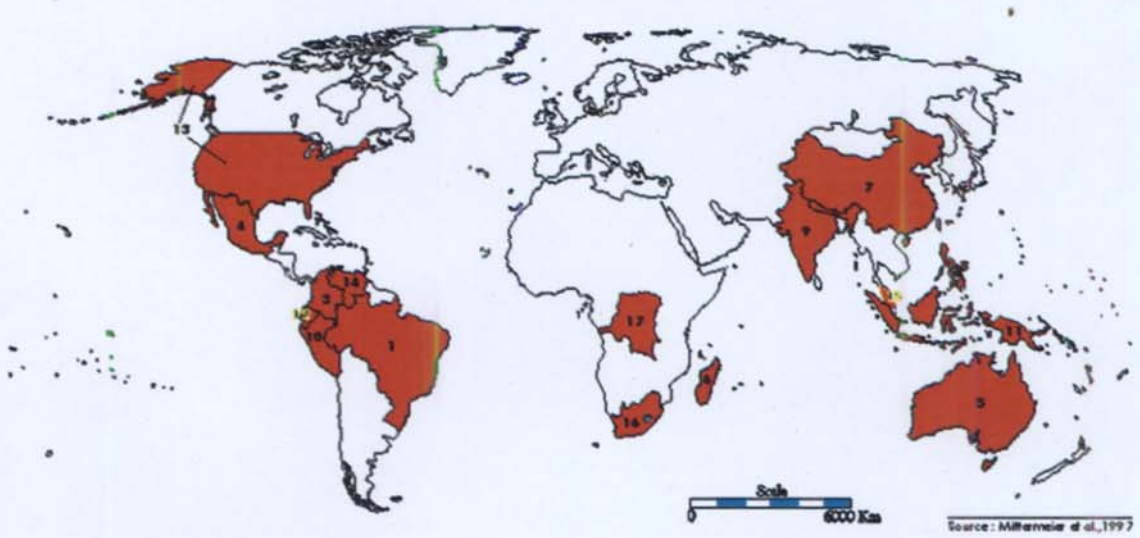

Fig. 1. 17 Megadiversity Centres of the World

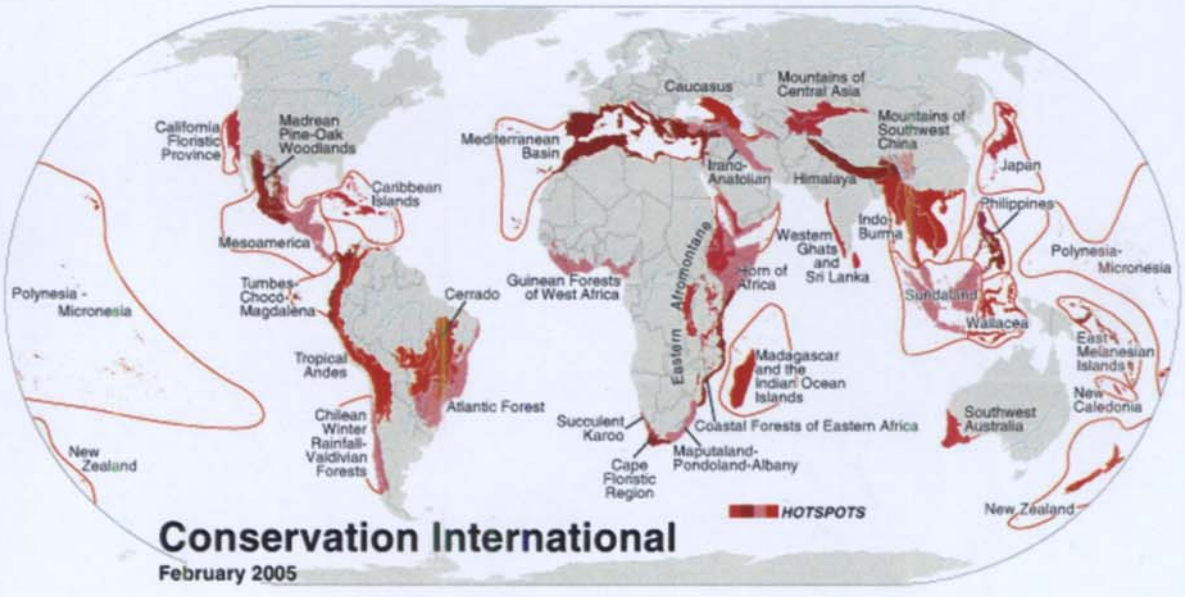

Fig. 2. 34 Biodiversity Hotspots of the World

1. INTRODUCTION

Endemics are found on all land masses of the world, both continents and islands, and in all major biomes. Most of the 'botanically interesting' areas of the world are relatively rich in endemic plants. Good (1974) stated that endemism, in the sense of restriction to a floristic province, accounts for more than 90% of the world plant species. Further, endemism manifests itself at various taxonomic levels from variety to higher categories. According to Braun-Blanquet (1923) the study and precise interpretation of endemism of a territory constitute the superior criterion, indispensable for the consideration of the origin and age of its plant population. It enables us better understanding of the past and the transformations that have taken place during the course of evolution. Besides, it provides us with a means for evaluating the extant and approximate timing of these transformations and the effects they produced on the development of the flora and vegetation.

Endemic species of a country once lost or became extinct, is a loss for ever for that country as biodiversity is a sovereign right of each nation as per the Convention on Biological Diversity (CDB) held in Rio de Jeneiro in June, 1992. Raven (1988) estimated that out of 1,80,000 species of tropical flowering plants, about 1,35,000 species have remained in patches of disturbed forests in the beginning of the Twentieth century and they would face extinction during the next 30 years unless remedial steps are taken. With the increasing awareness on the importance of bioresources, the biodiversity-rich countries realized the need for assessing and conserving their biodiversity and endemic wealth. The primary tool for conservation is derived from the analysis of basic taxonomic and phytogeographical data; it defines the centres of endemism and species diversity for conservation. On the basis of endemism and high species diversity, 34 'hotspot' areas were identified in the world, which support about 44% of the global endemics (Myers et al., 2000). The statistics on endemism may vary with more and more botanical explorations and increasing knowledge on distribution of species at the global level.

India is one among the 17 megabiodiversity nations of the world (Fig. 1; Table 1), showing a high degree of endemism [approximately 43%, i.e. 7,025-7,875 endemics out of > 17,000 of the total species (Mittermeier & Mittermeier, 1997)].

Table 1. Megadiversity Countries: Plant diversity and Endemism

No.	Country	Total species	Endemics
1	Brazil	~ 50,000–56,000	~ 16,500–18,500
2	Indonesia	~ 37,000	~ 14,800–18,500
3	Colombia	45,000–51,000	15,000–17,000
4	Mexico	18,000–30,000	10,000–15,000
5	Australia	15,638	14,458
6	Madagascar	11,000–12,000	8,800 – 6000
7	China	27,100–30,000	~ 10,000
8	Philippines	8000–12,000	3800 – 6000
9	India	> 17,000	7,025–7,875
10	Peru	18,000–20,000	5,356
11	Papua New Guinea	15,000–21,100	10,500–16,000
12	Ecuador	17,600–21,000	4,000 – 5,000
13	U S A	8,956	4,036
14	Venezuela	15,000–21,070	5,000 – 8,000
15	Malaysia	15,000	6,500 – 8,000
16	South Africa	23,420	16,500
17	Democratic Republic of Congo	11,000	3,000

Source: Mittermeier & Mittermeier, 1997

Among the 34 hotspot areas of the world (Fig. 2, Table 2), the one representing India, viz. Western Ghats/Sri Lanka, constitutes about 3049 endemic plants (1% of global plants, with a total of 300,000 species).

Table 2. The 34 Biodiversity Hotspots

No	Hotspots	Plants species		
		Occurrence	Endemic	Percentage
1	Tropical Andes	30000	15000	50
2	Tumbes-Choco-Magdalen	11000	2750	25
3	Atlantic Forest	20000	8000	40
4	Cerrado	10000	4400	44
5	Chilean Winter Rainfall-Valdivian Forests	3892	1957	50
6	Mesoamerica	17000	2941	17
7	Madrean Pine-oak Woodlands	5300	3975	75
8	Caribbean Islands	13000	6550	50
9	California Floristic Province	3488	2124	61
10	Guinean Forests of West Africa	9000	1800	20

No	Hotspots	Plants species		
		Occurrence	Endemic	Percentage
11	Cape floristic Region	9000	6210	69
12	Succulent Karoo	6356	2439	39
13	Maputaland-Pondoland-Albany	8100	1900	23
14	Coastal Forest of East Africa	4000	1750	44
15	Eastern Afromontane	7598	2356	31
16	Horn of Africa	5000	2750	55
17	Madagascar and the Indian Ocean Islands	13000	11600	89
18	Mediterranean Basin	22500	11700	52
19	Caucasus	6400	1600	25
20	Irano-Anatolian	6000	2500	42
21	Mountains of Central Asia	5500	1500	27
22	Western Ghats (India) / Sri Lanka	5916	3049	52
23	Himalaya	10000	3160	32
24	Mountains of Southwest China	12000	3500	29
25	Indo-Burma	13500	7000	52
26	Sundaland	25000	15000	60
27	Wallacea	10000	1500	15
28	Philippines	9253	6091	66
29	Japan	5600	1950	35
30	Southwest Australia	5571	2948	53
31	East Melanesian Islands	8000	3000	38
32	New Zealand	2300	1865	81
33	New Caledonia	3270	2432	74
34	Polynesia-Micronesia	5330	3074	58

Source: Hotspots Revisited, 2005

Peninsular Indian region has a high degree of endemism making it the second highest endemic centre after Himalayas (Turrill, 1964). Western Ghats of India, which is often compared to 'oceanic islands' in terms of its phytogeographical characteristics, is the abode of several endemic angiosperms, many of which are either economically potential or wild relatives of cultivars and other useful plants. Eventhough there is no authentic estimate of the endemics of the Western Ghats supported by field data, it is expected that out of 4000 taxa of angiosperms found in the region about 1932 species are endemics, which comes to about 48% of the total floristic elements of the region (Basha & Nair, 1991). Kerala with its rich and diverse monsoon flora, has a comparatively high representation of Western Ghats endemics, eventhough their exact number is yet to be ascertained authentically.

In spite of the varied nature of its forest and richness in plant diversity, very little attempt has ever been made to perform an in-depth study on the endemic diversity of Kerala State. Eventhough much work has been done on the endemics of the Western Ghats, Kerala which represents its richest region has not received the special attention it deserved. In the development of conservation oriented management strategies to protect and regenerate the endemic angiosperms of Kerala, data on their present availability in the State is an absolute necessity, particularly to facilitate their relocation. In this context, it is also essential to understand their distribution pattern within the State, their habitat preferences and population structure, and also ecological constraints rendering them to endemic category.

In the above background, the present study has been made that attempts to analyse the distribution patterns of endemic angiosperms in the political boundary of Kerala (political region endemism) with a view to identify centres of endemic concentration within the State. Earlier studies revealed that only about 8% of the Southern Western Ghats endemic taxa are strictly confined to the State. This view is far from reality. Many workers have concentrated their studies on endemism of highland forests, which resulted in the enumeration of a good number of strict endemic species from different ecosystems of the highlands (Sebastine and Vivekananthan, 1967; Shetty and Vivekananthan, 1968; 1969; 1970; 1971; 1976; 1978). Isolated patches of forest formations in the sacred groves of the midlands also possess some restricted endemic species, on which a few studies have focused (Gadgil and Vartak, 1976; Nair and Mohanan, 1981; Vartak, 1983; Induchoodan, 1988; Ramachandran and Mohanan, 1989; Induchoodan and Balasubramanyan, 1991). But lowlands (comprising of the coastal areas and wetlands) were least studied in endemic point of view. A comprehensive taxonomic study on the endemic angiosperms of Kerala has so far not been attempted, except for the discovery of a few species from specific localities or plant groups within the State. As per the available literature, Kerala is the natural habitat of about 120 taxa of palaeoendemic angiosperms belonging to 75 genera and 40 families (Nair & Basha, 1995) which in no way, reflects the overall endemic concentration in the State.

Political region of Kerala located in the tropical equatorial belt, is characterized by an unique synthesis of rich diversity within an area of 39,863 sq.km - 565 km long and 30-120 km broad - with a distinct physiographic demarcation into lowlands, midlands and highlands lying between the Arabian Sea in the west and the Western Ghats in the east. The highlands and a notable part of midlands house the most characteristic vegetation comprising of forest systems ranging from Tropical Wet Evergreen through Moist and Dry Deciduous forests and Grassland-Shola complexes. Isolated patches of forest formations in the sacred groves of midlands and relicts of mangrove vegetation found along the coastal belt of the lowlands speak of a glorious past; even now in such formations several endemics and other characteristic

species flourish. In general, Kerala manifests an epitome of biodiversity of the Western Ghats in India. It is estimated that there are over 4681 species of flowering plants in Kerala, of which 35% taxa are endemic to the State and its adjacent regions (Nayar et al., 2006). It accounts for 22% of Indian endemics. The endemic flora in Kerala is a palaeotropic one, being a part of Peninsular India of Gondwanaland origin. In fact, the State houses the rich assemblage of endemic species compared to the relic endemic flora of the Deccan plateau or Eastern Ghats. Eventhough there is no authentic estimate on the exact number of endemic angiosperm taxa in Kerala – which is also practically difficult because of the distribution patterns of such species often extending to adjoining parts of the Western Ghats in Tamilnadu and Karnataka - with the available data (Nair & Basha, 1995) enlisted 120 taxa of flowering plants as species confined to the State of Kerala in their natural habitats. This estimate is much on the lower side, mainly because those 'neoendemics' from Kerala were left out in that list, as their taxonomic status and distribution patterns are yet to be ascertained. An attempt has also been made in the present work to study and document ethnobotanical information possessed by various tribes of Kerala on the use endemic species in food, medicine, insect control and in other areas of their interest

While the above forms the backdrop, the specific objectives of the present study were as follows:

- To analyse and document the endemic flowering plants of Kerala (political region), with emphasis on their distribution pattern and status.

- To conduct extensive taxonomic survey in the priority areas of endemism forming habitats of the existing and supposed to be extinct endemic taxa (as per the records), and the least studied ecosystems of the State other than the priority areas.

- To prepare District-wise distribution map of exclusive endemic species of the State, with a view to demarcate the zones of endemic concentration (old and new endemic belts) and identification of possible areas of active speciation.

- To enumerate the exclusive endemics as per IUCN categorization and the species those are yet to be assessed.

- To identify areas of high endemism and centres of speciation those have long been targeted, and recognize new endemic centres for further studies.

- To document ethnobotanic information on the use of endemic species in food, medicine,

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2. REVIEW OF LITERATURE

2.1. Endemism and its importance

Endemism denotes confinement of a plant or animal species of a certain genus or family to a restricted area which may range from a small habitat to a biogeographical region, usually isolated by geographical or temporal barriers. Such species are known as endemic species as against those which are widely distributed called cosmopolitan or wide. The botanical value of a country's flora depends on the concentration of its endemic components. The distribution of endemic floristic elements of a country throws light on the biogeography of the region, centers of speciation, areas of extinction, vicariance and adaptive evolution of the flora occurring in that country. The study on endemism provides an insight in to the centres of diversity and highlights the indigenous nature of its biological diversity and it also provides important clues to the pattern of distribution and process of speciation.

The concept of endemism was introduced by A. de Candolle (1855). Engler (1882) recognized two types of endemism: one based on preservation of ancient forms, which might have originated in entirely different regions, and the other based on the development of entirely new forms. The first forms are called paleoendemics and the other known as autochthonous or neoendemics.

Palaeoendemic species represent ancient taxonomic lineage with their restricted distribution in specialized habitats which are themselves a result of the past geological events. This antiquity can be judged by its phylogenetic sequences, taxonomic isolation, habitat structure and past fossil history. Some times such taxa occur in disjunct areas due to loss of intermediate link by environmental or geological causes. These ancient endemics or palaeoendemics (Chevalier & Guenot, 1925) are also known as evolutionary relicts (Drude, 1890; Herzog, 1926) and conservative endemics (Diels, 1909). The main characteristics of palaeoendemics are that these species are usually woody, taxonomically isolated, having no closely related species, with a high ploidy level, and may show disjunction in their distribution or may have possible fossil evidence provided by homologous taxa or congeners of living taxa (Bramwell, 1972). Due to the phenomenon of vicariance and adaptive radiation, some of these

palaeoendemics appear as an evolving group of species and are called active epibiotics (Wulff, 1950).

Neoendemics species are newly evolved endemic species of relatively recent origin from an actively evolving genetic stock occurring in a particular ecotone. They develop in different ecological niches or habitats through geographic speciation, quantum speciation, and sympatric speciation. They will have closely related taxa occurring in the same area. Polyploidy is a common feature, which is stronger in herbaceous perennials (Stebbins, 1938). Neoendemics generally have herbaceous and shrubby forms and they occur in the areas that are prone to climatic and environmental stresses. They develop due to mutation, chromosomal re-arrangements, polyploidy, adaptive radiation and vicariance in a new environment having climatic and edaphic stresses. These progressive endemics (Diels, 1909) or neoendemics (Herzog, 1926; Braun-Blanquet, 1923; Chevalier & Guenot, 1925) are also termed autochthonous endemics (Engler, 1882) or secondary endemics (Drude, 1890).

The evolutionary history of all endemics starts as neoendemic and ends up as palaeoendemic (Richardson, 1978). However, it is generally considered that neoendemics in favorable environmental conditions tend to behave as holoendemics, which is an intermediate stage between neoendemics and palaeoendemics. The different steps involved in the process are: origin, expansion, stabilization, diversification, migration, fragmentation, contraction and ultimately extinction (Fig. 3). There is no time scale for this evolutionary pathway that the taxa pass along at different rates, and a holoendemic could only be one step removed from the ancestor of the group (i.e., in having a few advanced or derived characters), while a contemporaneous relict would be many steps removed, with numerous such characters (Richardson, 1978).

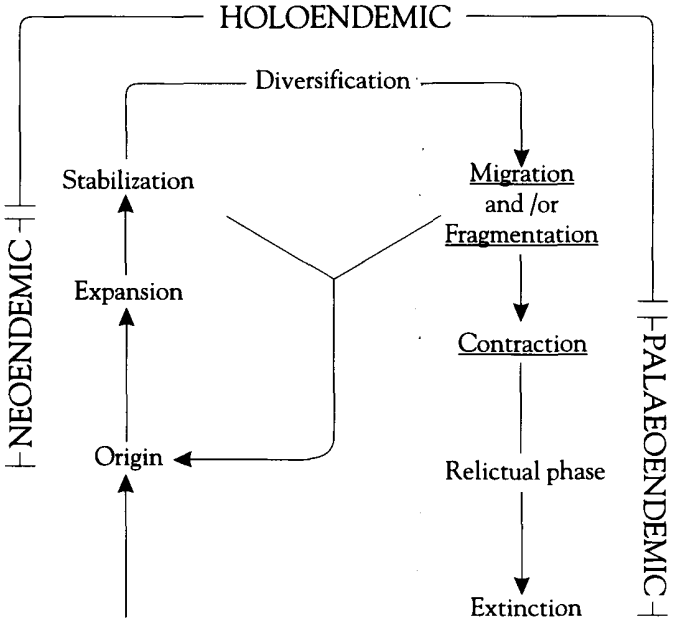

Fig. 3. The evolution of taxa of monophyletic assemblage, showing changes in geographical area (underlined) and endemic status. (reproduced from Richardson, 1978)

However, based on cytological studies, Favarger and Contandriopoulos (1962) proposed a new scheme with the recognition of the following four categories of endemics:

- Palaeoendemics: these are taxonomically isolated, which show no variation and occur in isolated areas. They show high level of ploidy, whose diploid ancestors are either extinct or unknown.

- Schizoendemics: these are produced as a result of gradual speciation having common origin but occur in isolation in different ecological niches.

- Apoendemics: these are polyploids which are usually of hybrid origin arising from widely distributed diploids.

- Patroendemics: these are restricted diploids which give rise to polyploids.

Here schizo-, apo- and patro-endemics are further subdivisions of Engler's (1882) neoendemics. In general, the phylogenetic methods, which consider the distribution of characters among taxa in a cladistic context, provide a more rigorous basis for assessing the age and affinities of endemism. In this context, low-ranking taxa correspond to neoendemics and high ranking taxa to palaeoendemics.

Endemism occurs at different scales and may arise from many different causes. On a world-wide scale, taxa may be 'endemic' to a continent or subcontinent; at the opposite extreme, many plant species appear to be naturally restricted to areas as small as few square kilometres. Depending on the range of occurrence, the endemic species may be grouped in to the following categories (Cowling, 2001).

- Point endemism: Species restricted to a small habitat range size (– < 5 km^2) are regarded as point endemics. For example, *Amorphophallus bonaccordensis* Sivad. & N. Mohanan (Araceae) is restricted to Agasthyamala hotspot area in Kerala. Similarly, *Polyalthia shendurunii* Basha & Sasidh. (Annonaceae) is found only at Shenduruni forest area in Kerala.

- Biotope endemism: It is also called geographic endemism. In this category the endemic species are found in particular geographic regions such as mountain ranges, islands, lakes, etc. For example, *Nepenthes khasiana* Hook.f. (Nepanthaceae) is restricted to the Khasi Hills in Meghalaya, and Crotalaria conferta Fyson (Fabaceae) is found in Palani Hills, Tamil Nadu.

- Biogeographic region endemism: Taxa which are endemic to broader regions encompassing a broad range of habitats with common bio-climatic characteristics;

example, *Syzygium palghatense* Gamble (Myrtaceae) found in Western Ghats, *Ziziphus horrida* Roth. (Rhamnaceae) found in Estern Ghats and Western Ghats.

- Political area endemism: These endemics occur in the political boundary of a country, provinces or administrative units. For example, distribution of *Kunstleria keralensis* C. N. Mohanan & N. C. Nair (Fabaceae), *Pothos keralensis* Pandurangan & V. J. Nair (Araceae) and *Bulbophyllum keralensis* M. Kumar & S. Seq., (Orchidaceae) are restricted to the State of Kerala.

- Regional endemism: These endemics are restricted to a very large phytogeographical region, subcontinent, etc., encompassing more than one country. For example, Saraca asoca (Roxb.) De Wilde (Fabaceae) is found in India and Sri Lanka.

2.2. Concepts on endemism

Biologists have recognized the existence of rare and endemic species for centuries. A. de Candolle (1855) used the concept of endemic area which he defined as an area of a taxonomic unit which has a restricted distribution or habitat, isolated from its surrounding regions through geographical or temporal barriers. These isolated areas provide favourable conditions for the preservation of the endemic taxa. The great exploration from the seventeenth through the nineteenth centuries brought into light numerous rare and endemic taxa. Though Linnaeus's Species Plantarum (1753) lists no rarities or endemics for North America, his South African list of Proteaceae contained local endemics, Protea and Leucadendron.

Engler (1882) appears to be the originator of the endemic dichotomy of old vs. new endemism, which has been used extensively by other plant geographers. There are many theoretical considerations put forward by many authors to classify endemics into various types. Ridley (1930) proposed the term 'epibiotic' which denotes the end of a species life. They do not spread, but represent the remains of a flora which has long been disappeared. They persist only in isolated spots, which for some reason have not been overturned by the later invading flora, but still are unable to spread any further. They are usually not provided with sufficient means for dispersal to cross the barrier of the modern flora and to reach another suitable place for their growth. This view was supported by suitable evidences, among which the existence of giant living gymnosperms in California (*Sequoia sempervirens* and *S. giganteum*) is noteworthy. *Sequoia sempervirens*, once broadly distributed throughout western North America, from Alaska to southern California and the Rocky Mountains, is now restricted to coastal California. The highly restricted big tree, S. giganteum, now found in

isolated groves in California's Sierra Nevada, was once more extensive in California floristic Province and Nevada.

Willis (1922) in his 'Age and Area' hypothesis, assumed that the area occupied by a species depends primarily upon its age (the older the species, the wider its range) and that 'dying out' of species occur very rarely. According to him most endemic species are young rather than old relics. This theory maintains that the frequency of a species over an area is directly proportional to its age in the scale of evolution. Consequently a small area of distribution of a species indicates its relatively young age, while a large area means its comparative advancement in age. Though he draws supports to this view with striking evidences, this theory became controversial and largely discredited.

Gleason (1922) pointed out that this hypothesis falsely assumes that all species migrate at the same rate. Fernald (1924) proposed the theory of 'Relictual Endemism' suggesting that narrow endemics are old taxa which had once been more widespread. He held that as taxon gets older, it becomes senescent and loses its competitive ability. Griggs (1940) also related rarity in plants to a lack of competitive ability. He described rare species as those which cannot compete more successfully with more common, widespread species and find their habitats in the early stage of succession. Stebbins (1942) agreed, but did not support the notion that rare species are restricted to pioneer habitats and are 'dying out'. Instead, he suggested a genetic explanation for the epibiotics or relictual endemics. Such taxa, he argued, have depleted their store of genetic variation, a process called biotype depletion, and thus they are unable to expand their ranges. Cain (1944) in his classic work on plant geography set forth the then prevailing notions on the kinds and origins of endemic species and proposed three dicta on endemic merit: (a) Endemism includes two types of plants that are confined to a single region - sensu stricto endemics, which are relatively youthful species, and epibiotics, which are relatively old relict species, (b) Youthful endemics may or may not have attained their complete areas by having migrated to their natural barriers. Epibiotics may, but frequently do not, contain the biotype richness that will allow or has allowed them an expansion of area, following their historical contraction of area, (c) A high degree of endemism usually correlates with age and isolation of an area, and with the diversification of the habitats, as these factors influence both evolution (the formation of new endemics) and survival (the protection of relic endemics). Lewis and Raven (1958) observed repeated extinction and recolonization events by closely related species. With their theory on 'Saltational Speciation' they proposed that if such events were repeated often enough, the result would be speciation and formation of highly endemic populations. Lewis (1972) further suggested that sudden, catastrophic alterations in climate could similarly drive selection and lead to the development of endemic species,

especially among the populations on the margin of a taxon's range.

Stebbins and Major (1965) recasted Cain's (1944) two categories as Palaeoendemism and Neoendemism. These authors point to persistent defects in the new vs. old endemic dichotomy. First, often little basis exists to judge whether an endemic taxon is new or old. On this point Cain has the last word: ". . . . the relic nature of an endemic should never be accepted without some form of positive evidence". Second, the mode of origin of either type of endemic taxon remains obscure.

Stebbins and Major (1965) based their classification upon the way in which narrow endemics have achieved their restricted distributions, since this varies among species; this system was also proposed by Favarger and Constandriopoulos (1962). Stebbins and Major's system incorporates the age of the endemic, its systematic position, and cytological data (Chromosome number and ploidal level). In group of related species diploids are older than derivative low polyploids, while both high polyploids are palaeoendemics. Endemics with more than one disjunct population are most likely relictual (palaeoendemics), while endemics confined to a single population can either be palaeoendemics or neoendemics.

Recent reviews agree that there are multiple causes for rarity and endemism (Drury, 1974, 1980; Raven & Axelrod, 1978; Stebbins, 1980). Neither genetics and ecology, nor history alone will suffice to explain the origin of endemic taxa. Moreover, the interplay among various causal factors will vary in intensity, depending on the particular taxon under scrutiny. Stebbins (1980) proposed the gene pool/niche interaction theory to explain origin of rarity and endemism. His notion was grounded on the assumption of multiple causation. According to this theory, "the primary cause of localized or endemic distribution pattern is an adaptation to a combination of ecological factors that are themselves localized. Factors of soil texture or chemical composition are the most common but by no means the only ones . . . . Next to climatic and edaphic factors, those inherent in the gene pool of the population are of critical importance. They include the total amount of variability, the amount of variability that can be released at any one time, and the amount of variation that can be generated with respect to those particular characteristics that affect most strongly the establishment of new populations".

Stebbins (1980) uses an abstraction to envision the interaction of these factors: "....the niche as a depression that is partly filled with a liquid, the gene pool. Variations in the size and steepness of the sides of the niche and the depth to which the liquid gene pool occupies the niche provide the variables that can lead to rarity". A deep pool in a niche with a precipitous rim would represent a species that is highly specialized, i.e. endemic.

2.3. Relevance of endemism in conservation

Human beings, in their quest for economic development and enjoyment of the riches of nature, must come to terms with the reality of the resource limitation and the carrying capacity of ecosystems, and must take account of the needs of future generations. This is the message of conservation. The Convention on Biological Diversity adopted at the UN Conference on Environment and Development (UNCED) at Rio de Janeiro in June 1992, is a clear index of the concern and commitment on the part of international community for the conservation and sustainable and equitable utilization of biodiversity of our planet. Hence it is the primary responsibility of the people and the state to protect their own endemic biological resources. Besides ethical considerations, saving a species and its ecosystems is a national gain. Some of the endemic species are of medicinal value or of ornamental importance or may be progenitors of cultivated plants. However, their habitats are constantly under pressure due to population explosion and concomitant rising demands. It is therefore necessary to understand and appreciate the future gains to the country through conserving and maintaining its endemic species.

The accelerating and potentially catastrophic loss of biotic diversity, unlike other environmental threats, is irreversible. Given the rapid loss of biodiversity and limited resources available to address environmental issues, we must set priority for our efforts to conserve biological resources. However, biodiversity by no means is evenly distributed; some areas are characterized by exceptional concentration of species with high level of endemism and are experiencing unusually rapid rates of depletion, forming 'hotspots'. Additionally, endemic plants by virtue of their more restricted ranges, are often among the most vulnerable components of any particular community (Balmford & Long, 1994). These restricted range species confined to highly threatened ecosystems will almost certainly be the first hit by extinction episodes (Pimm et al., 1995) and are most in need of rapid and effective conservation. Technically, hotspots are identified by two main criteria: first, plant endemism, and the second, degree of threat. Thus strong emphasis is placed on endemism as the criterion for survival, bringing in to play the "doctrine of ultimate responsibility" (McNeely et al., 1990).

Of the three different priority-setting approaches of Mittermeier et al. (1997), the two - biodiversity hotspots and major tropical wilderness areas - are discussed in some detail. A third approach, megadiversity countries, represents a country-based method intended mainly to better market biodiversity conservation in the world's top 17 countries for species diversity and endemism. All three of these approaches are based on five fundamental premises:

❖the biodiversity of each and every nation is critically important to that nation's survival and must be a fundamental component of any national and regional development strategy;

❖some areas simply harbour far greater concentration of biodiversity than others;

❖many high-biodiversity areas exhibit very high levels of endemism;

❖many high-biodiversity areas are under severe threat; and

❖to achieve maximum impact with limited resources, we must concentrate heavily (but not exclusively) on those areas highest in diversity and endemism and most severely threatened.

2.4. Endemism in global biodiversity centres

Centers of diversity have been recognized on global, regional and local scales. Centres selected at one scale, say national, may have little relevance to another, say global (Heywood, 1997). Global and regional centres of diversity are recognized not only by species richness, but also by some other measures of biodiversity, such as the number of different phylogenetic lineages, number of endemics, etc. On local scale, the large number of species alone identifies such centres. Only in recent years (following the letter and spirit of the Biodiversity Conservation) reliable analysis of centres of diversity covering all three geographical scales have been attempted (Williams & Humphries, 1994). On a global scale, four important analysis merit mentioning: (i) Myer's Hotspots, (ii) IUCN's Centers of Plant Diversity (CPDs), (iii) Mega-diversity Centres, and (iv) Diversity zones of Bartholott et al. (1996).

Myers (1988), in his analyses on biodiversity hotspots used plants as indicators for biodiversity and identified 10 tropical rain-forest hotspots containing an estimated 13% of all plant diversity in just 0.2% of the total land area of the planet. In subsequent analyses (1990), he added several other rain forest areas and four Mediterranean type ecosystems, resulting in a total of 18 hotspots that account for 20% of global plant diversity in just 0.5% of the land area. Further, in 1998 Mittermeier et al., identified 24 high priority terrestrial biodiversity hotspots. Compared to the earliest version of hotspot analysis; this analysis included wider variety of terrestrial biomes, with exclusively tropical rain forest system accounting for only 37.5% of the total. The remaining natural vegetation in these 24 hotspots covers only about 2% of the land surface of the planet, and yet has within them a phenomenal total of 124,035 plant species or 45.9% all plant diversity represented as endemics. As per a more recent effort (Myers et al.,

2000), a biodiversity hotspot region must harbour 1500 or more endemic species, which are found in that particular area but nowhere else, and must have lost at least 70% of its original habitat, primary vegetation. By matching these two criteria with global diversity distribution databases, they identified 25 hotspots comprising 44% of all plant species in only 1.4% of Earth's land area. IUCN has recognized around 234 Centers of Plant Diversity (CPDs) the world over, and classified them into three types: (i) botanically rich that can also be defined geographically (e.g., Mt. Kinabalu in Borneo), (ii) geographically defined areas with high species richness and endemism (e.g., the Atlas Mountains in North Africa and the Cordillera Betica in Spain), and (iii) vegetation types and floristic provinces that are exceptionally species-rich (e.g., Amazon rain forest, South Western Australia, and Atlantic forest of Brazil).

2.5. Endemic wealth of Indian subcontinent

Endemism usually occurs in areas that are isolated in someway. The diverse climatic and habitat conditions in India provide favourable conditions for speciation and endemism. This has facilitated the development of much varied vegetation types of the country and included in third group among the 17 megadiversity countries in the world. The reason for high endemism in India are high mountains in the north, preventing migration northward, large water mass of Arabian sea, Indian Ocean and Bay of Bengal around the southern region, extreme arid conditions on the west blocking westward migration and the most humid tropical conditions of Western Ghats and the North-eastern India, resulting in the evolution and speciation of endemic elements as in the case of oceanic islands. With respect to the recent analysis of plant diversity and endemism in mega-diversity countries (Myers et al., 2000), India harbors approximately > 17,000 species with an endemic content ranging from 7,025-7,858 species. The percentage of endemism (approximately 43%) in India is so high that it can be compared favourably with some of the oceanic islands. Owing to high endemism, floristic richness and threats by environmental factors, Western Ghats/Sri Lanka region is included in the list of so far identified 'Hotspots' in the world. Endemic plants of India largely belong to the three major geomorphological divisions: (i) The Himalayan endemics, (ii) Peninsular Indian endemics, (iii) Andaman & Nicobar Island endemics. Of the above mentioned categories, Peninsular Indian endemics and Andaman & Nicobar island endemics are distinct, and they occur within their geographical boundaries. Peninsular Indian regions have always been considered as an oceanic island in having conditions favourable for high degree of endemism (Turrill, 1964). The Western Ghats, called so because of the position they occupy in Peninsular India, protected by the Arabian sea along western side, Vindhyan and Satpura ranges on the northern side, semi-arid Decan Plateau on the eastern side and Indian ocean on the south, is like an oceanic island; thus thereby have very high degree of endemism. The

Himalayan endemic zone is a biogeogrphical entity with adjoining Palmir mountains, Tibetan and SW Chinese landmass. Western and Eastern Himalayas have high degree of endemism because the warm alluvial Indo-Gangetic regions and Brahmaputra basin on the south and arid and semi-arid regions on the south-west act as barriers to check the migration of species from the bordering and neighboring countries into the Himalayan regions and vice-versa. These regions are the primary centers of endemism in India. Again the endemic regions are subdivided into 25 microcentres of endemism (Nayar, 1996) (Fig. 4; Table 3,3a).

Table 3. Megacentres of Endemic Plants in India

No.	Name of Megacentre	Number of endemic species
1	Eastern Himalaya	1808
2	Western Ghats	1500
3	Western Himalaya	1195

Table 3a.

Microcentres of Endemic Plants in India

No.	Name of Microcentre
1	Andaman Group of Islands
2	Nicobar Group of Islands
3	Agasthyamalai hills
4	Anamalai & High ranges (Cardamom hills)
5	Palni Hills
6	Nilgiris-Silent Valley, Wayanad, Kodagu
7	Shimoga-Kanara
8	Mahabaleshwar-Khandala Ranges
9	Konkan-Raigad
10	Marathwada-Satpura Ranges
11	Tirupati-Cadappa-Nallamalai hills
12	Vizagapatanam-Ganjam-Jeypore hills
13	Southern Deccan (leeward side)
14	Chotanagpur plateau
15	Kathawar Kutch
16	Rajasthan-Aravalli hills
17	Khasia-Jaintia hills
18	Patkoi-Manipur-Lushai hills
19	Assam
20	Arunachal Pradesh Himalaya
21	Sikkim Himalaya
22	Garhwal-Kumoan Himalaya
23	Lahul-Himachal Predesh Himalaya
24	Kashmir-Ladak Himalaya
25	Nepal

Source: Nayar, 1996

In spite of the richness and great diversity of Indian flora, Hooker (1904) was of the opinion that the Indian flora was a mixture of floras of surrounding countries like Malaya, Tibet, China, Japan and Africa; Champion and Trevor (1938) also expressed the same view. According to Chatterjee (1939, 1962) who did pioneering work on the endemism in Indian flora, it is now a matter for the consideration whether all the flowering plants in India or their ancestors have come from surrounding countries as invaders or colonizers, or there existed an original flora which got mixed up and became partly masked due to invasion

of plants from other countries. The first view is untenable because of rate of invasion of plants must have been very slow due to effective barriers like high Himalayan ranges, dry desert, warm alluvial Indo-Gangetic plains and oceans (Chatterjee, 1962). Besides it is difficult to imagine that the fertile land of India with its highly varied climate and topography would remain absolutely barren of any vegetation, while at the same time the surrounding countries of more or less similar geological age and climate would hold rich and luxuriant vegetation. Chatterjee studied the Indian flora in great details with a view to ascertain its endemic status. He estimated 11,124 dicot species of flowering plants under 1831 genera and 173 families in Indian region, which included Pakistan, Nepal, Bhutan, Myanmar, present day Bangladesh and Sri Lanka. Out of this, he estimated that 6850 species were endemic to this region, representing 61% of the flowering plants. He estimated 3169 species of the dicots to be endemic to Himalayas, including North Bengal and 2045 species of dicot to be endemic to Peninsular India. He further estimated about 34 genera to be endemic to Peninsular India out of a total of 134 genera endemic to Indian region.

According to Nayar (1980a) there are 141 endemic genera in India. Acacthaceae and Poaceae have the highest representation of endemic genera (17 each); the genera *Plectranthus* and *Nligirianthus* have the highest number endemic species (20 each). Since Nayar's (1980b) publication, five endemic genera have been recorded additionally from India. About 114 endemic genera are monotypic. There are about 5725 endemic species, which represent 35% of Indian flora (1700 sp.). Sarkar (1995) estimated that there are 142 endemic genera with 246 species under 46 families in India. Later in his revised publication of 1996, Nayar estimated that there are 148 genera with 236 species exclusively endemic to India. According to the present estimates (Balakrishanan, 1996), pertaining to the political boundaries of present day India, there are more than 6100 species endemic to India out of a total of about 17500 flowering plants (more than 36%). These are largely concentrated in four principal biogeogrphic zones, viz. the North-West and West Himalayas (c. 800 species), Eastern Himalaya and North East India (c. 2500 species), Peninsular India (c. 2600 species) and Andaman & Nicobar Islands (more than 2000 species). Ahmedullah (2000) estimated that the Indian subcontinent represents 140 endemic genera, of which 66 genera are confined to the Himalaya region, 59 genera included in Peninsular India and the rest 15 genera are found in more than one phytogeographical area. A recent study (Mitra & Mukherjee, 2007) revealed that 121 genera are confined to India only, of which 56 genera are confined to Himalayan region, 42 genera confined to Peninsular India and 19 genera are restricted in more than one phytogeographic region, and 4 genera are confined to Andaman & Nicobar group of Islands.

Turrill's (1964) contention that next to islands, the peninsular regions provide

favourable condition for endemism is acceptable as far as Peninsular India is concerned. Peninsular Indian region has a high degree of endemism making it the second richest endemic centre after Himalayas. According to Major (1988) "the logarithm of number of plant species occurring in a series of areas of increasing size increases linearly with the logarithm of the area. Evidently, a similar relationship holds for the percentage of the endemism and area". It is considered that ecological variations in large areas on the borders of floristic provinces help in the development of endemism. As mentioned earlier, islands because of their insularity are ideal for studies on endemism; this principle applies to peninsular regions, which are isolated by physical, temporal, geographical or climatic factors.

The Peninsular India, bordered in the north by the Vindhyan range, is a triangular plateau. It is highest in the south and west, and sloping eastwards. It represents ancient table-land, bordered on the west and east by Western Ghats and Eastern Ghats respectively. It has a characteristic flora derived from the original Gondwanaland, which possess good representation of temperate Glossopteridian flora represented by the fossils occurring in the Indian landmass (Sahni, 1936). The intertrappean bed in Central India is of upper Cretaceous close to Eocene and in these strata there are fossil woods referable to some of the modern genera. It is interesting to evaluate the genera of fossils closely allied to modern genera, which have a large compliment of endemic species in Peninsular India. Due to tectonics, Deccan lava-flow and progressive desiccation, most of the characteristic Peninsular Indian flora became extinct as Indian plate moved northwards through different climatic regimes after its separation from the main Gondwanaland about 100 m Y.B.P. (Nayar, 1972). Some of the fossil genera are referable to modern genera with a number of endemic species occurring in Peninsular India. For example, the fossil wood *Homalioxylon* (Bande, 1974) is represented by modern genus *Homalium* (Flacourtiaceae); *H. travancoricum* is endemic to Southern Western Ghats. The fossil wood *Michelioxylon* (Bande, 1974) is represented by the modern genus *Michelia* (*M. nilgirica*). Endemic species *Elaeocarpus munroni* and *E. venustus* occur in Western Ghats and the fossil wood *Elaeocarpoxylon* (Prakash & Dayal, 1963) was collected from the intertrappean beds near Nagpur. The genus *Glochidion* has nine endemic species in Peninsular India and the fossil wood *Glochidioxylon* (Prakash, 1958; Lakhanpal, 1973) was collected from Madhya Pradesh.

Nayar (1997) estimated the presence of about 2100 endemic flowering plants in Peninsular India. Ahmedullah and Nayar (1987) have made extensive study on the endemic flora of Peninsular India. According to them there are 58 endemic genera in Peninsular India of which 47 are monotypic. There are 1932 taxa - 1788 species and 144 infraspecific taxa, endemic to this region. Out of these, 1384 endemic taxa belong to 96 families of dicot group and 548 taxa belong to 14 families of monocot group.

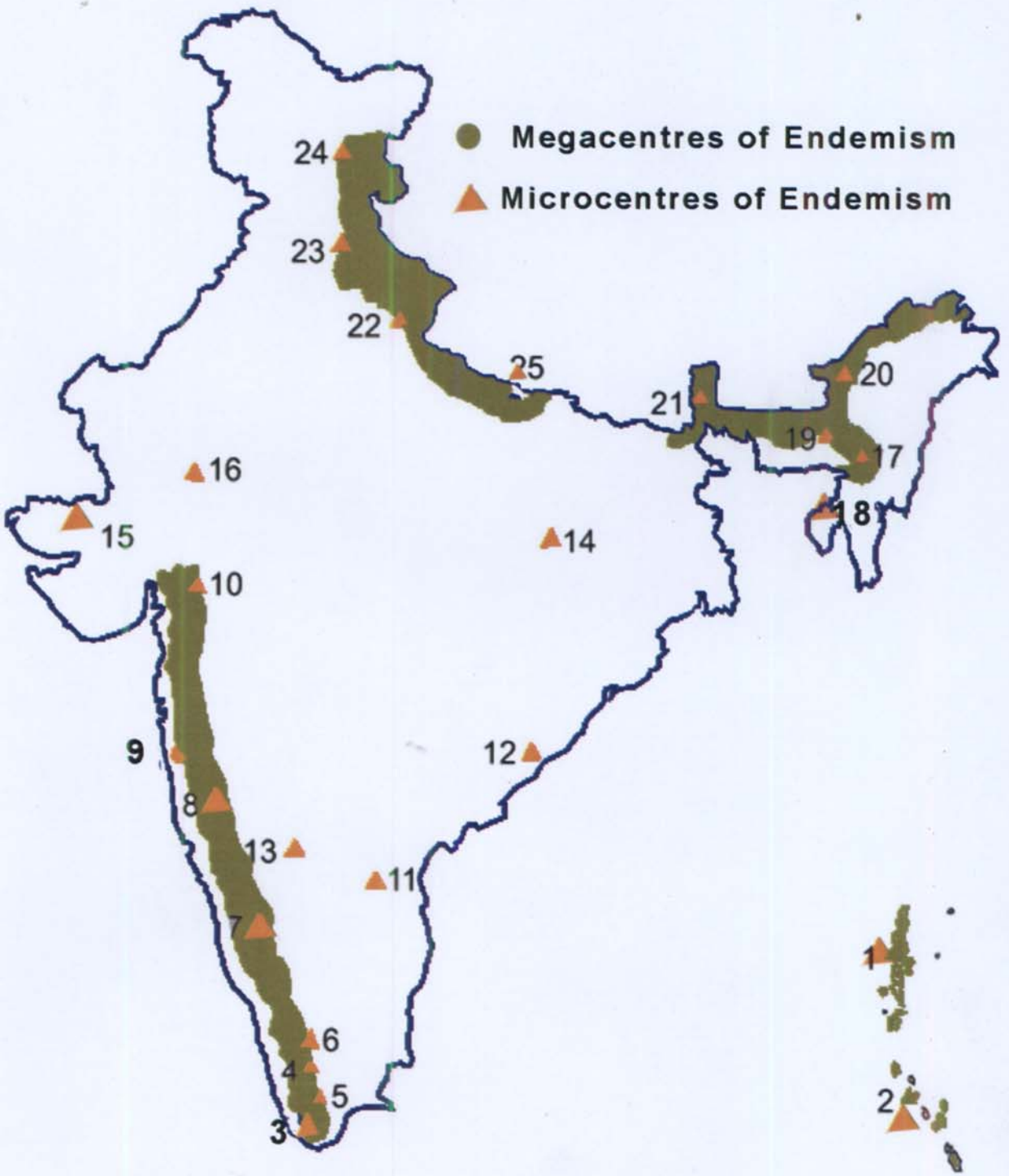

Fig. 4. Mega & Microcentres of Endemism in India

Western Ghats, one among the nine biogeographic zones of India is like an oceanic island, and is responsible for the richness of biodiversity in Peninsular India. Geographically the Western Ghats is divided into two sections: Southern Western Ghats and Northern Western Ghats. Northern Western Ghats starts below Tapti river mouth up to Goa. Southern Western Ghats lie south of Goa extending up to Agasthyamala ranges at the southern end of Western Ghats. It is popularly known as 'Sahyadri' meaning 'facing the sea', which is constituted by a range of hills running almost parallel to Arabian Sea through Kerala, Karnataka, Goa and Maharashtra. In oceanic islands, endemism may be either due to the fact that fortified by its insularity or to the protection by the sea from the onslaught of extreme climatic changes. With the insularity, the flora of oceanic islands might have undergone evolution giving rise to endemic species. The first view supports the contention that islands are nurseries of speciation, while the second view considers the island flora as relic flora or established floras relatively free from at least some of the climatic changes and biological instabilities which affect larger land mass. On the basis of distribution of endemics, Ahmedullah and Nayar (1987) divided Western Ghats in to three sections, viz. Northern Western Ghats, Central Western Ghats and Southern Western Ghats. The Western Ghats possess various types of tropical forests such as wet-evergreen forests, moist-deciduous forests, dry-deciduous forests, sub-tropical montane forests, tropical thorn forests, grasslands of lower altitude, and grasslands of higher altitude.

Being tropical forests, the Western Ghats forests are rich in species diversity. Botanically, the Western Ghats are very well covered in many floras and Icones: The Flora of British India (Hooker, 1875-1897), The Flora of the Presidency of Bombay (Cooke, 1901-1908); The Forest Trees of Travancore (Bourdillion, 1908), Flowering Plants of Travancore (Rama Rao, 1914), Flora of Anamalai Hills (Fischer, 1921), The flora of South Indian Hill Stations (Fyson, 1932), Flora of the Presidency of Madras (Gamble, 1915-1936), Icones Plantarum Indiae Orientalis (Wight, 1840-1853), Illustrations of Indian Botany (Wight, 1840-1850), Icones Plantarum Indiae Orientalis (Beddome, 1868-1874) and Flora Sylvatica for Southern India (Beddome, 1869-1874) are among the notable older ones.

Endemics are of great interest to taxonomists as some of them may be very ancient in origin while others may be comparatively new. They make phytogeographical zones unique. It is well known that endemic plants determine whether a region has a typical or characteristic flora or not. The high percentage of endemic elements shows that the Western Ghats forests have a typical flora of their own. Most of the species of flowering plants endemic to Peninsular India are confined to the Western Ghats (Nayar, 1980). Subramanyam and Nayar (1964) considered that the summits of Western Ghats are comparable to islands with respect to

endemic species content. Nayar (1977) was of the opinion that the Himalaya presides over the biogeography of India, the Western Ghats to a large extent presides over the ecology and biogeography of Peninsular India. If this is so, no wonder then that the entire Western Ghats are relatively rich in endemic species.

It has been estimated (Ahmedullah & Nayar, 1987) that there are about 1932 taxa of angiosperms endemic to Peninsular India of which majority are those confined the Western Ghats. If one accepts the estimates of Nair and Daniel (1986) as to the total number of species in the Western Ghats as 4000, then about 48% species among them are endemic to the region. Eventhough there are a number of instances of reporting endemic angiosperms from different parts of Peninsular India or Western Ghats in general or enumerating endemics of a specific area within the region or analysing the distribution pattern of a particular angiosperm family within the State, an exhaustive list of endemic angiosperms of this part of the country is so far lacking. This is mainly due to the constraints of floristically surveying the whole region to have a more or less accurate estimate of endemics. Often preparation of the list of endemics is based on herbarium scrutiny, floristic survey of small areas or taxonomic studies on selected genera or families within the region. Obviously, such studies result in lists of endemics of the taxonomic entities selected for the study or a floristic entity explored. As examples of such studies, the works by Chandrabose and Sreenivasan (1976) on the endemic plants of south India, Sharma and Kulkarni (1980) on the rare plants from Maharashtra, Mohanan and Henry (1980) on the discovery of a few endemic plants from Kerala, Nair and Mohanan (1981, 1982) on four endemic taxa from Kerala, Henry and Swaminathan (1983) on the rediscovery of rare and endemic plants of Peninsular India, Henry et al. (1984) on the endemics of Agasthyamalai and Thirunelveli hills, Nair and Sreenivasan (1983) on interesting plants of South India, Shetty and Vivekananthan (1983) on the endemics of Kundha range of Nilgiri Plateau, Kothari and Murthy (1984) on a few noteworthy endemic species of Maharashtra, Raghavan and Singh (1984) on endemic and vulnerable species of Western India, Nair (1982, 1985), Nair and Nayar (1986, 1987) on extinct and endangered endemic angiosperms of Courtallum, Tamilnadu, and Ramachandran et al. (1985) on four endemic species of Kerala are worth mentioning. Several other reports on rare, threatened and vulnerable species are also available from different parts of Peninsular India. Attempts were also made in the past to consolidate information on endemics of South India and Western Ghats as evidenced by the works by Subramanyam and Nayar (1974), Henry et al. (1978), Vajravelu and Daniel (1983), Nair and Daniel (1986) and that of Ahmedullah and Nayar (1987). Concerted attempts were also seen to have been made to survey the plants of the sacred groves of the Western Ghats region. These groves are known to support several endemics as reported by Gadgil and Vartak (1976), Nair and Mohanan (1981), Vartak (1983), Vartak et al. (1986), etc.

2.6. Kerala's (political area) endemic flora

Southern Western Ghats to which the State of Kerala belongs to has attracted many veteran botanists because of its enormous floristic richness and diversity. The history of botanization starts from the publication of Coloquis dos Simples e drogas he cousas medicinais da India (Garcia de Orta, 1565) which contained enumeration of the medicinal plants of India and is the first published botanical work on the plants of Western Ghats. Subsequently after a century, an elaborate work on the plants of Malabar coast was brought out by van Rheede (1678-1703) in his Hortus Malabaricus. It was a milestone in the botanical research published in the 17th century. This 12 volume monumental work is the first ever published literature from Kerala region on any subject. It is intimately implicated with systematic botany in general and medicinal properties of the plants of the Malabar Coast in particular (Manilal, 1980). Though, van Rheede was not a trained botanist, he was fascinated by the richness and diversity of the flora while serving as the Dutch Governor in erstwhile Malabar Province. In his endeavor to bring out Hortus Malabaricus, van Rheede was assisted by Itty Achuthan, a native physician and three Konkani priest-physicians, viz. Ranga Bhat, Vinayaka Pandit and Appu Bhat supplemented the information. Herm (1646-1695) of Leiden who had contacts with van Rheede, visited Kollam and Kochi and collected several plant specimens from these areas. Both of their works later helped Linnaeus to describe many species from this part of the world (Linnaeus, 1753).

The floristic richness and diversity of Kerala, especially of the Western Ghats region, was attracted by many well known botanists in the subsequent years. Names worth mentioning among them during the first half of 19th century are Buchanan-Hamilton (1807), and Robert Wight (1840-1853). Robert Wight, a British botanist, worked on the flora of Peninsular India. His major contributions are: Illustrations of Indian Botany (1840-1850) and Icones Plantarum Indiae Orientalis (1840-1853). With Arnott, he published Prodromus Florae Peninsulae Indiae Orientalis (1834). William Cullen (1842), Cleghorn (1855), Alfred Augustus (1880), Davidson (1883), Rev. Fr. Johnson (1858, Lawson (1894) were others who studied the floral aspects of this region during the 19th century. The notable contributions during this century were The Flora of Sylvatica for South India (Beddome, 1869-1874), Icones Plantarum Indiae Orientalis (Beddome, 1868-1874), and Flora of British India (J. D. Hooker, 1872-1897). The 7 volume publication of Flora of British India dealt with phanerogams of the erstwhile British India with phytogeographical information. Subsequently the regional floras like Flora of the Presidency of Bombay (Cooke,1908), and Flora of the Presidency of Madras (Gamble, 1915-1936) were published and the latter work is adjudged as the best among the regional floras. T. F. Bourdillon (1908), 'Father of Travancore Forestry', in his comprehensive work on the flora entitled Forest Trees of Travancore, dealt with 582 indigenous trees.

Nevertheless, it is difficult to analyse the plant diversity of the State due to the absence of a comprehensive State flora. Floristic studies in most of the districts and protected areas in Kerala have either been completed or in the process of completion. They include Flora of Calicut (Manilal & Sivarajan, 1982), Flora of Cannanore (Ramachandran & Nair, 1988), Flora of Kottyam District (Antony, 1989, Ph. D.), Flora of Palghat District (Vajravelu ,1990), Flora of Thiruvananthapuram (Mohanan & Henry, 1994), Flowering plants of Thrissur Forest (Sasidharan & Sivarajan, 1996), Flora of Nilambur (Sivarajan & Philip Mathew, 1997), Flora of Pathanamthitta District (Anil Kumar et al., 2005), Flora of Alappuzha District (Sunil & Sivadasan, 2009); and doctoral theses on the flora of Quilon (Mohanan, 1984), flora of Kasaragod (Ansari, 1985), flora of Malappuram District excluding Nilambur Forest (Babu, 1990), and flora of Wayanad (Ratheesh Narayanan, 2009). In addition to these, there are two more flora published on the 'hotspots' areas in the State, namely Flora of Silent Valley (Manilal, 1988) and Flora of Agasthyamala Hills (Mohanan & Sivadasan, 1995). Further, flora of protected areas such as Shenduruny Wildlife Sanctuary (Sasidharan, 1997), Periyar Tiger Reserve (Sasidharan, 1998a), Chinnar Wildlife Sanctuary (Sasidharan, 1999a), Parambikulam Wildlife Sanctury (Sasidharan, 2002) have been published. Other floristic studies of relevance include Observations in the Aquatic Angiosperms of Malabar (North Kerala) (Joseph, 1991), Flora of Thenmala Division (Subramaniyan, 1995), Studies on Epiphytic Flora in the Tropical Ecosystem of Western Ghats with Special Reference to Nilgiri Biosphere Reserve (Muktesh Kumar, 1998), Floristic studies on Vellarimala on the Western Ghats of Kerala (Pradeep, 2000), and Epiphytes and Parasites of Kerala (Shanavas & Sivadasan, 2009). Besides these general floristic studies, revisionary studies of several genera and families pertaining to the State have appeared in a number of publications. The important studies among these are Introduction to Orchids (Abraham & Vatsala, 1981), A Catalogue of Indian Orchids (Sath. Kumar & Manilal, 1994), A Revision of the Indian Species of Oberonia (Ansari & Balakrishnan, 1990), Flora of Kerala: Grasses (Sreek. & Nair, 1991), Taxonomy of Cyperaceae of Kerala (Rejani, 1991), A Taxonomic and Phylogenetic Study of South Indian Zingiberaceae (Sabu, Ph. D. Thesis,1991), Bladderworts of India (Janarthanam & Henry, 1992), The Family Eriocaulaceae in India (Ansari & Balakrishnan, 1994), Malvaceae of Peninsular India (Sivarajan & Pradeep, 1996), and Palms of Kerala (Renuka, 1999). Another two important contributions on the floristic wealth of Kerala are Biodiversity Documentation for Kerala - Part 6: Flowering Plants (Sasidharan, 2004) and Flowering Plants of Kerala (T.S. Nayar et al., 2006). During these studies, several new taxa were described. Manilal and Raveendrakumar (1998) have compiled a list of 625 taxa of flowering plants as addition to the flora of Kerala after the publication of Flora of Presidency of the Madras (Gamble, 1915-1936). Of these, 237 are new taxa (193 species, 3 subspecies and 41 varieties). Since, then several more species were reported from Kerala.

Being the part of Western Ghats, Kerala State is the natural abode of a much diverse flora, very rich in endemics. Rough estimates, mainly based on literature and herbarium scrutiny, have revealed that about 6.5% of the Western Ghats endemic angiosperms are strictly confined to Kerala region in their distribution. Eventhough there is no authentic enumeration on the exact number of exclusive endemic angiosperms of the State, Sasidharan (2004) revealed that there are 1,637 Peninsular Indian endemic species represented in Kerala, of which 263 are reported to occur only within the State. Nayar et al., (2006) estimated the occurrence of the 851 Western Ghats endemics in Kerala, including 234 species exclusively restricted to the State. In their later estimate of (2008), the number of species found in the State was 237.

While enumerating endemics of Peninsular India, Ahmedullah and Nayar (1987) reported 109 species with confined distribution to the State of Kerala. Henry et al. (1978) have shown 132 endemics restricted to Kerala while listing the rare and threatened angiosperms of South India. Further, in the Red Data Book of Indian Plants, Nayar and Sastry (1987, 1990) enumerated rare, vulnerable, endangered and possibly extinct species of India; quite a few of them (over 60 species) are confined to Kerala. A symposium organized by the Kerala State Forest Department on Rare, Endangered and Endemic Plants of the Western Ghats (Karunakaran, 1991), brought out notable accounts of the endemic angiosperms of Kerala in its deliberations. Among these, relevant to endemic wealth of the State are: Rare and endemic plants located on the Western slopes of Agasthyamala coming in the Thiruvananthapuram District of Kerala State (Benoy et al.,1991), Rare and endemic trees in the forests of Trichur (Sasidharan, 1991), Rare, endangered and endemic tree species of Shenduruney Valley (Zacharia, 1991), The endemic and endangered plants of the high ranges, Idukki District, Kerala (Shetty & Vivekananthan, 1991), A few rare and endemic aquatic angiosperms of Kerala (Joseph, 1991), Sacred groves: Saviour of endemics (Induchoodan & Balasubramanyan, 1991), Endemic angiosperms of the Western Ghats of India with special reference to Kerala: A review (Basha & Nair, 1991), Endemic plants of Kerala and need for its conservation (Gurudev & Shanmugasundaram, 1991), and Change detection study of Idukki region and endemism (Menon & Pillai, 1991). Some of the papers emphasized certain groups of endemics like Legumes (Sanjappa, 1991), Impatiens (Nair, 1991), Euphorbias (Binojkumar & Balakrishnan, 1991), Rattans (Renuka, 1991), Orchids (Mohanan & Balakrishnan, 1991; Kumar, 1991; SathishKumar (1991), etc.

2.7. Ethnobotany of endemic angiosperms of Kerala

Dependence of humans on plants and plant products is as old as the history of human race. Many important information about this interrelationship have come to the present

generation through the oral tradition, still prevalent among many tribal communities inhabiting different parts of the world.

2.7.1. Significance of ethno-ecology and ethnobotany

The term ethno-ecology is used to encompass all studies which describe the interactions of ethnic people with the natural environment. In the past, the tribal and other rural inhabitants were almost isolated from the outside world. Due to lack of communication, they were almost fully depended upon local herbal remedies. These ethnic people thus hold considerable knowledge about plants which they collect from their surroundings. Ethnobotany is precisely a part of ethno-ecology that deals with the knowledge possessed by the ethnic people on plants (Harshberger, 1896; Power, 1814; Robbins et al., 1916; Prance, 1991; Martin, 1995). Ethnobotany has developed in the recent years into an important pursuit of natural science. There are two main reasons for this rapid spurt of interest: (i) the awareness that the traditional (tribal) communities and their cultures represent a vast body of knowledge system; and (ii) the realization that such knowledge system is being depleted at a faster rate since natural ecosystems and culture are being destroyed by the encroachment of development. The tribal communities depend upon wild plants mainly for food and medicine apart from using them as construction materials and fuel, and for a variety of traditional and economic uses. Their interaction with the ambient vegetation for centuries helped them evolve sound oral knowledge system on the utility of the plants, which remain unrecorded until recently when ethnobotanists started systematically documenting them. Since such oral traditions are mainly based on local plant resources, they differ from region to region, and on many occasions, from tribes to tribes of the same region.

As the source of information on lesser known wild plant resources for food, medicine, fiber, gums, dyes, fodder, etc., ethnobotanical studies have been appreciated since long. The information on the use of 'periwinkle' by the natives of Madagascar as an oral hypoglycaemic, led to the recognition of the wonder drug plant *Catheranthus roseus*, as a source of over 75 alkaloids including vincristine and vinblastine. Further, ethnobotanical studies have great value as a source of information on genetic diversity of crop plants with healthy stocks, strains and desirable cultivars. Manilal (1981) reported that 26 primitive varieties of rice were used by the tribals of Malabar. Such information is of high value in plant breeding and crop improvement progammes. Another importance of ethnobotanical investigation is to tap indigenous knowledge on traditional skills and crafts for upgrading vocational jobs. Basketry with canes and bamboos is a skilled work adopted by some tribals of the Western Ghats and their artisanships can be exploited commercially.

2.7.2. Tribes of Kerala

In Kerala, the tribal communities make 1.1% of the total population, i.e. out of 29098500 people, 3, 20,900 are tribals (Census 1991) belonging to 35 tribal communities. Singh (1994) is of the opinion that they are in general a mixture of Proto-Austroloid and Nigrito racial stocks. Earlier studies carried out on different tribes of the State by Pisharoti (1935), Gnanambal (1952) and Mukherjee (1953) were basically with an anthropological point of view and no serious ethnobotanical investigations were carried out in Kerala until very recently. Nevertheless, Hortus Malabaricus (van Rheede, 1678-1703) reported three species of medicinal plants (Adel-odagam - *Adhathoda vasica*, Codaga-pala - *Holarrhena pubescens* and Tsjovanna ampelodi - *Rauvolfia serpentina*) prevalent among the people of central Kerala during that period. The Malabar region is known throughout the world as the land of spices, ie. cinnamon, cardamom, ginger, pepper, turmeric and nutmeg. While studying the ethnobotany of rice varieties of Malabar, Manilal (1981) reported 25 primitive varieties of rice used by different tribes of Malabar, many of them as they claimed, have medicinal values. Ramachandran (1987) conducted an ethnobotanical survey in Kannur District and reported 93 species of plants used by the tribes of that area for various purposes. Nagendraprasad and Abraham (1984) studied the plants used by the Nayadis of Northern Kerala and documented the ethnic uses of 74 species. Pushpangadan and Atal (1984), through an ethno-medico-botanical investigation concentrating on seven primitive tribes living in the densely forested highlands of the Western Ghats of Kerala, reported the uses of 79 plant species.

India harbors about 17,000 species of flowering plants (Nair & Daniel, 1986) and it is estimated that about 9,500 species of them are ethnobotanically important (Ministry of Environment and Forests, 1994). This constitutes 55% of Indian flora. Though Kerala has about 4700 species of flowering plants, no comprehensive data is available on the exact number of plant species used by different tribes in the State. In Kerala, the tribes constitute a weaker section of the population (Ashok, 1989) as in other parts of the country. Due to peculiar pattern of their settlements and traditional occupations, they are concentrated in certain regions of the State (Narayan, 1973). The Western Ghats, which dominate the cultural geography of Kerala, is an area where most of the tribes reside. They still practice customs and conventions that are unknown to the larger society.

Tribals communities in Kerala differ from one another in racial traits, language, social organizations, economy, religion and beliefs, customs and manners. They show much difference not only from one another, but also from the common non-tribal people. Tribals are found in almost all districts, but large numbers of them inhabit in the districts of Wayanad, Kannur, Idukki, and Palakkad. Most of them inhabit forest areas in and around the Western

Ghats. Wayanad district is the homeland for a variety of tribal communities and they form an integral part of its population. A total of 11 tribal communities are found in Wayanad alone with a total population of 1,21,362. The major tribes inhabiting the forests of Kerala are the following:

Adiyas: They inhabit the northern parts of Wayanad, and occupy themselves mostly as agricultural laborers (Plate 1: a).

Cholanaikans: The most secluded hill tribe of Kerala, the Cholanaikans of Nilambur were unknown to outside world till recently as they live in caves in deep and inaccessible areas of forests (Sivarajan & Mathew, 1997). They live in colonies and their population is dwindling. Their subsistence depends on root tubers, fruits, etc.; they also collect minor forests products.

Irulas, Mudugas and Kadars: They are seen mostly in Palakkad district. Basically they are agricultural laborers; they live in Parambikulam and Malampuzha. They are comparatively more civilized than any other tribe in Kerala (Plate 1: b).

Kanikkar or Kanis: They live in the forests of Thiruvananthapuram and Kollam districts. They practice shifting-cultivation in addition to collecting hill products. The Moopan, the chief of the tribe, also practices herbal medicine (Plate 1: c).

Karimpalans: They live in the low-lying forests of Kannur and are mainly engaged in cultivation and collection of wild pepper.

Kattunaikkas: They inhabit deep forests in north Wayanad. As the name indicates they are the leaders of the forests and are otherwise called 'then kurumbas' based on their main occupation of honey collection ('then' means honey). They subsist on roots, tubers, herbs, fruits and honey (Plate 1: d).

Koragas: Inhabitants of Kasaragod district; they are of two subtribes – Sopukoragas who use garments made of leaves, and Kuntukoragas using normal clothes. They engage themselves in basket and mat-making for their subsistence.

Kudiyas: They inhabit Hosdurg in Kasaragod district. Their chief occupation is agriculture, and cattle and poultry rearing.

Kurichiyas: They are considered as the aristocrats among the tribes of the State, and occupy a higher social status. They practice both shifting and permanent cultivation (Plate 1: e).

Mala Arayans: They are considered as one of the indigenous tribes. They inhabit the hilly tracts of Kottayam and Ernakulam districts and subsist mainly on pepper cultivation in forests in addition to collecting minor forests products.

Malakkuravas: They are basically hunters and claim themselves to be the descendants of Lord Ayyappa. They inhabit Sabarimala, Ranni and Konni reserve forest areas in Pathanamthitta district. They are also called Kochuvelans (Plate 2: a).

Malapandarams: These tribes live in the forests of Kollam, Pathanamthitta and Kottayam districts. A primitive hunting tribe; they also gather hill products as they roam around the forests. This primitive race inhabits usually deeper and higher forest tracts of Achankovil, Manimala and Sabarimala (Plate 2: b).

Malapulaya (Karavazhis): They are confined to Chinnar and Marayur in Anchanad Valley in Iukki district. They are basically an agricultural tribe.

Malavedans: They are confined to Kollam and Pathanamthitta districts and are primarily hunters, but at times cultivate rice and collect hill produce (Plate 2: c).

Malayalars: a relatively advanced tribe of Wayanad, concentrating on agriculture.

Malayans: Forest dwellers in Kannur district forming food gatherers; also engaged in collection of bamboos and basket-making.

Mannans: They generally inhabit in Pathanamthitta and Kottayam districts. They are mainly an agricultural tribe, but they collect minor forest products and honey, also hunt animals to supplement their diet.

Mulla kurumbas: The word 'kuruma' means one who tends sheep; now they are mainly engaged in agriculture. This tribe is found only in north Wayanad (Plate 2: d).

Muthuvans: A civilized tribe found in Idukki and Kottaym districts, inhabiting amongst the hill regions of Neriyamangalam and Pooyankutty regions. They collect forest products for their livelihood and follow different occupations (Plate 2: e).

Mala Ulladans: A hunter-gather group considered as people of interior forests. They subsist on fruits, roots, tubers, small animals and fish besides bison meat. Women folk make baskets and mats while the men folk collect medicinal herbs. They live in Pathanamthitta and Kottayam districts (Plate 2: f).

Naikans: They are comparatively an advanced tribe and freely mix with the outside world although they still live in fringes of forests in Nilambur. These people also collect minor forest products and honey.

Paliyar: They are comparatively primitive type of tribal group seen in Kumili, Periyar and Udumbanchola forests of Idukki district. They are also an agricultural community.

Paniyas: Paniyas are one of the primitive tribes in Kerala, living in colonies in the fringes of forests. They are numerically the most dominant scheduled tribe of the State; about 90 % of them inhabit in the Wayanad district (Plate 2: h).

Urali kurumbas: They are found in several forest areas in Kannur, living in small huts made of bamboo and reeds, thatched with grasses. Being primarily a nomadic hunter and gatherer group, they also make baskets and mats.

Uralis: They are supposed to be the aborigines of Aryans. They are mainly found inhabited in Devikulam and Peerumedu taluks of Idukki district, and Thodupuzha and Muvattupuzha of Ernakulam district. They generally collect minor forest products, honey, cardomom, etc. (Plate 2: g).

2.7.3. Tribal taxonomy

Folk taxonomy, a unique system of classification and identification of plants in the forests prevalent among the tribals in Kerala, might have derived from their folk wisdom and traditional knowledge on the characteristic features and uses of the plant resources (Binu & Nayar, 1999). The system does not have any sound concept about the forest types or ecosystems, and hence they do not use any terminology to denote or distinguish them. However, they have a better perception on the taxonomic delimitation of life forms, as evident from the use of the words 'maram' for trees, 'kuttichedi' for shrubs and 'chedi' for herbs. A few epithets are also used to denote some special groups, which are comparable to certain 'families' in the organized/modern taxonomic systems. All Apocynaceae and Asclepiadaceae twiners which produce milky latex are referred to as 'palvalli' ('pal' = milk; 'valli' = twiner). They also have a noteworthy system of terminology for the life forms at species level for habit, leaf form, stem structure, fruit shape, etc. These examples substantiate beyond their talent and wisdom in selecting appropriate and specific epithets for species which are connected with their day to day life. Thus the tribal taxonomy under discussion is a value added taxonomy which also indicates the use(s) of resources.

Plate 1. Photographs representing various tribes of Kerala

a. Adiya; b. Kadar; c. Kani; d. Kattunaika; e. Kurichiya

TAXONOMIC AND ETHNOBOTANIC STUDIES OF ENDEMIC ANGIOSPERMS OF KERALA

THESIS SUBMITTED TO THE
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IN BOTANY

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3. STUDY AREA AND METHODOLOGY

3.1. Study area

This piece of work is an attempt to enumerate, document and analyze the status and distribution of endemic flowering plants within the political boundary of Kerala State, the narrow strip of land on the south-western corner of Indian Peninsula. Lying within the species-rich equatorial tropical belt, this green land, commonly referred to as 'God's own Country' known for its scenic splendour and spice/timber trade from time immemorial is characterized by an unique synthesis of diverse ecosystems and cultural diversity. Kerala, occupying a geographical area of 39,863 sq. km (1.8% of the total land area of India), is located between the geographical coordinates of 8° 18' and 12° 48" N latitudes and 74° 52' and 77° 22" E longitudes which is bounded by the Arabian Sea on the west and the mountainous belt of the Western Ghats on the east. The vegetation, occupation, habitation patterns and developmental attributes follow the physical features of Kerala although the State is often described as a large village by virtue of the continuity in spread of the human settlements.

3.1.1. Topography

The State has a complex topography with high mountains, low hills, valleys, ridges and scrap, and presents an array of varied climatic regions and habitats. Based on physiography, the State is divided into three natural zones (Fig. 5) as follows.

The lowlands or coastal zone (Theerabhoomi): This narrow strip of land, usually flat but undulating at times, extends for about 560 km from Kasaragod in the north to Thiruvananthapuram in the south with an average width of about 25 km and an altitude ranging between 10 and 30 m.

The Midlands (Edanadu): Lying between coastal region and the mountainous region, the midland consists of a highly undulating, lateritic hilly tracts extending to over 500 km long and 10-40 km wide. This tract is traversed by several rivers and streams. Most of the midland regions are highly populated and are under aggressive cultivation. The major agricultural crop in the area is paddy and the tree crops being coconut, arecanut, cashew, jack and mango.

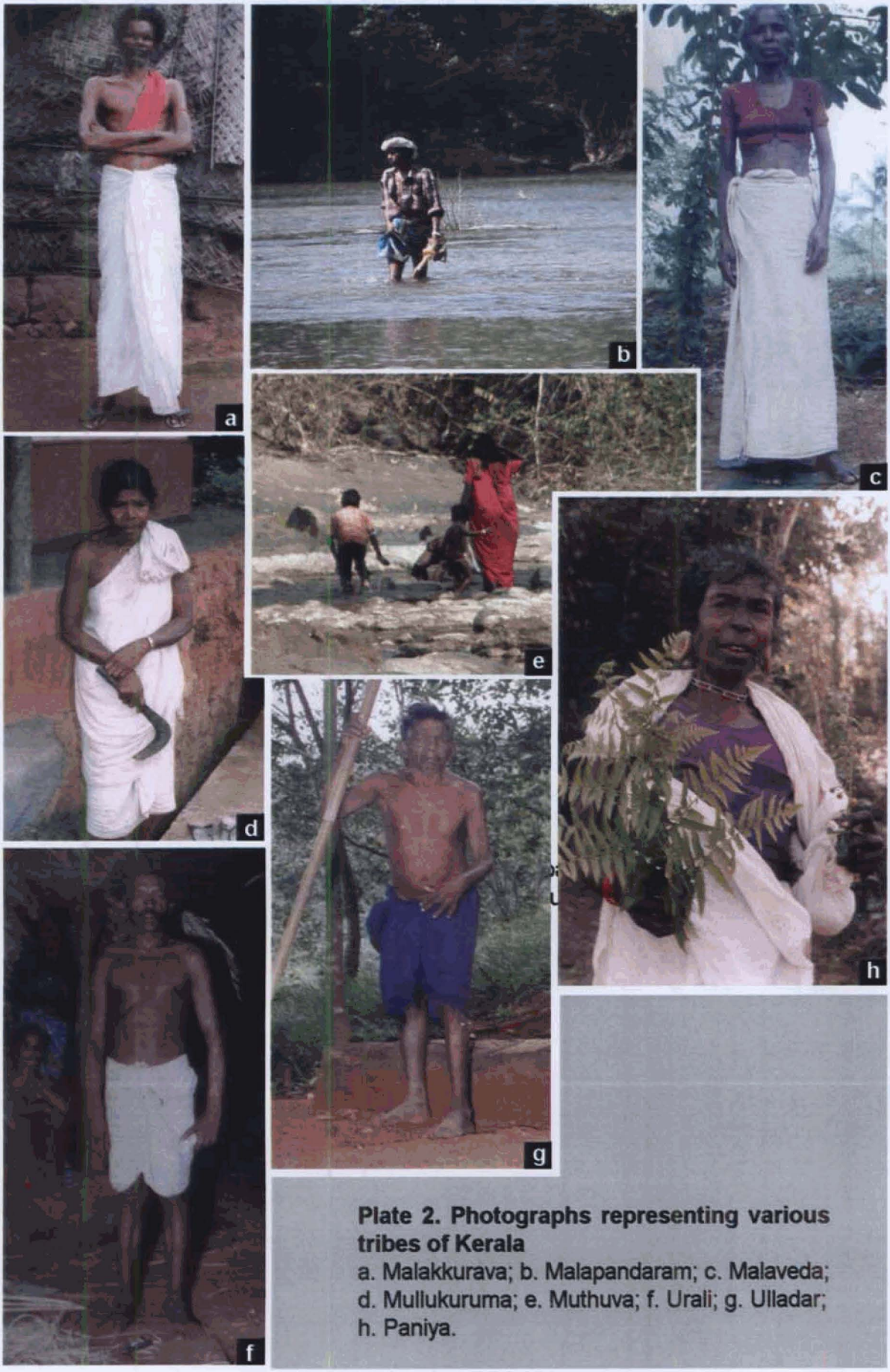

Plate 2. Photographs representing various tribes of Kerala

a. Malakkurava; b. Malapandaram; c. Malaveda; d. Mullukuruma; e. Muthuva; f. Urali; g. Ulladar; h. Paniya.

The Highlands (Malanadu): The mountanious region consists of a series of hilly ranges of Western Ghats clothed with dense forest vegetation. The eastern border of Kerala is bounded by an almost unbroken mountain wall, the Western Ghats, with major hills like Anamala, Choolamala, Elamala, Amruthamala, etc. The continuity of the Ghats is broken by a prominent depression, the 'Palghat Gap'. South of this gap lies the Anamala range with 'Anamudi' the highest peak (2695 m) in Peninsular India. On the lower south-western side of the Nilgiri Plateau lies the verdant Silent Valley. Along the south, the Western Ghats is rather interrupted and extends up to Kanyakumari.

The most magnificent among the backwaters of Kerala are the 'Vembanad lake' which is largest one in the State and the 'Ashtamudi lake' is the deepest one. Other important backwaters include Veli, Katinamkulam, Anchuthengu, Edava, Nadayara, Paravoor, Kayamkulam, Kodungallur and Chettuva. The 'Sasthamkotta lake' is the only natural fresh water lake in Kerala.

The unique feature of the State is the presence of 44 main rivers with their innumerable tributaries originating in Western Ghtas and cutting across Kerala and joining the Arabian Sea. Among these 'Bharathpuzha' is the longest one in the State, which originates from Anamala and falls in Arabian Sea. 'Pamba' is another important river of Kerala which is otherwise known as 'Gift of Kuttanadu'. 'Periyar' – the second longest river in Kerala makes its origin from Sabarimala. Other important rivers include 'Meenachal', 'Manimala', 'Achankovil', 'Kallada', 'Karamana', 'Neyyaru', 'Chandragiripuzha', 'Valapattanampuzha', 'Bepurpuzha', 'Chalakkudipuzha and 'Kabani'. Most of these rivers originate from the western slopes of the Western Ghats and flow westward across the plains, with the exception of three rivers viz. Bhavani, Kabani and Pambar, which are east flowing.

3.1.2. Geology and Soil

Kerala is stratigraphically different from the extra-peninsular Indian region being a part of the continental fragment of the earth's surface. The mountains and the surface relief are considered to be relic in nature and are not formed by uplift. Geologically the entire area is divisible in to: (i) a coastal belt of recent deposits, (ii) a narrow belt of Pleistocene or late Tertiary, (iii) another narrow belt of laterite, and (iv) a highland mountain belt in the midlands and mountainous zones formed from Precambrian-Achaean crystalline hard rocks consisting of granites, schists, gneisses, quartz, etc. Soils are predominantly lateritic, consisting of both sedimentary and residual laterites. While the upland soils are developed from bedrocks, the lowland soils are formed from alluvial materials brought from uplands. The soils of Kerala are classified as: (i) Laterite soil (high and low level), covering the major part of the hilly areas of

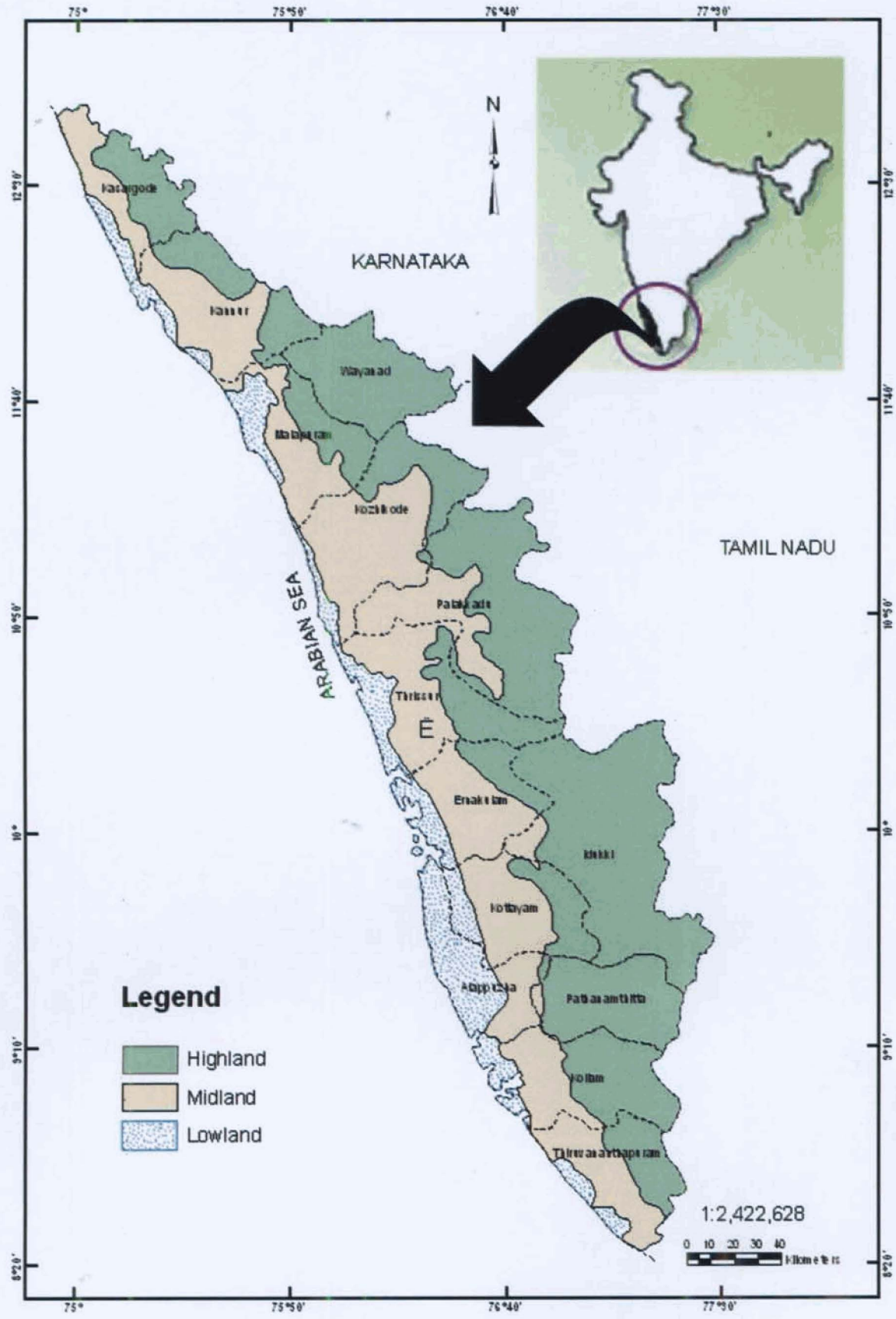

Fig. 5. PHYSIOGRAPHIC DIVISIONS OF KERALA

the State which is derived from the bed rocks, (ii) Red soil, covering large areas of midland and some places in the coastal region which is derived from ancient crystalline and metamorphic rocks, (iii) Forest soil (medium black soil), derived from the decomposition of the trap-rocks, (iv) Alluvial soil, found in low-lying, marshy and submergible areas and along the coast, and (v) Peaty or Kari soil, found in 'karinilams' (wetlands with a number of trees at different stages of decomposition buried at different depth) having accumulation of large quantities of organic matter.

3.1.3. Climate

A warm-humid tropical climate prevails in Kerala with very little variation in temperature. The maximum mean daily temperature in the coastal region is 32°C (April-May) and the minimum is 22°C (December-January). The maximum temperature may rise up to 37°C in some areas in the plains. The minimum temperature also drops to 7°C in mountains. The average rainfall in Kerala is quite high as the State gets the benefit of two monsoons, the south-west and the north-east during June to September and October to November respectively. Majority of the land area formed by the windward side of the Western Ghats, on an average receives 2000 mm rainfall. Locally, some regions like the High Range and the western border of the Wayanad Plateau receive more than 6000 mm rainfall. However, some areas like the eastern parts of Wayanad Plateau, Attappadi Plateau and High Range, which are beyond the crest of the Ghats and also the eastern part of the Palakkad Gap show gradual decline in the rainfall to around 1500 mm or even less. The atmosphere is highly humid with the relative humidity varying between 70 to 90 per cent throughout the year, particularly during southwest monsoon. The relative humidity decreases during December-April. High humidity and uniformly high temperature have given rise to the characteristic vegetation of Kerala. Temperature and rainfall pattern of the State can be termed mega-thermal of tropical rain type. The pattern of natural plant life changes progressively from the lowland to the uplands in conformity with the climate regime and soil structure. The tropical rain forests are therefore proposed to be maintained as a biotic treasure so that ecology and climate of the region are not endangered and the unique gene bank is not lost forever.

3.1.4. Vegetation

The vegetation of Kerala is most luxuriant and diverse resulted by the varied topographical features, high rainfall and geological conditions. This favoured the formation of shola forests on the mountain valleys to the mangrove forests along seacoast and estuaries. As stated above, Kerala is divisible in to three distinct altitudinal zones, viz. the highlands, the midlands and the lowlands (Kerala State Atlas, 1984), each with its distinct biological wealth,

vegetational composition and agricultural / land-use patterns. The highlands abode the State's most characteristic vegetation. The midlands, lying between the mountains and the lowlands, with intensive cultivation are formed of undulating hills and valleys with isolated pockets of forest formations. The midland and coastal areas also house a number of small and medium-sized sacred groves, which represent the remnants of the past vegetation. The lowlands or the coastal area is interspersed by river deltas and back waters with relicts of mangrove vegetation.

All major types of vegetation recognized in the Western Ghats are found in Kerala. Champion and Seth (1968) have classified the vegetation of Kerala in to 28 types, including both primary as swell as secondary forests. Tropical wet-evergreen and semi-evergreen forests and tropical moist-deciduous forests together hold about 95% of the total forests area in the State. Nearly 80% of the endemic plants of the State are concentrated in these forests. Tropical dry-deciduous, montane subtropical temperate forests and grasslands are other forests types found in the State. This also includes a few edaphic types such as Myristica swamps as well as bamboo and reed breaks. Major forest types (Plate 3) and their area of distribution is given in Table 4.

Table 4. Major forest types of Kerala

Forest types	Area (sq. km)	Percentage
Tropical wet-evergreen and semi-evergreen	3299	35.1
Tropical moist - deciduous	4100	43.6
Tropical dry-deciduous	100	1.1
Montane sub - tropical temperate forests	70	0.7
Forest plantations	1701	18.1
Grasslands	130	1.4
Total	9400	100

3.1.4.1. Tropical wet-evergreen and semi-evergreen forests

The evergreen forests are seen at altitudes from 200 to1200 m. It has been observed that there are differences in the physiognomy and composition of species with respect to altitude and is characterized by its diversity consisting of three strata of vegetation. The upper stratum is composed of trees and woody climbers. Very often trees are buttressed at the base and boles are clear, cylindrical unbranched at least up to two-third of their height and are generally with umbrella-shaped canopy at the top. The middle stratum is more or less candle-shaped and the lower one is characteristically conical. Infestation of epiphytes and other life forms tend to increase with altitude while woody climbers decrease. The multiplicity of species co-existing in a complex biological equilibrium gives this type of forests with the highest status, viz.

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'climatic climax'. The evergreen forests occupy different ecological niches depending on the local factors like elevation, slope and soil conditions and there is characteristic preponderance of one or more tree species at specific locations, forming associations like Vateria-Calophyllum-Cullenia, Mesua-Cullenia-Palaquium, and Mesua-Plaquium. The evergreen forests below 700 m are occurring in patches and mostly confined along the watercourses (riparian forests).

Semi-evergreen forests are mainly distributed with an altitude ranging from 400-700 m. This forest type occupies about 11% of the forestland of the State. These forests are constituted by both evergreen and deciduous elements, although evergreen ones are predominant. Semi-evergreen forests are observed adjacent to evergreen forests or within disturbed evergreen forests. Because of the indiscriminate felling of evergreen tree species, the evergreen forests of the past are now changing to this category. The species diversity is less when compared with that of evergreen forests. The top canopy is not dense and trees attain a height of more than 40 m. Lower storey is mainly evergreen.

3.1.4.2. Tropical moist-deciduous

This type of forests occurs from low hills to low elevation of c. 200 m. The general canopy is open or less dense. About 44% of the forest area of the State is occupied by moist-deciduous forests. Its canopy is quite similar to that of semi-evergreen forests and hence it is very difficult to distinguish between the two during wet season. However, February to May is the dry season when they shed leaves and at this stage moist-deciduous forests are easy to identify. The trees in general are tall and consist of much hard and durable timber-yielding ones. Therefore, moist-deciduous forests have been heavily exploited for extraction of valuable timber.

3.1.4.3. Tropical dry-deciduous

This forest type is mostly confined to the rain-shadow regions of the State. The forests in general are with small to medium-sized deciduous trees. The under growth is often with thorny species.

3.1.4.4. Montane sub-tropical temperate forests (Sholas)

This forest type is confined to the valleys or folds of the hills above 1500 m. The trees are small and highly branched. The branches of trees are clothed with a dense growth of mosses. Epiphytes are very common.

3.1.4.5. Grasslands

Grasslands can be classified into two types, viz. low-level grasslands and high-level grasslands. Low-level grasslands are seen distributed along with the evergreen forests at altitudes 1000-1800 m at Silent Valley, Munnar, Wayanad, Agsthyamala, etc.; repeated annual fires prevent these grasslands from progression towards woodlands. Those occurring in the margin of evergreen forests very often get burnt and fire invades the evergreen forests. The trees present in this area are pyroresistant with thick bark and stunted growth. High-level grasslands are encountered above1800 m at Silent Valley, Munnar, Eravikulam, Wayanad, Agasthyamala, etc. and are characterized by carpet like formation. Rainfall is quite high, often above 6000 mm and due to sloppy nature of the terrain, runoff is also high. Heavy wind and frost are common. These grasslands are interspersed with patches of evergreen forests, commonly called as 'sholas'.

3.2. Methodology

In the present study, the area within the political boundary of Kerala has been taken into consideration. As the first effort, a comprehensive checklist of the endemic species of Kerala was prepared with reference to the Floras/floristic checklists, revisions and monographs pertaining to the State of Kerala. From this, the endemic species reported to be having exclusive distribution in the State were enumerated with details on their type locality, distribution pattern and habitat specificity. Herbarium studies were made subsequently for detailed observation of the characteristics of the species, the confirmation of type localities and other data. This was followed by a series of field explorations with special emphasis to the type locality and other areas of distribution of each species. The data generated through field study were analyzed with reference to the information gathered from published Floras that covered the geographical area of Kerala, reversionary/ monographic works that dealt with flowering plants occurring in the State, and other relevant information from journals that provide details of plants in Kerala.

Eventhough some sporadic reports on the endemic plants of certain areas within the State or of a few families have appeared from time to time (Karthikeyan, 1983; Henry et al., 1984; Singh & Subramaniam, 1991; Basha & Nair, 1991; Sreekumar & Nair, 1991; Mohanan & Nair, 1999), there is no authentic estimate on the exact number of exclusive endemic angiosperm taxa in Kerala, which is also practically difficult to achieve as the distribution of such species often extend to the adjoining parts of the Western Ghats in Tamil Nadu and Karnataka States. To analyze this extended distribution of such endemic species, the Floras/Floristic checklists and herbarium details pertaining to adjacent regions/neighbouring

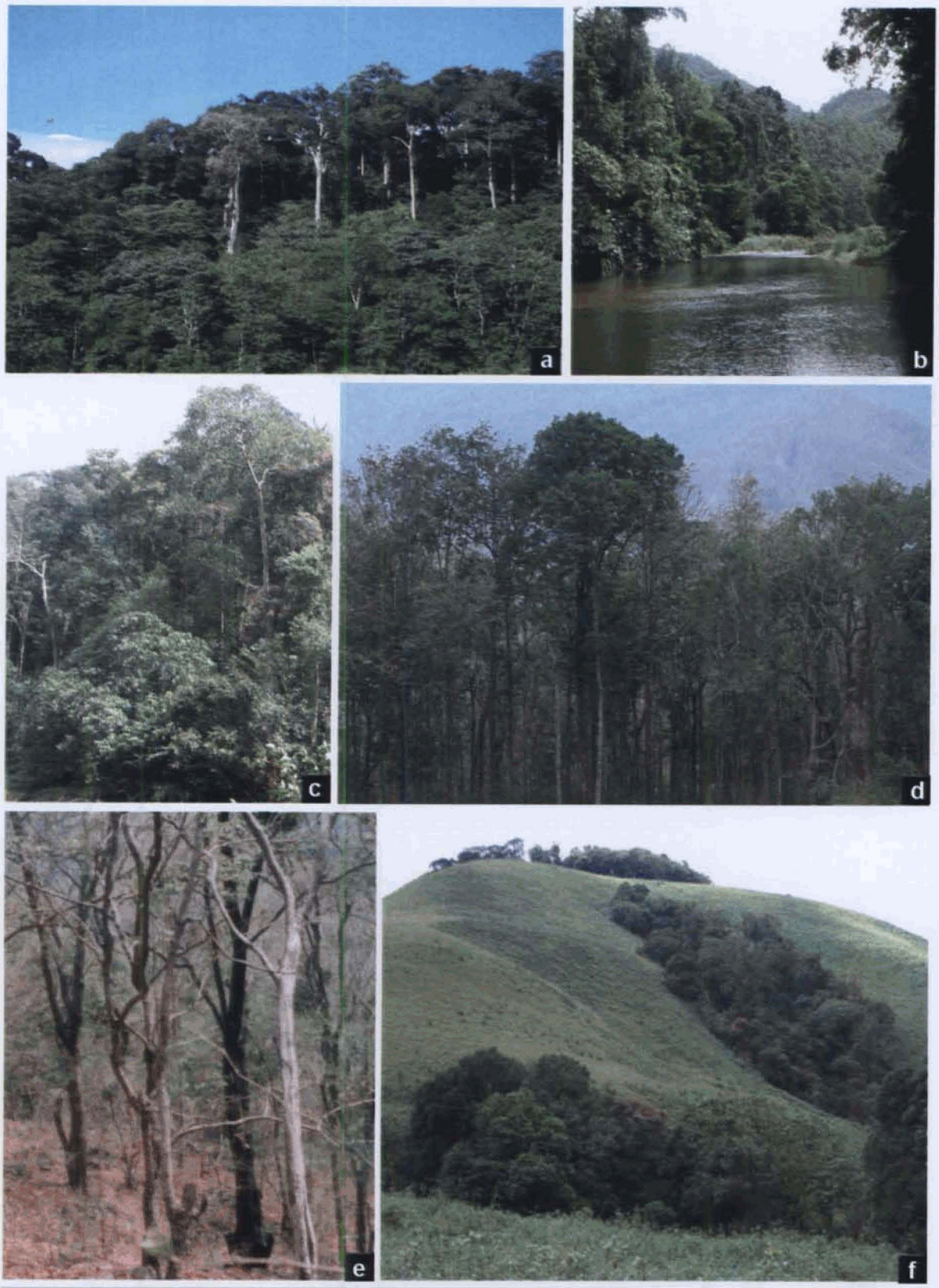

Plate 3. Major Forest types of Kerala

a. Tropical wet-evergreen forest; b. Wet-evergreen forest; c. Tropical wet-semi-evergreen forest; d. Tropical moist-deciduous forest; e. Tropical dry-deciduous forest; f. Montane subtropical temperate forest (shola-grasslands)

States, have been referred.

3.2.1. Herbarium study

Herbarium scrutiny was carried out from the relevant herbaria in India, where the specimens of endemic species represented from the state are deposited. Most of them are deposited at the herbaria of Botanical Survey of India [Central National Herbarium, Howrah (CAL), Madras Herbarium of Southern Circle of BSI, Coimbatore (MH)]. A very good representation of political region endemics, including their type specimens is gathered at the herbaria of the Calicut University (CALI), Kerala, the Tropical Botanic Garden and Research Institute, Palode, (TBGT), and the Kerala Forest Research Institute, Peechi (KFRI). A major constraint faced was with respect to the verification of type collections and old collections by the British botanists which are deposited in Kew Herbarium, UK, except for a few (numbering eight) referred from the web catalogue of the Kew Herbarium. The list of noted herbaria of India having Kerala flora are given below in Table 5.

Table 5. Details of herbarium consulted having specimens from Kerala

No.	Herbaria	Major collectors
1	Central National Herbarium, Howrah (CAL)	R. H. Beddome, J. D. Hooker, C. B. Clarke, A. N. Henry, J. S. Gamble, S. K. Mukharjee
2	Calicut University Herbarium, Malappuram (CALI)	K. S. Manila, B. K. Nair,V. V. Sivarajan, M. Sivadasan, Philip Mathew, M. Sabu, A. K. Pradeep, N. Anil Kumar, Jomy Augustine, V. A. Jaleel, P. Sunojkumar
3	Institute of Forest genetics and Tree Breeding, Coimbatore (FRC)	T. F. Bourdillon, C. E. C. Fischer, M. Rama Rao, K. N. Subramanyam
4	Kerala Forest Research Institute, Peechi (KFRI)	K. K. Nair, M. G. Nair, V. P. K. Nambiar, C. Renuka, N. Sasidharan, Muktesh Kumar, Stephen Sequeria
5	Madras Herbarium, Botanical survey of India, Southern Circle, Coimbatore (MH)	R. H. Beddome, T. F. Bourdillon, J. L. Ellis, C. E. C. Fischer, J. S. Gamble, G. H. K. Thwaites, R. Wight, J. D. Hooker, M. A. Lawson, K. M. Sebastine, K. C. Jacob, A. N. Henry, V. J. Nair, N. C. Nair, K. Ramamurthy, N. C. Radhakrishnan, N. P. Balakrishnan, B. D. Sharma, E. Vajravelu, B. V. Shetty, K. Vivekananthan, P. V. Sreekumar, A. G. Pandurangan,

No.	Herbaria	Major collectors
6	Tropical Botanic Garden and Research Institute, Palode (TBGT)	M. Mohanan, C. N. Mohanan M. Rama Rao,K. Venkoba Rao, T. F. Bourdillon, V. Narayanaswamy, N. Ravi, N. Mohanan, C. Sathish Kumar, A. E. Shanavas, E. S. Santhosh Kumar, Mathew Dan, G. Rajkumar, M. P. Geetha Kumary
7	Department of Botany, University of Kerala, (UCT)	T. F. Bourdillon, M. Rama Rao, K. Venkoba Rao, Thiruvananthapuram

Apart from the above herbaria, herbarium collections of other research /educational institutes like Govt. Victoria College (Palakkad), Sree Narayana College (Kollam), Union Christian College (Aluva), C M S College (Kottayam), S. N. M. College (Maliankara), Centre for Advanced Study in Botany of Madras University (Mudalaivayal, Chennai), Community Agrobiodiversity Centre, M. S. Swaminathan Research Foundation (Kalpetta), and Environmental Resources Research Centre (Thiruvananthapuram) have also been referred covering type collections, specimens representing rediscoveries, and other personal collections available.

3.2.2. Field study

As stated above, field explorations for the present study have been carried out based on the preliminary knowledge gathered from published reports and herbarium records on distribution patterns and habitat preferences of exclusive endemic plants within the State. Several field trips (47 exploration trips during 1996-2000 and 33 trips during 2004-2007) were made at regular intervals covering all seasons to different ecosystems where the endemics inhabited. Based on available distributional data on exclusive endemic species of the state, district-wise exploration trips (Table 6) were conducted to specific localities and other biodiversity-rich areas including hotspots, protected areas like national parks, wildlife sanctuaries and biosphere reserves (Fig. 6), and wetlands including Ramsar sites.

Table 6. District-wise field explorations

Name of District	Areas of Field Exploration
Thiruvananthapuram	Agasthyamala-Chemunji Hills, Ponmudi hills (Merchiston Estate), Peppara WLS, Neyyar WLS, Palode forests, Kallar forests, Kottur forests.

Kollam	Shendurney WLS, Aryankavu (Palaruvi), Thenmala (Dam site), Kulathupuzha (Myristica swamps, Sankili) and Achenkovil forests, Sacred groves (Aika kavu, Edamon kavu) and some wetland areas including Sasthamkotta, Perukulam, Ashtamudi, etc.
Pathanamthitta	Ranni and Konni forests (Perumthenaruvi, Kakki hills), Moozhiar, Sabarimala, Arampa, Kottampara, Gurunathanmannu, Chelikallar, Vakkallar, Ponnambalamedu, etc.
Alappuzha	Pallana, Kalavoor, Kuttanadu
Kottayam	Vaikom, Vallikkode, Erumeli
Idukki	Idukki WLS, Chinnar WLS, Periyar WLS, Eravikulam National Park, Puyankutty, Mamkulam, Kulamavu, Devikulam, Peerumedu, Thekkady
Ernakulam	Aluva, Kochi, Kothamangalm, Nerymangalam Thattekkad, Bhuthathankettu, Idamalayar, Iringole Sacred grove.
Thrissur	Peechi-Vazhani WLS, Athirapally -Vazhachal, Sholayar, Peringalkuthu.
Palakkad	Silent Valley, Pathrakkadavu, Attappady
Malappuram	Nilambur, Meppadi, Nadukani
Kozhikode	Kakkayam, Thusharagiri, Chempukadavu, Eliyottimala, Pokkunnamala
Wayanad	Thirunelli (Pakshipathalam), Periya, Mananthavadi, Kalpetta, Wythiri
Kannur	Ezhimala, Valapattanam, Irutti, Madai, Sacred groves and lowland regions.
Kasaragod	Low-level dry grassland areas at Bekkal, Cherkalam, Seethamgoli, Elkanna river basin, Paramba and some sacred groves of Neeleswaram

Eventhough repeated seasonal field trips were made concentrating on the type localities and other floristically rich areas for collection and documentation of exclusive endemic taxa of the state, only a few species (numbering slightly over 70) could be collected from the field in their generative stage, i.e. in flowering/fruiting or both, with 1-2 extra specimens.

For collection and preservation, the general procedures given by Jain & Rao (1977) and van Baloogy (1987) were followed. Field notes such as date of collection, locality, altitude, habit, habitat, colour of leaves, flowers, fruits, etc. and dominance and associations were also made during the exploration trips. Same taxa were collected from different available localities for ascertaining the range of variation, local distribution, commonness/rarity, etc. of the taxa.

For preservation at field, wet method (Fosberg & Sachet, 1965) using 70% methyl alcohol was employed. Drying and processing were done at the herbarium, following standard methods. Identification, description, illustration and other critical analyses were made from dried specimens as well as specimens pickled in 70% alcohol. The herbarium prepared during the present study were deposited in the Herbarium of the Tropical Botanic Garden and Research Institute, Thiruvananthapuram (TBGT), and a few relevant specimens deposited at the Herbarium of the Southern Circle of the Botanical Survey of India (MH), at Coimbatore.

Along with the exploration trips, available information on ethnobotanical uses of exclusive endemic species of the state were also collected through personal interviews, especially while exploring tribal inhabited forest areas.

3.2.3. Plan of Presentation of Data

The format proposed by Radford et al. (1974) was followed for general taxonomic presentation of the taxa. The families were classified according to Bentham & Hooker's system of classification (1862-1883). Artificial keys were provided for families, genera, species and varieties. Keys are strictly dichotomous and indented, and are relevant only to the taxa included. As far as possible, both vegetative and generative characters readily observable were utilised for the preparation of keys. Full citation of the generic name has been given referring to Index Nominum Genericorum (Farr et al., 1979) and International Code of Botanical Nomenclature [Tokyo Code (Mc Neill et al., 2006)]. Alphabetical order is followed in the treatment of genera with in families and species with in genera. Each species is provided with detailed nomenclatural citations including reference from Flora of British India (Hooker, 1872-1879), Flora of the Presidency of Madras (Gamble & Fischer, 1915-1936) and other published Floras, such as Flora of Cannanore District (Nair & Ramachandran, 1988), Flora of Calicut (Manilal & Sivarajan, 1982), Flora of Palghat District (Vajravelu, 1990), Flora of Malppuram District (Babu, 1990), Flora of Kottayam District (Antony, 1989), Flora of Pathanamthitta District (Anil Kumar et al., 2005), Flora of Thiruvananthapuram District (Mohanan & Henry, 1995), Flora of Nilambur (Sivarajan & Philip Mathew, 1996), Flowering Plants of Thrissur Forest (Sasidharan & Sivarajan, 1996), Flora of Alappuzha District (Sunil & Sivadasan, 2009), Flora of Silent Valley (Manilal, 1988), Flora of Agasthyamala (Mohanan & Sivadasan, 2002). Besides these floras, relevant monographs, revisions, etc. were also cited. Icones of Wight (1839-1853) and Beddome (1868-1874) were cited wherever relevant. Synonyms were given in italics. Local names, if available, were given at the end of the nomenclatural citations. For the abbreviations of periodicals, Botanico Periodicum Huntianum (B-P-H) (Lawrence et al., 1968) and for name citation of authors, Authors of Plant names (Brummitt & Powell, 1992) were referred and cited. Illustrations and photographs of

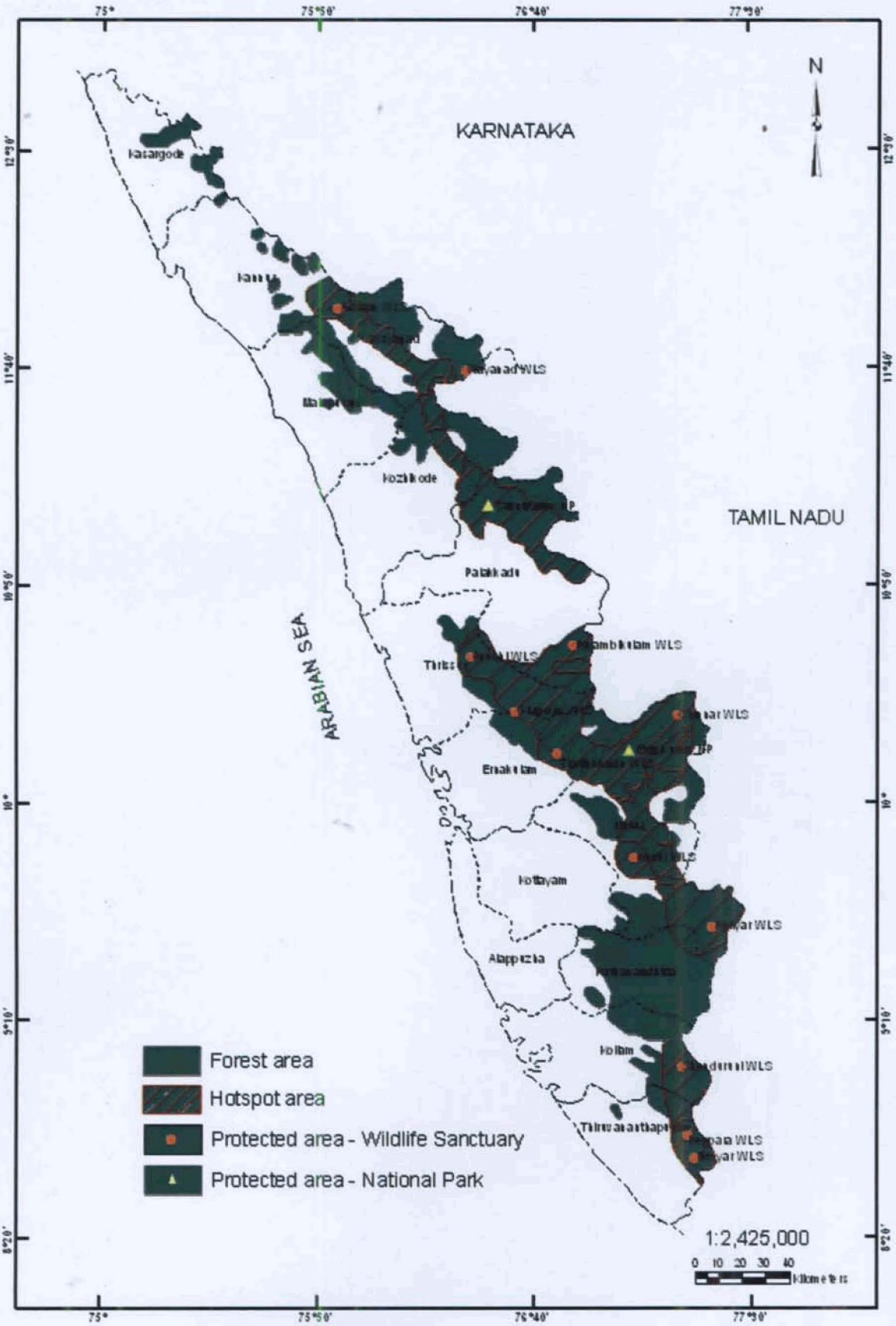

Fig. 6. PROTECTED AREAS & BIODIVERSITY HOTSPOTS OF KERALA

selected plants and photographs of most of the type specimens were also provided.

The following abbreviations and symbols were used in the treatment:

BSI : Botanical Survey of India
BM : British Museum of Natural History, London
BRSL : Breslau Herbarium, Poland
c. : (±) more or less
cm : Centimeter
CAS : Centre for Advance Studies in Botany, Chennai
CALI : Calicut University Herbarium
CNH : Central National Herbarium
ERRC : Environmental Resources Research Centre, Thiruvananthapuram
FRLHT : Foundation for Revitalisation of Local Health Traditions, Bangalore
K : Kew
KFRI : Kerala Forest Research Institute, Peechi
m : meter
mm : millimeter
MH : Madras Herbarium
SNCH : Sree Narayana College Herbarium, Kollam
TBGT : Herbarium of Tropical Botanic Garden and Research Institute, Thiruvananthapuram
FRC : Herbarium of Institute of Forest Genetics and Tree Breeding, Coimbatore
UCT : Herbarium of Department of Botany, University College, Thiruvananthapuram
UCC : Union Christian College, Aluva
SD : Sanatana Dharma College, Alappuzha
W : Naturhistorisches Museum Wein, Austria, Wein
Z : Universitäl Zürich, Switzerland, Zurich

Ethnobotanical information gathered was presented as per the medicinal and economic uses of the resources.

TAXONOMIC AND ETHNOBOTANIC STUDIES OF ENDEMIC ANGIOSPERMS OF KERALA

THESIS SUBMITTED TO THE
UNIVERSITY OF CALICUT

IN PART-FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN BOTANY

BY
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SEPTEMBER 2010

4. OBSERVATIONS AND DISCUSSION

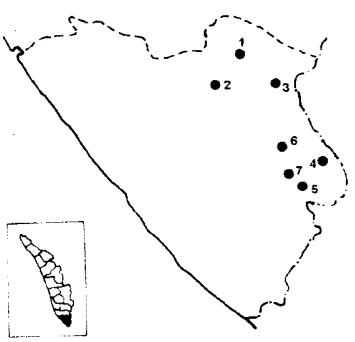
The present study, comprising comprehensive literature survey and herbarium visits coupled with field exploration and integrated analysis yielded significant findings on the content and distribution of endemics within the geographical area of Kerala State. The State with a geographical area of 39,863 sq. km, as per available records (Nayar et al., 2006), houses 4681 species of flowering plants in its varied ecosystems; of these, 851 are Western Ghats endemics which account for 20.4% percent of the total endemics. The present floristic analysis further revealed that among these 851 endemics, 240 species, 1 subspecies and 26 varieties are exclusive endemics of Kerala (Appendix-1), manifesting an exceptional concentration of endemic species in the State that are confined to relatively smaller areas. The following forms a detailed account of the analysis performed during the present study. For convenience, a district-wise profile of endemics starting from the southern most district has been presented followed by a systematic tretment of families and rarity analysis.

4.1. Endemic plants profile of Districts of Kerala State

4.1.1. Thiruvananthapuram

4.1.1.1. Ecosystem characteristics

On a physiographic basis, the district is well demarcated into coastal, midland and highlands with characteristic vegetation types. The coastal zone comprises of flat and gently undulating lands with estuarine vegetation at places. One of the many natural advantages of the district is the presence of an extensive system of backwaters and canals with characteristic vegetations. Midland zone lying between the coastal



1 Ponmudi Hills
2 Palode
3 Kallar
4 Agasthyamala - Chemunji
5 Kottur
6 Peppara WLS
7 Neyyar WLS

Fig. 7. Profile of Thiruvananthapuram District

and mountain zones manifests an undulating topography and is mostly under cultivation. Occurrence of sacred groves is not common. Highlands or mountain zone consists of hills and valleys and mountains of the southernmost part of the Western Ghats. Potentially, the major types of vegetation occurring within the zone are Tropical moist-deciduous forests, Tropical wet-evergreen forests, Subtropical montane forests and swards of higher altitudes.

Agasthyamala ranges in the highland zone, a compact block of hills situated at the southernmost end of the subcontinent is considered as an important hotspot, both in terms of species richness and higher-taxonomic-level-endemism. It is also considered as one of the important centres of plant speciation. The part of Agasthyamala in the Kerala region is about 180 sq. km and has been recently designated as the 13th Biosphere Reserve of the country, viz. Agasthyamala Biosphere Reserve. The areas in Thiruvananthapuram district coming under this Biosphere Reserve were earlier proposed for a biological park, viz. Agasthyvanam Biological Park. Altitude of the area varies from 100 m above MSL at the base of the hills to 1868 m of the highest peak Agasthyarkudam, associated with the legendary sage Agasthya. Ponmudi, another highest ridge makes one of the hottest hotspots of biodiversity. The area also includes two Wildlife Sanctuaries, viz. Peppara Wildlife Sanctuary and Neyyar Wildlife Sanctuary. Peppara Wildlife Sanctuary is part of the Agasthyamala Biosphere Reserve area and thus the sanctuary is a component of a major conservational complex in the Western Ghats, situated in Nedumangad Taluk of Thiruvananthpuram district with an area of 53 sq. km enclosing the Peppara reservoir. The area manifests a complex and diverse vegetational cover including tropical and subtropical evergreen forests and preserves an ideal gene pool of endemics. Neyyar Wildlife Sanctuary spreads over 128 sq. km forest area, which forms the catchments of Neyyar reservoir. It is in the southern end of Kerala and has flora and fauna of ecological and geomorphological significance. Being a part of Agasthyamala, one of the hotspots, the significance of this area is evident from the fact that about 12% of the identified plants are endemic to the region.

4.1.1.2. Floristics

The first authentic reference about the plants of Thiruvananthapuram district can be found in the Hortus Indicus Malabaricus of Hendrik Andrian van Rheede published between 1678 and 1703. C. A. Barber, R. H. Beddome, T. F. Bourdillon, K. C. Jacob, M. A. Lawson, V. Narayanaswamy, M. Rama Rao, K. Venkoba Rao and R. Wight were the pioneers who botanized this district which was forming a part of the erstwhile Travancore state. Wight's Icones Plantarum Indiae Orientalis (1840-1853) and Illustrations to Indian Botany (1840-1850) included accounts of many plants from this region. Bourdillon (1893) presented a report on the Forests of Travancore, which formed the basis of his later monumental work on the Forest

Trees of Travancore (1908). Nagam Aiyya (1906) and Velupillai (1940) gave a delightful description of the vegetation of the erstwhile Travancore. Lawson who frequently visited Kerala during 1893-1894 collected at Ponmudi, Merchiston and Thiruvananthapuram in southern Kerala. Observations made on his tour to the southern part of the state were published in his Notes of a tour in Travancore etc. (1894). Rama Rao (1914), the then Conservator of Forests of Travancore State compiled A Preliminary List of 3335 Plants with the help of curator Vencoba Rao, who was a devoted plant collector of this area. Botanically, the coast of Thiruvananthapuram has received a rather scanty attention. Thomas (1962, 1976) has explored Veli hills in Thiruvananthapuram with reference to ecological factors and published an account of 249 species. Rao and Sastry (1972, 1974a, 1974b) have given an account of coastal floristics and ecology of Veli. Abraham (1962) and Adriel (1964-1974) have given a general account of the vegetation. Contributions have also been made by Raizada and Chatterjee (1963), Maheshwari (1964), Vasudevan Nair (1967), Nayar (1966, 1969), Ravi (1970), Mohanan (1981) and Mohanan et al. (1980, 1982) based on sporadic collections. Joseph and Chandrasekharan (1973, 1974, 1978, 1982) have undertaken three exploration trips to Bonaccord northwest slopes and western slopes of Agasthyamala. However, a clear picture of the floristics of the district was lacking. In 1994, M. Mohanan published the Flora of Thiruvananthapuram, which formed an authentic report on the floristic diversity of the district. Mohanan and Sivadasan (2002) published an exclusive floristic study of Agasthyamala, one of the three endemic hotspots recognized in the state. It gave an account of the magnificient floristic wealth of the hilly ranges of the district. All these studies resulted in recording 1872 species from the district with 324 endemic representations.

The present study based on the previous works and data gathered through field explorations unravelled the status of endemic floristic diversity of the district that contributes significantly to the floristic uniqueness of the state. It is mainly the forested highland zone of the state where natural vegetation flourishes and which forms the major habitat of endemics. Agasthyamala hills alone constitute an important area of high endemism in the state, having about 180 endemic species of which 44 species, 1 subspecies and 5 varieties are exclusively represented from the state (Table 7), of which the distribution of 21 species, 1 subspecies and 4 varieties is strictly confined to the district only (marked with asterik). During the present study, all type localities of the above endemic species and their surrounding areas were explored, which resulted in the collection of 14 species, 2 varieties and also identified some extended distribution localities of the above taxa. Most of the species are represented by small populations and are found in specific localities. Such species include *Acrotrema agastyamalaynum, Arisaema agasthyanum, Fuirena ponmudiensis, Grewia palodensis, Isachne jayachandranii, Memecylon agastyamalaianum, Memecylon sivadasanii, Strobilanthes pushpangadanii,* and *Symplocos macrophylla* ssp. *namboodirianus*. It is generally considered that

mountain peaks behave like islands in their endemic contents and the research-results of the present study significantly support this view as majority of the species described from the highlands of the district are strictly confined to the mountain peaks of Agasthyamala, Chemungi and Ponmudi. Woody life form is considered as one of the characteristic features of palaeoendemism (Bramwell, 1972). Species like *Buchanania barberi, Dialium travancoricum, Humboldtia unijuga* var. *trijuga, Ixora agasthymalayana, Litsea beei, Memecylon agastyamalaianum, Memecylon sivadasanii, Pavetta bourdillonii,* and *Symplocos macrophylla* ssp. *namboodirianus* with characteristic woody habit substantiate the relic nature of the flora.

From the above analysis, it could be concluded that most of the exclusive endemic species of the district are confined to very narrow geographical areas at different altitudinal zones within the high ranges, probably due to their antiquity or habitat specificity. Further, these floristic areas of relict nature represent an active epibiotic zone for speciation as evidenced by the occurrence of a few newly evolved species, such as *Memecylon sivadasanii, M. agastyamalaianum, Ixora agasthyamalayana, Acrotrema agastyamalaynum* and *Litsea beei.* The present study led to the discovery and description of *Memecylon sivadasanii*, a species new to science and also the rediscovery of an exclusive endemic and endangered species *Buchanania barberi* Gamble, known only by the type collection by C. A. Barber in 1904 from the coastal area of 'Nadarai' (= Nadayara), after a lapse of 97 years of its first collection. The findings assume conservation significance.

Table 7. Checklist of exclusive endemic taxa of Kerala recorded from Thiruvananthapuram District

Sl. No	Names of endemic taxa	Locality
1	*Acrotrema agastyamalaynum**	Braemore, Agasthyamala
2	*Amorphophallus bonaccordensis**	Bonaccord,Agasthyamala
3	*Amorphophallus nicolsonianus*	Agasthyamala
4	*Antidesma keralense**	Chemungi,Agasthyamala
5	*Ardisia stonei*	Agasthyamala
6	*Arisaema agasthyanum**	Agasthyamala
7	*Arisaema sarracaenioides*	Agasthyamala
8	*Biophytum reinwardtii* var. *keralanum**	Pongumudu
9	*Biophytum veldkampii*	Nedumangad
10	*Buchanania barberi**	Palode
11	*Calamus dransfieldii*	Braemore
12	*Cheirostylis seidenfadeniana**	Agasthyamala
13	*Cynometra beddomei*	Agasthyamala
14	*Dialium travancoricum**	Ponmudi hills

Sl. No	Names of endemic taxa	Locality
15	*Dimeria agasthyamalayana**	Agasthyamala
16	*Exacum courtallense* var. *bonaccordensis*	Bonaccord, Agasthyamala
17	*Fimbristylis angamoozhiensis*	Agasthyamala
18	*Fimbristylis pseudonarayanii*	Bonaccord
19	*Fuirena ponmudiensis**	Ponmudi hills
20	*Grewia palodensis**	Manthuruthy Kavu, Palode
21	*Humboldtia unijuga* var. *trijuga**	Chemungi, Agasthyamala
22	*Isachne fischeri*	Palode
23	*Isachne jayachandranii**	Agasthyamala
24	*Ischaemum agathyamalayanum**	Agasthyamala
25	*Ischaemum quilonensis*	Palode
26	*Ixora agasthymalayana**	Agasthyamala
27	*Julostylis polyandra*	Ponmudi hills
28	*Kunstleria keralensis*	Palode
29	*Litsea travancorica*	Chemungi
30	*Litsea beei**	Attayar, Agasthyamala
31	*Medinilla anamalaiana*	Chemunji, Agasthyamala
32	*Memecylon agastyamalaianum**	Chemunji, Agasthyamala
33	*Memecylon sivadasanii**	Kurusumala, Agasthyamala
34	*Memecylon wightianum*	Bonaccord
35	*Oberonia agasthyamalyana**	Agasthyamala
36	*Ophiorrhiza caudata*	Mercheston
37	*Pavetta bourdillonii**	Agasthyamala
38	*Pavetta oblanceolata*	Mercheston
39	*Pavetta travancorica*	Agasthyamala
40	*Phaeanthus malabaricus*	Agasthyamala
41	*Phyllocephalum rangacharii* var. *agastyamalayanum**	Ponmudi
42	*Symplocos macrophylla* ssp. *namboodirianus**	Agasthyamala
43	*Strobilanthes barbatus* var. *bonaccordensis**	Bonaccord
44	*Strobilanthes pushpangadanii**	Agasthyamala
45	*Syzygium bourdillonii*	Mercheston
46	*Tephrosia travancorica**	Agasthyamala
47	*Thottea abrahamii**	Braemore, Agasthyamala
48	*Thottea Idukkiana*	Agasthyamala
49	*Thottea ponmudiana**	Ponmudi hills

Sl. No	Names of endemic taxa	Locality
50	*Vernonia beddomei*	Agasthyamala

* Taxa reported as new to science from the district

4.1.2. Kollam

4.1.2.1. Ecosystem characteristics

Considering the physical features, this district can be divided into three natural divisions. The coastal zone of the district is famous for its backwaters, rich mangroves and estuarine vegetation. Extensive areas of midland zone are under cultivation and have thus lost their natural vegetative features, but some sacred groves of this zone maintained as a remnants of the past natural vegetation. As a part of the Western Ghats, highlands or mountain zone of the district hold all major type of vegetations. They are tropical evergreen forests, tropical semi-evergreen forests and tropical moist-deciduous forests. In addition to these major categories of forests, vegetation of special habitat include the following types: Grasslands, Bamboo thickets and *Myristica* swamps.

1 Shenduruny WLS
2 Kottarakkara
3 Ashtamudi
4 Thenmala

Fig. 8. Profile of Kollam District

Shenduruny Wildlife Sanctuary (the name 'Shenduruny' has been derived from an endemic tree locally called 'Chenkurinji' (*Gluta travancorica*), which is confined to this tract), is located in the Thenmala forest division of Kollam district. The sanctuary has an area of 100 sq. km, including Kallada reservoir. The altitude varies from 120–1550 m and the highest peak is Alvarakurichi.

4.1.2.2. Floristics

The earlier workers who made contribution to the vegetation study of the district include renowned botanists like Wight (1840-1853), Beddome (1864-1868), Lawson (1894), Bourdillon (1908), Barber (1900-1915), Rama Rao (1914), Barnes (1939), Cherian Jacob (1947),

Krishnamoorthy (1960, 1973), N.C. Nair (1981), Gamble & Fischer (1915-1936) and Hooker *et al.* (1872-1897). The district was partially explored by Subramaniyan (1995) and later a few collections were made by Chandrabose (1967). A comprehensive account of the flora of the district was made by Mohanan (1984), which resulted in the recognition of 1400 species belonging to 160 families including a new report of the genus *Kunstleria* to Indian flora. Ravi (1969a, 1969b), Ravi *et al.*, (1998) also made remarkable contributions to the flora of the district.

The Shenduruny Wildlife Sanctuary is the part of erstwhile Travancore state. This region has been reasonably well explored by forest botanists like Beddome, Bourdillon, Barber and Fischer during the late 19th centuary (Burkill, 1965).Their studies resulted in the discovery of several new taxa, most of which are confined to this region only. Vignarajan (1990) listed out 212 species from Shenduruny. Zachariah (1991) studied the rare, endangered and endemic tree species of Shenduruy Valley. A study of Shenduruny flora by Sasidharan (1995) with emphasis on endemic species resulted in recognition of 951 taxa, of which 309 are Western Ghats endemics. He described one new species, viz. *Polyalthia shendurunii* and one new variety, viz. *Stereospermum colais* var. *shendurunii* and reported the rediscovery of some exclusively endemic RET (Rare, Endemic and Threatened) species like *Syzygium bourdillonii, Inga cynometroides, Sageraea grandiflora, Vernonia beddomei* from the area. Recently Santhosh Kumar *et al.* described two new species viz. *Andrographis chendurunii, Ophiorrhiza shendurunii* and Anto *et al.* described one new rattan species viz. *Calamus shendurunii* from the Sanctuary.

The analysis of the present study showed that the district represents 309 Western Ghats endemics including 32 species and 2 varieties of exclusive endemics of the state (Table 8), of which 16 species and 1 variety are strictly confined to the district and others showing extended distribution. Most of the species are concentrated on the upper ghat region of the district, forming an endemic belt. It is evident that palaeoendemics are on their way to extinction. This view is substantiated by the occurrence of some exclusive endemic species of the district coming under the IUCN Red List categories. Such species include *Aglaia malabarica, Aporusa bourdillonii, Cynometra beddomei, Dialium travancoricum, Inga cynometroides, Litsea travancorica, Polyalthia shendurunii, Phaeanthus malabaricus, Sageraea grandiflora, Syzygium bourdillonii* and *Vernonia beddomei.* Causes for its rarity and possible extinction may be due to deforestation for development or agriculture.

Ischaemum quilonensis, a new neoendemic grass species discovered from the low-lying wetlands of the district shows evolutionary significance. This genus includes the tribe

Andropogoneae – an actively evolving group in the Peninsular Indian region which is considered as the 'centre of speciation' of the genus (Mehrotra & Jain, 1980).

Table 8. Checklist of exclusive endemic taxa of Kerala recorded from Kollam District

Sl. No.	Names of endemic taxa	Locality
1	*Aglaia malabarica*	Rosmala
2	*Amorphophallus nicolsonianus*	Shenduruny
3	*Andrographis chendurunii**	Pandimotta
4	*Aporusa bourdillonii*	Kattalappara
5	*Ardisia stonei*	Rosmala
6	*Calamus shendurunii**	Shenduruny
7	*Curcuma ecalcrata*	Kulathupuzha
8	*Curcuma vamana*	Roockwood
9	*Curcuma haritha*	Achankovil
10	*Cynometra beddomei*	Shenduruny
11	*Dialium travancoricum*	Aryankavu
12	*Ecbolium ligustrum* var. *aryankavensis**	Aryankavu
13	*Fimbristylis pseudonarayanaii**	Chadayamangalam
14	*Gymnostachyum sahyadricum**	Chokkampatty hills
15	*Hibiscus sreenarayanianus**	Palkulangara
16	*Inga cynometroides**	Shenduruny
17	*Ischaemum quilonensis**	Perumkulam Ela
18	*Ixora johnsonii**	Kulathupuzha
19	*Julostylis polyandra*	Rosmala
20	*Kunstleria keralensis**	Kallar
21	*Litsea travancorica**	Thenmala
22	*Memecylon wightianum*	Shenduruny
23	*Ochlandra ebracteata*	Achankovil
24	*Ophiorrhiza shendurunii**	Pandimotta
25	*Pavetta oblanceolata*	Thenmala
26	*Phaeanthus malabaricus*	Palaruvi
27	*Polyalthia shendurunii**	Rosmala
28	*Sageraea grandiflora**	Kattalappara
29	*Sida ravii**	Paravur
30	*Stereospermum colais* var. *shendurunii**	Sangili
31	*Syzygium bourdillonii*	Rosmala
32	*Thottea Idukkiana*	Thenmala
33	*Utricularia subramanii**	Adoor

Sl. No.	Names of endemic taxa	Locality
34	*Vernonia beddomei**	Rosmala

* Taxa reported as new to science from the district

4.1.3. Pathanamthitta

4.1.3.1. Ecosystem characteristics

The district is endowed with geological antiquity, physiographic uniqueness, cultural linkages, vegetational diversity and the occurrence of high percentage of endemics. Most of the forest areas are under Ranni and Konni forest divisions. The holy temple of Lord Ayyappa is situated here.The district consists of three natural divisions as other parts of Kerala, viz. the lowlands, midlands and highlands. The topography of the district is highly undulating with hills and valleys. The lowland area of the district is small in size and restricted to western borders. The highland stretches through the Western Ghats and descends to the midland in the centre. Most of the areas are under rubber cultivation. The main attractive feature of this area is the presence of a large number of small sacred groves which once existed as dense lowland evergreen forests. The upland vegetation is primarily of 3 categories: tropical evergreen forests including small sholas of upper hills, tropical semi-evergreen forests, and tropical moist-deciduous forests with special vegetational habitats like grasslands, riparian vegetation and aquatic and semi-aquatic vegetation.

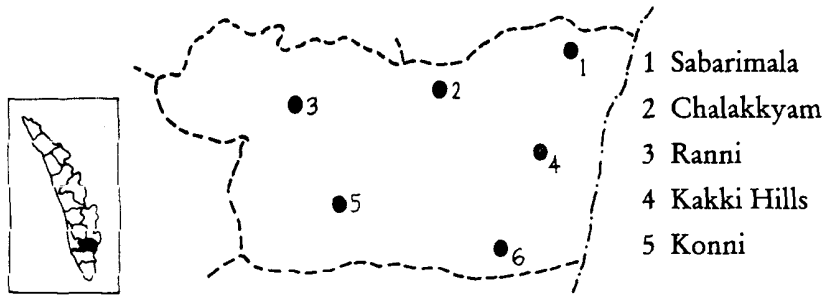


Fig. 9. Profile of Pathanamthitta District

4.1.3.2. Floristics

The district was first throughtly botanized by C. N. Mohanan (1984) who studied the flora of Kollam. A considerable extent of Pathanamthitta was part of erstwhile Kollam district. Menon (1947-1962) and Narayana Pillai (1958-1973) have given a general account of the vegetation of Konni and Ranni forest divisions. Chandrasekaran (1993, 1995) explored areas like Goodrical and Moozhiar. The other plant collectors of this region were Vajravelu, N.C. Nair, Vivekanandan, Pandurangan and Chandrabose of the Botanical Survey of India. Another notable plant collector of this region was Ravi. An exclusive floristic study of the

district was conducted by Anil Kumar and Sivadasan (1993), who recorded about 1250 species distributed in 658 genera belonging to about 148 families, of which 253 species are endemic to Peninsular Indian region, which forms 20% of the total endemics. During the study, 3 species namely *Julostylis polyandra, Dysoxylum swaminathanianum and Fimbristylis angamoozhiensis* were described as new exclusively from the district.

Present study indicated that most of the endemics are concentrated on the evergreen forests of Moozhiar, Angamoozhy, and Kakki hills of Goodrical forest range under Ranni forest division. Previous studies resulted in the recognition of 253 Peninsular Indian endemic species from the district. Present study and analysis revealed that the district represents 26 species and 1 variety of strict endemics of the state (Table 9), of which 9 species and 1 variety are exclusively reported from the district. The discovery of two grass species – *Dimeria sivarajanii* and *Dimeria namboodiriana* – from higher altitude proved the successful speciation of the Andropogonid genus in higher altitude also. *Diospyros sulcata*, a palaeoendemic species reported from the district is not collected after its type collection. When habitat parameters are disturbed, certain palaeoendemics which are extinction-prone become active epibiotics. The discovery of another phytogeogrphically interesting species, *Julostylis polyandra* from the district formed a record of its extended distribution of the genus *Julostylis*, which was considered as monotypic and endemic to Sri Lanka. The discovery of this species from

Table 9. Checklist of exclusive endemic taxa of Kerala recorded from Pathanamthitta District

Sl. No	Names of endemic taxa	Locality
1	*Bulbophyllum rosemarianum*	Perumthenaruvi
2	*Calamus gamblei* var. *sperocarpa**	Kakki
3	*Chrysopogon purushothamanii**	Kokkathodu
4	*Colubrina travancorica**	Ranni
5	*Cucumella silentvalleyii*	Moozhiar
6	*Curcuma coriacea*	Ponnambalamedu
7	*Curcuma ecalcarata*	Thiruvalla
8	*Curcuma haritha*	Karikayam
9	*Dimeria Idukkiensis*	Kakki
10	*Dimeria kurunthotticalana*	Kokkathodu
11	*Dimeria namboodiriana**	Ponnambalamedu
12	*Dimeria sivarajanii**	Ponnambalamedu
13	*Diospyros sulcata**	Ranni
14	*Disoxylum swaminathanianum**	Angamoozhy
15	*Fimbristylis angamoozhiensis**	Angamoozhy
16	*Fimbristylis pseudonarayanaii*	Ranni
17	*Hibiscus sreenarayanianus*	Adoor
18	*Julostylis polyandra**	Kakki
19	*Justicia pathanamthittiensis**	Ranni
20	*Kunstleria keralensis*	Kalleli
21	*Lepistemon vedcourtii**	Ranni
22	*Litsea travancorica*	Angamoozhy
23	*Ochlandra ebracteata*	Ranni
24	*Ochlandra keralensis*	Ranni
25	*Phaeanthus malabaricus*	Ranni
26	*Sida ravii*	Adoor
27	*Thottea Idukkiana*	Sabarigiri

* Taxa reported as new to science from the district

southern Western Ghats substantiated the view of Gondwanaland origin of Peninsular Indian flora. *Chrysopogon purushothamanii*, a neoendemic grass species was discovered from the highland region of the district.

4.1.4. Alappuzha

4.1.4.1. Ecosystem characteristics

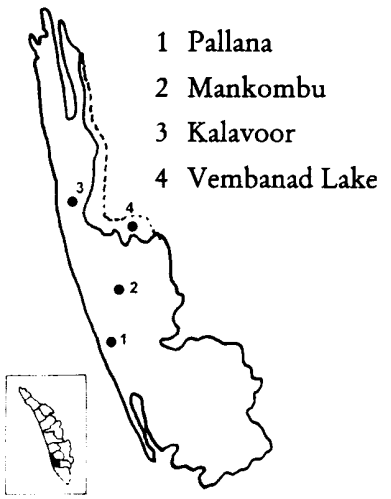


Fig. 10. Profile of Alappuzha District

Alappuzha district is one of the unique districts in Kerala which does not have any mountain region of the Western Ghats in Kerala. It is mainly a coastal district and the major part of the district is occupied by wetlands which are seen near the margins of water courses like pools, puddles, backwaters, along marshy places and coastal regions. Along the lowlands, reclaimed from Vembanad and Kayamkulam lakes, low-lying wet grasslands are found. Some of such areas are below the mean sea level. Thousands of hectare of such low-lying wet grasslands are found in the Kuttanad region, which forms a part of the Vembanad wetland system.

Coastal zone comprises flat, sandy belts with a series of backwaters and estuaries as intrusion from the sea. One of the many natural advantages of the district is the presence of an extensive system of backwaters and canals with characteristic vegetations such as sacred groves, aquatic and semi-aquatics, mangroves and semi-mangroves, and coastal and vegetation in cultivated lands.

4.1.4.2. Floristics

During the study of Kerala grasses, Sreekumar (1991) discovered several new and interesting species from the district. The other plant collectors of the district were the scientists like Prasad and Bhargavan of the Botanical Survey of India and Ravi (1996) of S. N. College, Kollam, who made valuble collections from the district. A systematic study of the district was done by Sunil and Sivadasan (2009) and it resulted in the recognition of 1111 species of flowering plants belonging to 617 genera under 139 families, of which 64 species were endemics. During the above study, previously described exclusive endemics of the district from type localities were collected and recorded extended distribution of some species like *Nymphoides macrospermum, N. sivarajanii* and *Justicia ekakusuma*. All these studies revealed that grass dominated ecosystems at lower altitude (wetlands) have much diversity and

Table 10. Checklist of exclusive endemic taxa of Kerala recorded from Alappuzha District

Sl. No	Names of endemic taxa	Locality
1	*Curcuma raktakanta*	Aroor
2	*Dimeria copeana**	Thrikkunnapuzha
3	*Dimeria copei**	Kalavoor
4	*Dimeria kalavoorensis**	Kalavoor
5	*Ischaemum kumarakodiensis**	Pallana
6	*Ischaemum vembanadense**	Thottapalli
7	*Justicia ekakusuma*	Alappuzha
8	*Nymphoides macrospermum*	Angadikal
9	*Nymphoides sivarajanii*	Kurupanthara
10	*Ruellia sivarajanii**	Alappuzha

* Taxa reported as new to science from the district

endemism. The district alone contributed 6 endemic species among the 10 exclusive endemic species of Kerala (Table 10) including one species of the genus *Ruellia* of Acanthaceae. It is interesting to note that the newly described grass species of the district coming under the genera *Ischaemum* and *Dimeria* of the tribe *Andropogoneae* are having the highest number of endemic grass species in the state. It is one of the actively evolving groups in the Western Ghats region. A new grass species, viz. *Ischaemum kumarakodiensis* has also been described from the district.The observations and analysis showed that the grass dominated ecosystems of the lower altitude of the district forms an endemic belt of active speciation center for aquatic plants. But unfortunately most of the species confined to this region have become very scarce and rare due to the distruction of the habitats.

4.1.5. Kottayam

4.1.5.1. Ecosystem characteristics

On a physiographic basis, the district is well demarcated into lowland, midland and highlands with characteristic vegetation types. The lowland of the district mainly comprises wetlands and it is noted for backwater and extensive paddy fields. Midland region is mostly undulated and cultivated. Occurrences of sacred groves are not common in this region. Highlands or mountain consists of fragmented vegetation of evergreen, deciduous and grasslands.

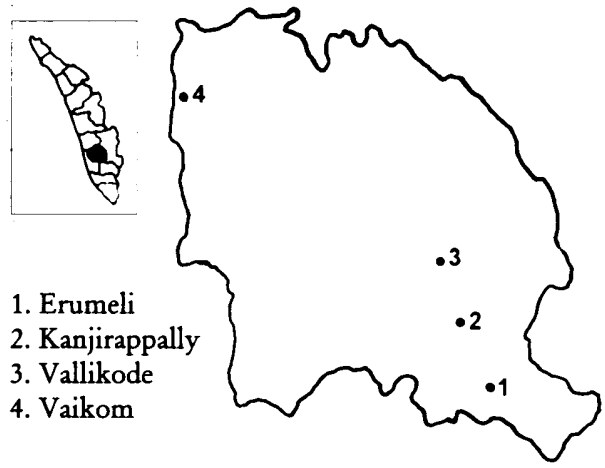


Fig. 11. Profile of Kottayam District

4.1.5.2. Floristics

Antony (1989) studied the flora of Kottayam district and published few papers on various aspects related to the flora (Antony, 1991). Jacob (1947), N. C. Nair (1966), Sreekumar have also studied the grass flora of the district. A total 929 angiosperm species were recorded from the district, of which 85 species are endemic. Among the 85 species, 5 species are exclusively endemic to the state (Table 11). During the present study 3 species, viz. *Curcuma ecalcarata* and *Phaeanthus malabaricus* from erumeli and *Curcuma raktakanda* from Vaikom were collected. The district shows low endemic percentage compared to other districts due to habitat destruction especially in the highlands.

Table 11. Checklist of exclusive endemic taxa of Kerala recorded from Kottayam District

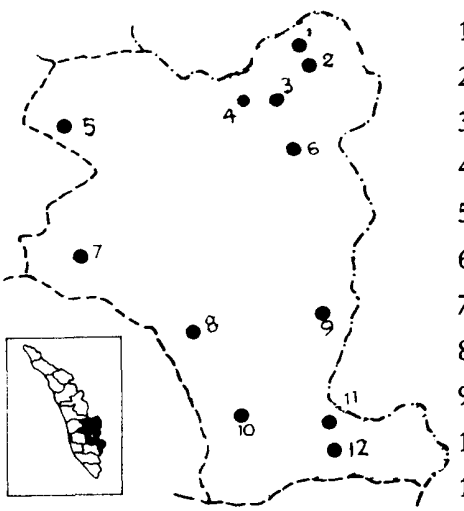
Sl. No	Names of endemic taxa	Locality
1	*Adenosma malabarica*	Palamattom,
2	*Curcuma ecalcarata*	Erumeli
3	*Curcuma raktakanda*	Vaikom
4	*Lepigagathis balakrishnanii**	Perunna
5	*Phaeanthus malabaricus*	Erumeli

* Taxa reported as new to science from the district

4.1.6. Idukki

4.1.6.1. Ecosystem characteristics

The district is mostly mountainous with almost unbroken undulating hillocks. The altitude ranges from 500 to 2695 m, with Anamudi, the highest peak in South India, forming the nodal point of the Southern Ghats. The district has a wide range of vegetational formations. They are: montane wet temperate forests, montane wet grasslands, tropical wet-evergreen forests, subtropical hill forests, moist-deciduous forests, tropical dry-deciduous forests and subtropical hill savannah. In Idukki district there are two National Parks, viz. Eravikulam National Park & Periyar National Park, and three Wildlife/ Bird sanctuaries, viz. Idukki Wildlife Sanctuary, Chinnar Wildlife Sanctuary and Thattekkad Bird Sanctuary.



1. Chinnar WLS
2. Marayur
3. Anamudi
4. Eravikulam NP
5. Pooyamkutty
6. Devikulam
7. Thodupuzha
8. Idukki WLS
9. Valakettimala
10. Peerumedu
11. Thekkady

Fig. 12. Profile of Idukki District

4.1.6.2. Floristics

Unlike other districts of Kerala, the flora of Idukki has not yet been completely

explored, perhaps because of the unique physiographic nature of the area. It occupies both the lowlands of the Deccan Plataeu at one end and the highest peak of the south of Himalaya (Anamudi) on the other end. Thus the available fragmented studies of the district were not enough to elucidate the actual picture of the floristic structure of this highly undulating terrain. It was Beddome (1882), who made the first botanical collection from the district. Barnes, Beddome, Bourdillon, Meebold and Venkoba Rao made collections in the late 19th centuary and early 20th centuary and these collections were cited by Hooker (1872-1897) and Gamble (1915-1936). A number of new species have been described from the area by Barnes (1939), Bor (1938), Fischer (1932, 1933, 1934a, 1934b, 1935, 1936, 1938a, 1938b, 1939) and Summerhayes (1936). Rama Rao (1914) in his *Flowering Plants of Travancore* refers several places of this area. Iyppu (1960) and Chandrasekaran (1962) described the forest type of this region. Sebastine and Vivekananthan (1967) and Shetty and Vivekananthan (1971, 1991) published brief accounts of the flora of Anamudi and Devicolam ranges. Vivekananthan (1978) studied vegetation of Periyar Wildlife Sanctuary and also enumerated 12 rare and threatened plants of the area. Studies by Shetty and Vivekananthan (1968–1975), Sharma *et al.* (1974), Nair and Sreekumar (1980), and Pandurangan and Nair (1985) resulted in the discovery of several new species from the district. Nagendran *et al.* (1976-1977) and Bhaskar and Razi (1978) have made collections of Podostemaceae and Balsaminaceae from the district. Mohanan *et al.* (1984) reported some rare and interesting plants from the Idukki Hydro-electrical project area. Balasubramanyam *et al.* (1989) described some rare and interesting plants from the Pooyankutty Hydro-electric project area. Jomy Augstine (2001) studied the angiosperm flora of Periyar Tiger Reserve of the district.

The unique physiographic-mountainous configuration coupled with high altitude, heavy rain fall and tropical humid climate made, the district bestowed with a large number of endemic species including biotopic and stenotopic endemics. Present study enumerates 845 species of Peninsular Indian endemics, particularly Western Ghats endemics distributed in the district. The district alone contributes 63 species and 3 varieties as exclusive endemics from certain niche-specific areas (Table 12).

During the present study, a new grass species named as *Arundinella ravii*, was discovered (Shaju & Mohanan, 2004) from the high altitude grasslands of Eravikulam National Park.

Table 12. Checklist of exclusive endemic taxa of Kerala recorded from Idukki District

Sl. No	Names of endemic taxa	Locality
1	*Anaphalis barnesii*	High ranges
2	*Antistrophe glabra**	Kanjiar
3	*Aporusa bourdillonii*	Anakulam

Sl. No	Names of endemic taxa	Locality
4	*Ardisia stonei*	Kulamavu
5	*Arisaema attenuatum* *	Munnar
6	*Arisaema peltatum**	Munnar
7	*Arisaema psittacus**	Mannavanshola
8	*Arisaema sarracaenioides**	Pambadishola
9	*Arundinella ravii**	Eravikulam National Park
10	*Biophytum congestiflorum**	Peerumedu
11	*Bothriochloa parameswaranii*	Eravikulam National Park
12	*Bulbophyllum rosemarianum**	Thalakode
13	*Ceropegia beddomei**	Kurisumala
14	*Christisonia indica**	Mannavan Shola
15	*Connarus parameswarani**	Adimali
16	*Cucumella silentvalleyii*	Adimali
17	*Curcuma coriacea*	Painavu
18	*Curcuma vamana*	Thekkadi
19	*Didymocarpus macrostachya**	Anamalai
20	*Dimeria Idukkiensis**	Kuttikkanum
21	*Dimeria sreenaryanii*	Kuttikkanum
22	*Dysoxylum beddomei*	Peerumedu
23	*Fimbristylis stigmatotecta**	Devikolam
24	*Habenaria flabelliformis**	Not specified
25	*Impatiens coelotropis**	Nemakad Gap
26	*Impatiens concinna**	Not specified
27	*Impatiens johnii**	Kallar
28	*Impatiens kulamavensis**	Kulamavu
29	*Impatiens macrocarpa**	Devikolam
30	*Impatiens munnarensis**	Kannimala
31	*Impatiens pallidiflora**	Devikolam
32	*Impatiens pandata**	Karamkulam
33	*Impatiens platyadena**	Anamudi
34	*Impatiens verecunda**	Periyakanal
35	*Impatiens violacea**	Pettimudi
36	*Isachne fischeri**	Eravikulam National Park
37	*Ischaemum agasthyamalayanum*	Lokhgat Gap
38	*Ischaemum tadulingamii**	Eravikulam National Park
39	*Ixora johnsonii*	Peerumedu

Sl. No	Names of endemic taxa	Locality
40	*Kunstleria keralensis*	Peerumedu
41	*Mucuna pruriens* var. *thekkadiensis**	Periyar Tiger Reserve
42	*Ochlandra soderstromiana*	Kallar
43	*Ochlandra spirostylis*	Adimali
44	*Ophiorrhiza barnesii**	Kallar
45	*Ophiorrhiza caudata**	Kallar
46	*Ophiorrhiza munnarensis**	Eravikulam National Park
47	*Ophiorrhiza nairii*	Adimali
48	*Palaquium ravii*	Anakulam
49	*Phaeanthus malabaricus*	Adimali
50	*Podostemon munnarense**	Munnar
51	*Pogostemon travancoricus* var. *devicolamensis**	Devikolam
52	*Pothos keralensis**	Kulamavu
53	*Psychotria keralensis*	Adimali
54	*Sageraea grandiflora*	Anamalai
55	*Schefflera chandrasekharanii**	Nemakad
56	*Smithia venkobarowii*	Peerumedu
57	*Sonerila nemakadensis**	Nemakad Gap
58	*Stictocardia sivarajanii**	Kallar
59	*Syzygium bourdillonii*	Adimali
60	*Syzygium periyarensis**	Periyar Tiger Reserve
61	*Taeniophyllum scaberulum**	Periyar Tiger Reserve
62	*Tripogon sivarajanii**	Valakettimala
63	*Vernonia anaimudica* *	Rajamala
64	*Vernonia multibracteata**	Peerumedu
65	*Zehneria maysorensis* var. *oblonga*	Kumili
66	*Zenkeria jainii**	Eravikulam National Park

* Taxa reported as new to science from the district

4.1.7. Ernakulam

4.1.7.1. Ecosystem characteristics

The district is well known for its coastal zone. This area was characterised by different ecosystems like mangroves, sacred groves and wetlands. Due to fast development of the district, these ecosystems are almost destroyed. The midland zone is mostly cultivated and the occurrence of several sacred groves especially Iringole sacred grove comprise a large number of endemic species. A thin layer of evergreen and deciduous forests form the highland vegetation.

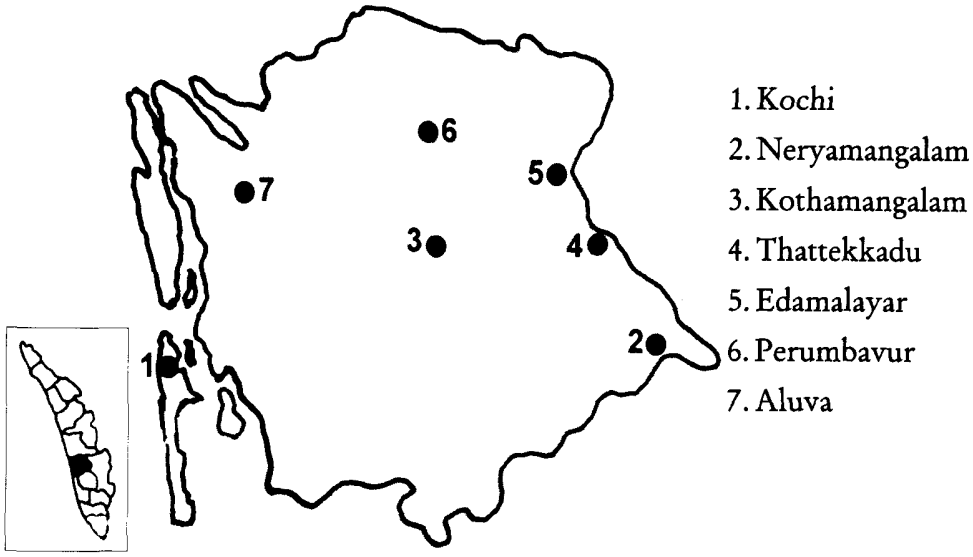


Fig. 13. Profile of Ernakulam District

4.1.7.2. Floristics

Hortus Malabaricus, a monumental work on the plants of Malabar gave basic informations about plants of this district. Meebold (1910) mentioned type localities of two species from the district, but any of the further studies could not relocate it. Yet a systematic floristic study of the district was not done. Certain studies on Mangoves (Anupama & Sivadasn, 2004), Sacred groves (Induchoodan *et al.*, 1991) and forest area of the district (Sivadasan *et al.*, 2001) adds to the floristic knowledge of the district.

Explorations at the type localities of *Impatiens cochinica* and *Burmania stricta* (Meebold,1910) during the present study, could not relocate the species which are supposed to be extinct. Recently discovered species like *Lagenandra keralensis* (Sivadasan *et al.*, 2001) and *C. raktakanda* (Mangaly & Sabu,1983) were recollected. This study revealed that only 6 exclusive endemic species (Table 13) are present in this district. The comparatively less endemic diversity of the district is due to destruction of natural vegetation by habitat degradation, and lack of conservational operations.

Table 13. Checklist of exclusive endemic taxa of Kerala recorded from Ernakulam District

Sl. No	Names of endemic taxa	Locality
1	*Burmannia stricta**	Cochin
2	*Curcuma raktakanta*	Neerikode
3	*Impatiens cochinica**	Kavalay-Cochin
4	*Lagenandra keralensis**	Bhoothathankettu
5	*Phaeanthus malabaricus*	Evergreen
6	*Rotala vasudevanii**	Aluva

* Taxa reported as new to science from the district

4.1.8. Thrissur

4.1.8.1. Ecosystem characteristics

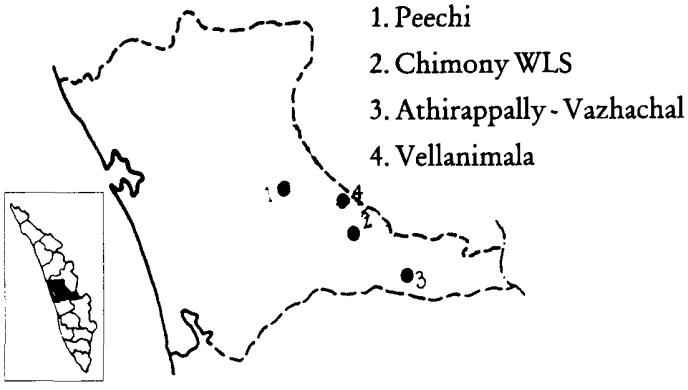


Fig. 14. Profile of Thrissur District

Based on topography, this district can be broadly divided into hilly regions in the east, cultivated lands with aquatic areas in the centre and the coastal belt in the west. Depending on altitudes the hilly regions consists mainly of evergreen, semi-evergreen and moist-deciduous forests. Sholas and grasslands are confined to small areas along the hill-tops.

There are two wildlife sanctuaries in the district, viz. Peechi-Vazhani Wildlife Sanctuary in Thrissur Forest Division, and the Chimmony Wildlife Sanctuary in Chalakudy Forest Division. Athirapally, the proposed hydro-electric project area having rich reverine vegetation is a part of this district.

4.1.8.2. Floristics

Earlier plant collections made from the district under study by Ramamurthy and Chandrasekharan (1981), and Ramamurthy and Rajan (1983, 1985) resulted in the discovery of some new and interesting taxa. A systematic study of the forest area of the district was done by Sasidharan & Sivarajan, and published in 1996. This gave a clear picture of the floristc wealth of the district having 1,645 species of flowering plants belonging to 703 genera under 129 families, and with 262 endemic species including 33 species of exclusive endemics of Kerala (Table 14). Among them there are several rare plants and few new taxa of botanical and phytogeographical interest. Exclusive endemic tree species like *Aglaia malabarica, Dysoxylum beddomei, Palaquium ravii* and occurrence of narrow endemic species like *Smithia venkobarowii, Aporusa bourdillonii, Strobilanthes dupenii* shows the palaeoendemic nature of the flora. Present study on the district is mainly concentrated on the Athirapally - Sholayar forest continuum and Peechi - Vazhani forest area, which results more than 150 endemic plants of Wesrtern Ghats including 5 exclusive endemic species of Kerala. They are *Aporusa bourdillonii, Smithia venkobarowii, Stobilanthes dupenii, Aglaia malabarica* and *Lagenandra nairii*, a *point endemic* species from the down stream area of Athirapally water falls.

The highly endemic areas of Athirapally-Vazhachal regions are under severe threat due to tourism and other activities. Implementation of proposed Athirapally hydal project will be

an irreparable loss of endemic wealth and extinction of narrow endemic species forever.

Table 14. Checklist of exclusive endemic taxa of Kerala recorded from Thrissur District

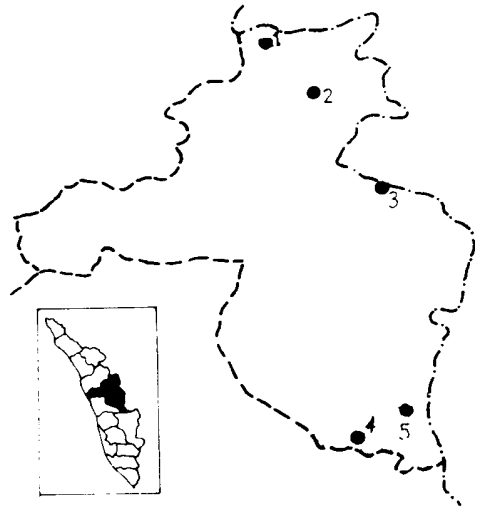
Sl. No	Names of endemic taxa	Locality
1	*Aglaia malabarica*	Peechi
2	*Alpinia smithiae*	Sholayar
3	*Amorphophallus nicolsonianus*	Peechi
4	*Aporusa bourdillonii*	Vazhachal
5	*Ardisia stonei*	Peechi
6	*Biophytum longipedunculatum**	Peringalkuthu
7	*Colubrina travancorica*	Kaladi, vellikulangara
8	*Cucumalla silentvalleyii*	Peechi
9	*Curcuma ecalcarata*	Vazhachal
10	*Curcuma raktakanda*	Chalakudy
11	*Curcuma vamana*	Peechi
12	*Dysoxylum beddomei*	Vellanimala
13	*Eriocaulon ansarii**	Kodungallur
14	*Fimbristylis dauciformis**	Peringalkuthu
15	*Fimbristylis humerosa**	Vazhachal
16	*Fimbristylis hyalina**	Athirapally
17	*Fimbristylis perspicua**	Peechi
18	*Hibiscus sreenarayanianus*	Vazhani
19	*Impatiens sholayarensis*	Sholayar
20	*Ischaemum cannanorensis*	Karimala
21	*Kingidium niveum*	Sholayar
22	*Kunstleria keralensis*	Sholayar
23	*Lagenandra nairii**	Athirapally
24	*Lepistemon verdcourtii*	Vazhachal
25	*Ochlandra ebracteata*	Sholayar
26	*Orophea malabarica**	Peechi
27	*Osbeckia abrahamii*	Sholayar
28	*Palaquium ravii*	Peechi
29	*Phaeanthus malabaricus*	Vellanimala
30	*Pycreus similinervulosus**	Orukomban
31	*Smithia venkobarowii*	Sholayar
32	*Strobilanthes dupenii*	Poringalkuthu
33	*Tarenna trichurensis**	Vellanimala

* Taxa reported as new to science from the district

4.1.9. Palakkad

4.1.9.1. Ecosystem characteristics

Physiography of the district varies with hills, valleys, rivers and streams making it rich in vegetation. Highlands or mountain zone consists of hills and valleys and mountains of the southern part of the Western Ghats. Potentially, the major types of vegetation occurring within the zone are tropical wet-evergreen forests, tropical moist-deciduous forests, subtropical montane forests, and swards of higher altitudes.



1. Silent Valley NP
2. Attappady
3. Malampuzha
4. Parambikulam WLS
5. Nelliyampathy

Fig. 15. Profile of Palakkad District

4.1.9.2. Floristics

The information available on the flora of Palakkad district is in the form of fragmentary publications. Sporadic collections were made by Wight (1844-48), Cleghorn (1852-59), Beddome (1865-71), Lawson (1883-84), Barber (1898), Fischer (1914-16), Jacob (1923-25). With regards to the publications having direct relevance to the flora of the district, the work of Ayyar (1932) dealing with the sholas of the Palakkad Division is worth mentioning.

Chandrasekharan (1962) has described the forest types of Kerala in general. Sebastine (1966), Joseph (1978, 1982), Sathishkumar (1994, 2004), Sharma & Srivastava (1993), Shivamurthy & Sadanand (1997), Nair *et al.*, (1979, 1980, 1982) have also made collections particularly from the Silent Valley and its environs. Silent Valley National Park, one of the megadiversity centres of the state was well studied by Manilal (1988). The district flora was studied by Vajravelu in 1990. Silent Valley is the most endemic-rich area of the district with 30% of the species endemic to Peninsular India or South India. Out of the1923 species recorded from the district, 1104 species are from the Silent Valley National Park alone. Among the 392 endemic species of the district, 15 species and one genus are exclusively endemic to Silent Valley National Park.

Parambikulam Wildlife Sanctuary situated adjacent to Nelliyampathy in Palakkad

district possess evergreen, deciduous forests with rich diversity. Sasidharan (2002) made extensive studies on the flora of this region. His study resulted in recognition of 285 species as endemic with 4 exclusive to this area. During his study, he rediscovered the species *Haplothismia exannulata*, hitherto considered as a possibly extinct species of the family *Burmaniaceae* from this area. *Willisia arekaliana*, an aquatic endemic species from Kunthipuzha in Silent Valley has not been collected after its type collection.

Present study recorded 46 species and 3 varieties which are exclusive endemic species of the state from this district (Table 15). Out of 16 restricted taxa of Silent Valley, the exclusive endemic monotypic genus represented by. *Silentvalleya nairii* could be collected from the type locality and Pathrakadavu area. A strictly endemic orchid coming under IUCN Red List category, viz. *Ipsea malabarica* was also collected from this area. Most of the restricted species are niche-specific and are narrow endemics. In a bio-geographical sense, the Silent Valley National Park represents an 'Ecological Island'. The particular characteristic nature of the forests of Silent Valley is due to the physical barrier caused by the presence of the surrounding high Western Ghats hills, which induce 'isolation' as an important factor in the biogeographical evolution.

Table 15. Checklist of exclusive endemic taxa of Kerala recorded from Palakkad District

Sl. No	Names of endemic taxa	Locality
1	*Alpinia smithiae*	Attappady
3	*Amorphophallus nicolsonianus**	Silent Valley
4	*Arisaema attenuatum*	Silent Valley
5	*Bulbophyllum keralensis*	Sispara
6	*Bulbophyllum orezii*	Silent Valley, Punnamala
7	*Bulbophyllum rosemarianum*	Pathrakadavu
8	*Bulbophyllum silentvalliensis**	Silent Valley
9	*Calamus dransfieldii*	Silent Valley
10	*Calamus neelagiricus**	Silent Valley
11	*Cassine kedarnathii**	Silent Valley
12	*Christisonia keralensis**	Silent Valley
13	*Cinnamomum palghatensis**	Singampatti
14	*Cucumella silentvalleyii**	Silent Valley
15	*Curcuma ecalcarata*	Attappady
16	*Curcuma haritha*	Parambikulam
17	*Curcuma vamana*	Kanjirapuzha
18	*Dalbergia beddomei*	Valiyaparathodu
19	*Dimeria josephii*	Nenmara

Sl. No	Names of endemic taxa	Locality
20	*Dysoxylum beddomei*	Parambikulam
21	*Eria tiagii*	Silent Valley
22	*Eriocaulon vasudevanii*	Nelliyampathy
23	*Haplothismia exannulata**	Parambikulam
24	*Hydnocarpus pendulus**	Silent Valley
25	*Impatiens sivarajanii**	Silent Valley
26	*Ipsea malabarica**	Silent Valley
27	*Jasminum rottelerianum* var. *glabrior**	Silent Valley
28	*Kingidium niveum*	Silent Valley
29	*Kunstleria keralensis*	Pathrakadavu
30	*Lepistemon verdcourtii*	Attappady
31	*Liparis walakkadensis*	Silent Valley
32	*Medinilla anamalaiana*	Silent Valley
33	*Memecylon wightianum*	Nelliyampathy
34	*Ophiorrhiza munnarensis*	Silent Valley
35	*Osbeckia abrahamii*	Silent Valley
36	*Piper nigrum* var. *hirtellosum**	Silent Valley
37	*Piper silentvalleyensis**	Silent Valley
38	*Pteroceras monsooniae*	Parambikulam
39	*Psychotria keralensis*	Not specified
40	*Pycreus palghatensis**	Silent Valley
41	*Schoenorchis manilaliana*	Silent Valley
42	*Silentvalleya nairii**	Dam site, Pathrakadavu
43	*Smithia venkobarowii*	Not specified
44	*Sonerila elegans* var. *beddomei**	Poovancholai
45	*Stobilanthes dupenii*	Silent Valley
46	*Syzygium palghatense**	Silent Valley
47	*Tephrosia wynaadensis*	Silent Valley
48	*Willisia arekaliana**	Silent Valley
49	*Xenikophyton seidenfadenianum*	Siruvani

* Taxa reported as new to science from the district

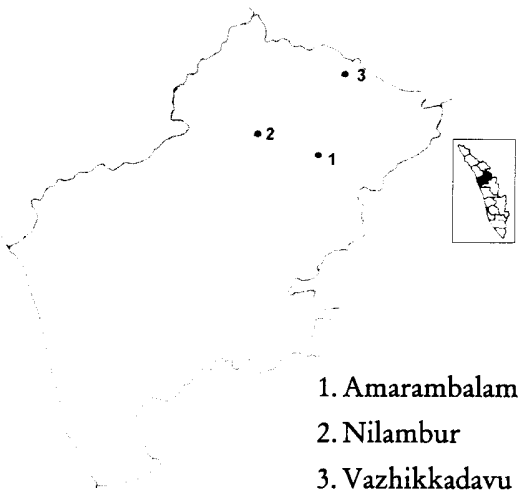
4.1.10. Malappuram

4.1.10.1. Ecosystem characteristics

The district is characterised by mostly lateritic undulating lowland and midland area with sparse vegetation. Highland area is comprised of different forest types like evergreen,

semi-evergreen, deciduous and grasslands.

4.1.10.2. Floristics



1. Amarambalam
2. Nilambur
3. Vazhikkadavu

Fig. 16. Profile of Malappuram District

A systematic floristc study of the district excluding Nilmbur forests was done by Babu (1990). In 1997, Sivarajan and Philip Mathew published an exhaustive flora of Nilambur forests, and Jayakumar (2003) studied the angiosperm flora of 'New Amarambalam' within the Nilambur forest subdivision of Malappuram district. These studies revealed the floristic diversity and the endemic species status of the district. Apart from the above studies several collections were made by Ravi (1995, 2001), Govindarajulu (1990, 1998), Joseph and Sivarajan (1988, 1989), Ansri and Balakrishnan (1994) and others, from the district.

Floristic analysis of the district showed that, out of the 1661 species, 232 are endemics, of which 14 species and 1 variety are the exclusive endemic species of Kerala (Table 16). Occurrence of palaeoendemic species like *Dysoxylum beddomei, Syzygium bourdillonii* and *Ipsea malabarica* from the upper ghats of the district showed the relic nature of the flora, and the comparatively neoendemic species of the genera *Dimeria, Ischaemum, Fimbristylis, Eriocaulon, Rotala, Nymphoides,* etc. from the midlands and aquatic ecosystems indicated the behavior as the centre of 'active speciation'.

Present study on the district also resulted the identification of a new spices, *Ischaemum abrahamii* (Ravi *et al.*, 2001).

Table 16. Checklist of exclusive endemic taxa of Kerala recorded from Malappuram District

Sl. No	Names of endemic taxa	Locality
1	*Cleistanthus sankunnianus*	Kottakkal Aryavaidyasala (cultivated)
2	*Curcuma mutabilis**	Nilambur
3	*Curcuma ecalcarata*	Nilambur
4	*Curcuma haritha*	Nilambur
5	*Dimeria chelariensis**	Chelari
6	*Dimeria eradii**	Thenhipalam
7	*Dysoxylum beddomei*	New Amarambalam
8	*Eriocaulon sivarajanii**	Calicut University campus
9	*Fimbristylis manilaliana**	Thenhipalam

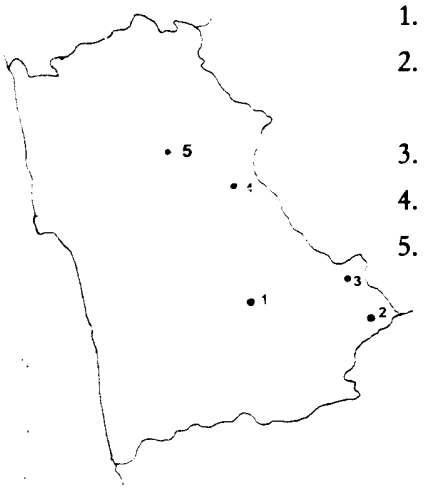
Sl. No	Names of endemic taxa	Locality
10	*Geissaspis tenella* var. *malabarica**	Thenhipalam
11	*Ipsea malabarica*	New Amarambalam
12	*Ischaemum abrahamii**	Manathumangalam
13	*Nymphoides sivarajanii*	Nilambur
14	*Rotala cookii**	Parappanangadi
15	*Syzygium bourdillonii*	New Amarambalam

* Taxa reported as new to science from the district

4.1.11. Kozhikode

4.1.11.1. Ecosystem characteristics

Phytogeogrphically the district is well demarcated into 3 regions. Coastal region consists of estuarine vegetation, mostly mangrove ecosystems. Midland zone consists of undulating lateritc hills and valleys. The lateretic hills show seasonal vegetation including dry grassland formations. Occurrence of sacred groves with *Myristica* swamps forms a special ecosystem in the midland. The highland area of the district is characterised by evergreen, semi-evergreen, deciduous, montane and grassland vegetations.



1. Thamarassery
2. Vellarimala (Kozhikode part)
3. Thusharagiri
4. Kakkayam
5. Peruvannamuzhi

Fig.17. Profile of Kozhikode District

4.1.11.2. Floristics

Malabar Coast has been well known in the history of world trade for being a very important centre of spice-trade. European traders lured into this region of 'black gold' however got into the rich vegetation of this coastal belt, and initiated the floristic studies. van Rheede (1678-1703) as mentioned elsewhere published the illustrations of many of the Malabar plants in *Hortus Malbaricus*. Subsequently, regional floras contributing to the knowledge of the Malabar flora were published by Cook (1901-1908) and Gamble (1915-1936). Other important names, connected with the floristic studies of Malabar Coast are Fischer, Blatter, Bourdillon *et al.* An authentic study on the forest ranges of the district was done by Ellis, Swaminathan & Chadrabose (1968). Manilal and Sivarajan (1982) surveyed Kozhikode district and recorded 983 angiosperms from the area. Subsequently collections were made by several

workers like Sreekumar, Ravi, Govindarajlu, Sabu, *et al.* Pradeep (2000), studied the plants of Vellarimala, the second highest peak (2240 m) within the district of Kozhikode and one among the 14 peaks of elevation above 1800 m on the Western Ghats of Kerala. His study revealed the palaeoendemic nature of this chunk forest on the Western Ghats region of the district. It houses a wide array of endemic plants including some exclusive endemic species restricted to the specific habitats of the area.They are *Julostylis ampumalensis,* a palaeoendemic tree species, *Pogostemon peethapushpam, Tripogon vellerianus* and *Ipsea malabarica* – a critically endangered narrow endemic species with its extended distribution outside its type locality. Collection of an endemic wild *Cinnamon* species, *Cinnmomum nicolsonianum* by Sivarajan from Peruvannamuzhi indicated its palaeoendemic nature. Isolated lateritic hills occuring along the midlands of the district are characterized by several endemic grass species. The rich species diversity and high degree of endemism of the tribe *Andropogonoids* form a successful group in Western Ghats. This view is supported by the distribution of several neoendemic species of the genus *Dimeria* and *Ischaemum* collected by Sreekumar and Ravi from the dry grassland areas of the district.

Floristic analysis of the district showed that, out of the 1401 species, are123 endemics, of which 19 species and 2 varieties are exclusive endemic species of Kerala (Table 17). Present study resulted in the collection of several exclusive endemic grass species from the dry grasslands of Eliyottimala and Pokkunnamala of the district and the present study has noticed the occurrence of some exclusive endemic species like *Thottea sivarajanii, Phaeanthus malabaricus, Kunstleria keralensis, and Kingidium niveum* from the upper region of Thusharagiri – a rich endemic centre in Thamarasseri range of Kozhikode forest division. But this area is highly disturbed due to tourism activities.

Present study resulted in the collection and description of a new grass species named *Ischaemum pushpangadanii* (Ravi *et al.*, 2000) from Kakkayam hills of the district.

Table 17. Checklist of exclusive endemic taxa of Kerala recorded from Kozhikode District

Sl. No	Names of endemic taxa	Locality
1	*Amorphophallus commutatus* var.*waynadensis*	Wayanad Ghat
2	*Cinnamomum nicolsonianum**	Peruvannamuzhi
3	*Curcuma ecalcarata*	Chelannur
4	*Curcuma haritha*	Kolathara
5	*Dimeria borii**	Kanjirakadavu
6	*Dimeria eradii*	Eliyottimala
7	*Dimeria jainii**	Pokkunnamala
8	*Ipsea malabarica*	Vellarimala

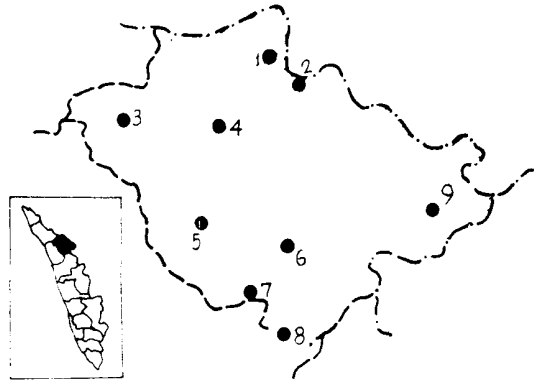
9	*Ischaemum calicutensis**	Pokkunnamala
10	*Ischaemum canannorensis*	Eliyottimala
11	*Ischaemum malabaricum**	Kalarimala
12	*Ischaemum nairii**	Kanjirakadavu
13	*Ischaemum pushpangadanii**	Kakkayam
14	*Ixora sivarajiana*	Vellarimala
15	*Julostylis ampumalensis**	Vellarimala
16	*Kingidium niveum*	Thusharagiri
17	*Kunstleria keralensis*	Thusharagiri
18	*Lindernia tenuifolia* var. *pygmaea*	Kallai
19	*Pogostemon peethapushpum**	Vellarimala
20	*Spermacoce malabarica*	Eliyottimala
21	*Thottea sivarajanii*	Thusharagiri

* Taxa reported as new to science from the district

4.1.12. Wayanad

4.1.12.1. Ecosystem characteristics

Wayanad is an east-sloping, gently undulating plateau and is one of the most forested districts of the state. Forest area is characterised by evergreen, semi-evergreen, moist-deciduous, dry-



1 Chembra
2 Thirunelli
3 Periya
4 Mananthavadi
5 Thariyode
6 Kalppetta
7 Wythiri
8 Vellarimala (Wayanad part)
9 Wayanad WLS

Fig.18. Profile of Wayanad District

deciduous, montane subtropical and shola forests, and grasslands.

4.1.12.2. Floristics

Among the pioneer workers, Beddome (1871-1873) and Lawson (1893-1894) made collections from this area which are noteworthy. After the reorganization of the Botanical Survey of India, Ellis and Chandrabose explored 'Chanthanathodu' (part of Periya R. F.) and

Chedeleth forest ranges intensively during 1965-67. Ramachandran and V. J. Nair (1988) who have studied the flora of Cannanore district covered some floristic regions of northern part of Wayanad district. Among the other works of significance on the botany of this area is one by Ellis *et al.*, (1968). However, a comprehensive floristic study of the district has been done recently by Ratheesh Narayanan (2009). Among the several fragmented studies, the important works are that of Sivadasan, Sasidharan, Ravi, Sathish Kumar, Sunojkumar and Santhosh Kumar. From the scrappy studies of the above workers, a fair idea on floristic diversity and endemism could be gathered.

Present analysis revealed that 19 species and 1 variety are exclusively endemic species of the state that are recorded from this district (Table 18). *Eugenia argentea* and *Maesa velutina* – critically endangered and recently relocated exclusive endemic species of the district were recorded during this study. *Thottea sivarajanii* and *Oberonia wynadensis,* the species described from the district were also collected from the type localities. During the present study a new grass species, viz. *Ischaemum wayanadense* was described based on the collection from Kellor near Sulthan Battery.

As the other forested districts, Wayanad is also rich in endemic diversity. The high altitude areas such as Pakshipathalam and Chembra possess several narrow endemic species because of their existance as 'Ecological Islands'.

Table 18. Checklist of exclusive endemic taxa of Kerala recorded from Wayanad District

Sl. No	Names of endemic taxa	Locality
1	*Aglaia malabarica*	Periya Reserve Forest
2	*Amorphophallus commutatus* var. *wayanadensis**	Wayanad Ghat
3	*Bulbophyllum keralensis**	Pakshipathalam
4	*Bulbophyllum silentvalliensis*	Chembra
5	*Curcuma ecalcarata*	Mananthavady
6	*Eria tiagii*	Pakshipathalam
7	*Eugenia argentea**	Periya Reserve Forest
8	*Ipsea malabarica*	Chempra
9	*Isachne henryi*	Pothumoola
10	*Ischaemum wayanadense*	Kellor
11	*Ixora sivarajiana**	Pakshipathalam
12	*Leucas beddomei**	Chembra
13	*Leucas sebaldiana*	Chembra
14	*Maesa velutina**	Mananthavady
15	*Oberonia wynadensis**	Pakshipathalam

16	*Orophea sivarajanii**	Periya Reserve Forest
17	*Phaeanthus malabaricus*	Thirunelli
18	*Sonerila wynaadensis**	Periya Reserve Forest
19	*Tephrosia wynaadensis**	Mananthavady
20	*Thottea sivarajanii**	Periya Reserve Forest

* Taxa reported as new to science from the district

4.1.13. Kannur

4.1.13.1. Ecosystem characteristics

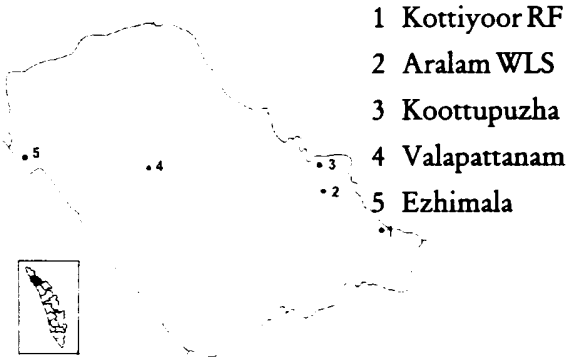


Fig.19. Profile of Kannur District

Coastal region consists of estuarine and strand vegetation. Midland region is the most thickly populated area, which covers the major part of the district forming an undulating topography gradually ascending and merging with the slopes of the Western Ghats. The natural flora of this area is that of the moist-deciduous forests consisting of a mixture of evergreen and deciduous elements. Mountain region consist of evergreen, semi-evergreen, moist-deciduous, shoals, grasslands and plantations. Aralam Wildlife Sanctuary is located on the western slopes of the Western Ghats in the district. It has a varied topography with good floristic diversity.

4.1.13.2. Floristics

The first published books on the botany of this area is van Rheede's monumental pre-Linnaean work namely, *Hortus Malabaricus* (1678-1703). During 1965-1967, Ellis explored Chandanathode, a part of Periya Reserve Forests. After that a comprehensive floristic study of the district was made by Ramchandran and Nair (1988) and published *Flora of Canannore District*. The district was well explored by Sreekumar for his study on *Flora of Kerala-Grasses* and described several exclusively endemic species collected especially from the midland and lowland areas of the district. Other valuable collections were made from the district by Sreekumar, Manilal, Sivarajan, Ravi, Pradeep, *et. al.* They explored the district and made valuable collections.

Floristic analysis of the district showed that, out of the 1577 species, 186 endemics, of which 21 species and 4 varieties were the exclusive endemics of Kerala (Table 19). Most of the exclusive endemic species of the district were concentrated on the lateritic dry grasslands of the midland zone. Present study resulted in the discovery of 2 new species from the mangrove

areas of the district. They are *Fuirena simpsonii*, a sedge species of neoendemic category, and *Ischaemum pappinisseriensis*, a species of the actively evolving genus of the tribe *Andropogoniae*.

Table 19. Checklist of exclusive endemic taxa of Kerala recorded from Kannur District

Sl. No	Names of endemic taxa	Locality
1	*Adenosma malabaricum**	Kannoth
2	*Amorphophallus nicolsonianus*	Meppadi
3	*Arundinella cannanorica**	Paramba
4	*Blumea membranacea* var. *gracilis**	Ambayathode
5	*Bulbophyllum rosemarianum*	Nellipara
6	*Cucurbita maxima* var. *badagarensis**	Vadakara
7	*Curcuma ecalcarata*	Kannoth,Kottiyoor
8	*Dimeria keralae**	Paramba
9	*Fuirena simpsonii**	Pappinisseri
10	*Gymnostachyum latifolium* var. *decurrens**	Kannoth
11	*Gymnostachyum febrifugum* var. *bracteatum**	Kannoth
12	*Ischaemum cannanorensis*	Ezhimala
13	*Ischaemum elimalayanum**	Ezhimala
14	*Ischaemum malabaricum**	Ezhimala
15	*Ischaemum pappinisseriensis**	Pappinisseri
16	*Justicia ekakusuma**	Payangadi
17	*Lepidagathis keralensis*	Madai
18	*Nymphoides krishnakesara**	Madai
19	*Orophea malabarica*	Irutti
20	*Phaeanthus malabaricus*	Irutti
21	*Psilanthus malabaricus*	Not specied
22	*Psychotria keralensis*	Chandanathode
23	*Rotala malabarica**	Aduthila
24	*Sonerila cannanorensis**	Chanthanathode
25	*Spermacoce malabarica**	Kottampara

*Taxa reported as new to science from the district

4.1.14. Kasaragod

4.1.14.1. Ecosystem characteristics

The northern most district of Kerala is having lowland coastal area, dry rocky plateau

and isolated hills. Occurrences of major sacred groves are characteristic vegetational feature of the district.

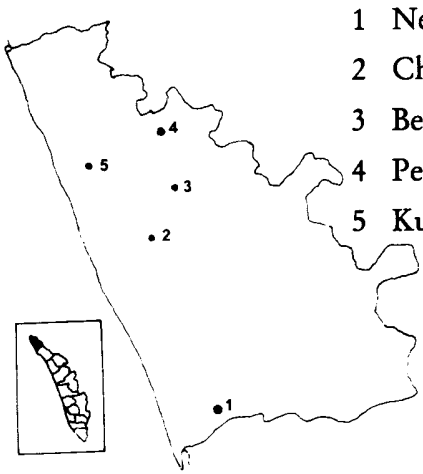


Fig. 20. Profile of Kasaragod District

4.1.14.2. Floristics

Ansari (1985) botanized the district while this was the part of Kannur district. Several floristic studies were conducted at different ecosystems of the district like dry grassland areas (Sreekumar,1991), sacred groves (Rajendraprasad, 1995; Unnikrishnan, 1995)) and mangroves (Anupama & Sivadasan, 2004). Sreekumar *et al.* (1983, 1984a, 1984b, 1985, 1987, 1991) and Ravi *et al.* (2000, 2001) reported several new species, exclusively endemic to Kerala from the dry grassland areas of the district.

Floristic analysis of the district showed that, out of the 1906 species, 107 are represented by endemic species, of which 10 species and 2 varieties are the exclusive endemics of Kerala (Table 20). Like other two districts, this district also possesses a good number of exclusive endemic species of neoendemic category. Present study resulted in the identification of a new grass species namely *Ischaemum lanatum* (Ravi *et al.*, 2000).

Table 20. Checklist of exclusive endemic taxa of Kerala recorded from Kasaragod District

Sl. No	Names of endemic taxa	Locality
1	*Arundinella cannanorica*	Bela
2	*Chamaesyce katrajensis* var. *kasaragodensis**	Bela
3	*Chrysopogon tadulingamii**	Periya
4	*Dimeria keralae**	Paramala
5	*Dimeria eradii*	Paramala
6	*Ischaemum cannanorensis**	Chattamchal
7	*Ischaemum copeanum**	Cherkala
8	*Ischaemum jayachandranii**	Neeleswaram
9	*Ischaemum lanatum**	Periya
10	*Ischaemum malabaricum*	Kumbla
11	*Ischaemum raui**	Mugu Road
12	*Scleria lithosperma* var. *muricata*	Pallathadaka

* Taxa reported as new to science from the district

4.2. Ethnobotanical information of the use of endemic species

Along with the floristic exploration, visits to the local tribal settlements have been made to gather information on their knowledge pertaining to the use of endemic floral elements.

The use of endemic plants by the tribes in their daily life is confined to a small number of species. The following forms a brief account on the available ethnobotanical knowledge possessed by various tribes of Kerala. The presentation of data is in the sequence of the name of the plant with author(s)'s name, family of the species, local name of the species, name of the tribe which uses the plant, parts used, mode of use, the locality from where collection was made, collectors name, collection number of the voucher specimen, and acronym of the name of the herbarium, where the herbarium specimen is deposited. Citation of the relevant photograph is provided in brackets after the name of the species.

4. 2. 1. Endemic medicinal plants:

Acrotrema agastyamalayanum Santhosh Kumar *et al.* (Plate 4: a)

Family : Dilleniaceae
Local name : Anachuvadi
Tribes : Kani
Parts used : Leaves. Used for relieving headache.
Preperation and application : Fresh leaves were made into a paste in a little of water and applied on the forehead.
Thiruvananthapuram district : Agasthyamala, Bonaccod, *Shaju 67932* (TBGT).

Colubrina travancorica Bedd. (Plate 4: b)

Family : Rhamnaceae
Local name : Vakkanathi
Tribes : Kochuvelans, Malappandaram
Parts used : Root, bark and leaves.
Preperation and application : Leaves pounded and applied to swellings. Root bark boiled in oil and applied to cure head-ache. Decotion of bark and leaves used to heal wounds.
Pathanamthitta district : Ranni, Perumthenaruvi, *Shaju 42251* (TBGT)
Thrissur district : Vellikulangara, *Shaju 6164* (TBGT).

Curcuma ecalcarata Sivar. & Balach. (Plate 4: c)

Family : Zingiberaceae

Local name : Van-kuzhikuva
Tribe : Kurichyar
Parts used : Rhizome
Preperation and application : Cleaned rhizome chewed and eaten for leucorrhoea.
Wayanad district : Thariyode, *Shaju 49118* (TBGT).

Ixora johnsonii Hook. f. (Plate 4: d)
Family : Rubiaceae
Local name : Kattuthetti
Tribe : Ulladar
Parts used : Used by Ulladar community in treating wounds and sores.
Preparaton and application : The root-paste is added to the supernatant of rice gruel. This paste is applied around the mouth of wounds and sores until they subside.
Pathanamthitta district : Moozhiyar, Ulunkal, *Shaju 66730* (TBGT).

Thottea Idukkiana Pandurangan & V. J. Nair (Plate 4: e & f)
Family : Aristolochiaceae
Local name : Alpam
Tribe : Malappandaram, Kani
Parts used : Roots, bark and leaves.
Preperation and application : Leaves, Fresh bark and root pieces are boiled in water until a concentrated decotion is obtained. This is taken internally for dysentery; and small root-pieces are chewed and juice is taken in as a remedy for stomach pain.
Thiruvananthapuram district : Agasthyamala, Podiyakkala, *Shaju 6827* (TBGT)
Kollam diastrict : Achankovil, Pulikayam, *Shaju 66768* (TBGT).

Kunstleria keralensis Mohanan & Nair (Plate 4: g)
Family : Fabaceae
Local name : Njarampupanal, Kariveppila valli
Tribes : Malappandaram, Kani
Parts used : Root, bark and leaves
Preperation and application : Fresh bark, root and leaves boiled in water. When cooled to lukewarm conditions, it is used for bathing. This relieves body pain.

Thiruvananthapuram district : Agasthyamala, way to Bonacoord, *Shaju 47392* (TBGT).

Curcuma raktakanta Mangaly & Sabu (Plate 5: a & b)

Family : Zingiberaceae
Local name : Chenthandankuva
Tribes : Mala Arayans
Parts used : Rhizome
Preperation and application : Rhizome pieces are ground into a paste in water. This paste is applied on the affected part.
Kottayam district : Kanjirapally, *Shaju 3228* (TBGT).

Curcuma vamana Sabu & Mangaly (Plate 5: c & d)

Family : Zingiberaceae
Local name : Kunjikuva
Tribes : Kani
Parts used : Rhizome
Preperation and application : Rhizome pieces are ground into a paste in water. This paste is applied on the affected part.
Kollam district : Rock wood, *Shaju 3268* (TBGT).

Amorphophallus nicolsonianus Sivad. (Plate 5: e)

Family : Araceae
Local name : Kattuchena
Tribes : Kani
Parts used : Corms
Preperation and application : Paste is applied on the spots of inflamation caused by snake bite.
Thiruvananthapuram district : Bonaccord, Cheenikala, *Shaju 65013* (TBGT).

4. 2. 2. Endemic plants of other traditional uses.

Wild edibles

Fruits : There are good number of wild edible fruits in the forests of Kerala that are consumed by various tribes of the State. The endemic species among them include:

Antidesma keralense Chakrab. et al. (Plate 6: a)

Family : Euphorbiaceae
Local name : Kattupulichi

Tribe : Kani

Parts used : Pericarp. Which is sour in taste.

Thiruvananthapuram district : Agasthyamala, way to Chemunji, *Shaju 65011* (TBGT).

Aporusa bourdillonii Stapf (Plate 6: b)

Family : Euphorbiaceae

Local name : Malavitti

Tribe : Muthuva

Parts used : Arils which are sweet and sour.

Idukki district : Puyankutty, Urulanthanny, *Shaju 46401* (TBGT).

Buchanania barberi Gamble (Plate 6: c)

Family : Anacardiaceae

Local name : Kulamavu

Tribe : Kani

Parts used : Arils are sweet and sour.

Thiruvananthapuram district : Palode, *Shaju 62754* (TBGT).

Ixora johnsoni Hook.f. (Plate 6: d)

Family : Rubiaceae

Local name : Kattuthetti

Tribe : Malampandaram

Parts used : Fleshy pericarp which tastes sweet.

Pathanamthitta district : Moozhiyar, Ulunkal, *Shaju 66730* (TBGT).

Syzygium palghatense Gamble

Family : Myrtaceae

Local name : Sevappunjaval

Tribe : Irular, Kurumbar

Parts used : Pericarp which tastes sweet.

Palakkad district : Silent Valley, Poochipara, *Shaju 4479* (TBGT).

Substitute to common salt :

Begonia malabarica Lam. (Plate6: e)

Family : Begoniaceae

Local name : Parapuli

Tribe : Malappandaram and Malavedar

Parts used : Leaves.

Plate 4. Endemic Medicinal Plants

a. ***Acrotrema agastyamalayanum*** Santhosh Kumar *et al.*: Leaves; b. ***Colubrina travancorica*** Bedd.: Leaves; inset: Bark; c. ***Curcuma ecalcarata*** Sivar. & Balach.: Rhizome; d. ***Ixora johnsoni*** Hook. f.: Roots; e & f. ***Thottea idukkiana*** Pandurangan & V. J. Nair: e. Leaves; f. Roots; g. ***Kunstleria keralensis*** Mohanan & Nair.: Leaves & Bark.

Plate 5. Endemic Medicinal Plants

a & b. ***Curcuma raktakanta*** Mangaly & Sabu: a. Habit; b. Basal portion of plant with rhizome; c & d. ***Curcuma vamana*** Sabu & Mangaly: c. Habit; d. Basal portion of plant with rhizome & runner; e . ***Amorphophallus nicolsonianus*** Sivad.: Corm.

Preperation : Substitute to common salt in curries and other dishes. Leaves of these plants are crushed and expressed juice is added to the dish.

Pathanamthitta district : Moozhiyar, *Shaju 6801* (TBGT),

Insect repellents:

Aglaia malabarica Sasidh. (Plate 6: f)

Family : Meliaceae

Local name : Akil

Tribe : Malappandaram

Parts used Bark, with fragrant smell is used in driving off the mosquitoes and other insects.

Kollam district : Achankovil, way to Pulikayam, *Shaju 66789* (TBGT).

Curcuma haritha Mangaly & Sabu (Plate 6: g)

Family : Zingiberaceae

Local name : Karpurakuva

Tribe : Irular

Parts used : Rhizome-paste applied to repel the blood-sucking leach.

Palakkad district : Attappady, *Shaju 4417* (TBGT).

Materials for thatching, tying (rope) and making basket and mats:

Different species of *Ochlandra, Calamus* and *Dimeria* are used by the tribes for thatching, for use as rope, tying, and for basket/mat making.

Thatching

Dimeria eradii Ravi (Plate 7: a, b & c)

Family : Poaceae

Local name : Njarunganam pullu

Tribe : Urali Kurumba

Parts used : Whole plants are used for thatching

Kasaragod district : Seethamgoli, near Yelkanna river, *Shaju 4613* (TBGT).

Ochlandra ebracteata Raiz. & Chatterjee (Plate 7: d & e; Plate 8: e)

Family : Arecaceae

Plate 6. Endemic Plants of Traditional Uses

Wild Edibles: a. ***Antidesma keralensis*** Chakrab. *et al.*; b. ***Aporusa bourdillonii*** Stapf; c. ***Buchanania barberi*** Gamble; d. ***Ixora johnsoni*** Hook. f.

Substitute of common salt: e. ***Begonia malabarica*** Lam.: Leaves.

Insect repellents: f. ***Aglaia malabarica*** Sasidh.: Leaves; g. ***Curcuma haritha*** Mangaly & Sabu: Rhizome.

Local name : Valleta

Tribe : Malppandaram, Malakkurava, Kani.

Parts used : Leaves are used for thatching

Kollam District : Achankovil, *Shaju 6877* TBGT),

O. travancorica var. *hirsuta* Gamble (Plate 8: d)

Family : Arecacea

Local name : Etta

Tribe : Malppandaram, Malakkurava, Kani.

Parts used : Leaves used for thatching

Thiruvananthapuram district : Agasthyamala, Way to Bonaccord, *Shaju 67963* (TBGT).

Tying

Kunstleria keralensis Mohanan et al., (Plate 7: f & g)

Family : Fabaceae

Local name : Njarampupanal

Tribe : Malappandaram

Parts used : Fiber from the stem bark, is used for tying as rope

Kollam district : Achankovil, Arampa, *Shaju 66793* (TBGT),

Calamus dransfieldii Renuka (Plate 8: a)

Family : Arecaceae

Local name : Chooral

Tribe : Malappandaram, Kani

Parts used : Slender young stem

Thiruvananthapuram district : Agasthaymala, Makki, *Shaju 65031* (TBGT).

Calamus shendurunii Anto et al.

Family : Arecaceae

Local name : Chooral

Tribe : Malappandaram, kani

Parts used : Slender yong stem

Kollam district : Rosemala, Shenduruni, *Shaju 58505* (TBGT).

Basket and mat making

There are many eco-development societes in the State which engage tribals in the

profession of making baskets and weaving mats. The main raw meterial used for this purpose is species of *Ochlandra* and *Calamus.*

O. *travancorica* var. *hirsuta* Gamble (Plate 8: d) & ***Ochlandra ebracteata*** Raiz. & Chatterjee (Plate 7: d; Plate 8: e)

Family : Poaceae
Local name : Etta
Tribes : Kani, Malveda, Malappandaram, Urali
Parts used : Stem

Calamus dransfieldii Renuka (Plate 8: a) & ***Calamus shendurunii*** Anto et al.

Family : Arecaceae
Local name : Chooral
Tribe : Kani, Malvedar, Malappandaram
Parts used : Stem

Plate 7. Materials used for Thaching & Tying

a - c. ***Dimeria eradii*** Ravi: a. Habit; b. Dried plants used in thaching; c. Hut with *Dimeria* based roofing; d & e. ***Ochlandra ebracteata*** Raiz. *et al.*: d. Habit; e. Leaves used in thaching; f & g. ***Kunstleria keralensis*** Mohanan *et al.*: f. Bark pealings; g. Bark used as tying material.

TAXONOMIC AND ETHNOBOTANIC STUDIES OF ENDEMIC ANGIOSPERMS OF KERALA

THESIS SUBMITTED TO THE
UNIVERSITY OF CALICUT

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FOR THE DEGREE OF
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IN BOTANY

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5. SYSTEMATIC TREATMENT

5.1. Key to the exclusive endemic angiosperms of Kerala

5.1.1. Key to Angiospermae

1. Leaves with reticulate venation; flowers usually 5 or 4-merous; embyo with 2 cotyledons ..... **Dicotyledones**
1. Leaves with parallel venation; flowers usually 3-merous; embryo with 1 cotyledon ..... **Monocotyledones**

5.1.2. Key to Dicotyledones

1. Perianth whorls 2-or more seriate ..... **Dichlamydeae**
1. Perianth whorls 1-seriate or absent ..... **Monochlamydeae**

5.1.3. Key to Dichlamydeae

1. Petals distinct, free from stamens ..... **Polypetalae**
1. Petals united, fused with stamens ..... **Gamopetalae**

5.1.4. Key to the families of Polypetalae

1. Stamens hypogynous.
  2. Sepals imbricate.
    3. Sepals free to base.
      4. Stamens many (more than 10).
        5. Sepals persistent ..... 1. **Dilleniaceae**
        5. Sepals deciduous ..... 3. **Flacourtiaceae**
      4. Stamens few (10 or less than 10).
        6. Flowers regular ..... 6. **Oxalidaceae**
        6. Flowers irregular ..... 7. **Balsaminaceae**
    3. Sepals connate at base.
      7. Trees with resin ..... 1. **Anacardiaceae**
      7. Trees without resin

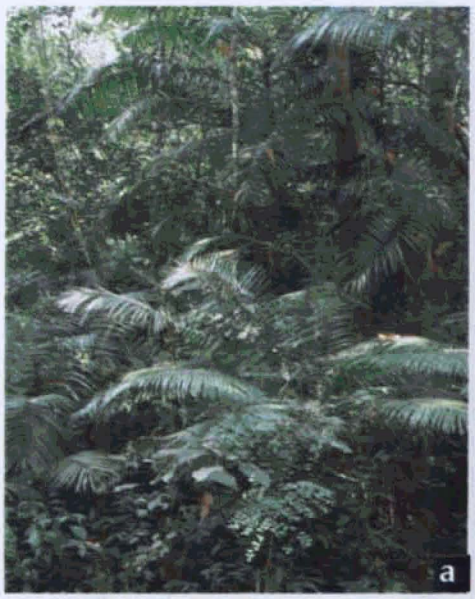

Plate 8. Materials used for making Baskets and Mats

a. ***Calamus dransfieldii*** Renuka: Habit; b. Malapandaram cleaning ratten stem for basket & mat making; c. Ullada female weaving mat; d. ***Ochlandra travancorica*** var. ***hirsuta*** Gamble: Culms; ***Ochlandra ebracteata*** Raiz. *et al.*: Culms.

8. Leaves compound..... 8. **Meliaceae**
8. Leaves simple..... 9. **Celastraceae**

2. Sepals valvate.
9. Sepals free; perianth 3-merous..... 2. **Annonaceae**
9. Sepals connate; perianth 5-merous.
10. Staminal filaments connate..... 4. **Malvaceae**
10. Staminal filaments free.
11. Ovary fused with the disc..... 10. **Rhamnaceae**
11. Ovary free from the disc..... 5. **Tiliaceae**

1. Stamens epi-or perigynous.
12. Ovules pendulous..... 19. **Araliaceae**
12. Ovules axile or basal.
13. Flowers unisexual.
14. Plants tendril-climbers..... 17. **Cucurbitaceae**
14. Plants non-tendrillar herbs..... 18. **Begoniaceae**
13. Flowers bisexual.
15. Leaves stipulate; pistil monocarpellary ..... 13. **Fabaceae**
15. Leaves estipulate; pistil multicarpellary.
16. Carpels free..... 12. **Connaraceae**
16. Carpels connate.
17. Fruit a capsule..... 16. **Lythraceae**
17. Fruit a berry.
18. Stamens many (more than 12)..... 14. **Myrtaceae**
18. Stamens few (less than 12) .....15. **Melastomataceae**

5.1.5. Key to the families of Gamopetalae

1. Ovary inferior.
2. Inflorescence a head or capitulum..... 21. **Asteraceae**
2. Inflorescence other than head or capitulum.
3. Stamens many, variously grouped;
ovary 3-locular..... 25. **Symplocaceae**
3. Stamens few, as many as or twice as many as petals;
ovary 1-10-locular.
4. Corolla zygomorphic; leaves modified into
insectivorous bladders..... 33. **Lentibulariaceae**
4. Corolla regular; leaves normal.
5. Leaves opposite..... 20. **Rubiaceae**

5. Leaves alternate..... 22. **Myrsinaceae**

1. Ovary superior
6. Stamens opposite to petals.
7. Corolla tubular-companulate ..... 24. **Ebenaceae**
7. Corolla salverform..... 23. **Sapotaceae**
6. Stamens alternate with petals.
8. Corolla regular.
9. Leaves opposite.
10. Stamens 2..... 26. **Oleaceae**
10. Stamens 4.
11. Carpels free..... 27. **Asclepiadaceae**
11. Carpels connate.
12. Terrestrial plants..... 28. **Gentianaceae**
12. Aquatic plants..... 29. **Menyanthaceae**
9. Leaves alternate..... 30. **Convolvulaceae**

8. Corolla zygomorphic
13. Carpel with 1-2 ovules..... 37. **Lamiaceae**
13. Carpel with many ovules.
14. Fruits dehiscent..... 36. **Acanthaceae**
14. Fruit indehiscent.
15. Ovary 1-locular.
16. Leafless parasites..... 32. **Orobanchaceae**
16. Leafy non-parasites ..... 34. **Gesneriaceae**
15. Ovary 2-locular.
17. Trees..... 35. **Bignoniaceae**
17. Herbs..... 31. **Scrophulariaceae**

5.1.6. Key to the families of Monochlamydeae

1. Ovary superior.
2. Flowers bisexual.
3. Perianth present.
4. Terrestrial plants; stem not tahlloid..... 41. **Lauraceae**
4. Aquatic herbs; stem thalloid..... 38. **Podostemaceae**
3. Perianth absent..... 40. **Piperaceae**

2. Flowers unisexual..... 42. **Euphorbiaceae**

1. Ovary inferior..... 39. **Aristolochiaceae**

5.1.7. Key to the families of Monocotyledones

1. Pollens united into pollinia..... 44. **Orchidaceae**

1. Pollens free, not in pollinia

2. Fruit a caryopsis.

3. Scapigerous herbs, stem 0; inflorescence a head..... 48. **Eriocaulaceae**

3. Plants with aerial stem (culms); inflorescence various.

4. Leaves 3-ranked; culms trigonus..... 49. **Cyperaceae**

4. Leaves 2-ranked; culms terete..... 50. **Poaceae**

2. Fruit a capsule, drupe or berry.

5. Inflorescence a spadix.

6. Stem woody; spadix branched..... 46. **Arecaceae**

6. Stem often fleshy; spadix unbranched..... 47. **Araceae**

5. Inflorescence not a spadix.

7. Flowers regular; fertile stamens 3

..... 43. **Burmanniaceae**

7. Flowers zygomorphic; fertile stamen(s) 1(2)

..... 45. **Zingiberaceae**

5.2. Family treatment

1. DILLENIACEAE

Table 21. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
12	400	3	12	2spp.

Kerala

Genus/genera	Species/subsp./var.
3	7 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Acrotrema Jack.	*A. arnottianum* Wight (Tamil Nadu)	*A. agastyamalayanum* Santhosh Kumar *et al.*

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ACROTREMA W. Jack

Malayan Misc. 1(5): 36. 1820.

Acrotrema agastyamalayanum Santhosh Kumar, Mathew Dan & G. M. Nair, Nord. J. Bot. 24(5): 543. 2007. *Valiyanachuvadi.*

Type : Thiruvananthapuram district: Braemore, ± 500 m, 12 Nov. 2002, *Santhosh Kumar 4841*(TBGT). (Fig. 21; Plate 9)

Perennial herbs with woody rootstocks. Stem very short. Leaves subradical, c. 26 x 16 cm, obovate, obtuse or rounded at apex, deeply cordate and auriculate at base, crenate-dentate at margins, densely pilose above and beneath, lateral nerves 25-30 pairs. Petiole c. 3 cm long, broadly winged. Racemes axillary, scape 1-2 cm long, 3-8-flowered. Flowers yellow. Pedicels c. 6 cm long, with villous hairs. Bracts c. 1.3 cm long, broadly ovate, bifid at apex. Sepals 5, ovate, 0.7-0.9 x 0.4-0.45 cm. Petals 5, obovate, c.1.2 x 0.8 cm. Stamens 20-30, filaments in 3 bundles, each c. 0.3 cm long. Carpels 3; ovules many; style linear. Follicles ovate, c. 0.9 x 1.2 cm. Seeds many, arillate.

Flowering & Fruiting: June-February.

Habitat: Along the muddy cliffs of trecking paths in evergreen and moist deciduous forests.

Note: In India, the genus *Acrotrema* W. Jack is represented by only two species, both of which are endemic to Southern Western Ghats. The newly described species *Acrotrema agastyamalayanum* is apparently similar to *A. arnottianum* Wight, but differs by the non-stoloniferous habit, densely pilose leaves with more number of lateral nerves, shortly peduncled recemes and a fewer number of stamens. As a species of palaeoendemic genus *Acrotrema,* its phytogeographical affinity and distributional status are yet to be ascertained.

Specimens examined: Thiruvananthapuram district: Braemore, ± 500 m, 12 Nov. 2002, *Santhosh Kumar 48414* (Holotype, TBGT); Attayar, ± 1000 m, 21 Dec. 1987, *N. Mohanan 9053* (TBGT); Athirumala, ± 1300 m, 16 May 1988, *N. Mohanan 9821* (TBGT); Way to Bonaccord, ± 600 m, 27 Feb. 2006, *Shaju 59481*(TBGT); *Ibid.*, 15 Oct. 2009, *Geeth Kumary & Shaju 67932* (TBGT).

2. ANNONACEAE

Table 22. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
130	2300-2500	24	133	19 spp.

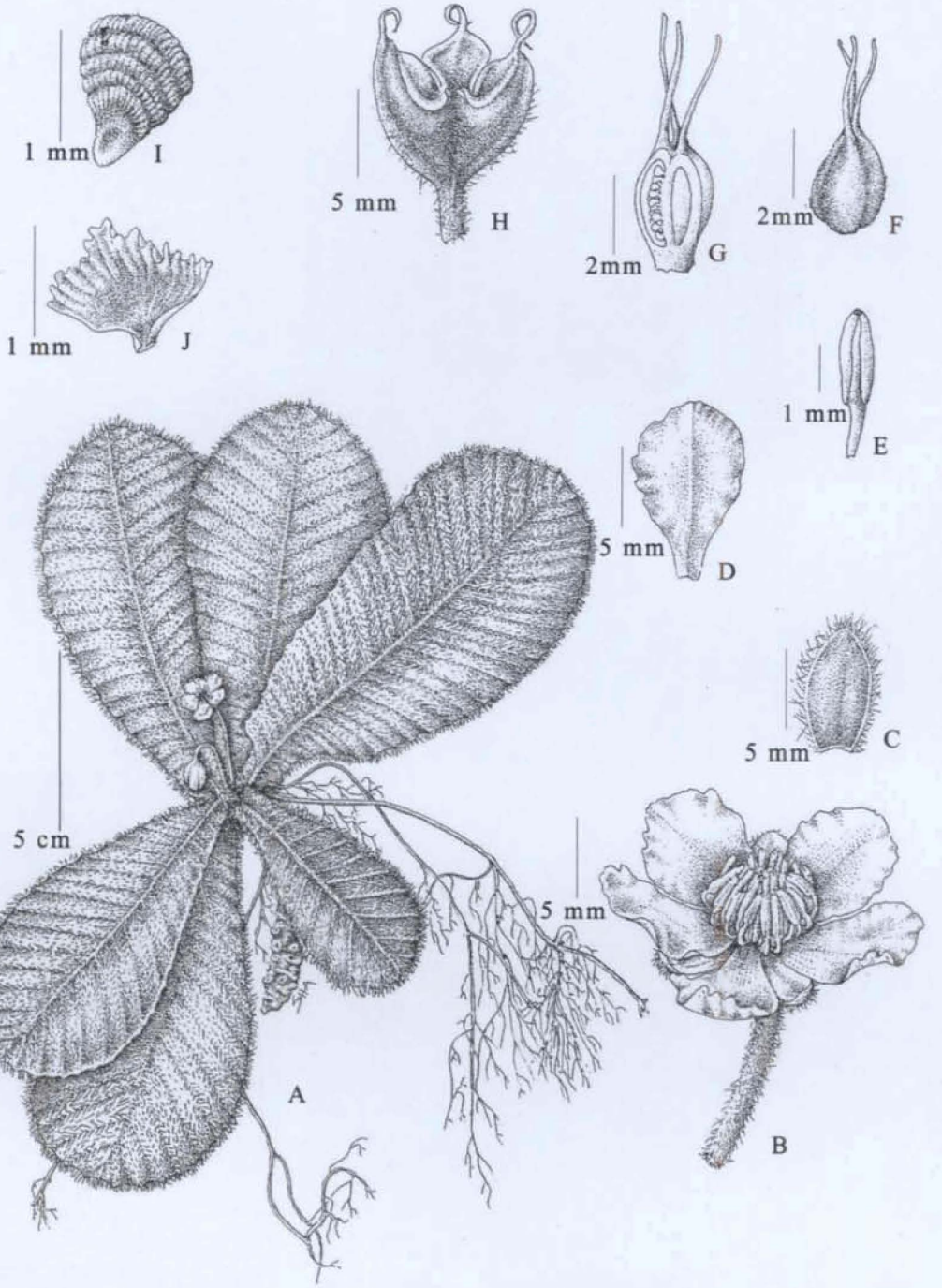

Fig. 21. ***Acrotrema agastyamalayanum*** Santhosh Kumar *et al*. A. Habit; B. Flower; C. Sepal; D. Petal; E. Stamen; F. Carpels; G. Carpels-L. S.; H. Fruit after dehiscence; I. Seed; J. Aril.

Kerala

Genus/genera	Species/subsp./var.
16	54 spp., 2 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Desmos Lour.	*D. viridiflorus* (Bedd.) Saff. (Tamil Nadu)	
Goniothalamus Hook.f & Thoms	*G. rhynchantherus* Dunn. (Tamil Nadu)	
	G. wightii Hook. f. & Thoms. (Tamil Nadu)	
	G. wynaadensis (Bedd.) Bedd. (Karnataka & Tamil Nadu)	
Miliusa Les. ex A. DC.	*M. nilagirica* Bedd. (Tamil Nadu)	
Orophea Blume	*O. thomsonii* Bedd. (Tamil Nadu)	*O. malabarica* Sasidh.&Sivar.
	O. uniflora Hook. f. & Thoms. (Karnataka & Tamil Nadu)	*O. sivarajanii* Sasidh.
Phaeanthus Hook. f. Thoms.	*P. malabaricus* Bedd.	
Polyalthia Blume	*P. fragrans* (Dalz.) Bedd. (Maharashtra, Karnataka & Tamil Nadu)	*P. shendurunii* Basha & Sasidh.
Popowia Endl.	*P. beddomeana* Hook. f. & Thoms. (Tamil Nadu)	
Sageraea Dalz.	*S. dalzellii* Bedd. (Tamil Nadu)	*S. grandiflora* Dunn
	S. laurifolia (Graham) Blatter (Maharashtra, Goa, Karnataka & Tamil Nadu)	

Key to the genera

1. Inner petals arching over the torus.
   2. Petals adhering throughout the margin ..... **Phaeanthus**
   2. Petals adhering at the tip only ..... **Orophea**
1. Inner petals not arching over the torus.
   3. Ovules 1-2 ..... **Polyalthia**
   3. Ovules 12-14 ..... **Sageraea**

OROPHEA Blume

Bijdr. 18. 1825.

Key to the species

1. Carpels 3; stamens 6 ..... 1. *O. malabarica*
1. Carpels 6; stamens 12 ..... 2. *O. sivarajanii*

1. **Orophea malabarica** Sasidh. & Sivar., Blumea 35: 269. 1990; Sasidh. & Sivar., Flr. Pl. Thrissur For. 29.1996; Sasidh., Biodiver. Doc. Kerala, Part 6. Flr. Pl. 19. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 58. 2006.

Type: Thrissur district: Vengappara, ± 500 m, 11 Mar. 1988, *Sasidharan 4833*(CALI).

(Fig. 22; Plate 10 a & b)

Shrubs. Leaves elliptic oblong, 5-10 x 2-4 cm, acute, acuminate or obtuse at the tip, obtuse or cuneate at base. Flowers white, often with pinkish tinge, in 2-3-flowered axillary or extra-axillary, peduncles pilose. Bracts ovate acuminate, densely pilose outside, c. 0.1 cm long. Peduncle slender, c. 2 cm long. Pedicels capillary, c. 1.5 cm long, densely pilose. Sepals ovate-rounded, c. 0.1 x 0.1 cm, minutely tomentose outside. Outer petals ovate-orbicular, c. 0.3 cm across, tomentose along margin; inner petals glabrous, c. 0.35-0.4 cm long, clawed, nectaries 2, narrowly oblong. Stamens 6, uniseriate; staminodes absent. Carpels 3; ovary glabrous; ovules 2; style hairy. Fruitlets sessile, 1-3, 0.8- I cm across, globose.

Flowering & Fruiting: September-December.

Habitat: Evergreen forests.

Note: *Orophea malabarica* can easily be distinguished from other three species, viz. *Orophea zeylanica* Hook. f. & Thoms., *O. uniflora* Hook. f. & Thoms. and *O. thomsonii* Bedd. by its 3-carpellary gynoecium.

After the type collection by Sasidharan (1990) from Thrissur district, this species has been collected from Irutti in Kannur district during the present study where its occurrence is in scattered populations with limited number of individuals. As an endemic species with narrow distribution, it deserves more conservational studies.

Specimens examined: Thrissur district: Vengappara, ± 500 m, 11 Mar. 1988, *Sasidharan 4833* (Isotype, CALI); Kannur district: Irutti, Kuttupuzha, ± 300 m, 10 Nov. 2001, *Shaju 2318* (TBGT).

2. **Orophea sivarajanii** Sasidh., Nord. J. Bot. 19: 301. 1999; Sasidh., Biodiver. Doc. Kerala, Part 6. Flr. Pl. 19. 2004; Daniel (ed.), Fl. Kerala 1: 159. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 59. 2006.

Type: Wayanad district: Periya Reserve Forests, ± 800 m, 20 Dec. 1999, *Sasidharan 10844* (KFRI). (Plate 10 c)

Plate 9. a - c. ***Acrotrema agastyamalayanum*** Santhosh Kumar *et al.*: a. Habit; b. Single plant; c. Type specimen at TBGT.

Shrubs. Leaves oblong to elliptic oblong, 7-15 x 3-6 cm, obtuse- rounded at base, acuminate at apex, glabrous. Flower(s) solitary or 2-3 in axillary or lateral recemes, 1.5-2 cm long, glabrous. Pedicel 0.8-1.2 cm long. Bract in upper half of pedicel, ovate-acute. Sepals ovate-deltoid, c. 0.2 x 0.25 cm, acute, ciliolate on margin, jointed at base. Outer petals ovate-orbicular, c. 0.4 cm across, tomentose along margin; inner petals ovate, c. 0.7 cm long, clawed, greenish towards the upper half and white on the lower half, tomentose along the margins; nectaries 2. Stamens 12 in 2 rows of 6 each. Carpels 6, glabrous; ovules 2; styles hairy. Fruitlets globose.

Flowering & Fruiting: November-February.

Habitat: Evergreen forests.

Note: This species is allied to *Orophea thomsonii* Bedd. in the longer peduncles and pedicels, thick undulating margins of nectaries, glabrous carpels and obtuse or rounded leaf base.

It is a narrow endemic species, so far known only from the type locality. Further explorations must be made to locate the species in its known distributional areas to confirm its conservation status.

Specimens examined: Wayanad district: Periya Reserve Forests, ± 800 m, 20 Dec. 1999, *Sasidharan 10844* (Isotype, KFRI); *Ibid.*, 13 Jan. 2002, *Shaju 48974* (TBGT).

PHAEANTHUS J. D. Hooker & T. Thomson
Fl. Ind. 146.1855.

Phaeanthus malabaricus Bedd., Ic. t. 76. 1868-1874; Hook. f. & Thoms. in Hook. f., Fl. Brit. India 1.72. 1872; Dunn in Gamble, Fl. Pres. Madras 17. 1915; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg.194. 1987; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 3: 16. 1990; D. Mitra in Sharma *et al.*, Fl. India 1: 230. 1993; Sasidh. & Sivar., Flr. Pl.Thrissur For. 32. 1996; N. Mohanan & Sivad., Fl. Agasthyamala 59. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 19. 2004; Daniel (ed.), Fl. Kerala 1: 161. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 59. 2006.

Type: South Wayanad, Thambracharry Ghats, Malabar, *Beddome Acc. No. 561* (MH) (Fig. 23; Plate 10 d & e)

Shrubs or small trees. Leaves elliptic lanceolate, 6-20 x 2-6 cm, acute or caudate-acuminate at apex, base rounded or subcordate, glabrous on both sides. Flower(s) solitary or very few in extra-axillary fascicles, cream coloured. Sepals 3, 0.15-0.2 cm long, small, pubescent. Petals 6 (3+3); outer smaller, sepal like, 0.3-0.4 cm long; inner larger, 1-1.5 x 0.5-0.7 cm, ovate-acuminate, inflexed, thick and fleshy, cohering by their margins, arching over the torus. Stamens many; anthers linear; connective truncate. Ovules 1-2; style clavate, ciliate. Fruit an aggregate of subglobose carpels, 0.8-1 cm diameter, stalked. Seeds 1-2.

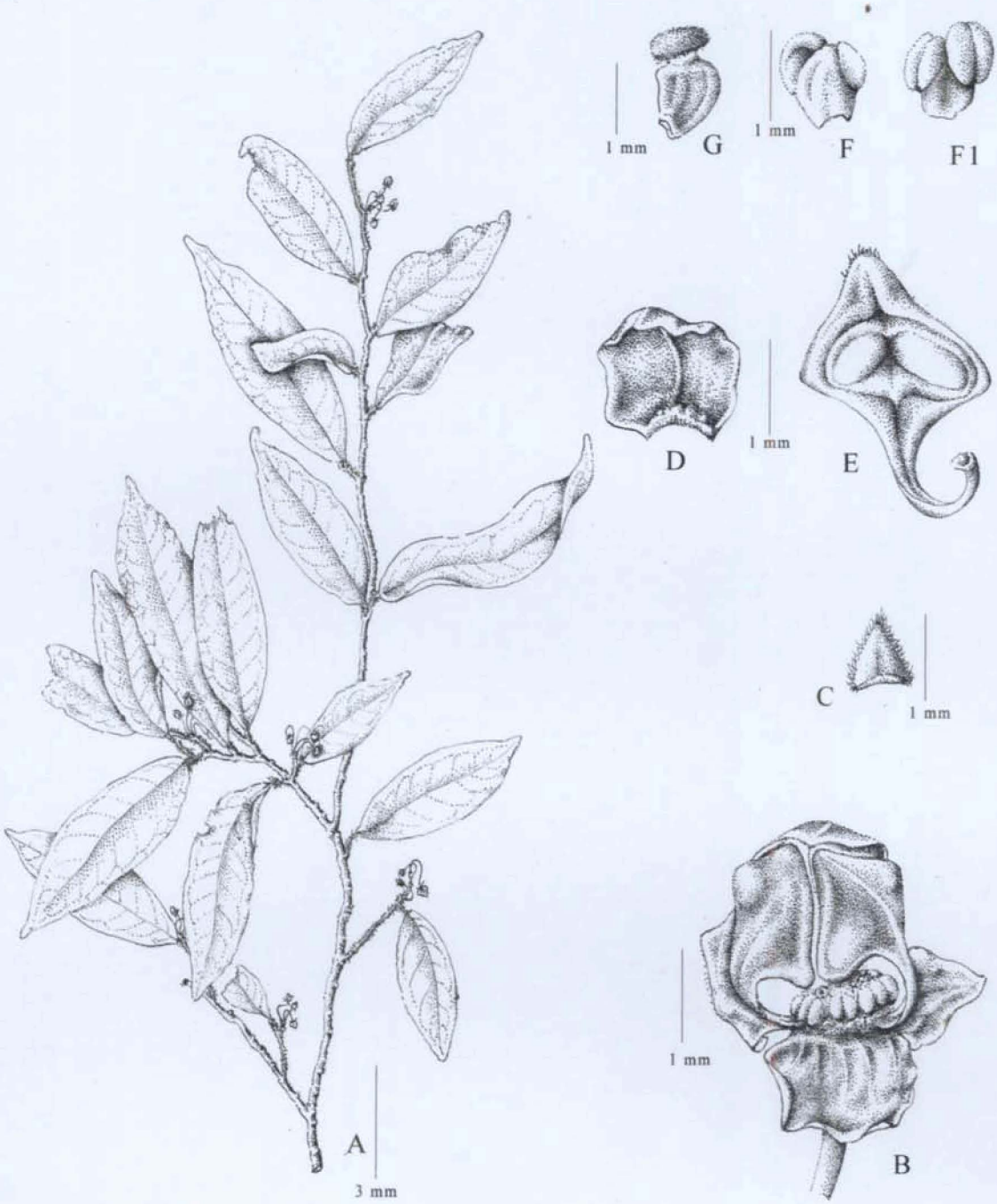

Fig 22. ***Orophea malabarica*** Sasidh. & Sivar.: A. Habit; B. Single flower; C. Bract; D. Sepal; E. Petal; F. Stamen - lateral view; F1 Stamen - dorsal view; G. Pistil

Flowering & Fruiting: December-March

Habitat: Recorded from evergreen and semi-evergreen forests, including riparian habitats.

Note: P. malabaricus Bedd. is the sole representative of the genus *Phaeanthus* Hook. f. & Thoms. recorded from India. This endemic species was first described by Beddome during 1868-1874 from South Wayanad (Type material – MH, Acc. No. 561, "Thambracharry Ghats, 2000 ft., Malabar") of Kerala state. In 1980 Ramachandran *et al.* relocated the species from Northern Wayanad after the type collection. However, the fruit of the species remained undescribed until A. G. Pandurangan and C. N. Mohanan collected and described the same from Idukki District in 1984. According to Nayar and Sastry (1990), this species is vulnerable and is confined to North Kerala only. The present study revealed that the species is rather well distributed in the evergreen and semi-evergreen forests of eight districts of the state. The consevation status of this phytogeographically interesting species has been assigned as 'Lower Risk; near threatened' in the IUCN Threatened Plant List of 2008.

Specimens examined: Thiruvananthapuram district: Attayar in Agasthyamala, ± 650 m, 1 Mar. 1991, *N. Mohanan 10552* (TBGT); Ernakulam district: Malayatoor, Evergreen, ± 450 m, 23 May 2004, *Shaju 5615* (TBGT).

POLYALTHIA Blume

Fl. Javae Anonac. 68. 1830.

Polyalthia shendurunii Basha & Sasidh., Rheedea 4: 21. 1994; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 20. 2004; Daniel (ed.), Fl. Kerala 1: 167. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 60. 2006.

Type: Kollam district: Shenduruny, ± 500 m, 25 May 1992, *Sasidharan 5842* (MH). (Fig. 24; Plate 11 a)

Large trees. Leaves oblong or elliptic lanceolate, 15-26 x 6-8.5 cm, base rounded or truncate, apex acuminate, lateral veins 8-16 pairs. Flowers on twigs solitary or in fascicles on tubercles on the trunk. Pedicels 4-6 cm long. Bract towards the lower half of the pedicel, ovate, acute, tomentose. Sepals 3, 1.5-2 x 1-1.3 cm, deltoid-ovate, acuminate, reflexed, connate at base, persistent. Petals 6, 3.5-4 x 0.5-1 cm, subequal, outer slightly smaller, oblong, acute to acuminate, coriaceous, minutely rugose and adpressed-tomentose on both sides, greenish yellow to yellow. Stamens many; anthers and connective hirsute, more on ventral surface, appendage glabrous. Carpels many, ovule solitary; style indistinct; stigma orbicular, depressed at middle. Fruitlets to 7, c. 3 x 2.5 cm, ovoid, bluntly pointed, stalked. Seed oblong.

Flowering & Fruiting: May-July

Habitat: Evergreen forests.

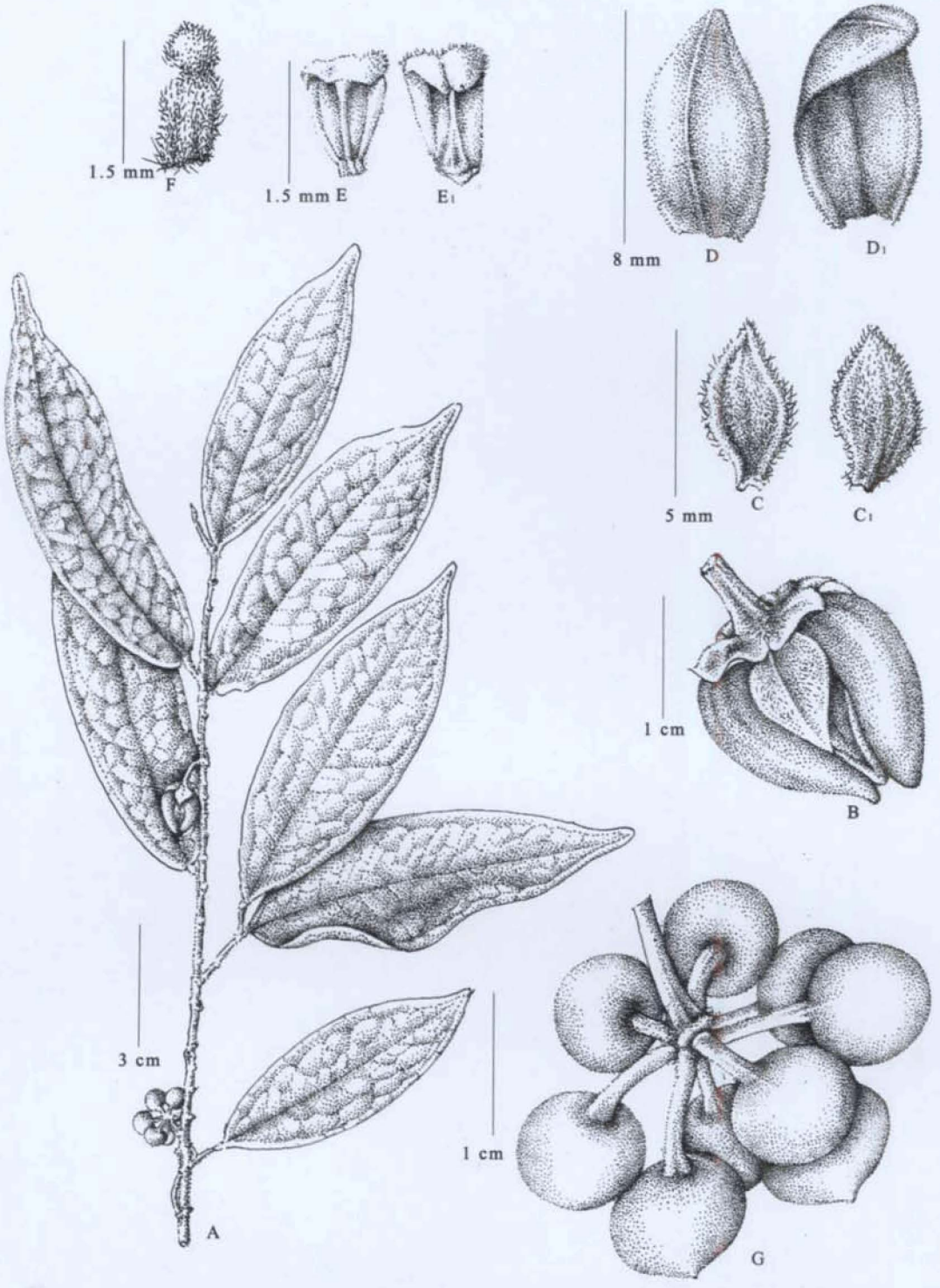

Fig. 23. ***Phaeanthus malabaricus*** Bedd.: A. Twig; B. Single flower; C. sepal - ventral view & C1. Sepal - dorsal view; D. Petal - vental view & D1. Petal - dorsal view; E. Stamen - ventral view & E1. Stamen - dorsal view; F. Pistil; G. Aggregate fruit.

Note: This palaeoendemic tree species reportedly occur only in the restricted localities of evergreen forests of Shenduruny Wildlife Sanctuary. The consevation status of this palaeoendemic species has been assigned as 'Endangered' in the IUCN Threatened Plant List of 2008.

Specimens examined: Kollam district: Shenduruny, ± 500 m, 25 May 1992, *Sasidharan 5842* (Isotype, KFRI); Pandimotta, Kulathupuzha, ± 560 m, 11 Jan. 1994, *Shanavaskhan & Santhosh Kumar 19177* (TBGT); *Ibid.*, 17 Dec. 2005, *Shaju* 58527 (TBGT).

SAGERAEA Dalz.

Kew Journ. iii. (1851)

Sageraea grandiflora Dunn, Kew Bull. 1914: 182 1914; Gamble, Fl. Pres. Madras 12. 1915; M. Mohanan, Bull. Bot. Surv. India 23: 62. 1981; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg.194. 1987; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 1: 30. 1987; D. Mitra in Sharma *et al.*, Fl. India 1: 282. 1993; Sasidh., Biodiver. Doc. Kerala, Part 6. Flr. Pl. 50. 2004; Daniel (ed.), Fl. Kerala 1: 171. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 61. 2006. ***Manjara.***

Type: 'Travancore', *Bourdillon 469* (MH). (Fig. 25; Plate 11 b-e)

Trees. Leaves oblong or elliptic, 25-35 x 7-8 cm, short acuminate, rounded at base, glabrous. Flowers clustered in axillary tubercles. Sepals 3, 0.2-0.3 cm long, connate at base, ciliate along margin. Petals 6, orbicular, creamy white, outer 1-1.5 cm, ciliate along margins; inner slightly larger. Stamens 12, obovate; connective prolonged, but not concealing the anther cells. Carpels 3-5; ovules 12-14; style short; stigma capitate. Fruitlets globose, each c. 3 cm diameter, stalked, solitary or few together.

Flowering & Fruiting: November-February.

Habitat: Evergreen forest.

Note: This species was first collected by Bourdillon (1894) from Kulathupuzha, the type locality, followed by Vencoba Rao (1915) from the nearby Achankovil area. Nayar and Sastry (1987) reported the species as endangered or possibly extinct; while the present study established the occurrence of the species in the above localities, though limited in number. Sasidharan (1996) reported its extended distribution in Idukki district. The species is of botanical and distributional interest as it belongs to one of the primitive families of flowering plants. Primitive characters and geographical isolation render its status as a palaeoendemic species. The consevation status of this specis has been designated as' Endangered' in the IUCN Threatened Plant List of 2008.

Specimens examined: Kollam district: Alappadi hills near Achankovill, Thenmalai, 5 Apr. 1915, *K. Vencoba Rao 2829; Ibid.* 24 Mar. 1915, *K. Vencoba Rao 2897* (TBGT); Palaruvi,

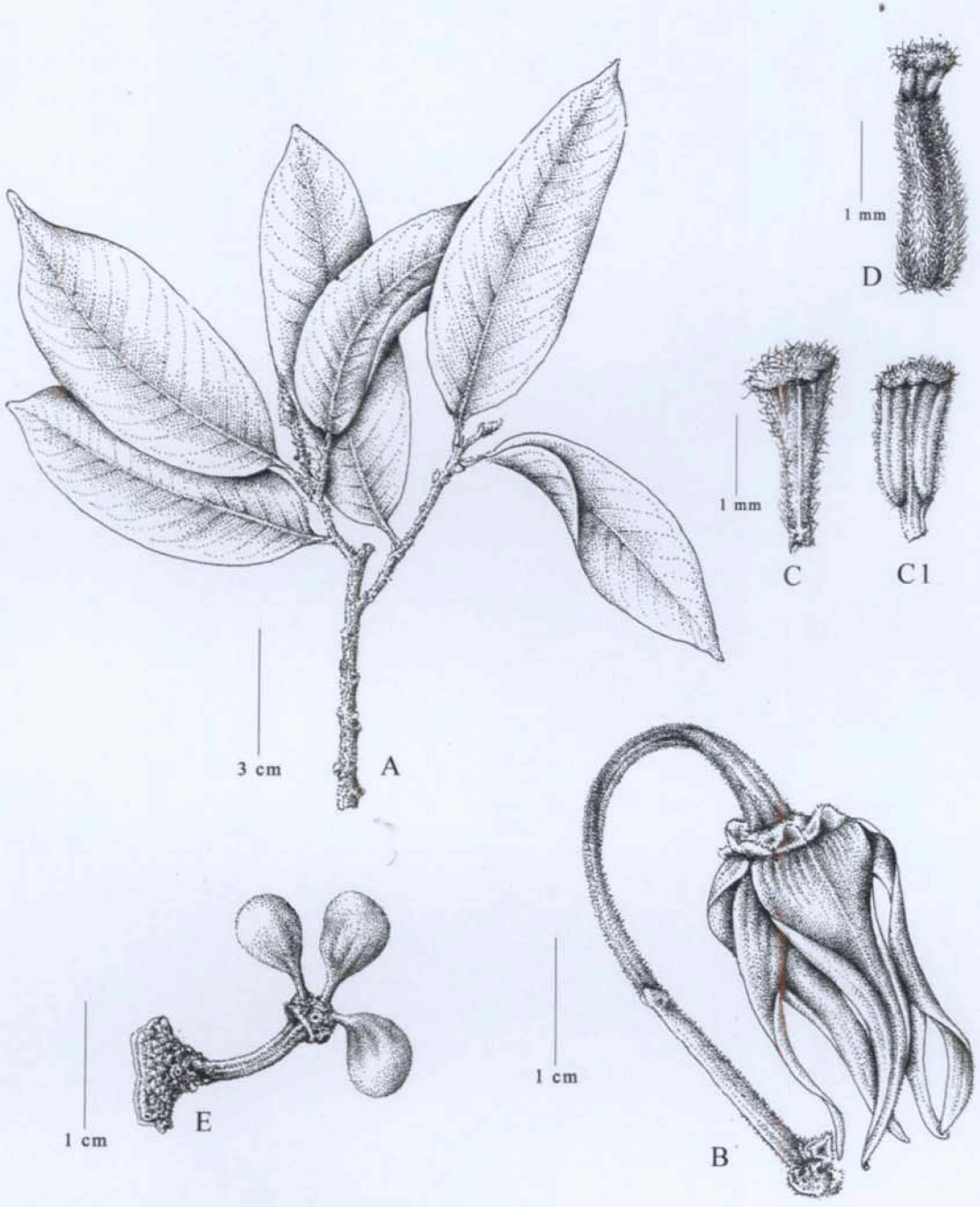

Fig 24. ***Polyalthia shendurunii*** Basha & Sasidh.: A. Twig; B. Single flower; C. Stamen - ventral view & C1. Stamen - dorsal view; D. Pistil; E. Fruits.

Aryankavu, ± 550 m, 12 Feb. 1997, *Santhosh Kumar 296790* (TBGT); *Ibid.*, 10 Mar. 1999, *Shaju 39757* (TBGT).

3. FLACOURTIACEAE

Table 23. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
89	800	8	41	3spp.

Kerala	
Genus/genera	Species/subsp./var.
6	23 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Homalium Jacq.	*H. jainii* A.N.Henry & Swamin. (Tamil Nadu)	
	H. travancoricum Bedd. (Tamil Nadu)	
Hydnocarpus Gaertner		*H. pendulus* Manilal et al.

HYDNOCARPUS J. Gaertner

Fruct. 1: 288, t. 60. 1788.

Hydnocarpus pendulus Manilal, M. Sabu & Sivar., Trop. Pl. Sci. Res. 1(4): 355. 1983; Manilal, Fl. Silent Valley 11. 1988; Anil Kumar *et al.*, Fl. Pathanamthitta 44. 2005; Daniel (ed.), Fl. Kerala 1: 276. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 335. 2006.

Type: Palakkad district: Mukkali, Silent Valley, ± 900 m, 8 Mar. 1982, *Sivarajan 35177* (Holotype,CAL). (Fig. 26; Plate 12 a-c)

Trees. Leaves lanceolate or oblong-lanceolate, 10-20 x 3-5 cm, base acute, apex gradually acute to slightly auminate. Flowers polygamous in axillary recemes, pendulous. Male flowers: pedicel slender, 2-3 cm long; sepals subequal, oblong or elliptic, c. 1 x 0.5 cm, rusty pubescent without; petals white, 0.8 x 0.1 cm, linear lanceolate, longitudinally stongly inflexed, enclosing a linear oblong scale. Stamens 5. Bisexual flowers: pedicels stouter and shorter, 2-2.5 cm long; sepals and petals, scales and stamens as in male; ovary ovoid, densely rusty-tomentose; ovules many, in 5-parietal placentae. Fruit globose, c. 8 cm across, densely soft rusty-tomentose. Seeds many, embedded in a white pulp.

Flowering & Fruiting: January-May.

Habitat: Growing in evergreen and moist-deciduous forests.

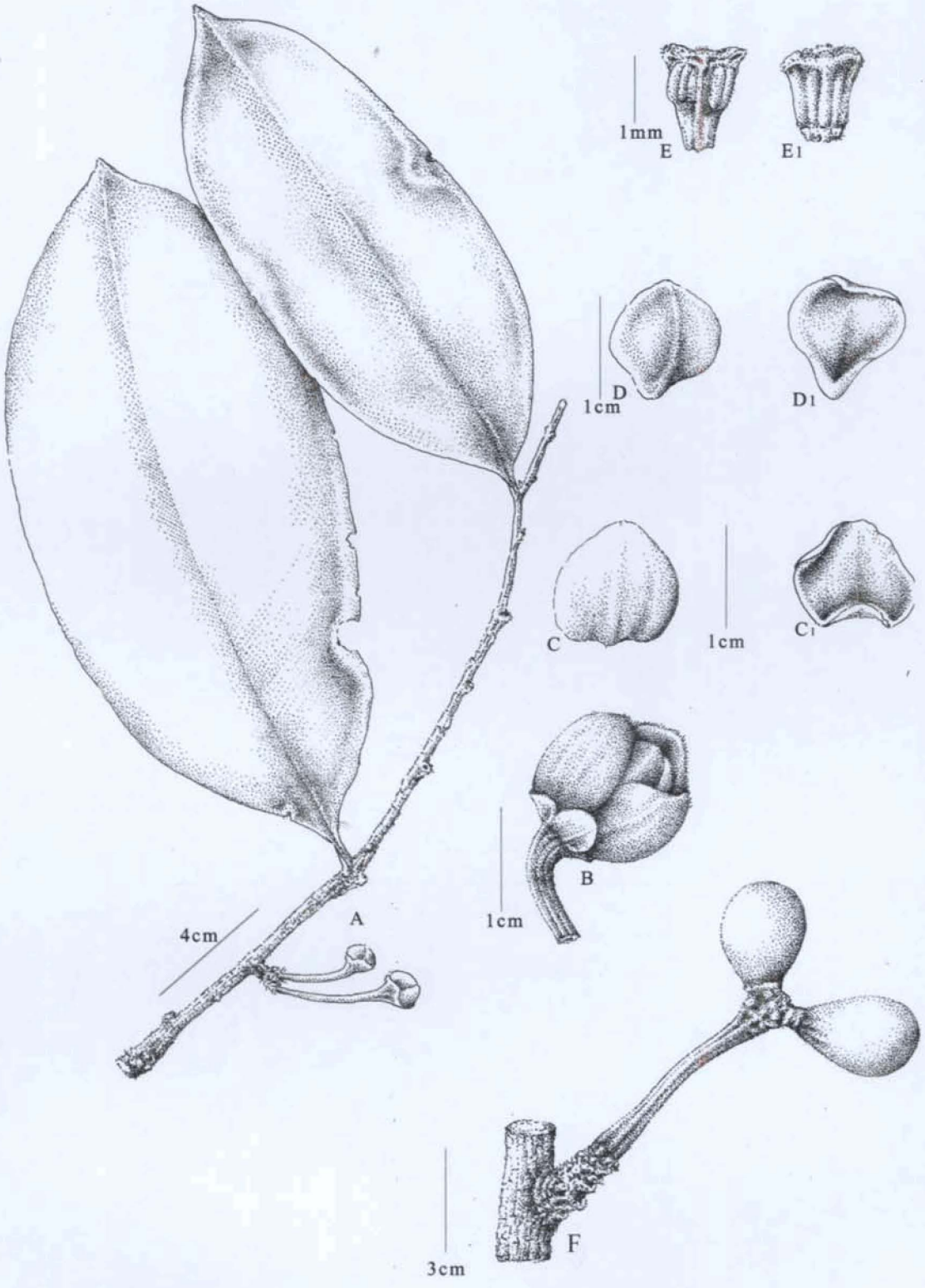

Fig. 25. ***Sageraea grandiflora*** Dunn.: A. Twig; B. Single flower; C. Sepal - dorsal view & C1. Sepal - ventral view; D. Petal - dorsal view & D1. Petal - ventral view; E. Stamen - dorsal view & E1. Stamen - ventral view; F. Fruits .

Note: This species is allied to *H. alpina* Wight in its habit, but can be distinguished by its acute or subacute leaves, pendulous flowers, oblong or elliptic-oblong sepals and scales.

It is a palaeoendemic species of botanical and distributional interest. After the type collection by Manilal *et. al.*, from Silent Valley in 1982, Anil Kumar collected this species from Arampa, of Pathanamthitta district during his floristic studies in 1993. Present study also resulted in the collection of this species from Araam mile, near Adimaly in Idukki district with very limited individuals. So far this species is not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimens examined: Palakkad district: Mukkali, Silent Valley, ± 900 m, 8 Mar. 1982, *Sivarajan 35177* (Isotype, CALI); Pathanamthitta district: Arampa, ± 400 m, 9 Oct. 1990, *Anil Kumar 2278* (SNCH); Idukki district: Adimali, Araam mile, ± 400 m, 15 Aug. 2002, *Shaju 44696* (TBGT).

4. MALVACEAE

Table 24. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
200	2300	c. 24	104	9 spp., 1 var.

Kerala

Genus/genera	Species/subsp./var.
12	49 spp., 4 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Hibiscus L.		*H. sreenarayanianus* Anil Kumar & Ravi
Julostylis Thwaites		*J. ampumalensis* Pradeep & Sivar.
		J. polyandra Ravi & Anil Kumar
Sida L.	*S. beddomei* Jacob (Goa, Karnataka)	*S. fryxellii* Sivar. & Pradeep
		S. ravii Sivad. & Anil Kumar

Key to the genera

1. Trees; flowers in large panicles ..... Julostylis
1. Shrubs or undershrubs; flowers solitary or in short panicles.
   2. Fruit a capsule; staminal column dentate ..... Hibiscus
   2. Fruit a schizocarp; staminal column truncate ..... Sida

Plate 11. a. ***Polyalthia shendurunii*** Basha & Sasidh.: Herbarium specimen at TBGT; b - e. ***Sageraea grandiflora*** Dunn: b. Flowering twig; c. Fruiting twig; d. Type specimen at MH; e. Herbarium specimen at TBGT, collected by K. Vencoba Rao in 1915.

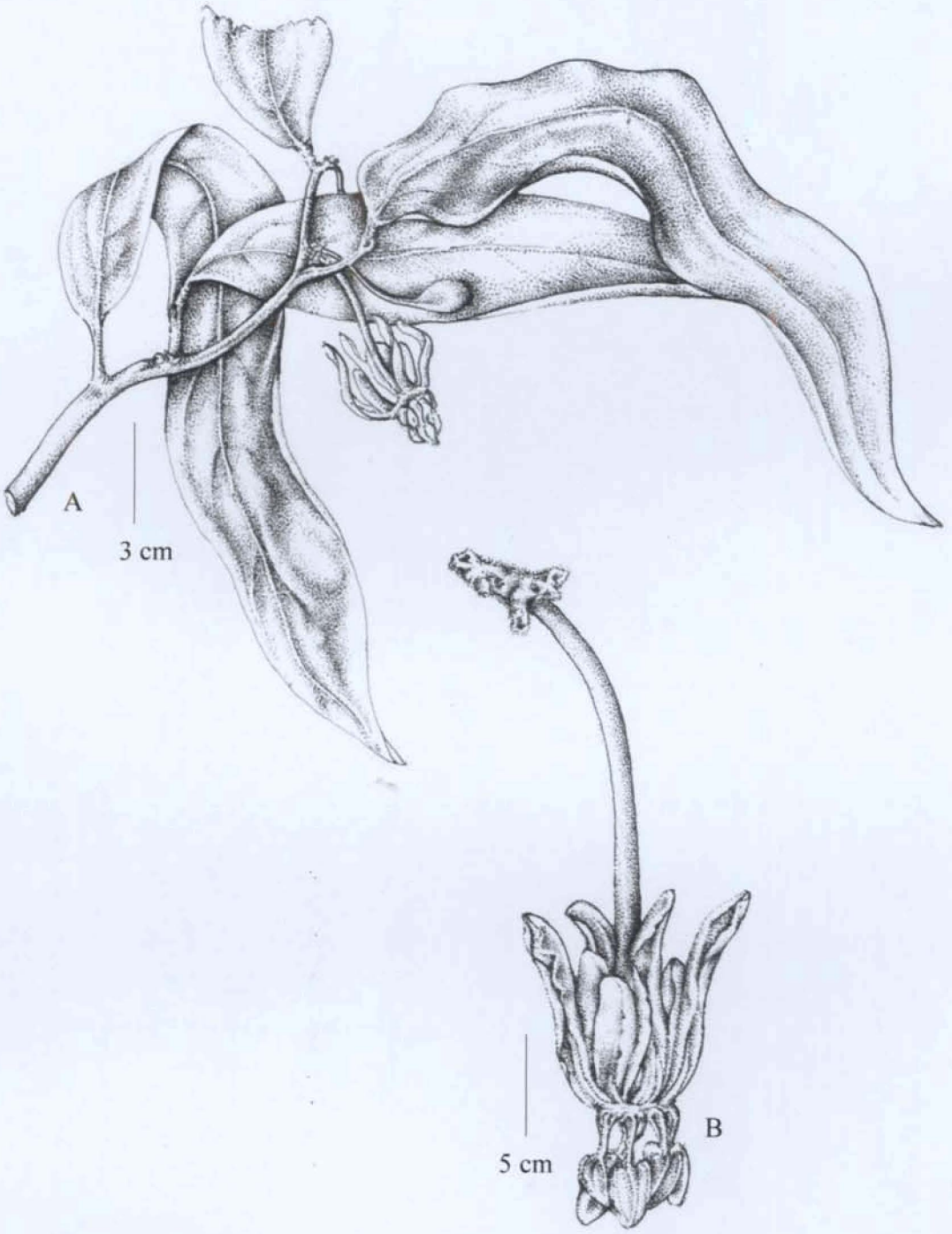

Fig. 26. ***Hydnocarpus pendulus*** Manilal *et al.*: A. Twig; B. Single flower.

HIBISCUS L.

Sp. Pl. 693. 1753, nom. cons.

Hibiscus sreenarayanianus Anil Kumar & Ravi, Rheedea 4: 129. 1994; Sivar. & Pradeep, Malv. Pen. India. 1996; Anil Kumar *et al.*, Fl. Pathanamthitta 82. 2005; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 50. 2004; Daniel (ed.), Fl. Kerala 1: 420. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 402. 2006.

Type: Kollam district: Palkulangara, ± 20 m, 25 Sep. 1991, *Ravi 3418* (CALI)

(Plate 13 a-c)

Annual, erect herbs. Stems coverd with soft bristles, simple and stellate hairs. Leaves entire or shallowly 5-lobed, 8-12 x 7-15 cm, ovate to orbicular, deeply cordate at base. Flower(s) solitary, axillary or in teminal racemes. Epicalyx lobes 8-10, c. 0.8 cm long, linear, subulate, hairy, persistent. Calyx lobes 3-angled, c. 2 x 1.8 cm, acuminate, simple and stellate hairy out side. Corolla yellow with reddish brown centre. Petals obovate-oblanceolate, c. 5 x 3.5 cm, obliquely cuneate at base, obtuse at apex. Staminal column antheriferous throughout, c. 2 cm long, 5-toothed at apex. Ovary orbicular or ovoid, pubescent; stigma discoid, purple. Capsules orbicular-ovoid, enclosed in accrescent calyx. Seeds reniform, glandular-papillose, brownish black.

Flowering & Fruiting: September-December.

Habitat: Bushes and plains along the lowland waysides.

Note: This species is characterised by its strikingly different indumentum; other characters like 7-nerved calyx lobes, articulated long pedicels and long simple haired capsule also help to differentiate it from other species.

As a horticulturally promising, narrow endemic species, its distributional status should be analysed for further assignment of status and conservational efforts.

Specimens examined: Kollam district: Palkulangara, ± 20 m, 25 Sep. 1991, *Ravi 3418* (Isotype, CALI); Pathanamthitta district: Adoor, Ezham mile, ± 20 m, 8 Oct. 1992, *Anil Kumar 3120* (SNCH).

JULOSTYLIS Thwaites

Enum. Pl. Zeyl. 30. 1858.

Key to the species

1. Stamens 10 in each flower; involucellar bracts longer than sepals ..... 1. *J. ampumalensis*

1. Stamens 17-20 in each flower; involucellar bracts

Plate 12. a - c. *Hydnocarpus pendulus* Manilal *et al.*: a. Habit; b. Flowering twig; c. Fruiting twig.

as long as sepals ..... 2. *J. polyandra*

1. **Julostylis ampumalensis** Pradeep & Sivar., Bot. Bull. Acad. Sin. 34: 282. 1993; Sivar. & Pradeep, Malv. Pen. India 150. 1966; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 51. 2004; Daniel (ed.), Fl. Kerala 1: 426. 2005; T .S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 402. 2006.

Type: Malappuram district: Koombara, Ampumala, ± 45 m, 20 Jan. 1992, *Pradeep 44981* (CALI). (Plate 13 d)

Small trees. Leaves broadly ovate, 6-16 x 4-11 cm, shallowly 3-lobed towards apices, rounded or truncate at base, 5-nerved at base. Flowers pedicellate in axillary and terminal panicles. Involucellar bracts 5, elliptic-obtuse, connate at base. Calyx 5-parted, c. 0.5 cm long, ovate-acute, much smaller than involucellar bracts. Corolla yellow with a purple centre; petals 5, c. 0.8 x 0.4 cm, narrowly obovate,connate at base. Stamens 10, staminal column c. 0.4 cm long, staminiferous towards middle, 5-toothed at apex. Ovary 2-3-locular; style slender, 2-branched towards apex; stigma peltate. Capsule subglobose, c. 0.5 cm across, densely stellate tomentose. Seeds reniform, concentrically striated.

Flowering & Fruiting: November–January.

Habitat: Semi-evergreen and deciduous forests.

Note: Restricted in distribution and confined only to the type locality. It's tree habit, narrow population size and disjunct distribution of the genus (from Sri Lanka), revealed the palaeoendemic nature of the species. Conservation measures should be extended to the existing populations in natural habitats (*in-situ*), in consideration of its phytogeographical and palaeoendemic characteristics.

Specimen examined: Malappuram district: Koombara, Ampumala, ± 45 m, 20 Jan. 1992, *Pradeep 44981* (Isotype, CALI).

2. **Julostylis polyandra** Ravi & Anil Kumar, J. Bombay Nat. Hist. Soc. 87: 260. 1990; Paul in B. D. Sharma *et al.*, Fl. India 3: 342. 1993; Pradeep & Sivar., Bot. Bull. Acad. Sin. 34: 277. 1993; M. Mohanan & A. N. Henry, Fl. Thiruvananthapuram 112. 1994; Anil Kumar *et al.*, Fl. Pathanamthitta 79. 2005; Sivar. & Pradeep, Malv. Pen. India 150. 1966; N. Mohanan & Sivad., Fl. Agasthyamala 98. 2002; Sasidh., Biodiver. Doc, Kerala, Part 6, Fl. Pl. 51. 2004; Daniel (ed.), Fl. Kerala 1: 427. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 402. 2006. ***Vazhukkal.***

Type: Thiruvananthapuram district: Ponmudi hills, 750 m, 15 Aug. 1988, *Ravi 2475* (TBGT). (Plate 13 e)

Medium sized trees. Leaves broadly ovate to rhomboid, 4-21 x 2-18 cm, palmately 5-angled towards the upper half, base rounded or cuneate, apex acuminate or acute, 5-nerved at base. Flowers in large terminal and axillary panicles. Epicalyx lobes 4-6, connate at base. Calyx

lobes 5, connate to the middle. Corolla yellow with a purple centre; petals 5, c. 2 x 1 cm, narrowly obovate, connate at base. Stamens 17-20, staminal column c. 0.6 cm long, staminiferous towards middle, 5-toothed at apex. Ovary ovoid, 2-locular; style slender, 2-branched towards apex; stigma peltate. Capsule compressed globose, c. 0.9 cm across, densely stellate hairy. Seeds reniform.

Flowering & Fruiting: December–April.

Habitat: Semi-deciduous forests.

Note: It is found that narrowly distributed significantly small populations occur in the reported areas. It is therefore necessary to identify more areas of its occurrence for planning conservation measures. The consevation status of this palaeoendemic and phytogeographically interesting species has been designated as 'Endangered' in the IUCN Threatened Plant List of 2008.

Specimens examined: Thiruvananthapuram district: Ponmudi hills, ± 750 m, 15 Aug. 1988, *Ravi 2475* (Isotype, TBGT); Agasthyamala, Meenmutty, ± 750 m, 6 Nov. 1990, *N. Mohanan 10102* (TBGT); Pathanamthitta district: Kakki hills (near dam site), ± 1000 m,17 Feb. 2004, *Shaju 6851* (TBGT).

SIDA L.

Sp. Pl. 683. 1753.

Key to the species

1. Leaves ovate to elliptic-oblong; rarely orbicular, base cordate, apex mostly acute ..... 2. *S. ravii*
1. Leaves obovate-orbicular to ovate or elliptic, base rounded or acute, apex mostly obtuse or retuse ..... 1. *S. fryxellii*

1. **Sida fryxellii** Sivar. & Pradeep, Kew Bull. 45: 725. 1990; Malv. Pen. India 259. 1966; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 53. 2004; Anil Kumar *et al.*, Fl. Pathanamthitta 79. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 405. 2006.

Type: Kozhikode district: Beypore, sea leval, 25 Oct. 1996, *Pradeep 6018* (CALI) (Plate 13 f)

Erect subshrubs, densely soft stellate-pubescent. Leaves dimorphic, early ones ovate-orbicular, later ones ovate or elliptic, 3-5 x 3-7 cm, base rounded or acute, margin crenate-serrate, apex mostly retuse or obtuse to acute. Flower(s) solitary, axillary, occasionally few in terminal recemes. Calyx 0.5-0.8 cm, lobes triangular, 5-lobed. Corolla yellow, petals 5, c. 1.5 cm, obliquely obovate. Staminal tube c. 0.3 cm long. Ovary subglobose, densely covered with stellate hairs; styles 8-10; stigma capitate. Mericarps 8-10, trigonous, awns c. 0.2 cm long, retrorsely hairy. Seeds subreniform, glabrous except the hilum.

Flowering & Fruiting: November-March.

Habitat: Gregarious subshrubs seen along the road sides and waste places.

Note: Supposed to be a neoendemic species, which shows high morphological variations. So it may be a descendant of *Sida cordifolia* L., which need taxonomic characterisation of different populations.

So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimen examined: Kozhikode district: Beypore, sea leval, 25 Oct. 1996, *Pradeep 6018* (Isotype, CALI).

2. **Sida ravii** Sivad. & Anil Kumar, Willdenowia 25: 651. 1996. Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 53. 2004; Anil Kumar *et al.*, Fl. Pathanamthitta 89. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 406. 2006.

Type: Kollam district: Maruthoor kulangara, Sea level, 25 May 1991, *Anil Kumar 2768* (MH). (Plate 13 g)

Erect, branched subshrubs. Leaves ovate-lanceate, base cordate or rarely rounded, margin crenate up to base, 2-7 x 1-4 cm. Flowers axillary, solitary or 3-4 on recemes. Calyx widely campanulate, 0.8-1 x 0.6-0.8 cm, 5- lobed with acute apex. Corolla yellow. Petals 5, 1-1.4 x 0.7-1.2 cm, obliquely ovate, apex asymmetrically emarginate. Staminal tube 0.3-0.4 cm long. Ovary ovoid; styles 8-10; stigma capitate. Schizocarp c. 0.7 cm in diameter; mericarps 8-10(-12), radially compressed, outer surface reticulately ribbed below the shoulder, glabrous, black, apex divergent-mucronate on a distinct shoulder, antrorsely (never retrorse) stellate hairy. Seeds subreniform.

Flowering & Fruiting: July-November.

Habitat: Small thickets in open waysides.

Note: Rhombic leaves with an obtuse or cuneate base and antrorse pubescence on the awns are the differentiating characters. Preservation of this species in plant conservatories are very essential because, of the higly vulnerable habitats (open waysides) of this narrow endemic species.

Specimens examined: Kollam district: Maruthoor kulangara, Sea level, 25 May 1991, *Anil Kumar 2768* (Holotype, MH; Isotype, SNCH); Pathanamthitta district: Adoor, ± 20 m, 11 July 1992, *Anil Kumar 2831* (Paratype, SNCH); Kollam district: Paravur, Sea level, 14 Nov. 2006, *Shaju 53251* (TBGT).

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Plate 13. a - c. ***Hibiscus sreenarayanianus*** Anil Kumar & Ravi: a. Habit; b. Fruit; c. Type specimen at CALI; d. ***Julostylis ampumalensis*** Pradeep & Sivar.: Type specimen at CALI; e. ***Julostylis polyandra*** Ravi & Anil Kumar: Type specimen at CALI; f. ***Sida fryxellii*** Sivar. & Pradeep: Type spcimen at CALI; g. ***Sida ravii*** Sivad. & Anil Kuamr: Habit.

5. TILIACEAE

Table 25. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
50	450	8	65	7 spp.

Kerala

Genus/genera	Species/subsp./var.
4	34 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Grewia L.	*G. gamblei* Drumm. (Tamil Nadu)	*G. palodensis* Santhosh & Kumar *et al.*
	G. heterotricha Masters (Maharashtra, Karnataka (Tamil Nadu)	
	G. lawsoniana Drumm. ex Gamble (Karnataka & Tamil Nadu)	
	G. pandaica Drumm. ex Dunn (Tamil Nadu)	

GREWIA L.

Sp. Pl. 964. 1753.

Grewia palodensis Santhosh Kumar, Shanavas, Binu & Almeida, Rheedea 11: 41. 2001; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 63. 2004; Santhosh Kumar, Shanavas, Binu & Almeida, J. Econ. Taxon. Bot. 28: 513. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 603. 2006.

Type: Thiruvananthapuram district: Manthuruthy Kavu, ± 80 m, 20 June 1994, *Santhosh Kumar 20091*(TBGT). (Plate 14)

Large scandent shrubs. Leaves broadly elliptic or oblong, 8-12 x 4-6 cm, rounded at base, crenate-serrate at margin, 3-nerved at base. Flowers in axillary and terminal umbellate cymes; peduncles 1-3 together. Sepals 5, c. 1.5 x 0.3 cm, light greyish, reflexed, longitudinally ribbed, stellately-tomentose. Petals 5, 0.5-0.6 cm, linear-oblong, obtuse-apiculate at apex, glandular at base within, stellate hairy without at base. Andro-gynophore distinctly 4-grooved. Ovary globose, villous, 4-locular; style puberulent; stigma capitate. Drupe deeply 2-partite, 1.5-2 cm,

sparsely stellate-hairy.

Flowering & Fruiting: May-October.

Habitat: Sacred grove.

Note: This species is distinguished from its sympatric species *G. umbellifera* Bedd. by many-flowered axillary and terminal cymes, distinctly 4-grooved androgynophore and the bi-partite fruit. Its habit (lianae) and specific habitat (sacred grove) show the conservational importance of this local endemic species.

Specimens examined: Thiruvananthapuram district: Manthuruthy Kavu, ± 80 m, 20 June 1994, *Santhosh Kumar 20091* (Holotype, TBGT); *Ibid.*, 6 May 2004, *Shaju 59484* (TBGT).

6. OXALIDACEAE

Table 26. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
8	75	3	22	5 spp., 2 var.

Kerala

Genus/genera	Species/subsp./var.
2	10 spp., 3 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Biophytum DC.	*B. insigne* Gamble (Tamil Nadu)	*B. congestiflorum* Govind.
		B. longipedunculatum Govind.
		B. reinwardtii var. *keralanum* Santhosh Kumar *et al.*
		B. veldkampii Shanavas *et al.*

BIOPHYTUM A. P. de Candolle

Prodr. 1: 689. 1824.

Key to the species

1. Perennials; stem branched; leaflets 15-22 pairs ..... 1. *B. congestiflorum*

1. Annuals; stem unbranched; leaflets 1-18 pairs.

2. Sepals shorter or equal to fruits ..... 3. *B. reinwardtii* var. *keralanum*

2. Sepals much exeeding the fruits.

Plate 14. ***Grewia palodensis*** Santhosh Kumar *et al.*: Type specimen at TBGT.

3. Peduncle 6-9 cm long; seeds not tuberculate..... 4. *B. veldkampii*

3. Peduncle 14-24 cm long;seeds tuberculate.....

..... 2. *B. longipedunculatum*

1. **Biophytum congestiflorum** Govind., J. Econ. Taxon. Bot. 20: 312. 1996; Manna in Hajra *et. al.*, Fl. India 4: 231. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 67. 2004; Daniel (ed.), Fl. Kerala 1: 570. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 470. 2006.

Type: Idukki district: Peermede, *Govindarajalu 5597* (CAL). (Plate15 a)

Perennials. Stems usually branched, 55-100 cm high. Leaves spindle shaped, 15-22-jugate, 6-10 x 2-3 cm, stipulate; rachis patently hairy, c. 11 cm long. Leaflets rarely overlapping; terminal pairs ovate, asymmetric, oblique, 0.8-1 x 0.35-0.4 cm; others linear oblong, more or less asymmetric, c. 0.9 x 0.25 cm. Inflorescence pseudo-umbel with 10-12 congested flowers. Peduncle 4-8 cm long, densely strigose. Pedicels 0.7-1 cm long, glabrous. Bracts linear-lanceolate, 0.4-0.45 cm long. Sepals ovate, lanceolate, 0.4-0.45 x 0.1-0.15 cm, sparsely strigose, 5-7-nerved. Petals obovate, rounded at apex, 0.5-0.55 x 0.5-0.7 cm, 5-nerved, yellow. Staminal filaments glabrous, c. 0.25 cm long. Ovary 5-lobed, glabrous; ovules 2-per cell. Fruits turbinate, c. 0.25 x 0.2 cm, sparsely hairy. Seeds broadly ovoid, muricately ridged.

Flowering & Fruiting: December

Habitat: Moist grasslands.

Note: This species is narrowly distributed in its areas of occurence. It can be easily recognised by its unusually branched dendroid habit, fusiform leaves and congested flowers. Owing to the narrow endemic nature, the species warrants critical evaluation to obtain conservation status.

Specimens examined: Idukki district, Murinjapuzha, ± 800 m, 21 Oct. 1997, *Santhosh Kumar 36202* (TBGT); Kottayam district: Valachakanam, ± 1150 m, 28 Nov. 1996, *Ravi 24788* (TBGT).

2. **Biophytum longipedunculatum** Govind., J. Econ. Taxon. Bot. 20: 312. 1996; Manna in Hajra *et. al.*, Fl. India 4: 234. 1997; Gopalan & A. N. Henry, End. Pl. India 56. 2000; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 68. 2004; Daniel (ed.), Fl. Kerala 1: 572. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 470. 2006.

Type: Thrissur district: Chalakudy, Anakayam, *Govindarajalu 2955* (MH). (Plate 15 b)

Annuals. Stem 30-40 cm high, densely retrorsely strigose towards apex. Leaves 9-18-jugate; 7.5-12 cm long, strigose; rachis 4-9 cm long. Leaflets asymmetric; terminal leaflets obovate, c. 1.8 x 0.1 cm, cuspidate, elliptic oblong, oblique at base; others asymmetric, 0.15-0.2 x 0.7-0.8 cm, elliptic-oblong. Peduncle 14-22 cm long, eglandular, hairy throughout. Bracts ovate-lanceolate, 0.1-0.15 cm long. Pedicels 7-10 mm long, strigose, eglandular. Sepals ovate,

lanceolate, acuminate, 0.3-0.35 x 0.2-0.3 cm, 7-nerved, longer than fruits. Petals obovate, rounded at apex, yellow, 0.35-0.45 x 0.5-0.6 cm, 4-nerved. Staminal filaments pubescent, c. 0.25 cm long. Ovary 5-lobed elliptic-ovate; ovules 3-4 per cell. Fruits obovoid, c. 0.3 x 0.35 cm. Seeds bipyramidal, irregularly tubercled.

Flowering & Fruiting: December.

Habitat: Moist grasslands.

Note: Fairly distributed in central and southern districts of the state. Unbranched habit, much longer leaves, remote leaflets, longer lower portion of rachis without leaflets and adaxially strigose leaflets are the distinguishing characters.

So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimens examined: Thrissur district: Chalakudy, Anakayam, *Govindarajalu 2955* (Isotype, MH); Thiruvananthapuram district: TBGRI campus, ± 120 m, 7 Dec. 1995, *Santhosh Kumar 25556* (TBGT); Pathanamthitta district: Charupara, ± 150 m, 27 Nov. 1996, *Ravi 24735* (TBGT).

3. **Biophytum reinwardtii** var. **keralanum** Santhosh Kumar, Yeragi, Babu & Shanavas, J. Econ. Taxon. Bot. 25: 745. 2001; Santhosh Kumar *et al.*, J. Econ. Taxon. Bot. 28: 741. 2004; Sasidh., Biodiver. Doc, Kerala, Part 6, Fl. Pl. 68. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 471. 2006.

Type: Kottayam district: Pampavalley, ± 80 m, 6 Aug. 2001, *Santhosh Kumar 45859* (TBGT).

(Plate 15 c-e)

Annuals. Stem, up to 15 cm high. Leaves 12-17-jugate; rachis slightly winged, 4-7.5 cm long. Leaflets overlapping; terminal largest, to 1.3-0.5 cm, asymmetric, obovate, midrib excentric-curved; others elliptic, symmetric, base truncate, midrib median, margin sparsely strigose. Peduncle 5-18 cm long, patent to appressed-strigose and septate-glandular hairy. Pedicel c. 0.6 cm long. Bracts ovate-attenuate, 0.1-0.15 cm long. Sepals ovate, 0.2-0.25 x 0.1-0.15 cm, acute-acuminate at apex, half as long as petals and equal to fruits. Petals elliptic to oblanceolate, 0.35-0.45 cm long, emarginate at apex. Staminal filaments puberulous, 0.2-0.25 cm long. Ovary apically ciliate; ovules 2 per cell. Fruits 0.3-0.35 x 0.2-0.25 cm, glandular hairy in the ribs. Seeds 1-2, transversely ridged and tubercled.

Flowering & Fruiting: June-February.

Habitat: Waysides, watelands and sacred groves.

Note: A local endemic variety, supposed to be neoendemic in origin. Owing to the narrow endemic nature, the species warrants critical evaluation to obtain conservation status.

Specimen examined: Kottayam district: Pampa valley, ± 80 m, 6 Aug. 2001, *Santhosh Kumar 45859* (Holotype, TBGT).

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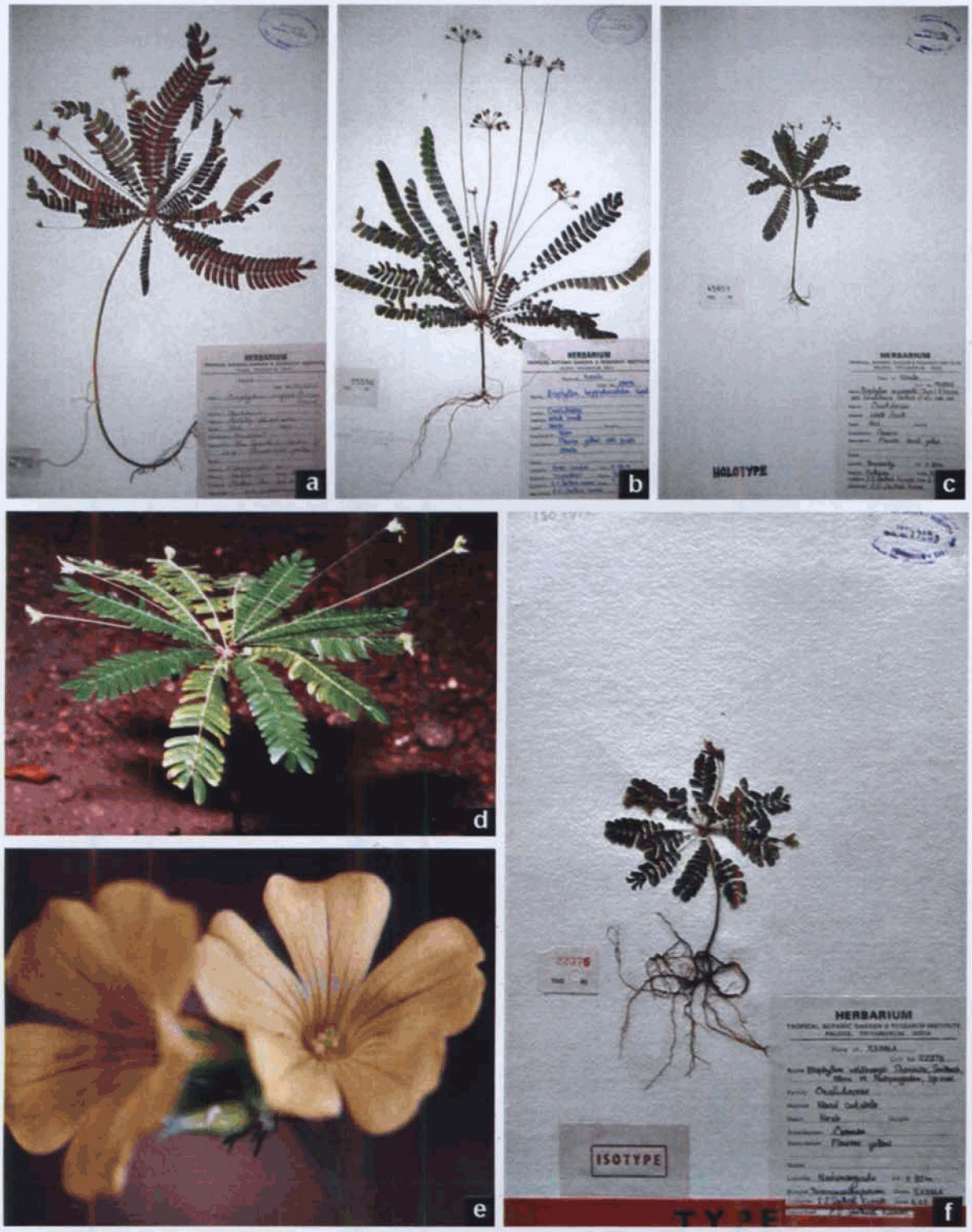

Plate 15. a. ***Biophytum congestiflorum*** Govind.: Herberium specimen at TBGT; b. ***Biophytum longipedunculatum*** Govind.: Herbarium specimen at TBGT; c - e. ***Biophytum reinwardtii*** var. ***keralanum*** Santhosh Kumar *et al.*: c. Type specimen at TBGT; d. Habit; e. Flowers; f. ***Biophytum veldkampii*** Shanavas *et al.*: Type specimen at TBGT.

4. **Biophytum veldkampii** Shanavas, Santhosh Kumar, Binu & Pushpangadan, Rheedea 8: 79.1998; Santhosh *et. al.*, J. Econ. Taxon. Bot. 28: 741. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 68. 2004; Daniel (ed.), Fl. Kerala 1: 575. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 471. 2006.

Type: Thiruvananthapuram district: Nedumangad, ± 80 m, 6 May 1995, *Santhosh Kumar 22376* (TBGT). (Plate 15 f)

Annuals. Stem up to 15 cm high. Leaves 7-16 jugate; rachis slightly winged, 3-12 cm long. Leaf-lets overlapping; terminal largest, 0.7-1.5 x 0.3-0.7 cm, obovate and falcate, oblique, midrib excentric; others oblong, base truncate, midrib median, apex apiculate, margin ciliate. Peduncle 6-9 cm long, appressed to patentely strigose, eglandular. Bracts ovate, 0.2-0.3 cm long, apex mucronate. Pedicels 0.15-0.25 cm. Flowers heterotristylous. Sepals ovate-lanceolate, 0.4-0.45 x 0.1-0.15 cm, half as long as corolla and much exeeding fruits. Petals oblanceolate, 0.8-1 x 0.4-0.5 cm, apex retuse, claw greenish, limb yellow. Staminal filaments puberulous, c. 0.25 cm long. Ovary apically ciliate; ovules 2 per cell. Fruit hispid, 0.3-0.35 x 0.2-0.25 cm, apically ciliate on the ribs. Seeds 1-2 per cells, transversely rigid, not tuberculate.

Flowering & Fruiting: December.

Habitat: Moist grasslands.

Note: A distinct local endemic species having eglandular inflorescence and calyx, pedicels distinctly shorter than calyx and the sepals exceeding the capsules.

Supposed to be a neoendemic species, further investigations are necessary to obtain a clear picture of conservation status.

Specimen examined: Thiruvananthapuram district: Nedumangad, ± 80 m, 6 May 1995, *Santhosh Kumar 22376* (Holotype, TBGT).

7. BALSAMINACEAE

Table 27. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
2	850	2	c. 203	60 spp., 6 var.

Kerala

Genus/genera	Species/subsp./var.
2	77 spp., 2 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Impatiens L.	*I. aliciae* C. E. C. Fischer (Karnataka)	

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	I. anaimudica C. E. C. Fischer (Tamil Nadu)	
	I. auriculata Wight (Tamil Nadu)	
	I. campanulata Wight (Taiml Nadu)	*I. cochinica* Hook.f.
	I. chandrasekharanii Chandrb. (Tamil Nadu)	*I. coelotropis* C. E. C. Fischer
	I. chinensis var. *brevicornis* Barnes (Karnataka)	*I. concinna* Hook. f.
	I. clavicornu Trucz. (Maharashtra & Tamil Nadu)	*I. johnii* Barnes
	I. crenata Bedd. (Maharashtra, Karnataka & Tamil Nadu)	*I. kulamavuensis* Pandurangan & V. J. Nair
	I. dasysperma Wight (Karnataka & Tamil Nadu)	*I. macrocarpa* Hook. f.
	I. denisonii Bedd. (Karnataka & Tamil Nadu)	*I. munnarenis* Barnes
	I. desoti Hook.f. (Taiml Nadu)	*I. pallidiflora* Hook. f.
	I. diversifolia Wallich ex Wight (Maharashtra, Karnataka & Tamil Nadu)	*I. pandata* Barnes
	I. elegans Bedd. (Tamil Nadu)	*I. platyadena* C. E. C. Fischer
	I. floribunda Wight (Tamil Nadu)	*I. sholayarensis* M. Kumar & S. Seq.
	I. gardneriana Wight (Karnataka & Tamil Nadu)	*I. sivarajanii* M. Kumar & S. Seq
	I. goughii Wight (Karnataka & Tamil Nadu)	*I. tilo* (DC) Suresh
	I. herbicola Hook.f. (Karnataka & Tamil Nadu)	*I. verecuna* Hook.f.
	I. leschenaultii (DC) Wallich ex Wight & Arn. (Tamil Nadu)	*I. violacea* M. Kumar & S. Seq.
	I. levingei Gamble ex Hook. f. (Tamil Nadu)	
	I. ligulata Bedd. (Tamil Nadu)	

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	I. lucida Heyene ex Hook. f. (Maharashtra, Karnataka & Tamil Nadu)	
	I. modesta wight (Tamil Nadu)	
	I. munroni Wight (Tamil Nadu)	
	I. neo-barnesii C. E. C. Fischer (Tamil Nadu)	
	I. parasitica Bedd.(Tamil Nadu)	
	I. parvifolia Bedd. (Tamil Nadu)	
	I. pendula Heyne ex Wight & Arn. (Karnataka)	
	I. pulcherima Dalz. (Maharashtra, Goa & Karnataka)	
	I. rufescens Benth. ex Wight & Arn. (Tamil Nadu)	
	I. rupicola Hook. f. (Maharashtra & Karnataka)	
	I. scabriuscula Heyne ex Roxb. (Maharashtra, Karnataka & Tamil Nadu)	
	I. scapiflora Heyne ex Roxb. (Maharashtra, Karnataka & TamilNadu)	
	I. tenella Heyne ex Wight & Arn. (Maharashtra, Karnataka & Tamil Nadu)	
	I. travancorica Bedd. (Tamil Nadu)	
	I. umbellata Heyne ex Roxb. (Tamil Nadu)	
	I. uncinata Wight (Tamil Nadu)	
	I. verticillata Wight (Tamil Nadu)	
	I. viridiflora Wight (Tamil Nadu)	
	I. viscosa Bedd. (Tamil Nadu)	
	I. wightiana Bedd. (Tamil Nadu)	

IMPATIENS L.

Sp. Pl. 937. 1753.

Key to the species

1. Plants scapigerous herbs; leaves radical.
   2. Flowers creamy white ..... 12. *I. sivarajanii*
   2. Flowers brownish-red ..... 9. *I. pandata*
1. Plants caulescent non scapigerous herbs; leaves cauline.
   3. Plants epiphytic.
      4. Wings 3-lobed
         5. Flowers 1-2 ..... 11. *I. sholayarensis*
         5. Flowers 1-4.
            6. Wings violet ..... 15. *I. violacea*
            6. Wings pink ..... 5. *I. kulamavuensis*
      4. Wings 2-lobed.
         7. Spur absent with a pit ..... 7. *I. munnarensis*
         7. Spur present, without pit
   3. Plants terrestrial herbs or shrubs.
      8. Lateral sepals ovate-lanceolate.
         9. Leaves oblong-lanceolate ..... 13. *I. tilo*
         9. Leaves ovate-cordate ..... 2. *I. concinna*
      8. Lateral sepals linear-lanceolate.
         10. Dorsal auricle of wings present ..... 8. *I. pallidiflora*
         10. Dorsal auricle of wings absent.
            11. Basal lobe of wing larger than distal lobe .....
                ..... 6. *I. macrocarpa*
            11. Basal lobe of wing smaller than distal lobe.
               12. Lip pubescent ..... 1. *I. cochinica*
               12. Lip glabrous.
                  13. Standard apiculate ..... 14. *I. verecunda*
                  13. Standard not apiculate.
                     14. Spur slender ..... 4. *I. johnii*
                     14. Spur stout.
                        15. Stem angled; lip pinkish .....
                            ..... 10. *I. platyadena*
                        15. Stem terete; lip bright green.....
                            ..... 3. *I. coelotropis*

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1. **Impatiens cochinica** Hook. f., Bull. Misc. Inform.1911: 355.1911; Gamble, Fl. Pres. Madras 142(101).1915; A. N. Henry *e. al.*, J. Bombay Nat. Hist. Soc. 75: 648.1978. (1979); Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg.186. 1987; Vivek. *et al.*, in Hajra *et al.*, Fl. India 133. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 70. 2004; Daniel (ed.), Fl. Kerala 1: 535. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 132. 2006.

Type: Cochin-Kavalay, 610 m, *Meebold 12183* (K). (Plate 16)

Branched shrubs, 40-50 cm high. Leaves alternate at base, whorled above, 6-10 cm long, ovate-lanceolate, acute or acuminate at apex, margin crenate; petioles 2-4 cm long, slender. Flowers solitary or in fascicles. Pedicels shorter than leaves. Lateral sepals triangular-ovate. Lip cymbiform, c. 0.6 cm long, cymbiform, pubescent. Spur slender, c. 1.8 cm long, incurved. Standard orbicular, bilobed. Wings bilobed, c. 0.8 x 0.8 cm; lobes broadly obcordate; basal lobes shorter than distal. Capsule ovoid, c. 1.5 cm long, gibbous, beaked. Seeds obovoid, pubescent.

Flowering & Fruiting: Not known.

Habitat: Along stream sides.

Note: The species is known only from its type collection by Meebold. It has not been collected in the recent years although its distributional localities have been well explored. Ahmedullah and Nayar (1987) categorised the species as 'Critically endangered'.

Specimen examined: Cochin-Kavalay, 610 m, *Meebold 12183* (K).

2. **Impatiens coelotropis** C. E. C. Fischer, Kew Bull.1934; 390. 1934; Gamble, Fl. Pres. Madras 1871.1936; Barnes, J. Ind. Bot. Soc. 18: 99. 1939; B. V. Shetty & Vivek., Bull. Bot Surv. India 14(4): 20. 1972; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg.194. 1987; Vivek. *e. al.*, in Hajra *e. al.*, Fl. India 134. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 70. 2004; Daniel (ed.), Fl. Kerala 1: 536. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 132. 2006.

Type: 'Travancore hills', Nemakad Gap, *E. Barnes 597* (MH). (Fig. 27; Plate 17)

Unbranched subshrubs, up to 1 m high. Leaves alternate, 5-13 x 3-5 cm, succulent, ovate-lanceolate, base cuneate or rounded, margin serrate. Petiole terete, 2-5 cm long, red, glandular. Racemes axillary, 2-4-flowered. Peduncles 2-8 cm long. Pedicels 1.5-3.5 cm long. Bracts lanceolate, acuminate, 0.5-0.6 x 0.2-0.25 cm. Flowers up to 3 cm long. Lateral sepals ovate-lanceolate, 1-1.5 cm long, concave, acuminate, keeled, scarlet. Lip cylindric-saccate, c. 1.5 x 1 cm, bright green, becoming scarlet at mouth with a crimson patch. Spur tubular, upcurved, 0.6-0.8 cm long. Standards sub-orbicular, c. 1.5 cm long, scarlet. Wings sessile, 2-lobed, c.1.5 cm long, scarlet. Capsule ellipsoid, c. 1.5 cm long. Seeds kidney-shaped, compressed, minutely papillose.

Flowering & Fruiting: August-November.

Habitat: Usually growing among the rocks near streams on grasslands.

Note: One of the several endemic species of the genus occurring in one of its main centers of speciation (biotope endemism) and hence is of tremendous botanical interest. A good population is seen in its reported area of distribution, which is easily distinguished from its characteristic showy flowers. Because of its restricted occurrence Nayar (1997) termed it as 'vulnerable'.

Specimens examined: Idukki district: Upper Vagavuari, ± 1800 m, 8 Aug. 1967, *Shetty 28338* (MH); Umaiyamalai, ± 2100m, 20 Nov. 1965, *Shetty 26574* (MH); Pettimudi, ± 2000 m, 26 July 1995, *Shaju & Rajlal, 22446* (TBGT).

3. **Impatiens concinna** Hook. f., Fl. Brit. India 1:449. 1874; Gamble, Fl. Pres. Madras 141.1915; A. N. Henry *et al.*, J. Bombay Nat. Hist. Soc. 75: 685.1978 (1979); Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 194. 1987; Vivek. *et al.* in Hajra *et al.*, Fl. India 134. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 71. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 132. 2006.

Branched annuals, 15-25 cm high. Leaves opposite, subsessile, ovate-cordate, acute at apex, serrate, 1.2-1.8 cm long, glandular, nerves prominent beneath. Stipules setaceous or absent. Flowers axillary, solitary, binate or in fascicles, c. 1 cm across, rose-purple. Pedicels shorter than leaves. Lateral sepals ovate or ovate-lanceolate. Lip subequal to lateral sepals, cymbiform. Spur very short, incurved. Standrard orbicular, spurred. Wings 2-lobed, distal lobes ovate, clawed. Capsules turgid, c. 0.8 cm long. Seeds subcompressed.

Flowering & Fruiting: Not known.

Habitat: Near water courses in grasslands.

Note: Hook. f. (1874) reported this species based on Wight's collection with a distributional record as "Mountains of Malabar" in Southern Western Ghats, which actually is in Kerala. But Wight did not mention this species in any of his works. Though he named it as *Impatiens gardneriana* Wight in the herbarium specimen, it is not the name given in the Icones. Thus a comprehensive taxonomic study is required for establishing the taxonomic identity of the species. Nayar (1997) reported it as an 'endangered' species. It has not been recollected although its type locality is well botanised. This would have become extinct due to habitat destruction. The description is provided based on available literatue.

4. **Impatiens johnii** Barnes, J. Ind. Bot, Soc. 18: 102.1939; A. N. Henry *et al.*, J. Bombay Nat. Hist. Soc. 75: 685.1978 (1979); M. P. Nayar & Sastry, Red Data Book Ind. Pl. 3: 55. 1990; Vivek. *et al.*, in Hajra *et. al.*, Fl. India 161. 1997; Biju & Manoj, Ind. J. For. 22: 174. 1999; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 73. 2004; Daniel (ed.), Fl. Kerala 1: 545. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 134. 2006.

Plate 16. *Impatiens cochinica* Hook. f.: Type specimen at Kew.

Type: 'Travancore hills', Kallar Valley, *E. Barnes 1646* (MH). (Plate 18 a)

Shrubs, up to 1 m high. Stems branching at base, swollen at nodes. Leaves alternate, opposite or whorled, 10-12.5 x 5-5.5 cm, ovate-elliptic, acute at base, acuminate at apex, margin serrate ending in glands, upper surface with scattered stiff hairs. Petiole slender, 5-8 cm long, reddish, tomentose. Flowers axillary, solitary, c. 5.5 cm long. Pedicels slender, 6-10 cm long, reddish, tomentose. Lateral sepals 2, ovate, 1-1.3 x 0.5-0.8 cm, cuspidate, green, hirsute. Lip broadly ovate, 1-1.5 x 1-1.3 cm, deeply concave, dark pinkish. Spur slender, 3.5-4 cm long, curved, pinkish red, hirsute. Standard obovate, c. 2 x 1.5 cm, pink. Wings bi-lobed, lobes oblong-ovate, c. 2.5 x 1.5 cm, pink. Capsules obovate, c. 2 cm long, beaked. Seeds verrucose.

Flowering & Fruiting: September-December.

Habitat: Growing in ravines or along streamsides, occasionally amongst stream-bed rocks in shola forests.

Note: Barnes described this species from Kallar Valley near Eravikulam National Park in 1931. After a lapse of 67 years Biju *et al.* (1999) rediscovered the species from the same locality. The earlier efforts for rediscovery were not successful and it was considered to be extinct. But, the rediscovery of the species from this biotope represents an extreme case of narrow endemism with evolutionary and phytogeographical interest. This species was categorized as 'rare' or 'threatened' by Vajravelu and Daniel (1983) and 'endangered' as Nayar (1997). A well conserved *ex-situ* population of the species was found at Gurukula Botanical Sanctuary Garden at Periya in Wayanad during the study.

Specimen examined: Idukki district: Kallar valley, *Biju & Manoj 36445* (TBGT).

5. **Impatiens kulamavuensis** Pandurangan & V. J. Nair, Novon 5: 57. 1995; Vivek. *et al.*, in *Hajra et al.*, Fl. India 165. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 73. 2004; Daniel, Fl. Kerala 1: 546. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 135. 2006.

Type: Idukki district: Kulamavu, ± 750 m, 6 Oct. 1983, *Pandurangan 82037* (MH).

(Fig. 28; Plate 18 b & c)

Epiphytic herbs, stem short, stout. Leaves alternate, ovate-lanceolate, 2.5-5.5 x 1.5-2.5 cm, cuneate at base, acuminate at apex, crenate-serrate along margins. Petioles 2-6 cm long. Inflorescence 1-3 flowered raceme. Peduncles 2.5-3.5 cm long. Pedicels 3.5-4.5 cm long. Flowers greenish yellow. Lateral sepals linear, 7-10 x 2-3 cm. Lip saccate, 0.8-1 x 0.4-0.6 cm, compressed, glabrous. Spur curved, 0.4-0.6 x 0.35-0.45 cm, tip obtuse. Standard orbicular, 0.5-0.6 x 0.75-0.85 cm, hairy at base. Wings 3-lobed, basal lobes smaller. Capsule ellipsoid, 1-1.5 x 0.35-0.45 cm, glabrous. Seeds pear-shaped, smooth.

Flowering & Fruiting: October-December.

Habitat: On moss-clad tree truks in shola forests.

Note: Occurrence of this narrow endemic species from the high range, also support the

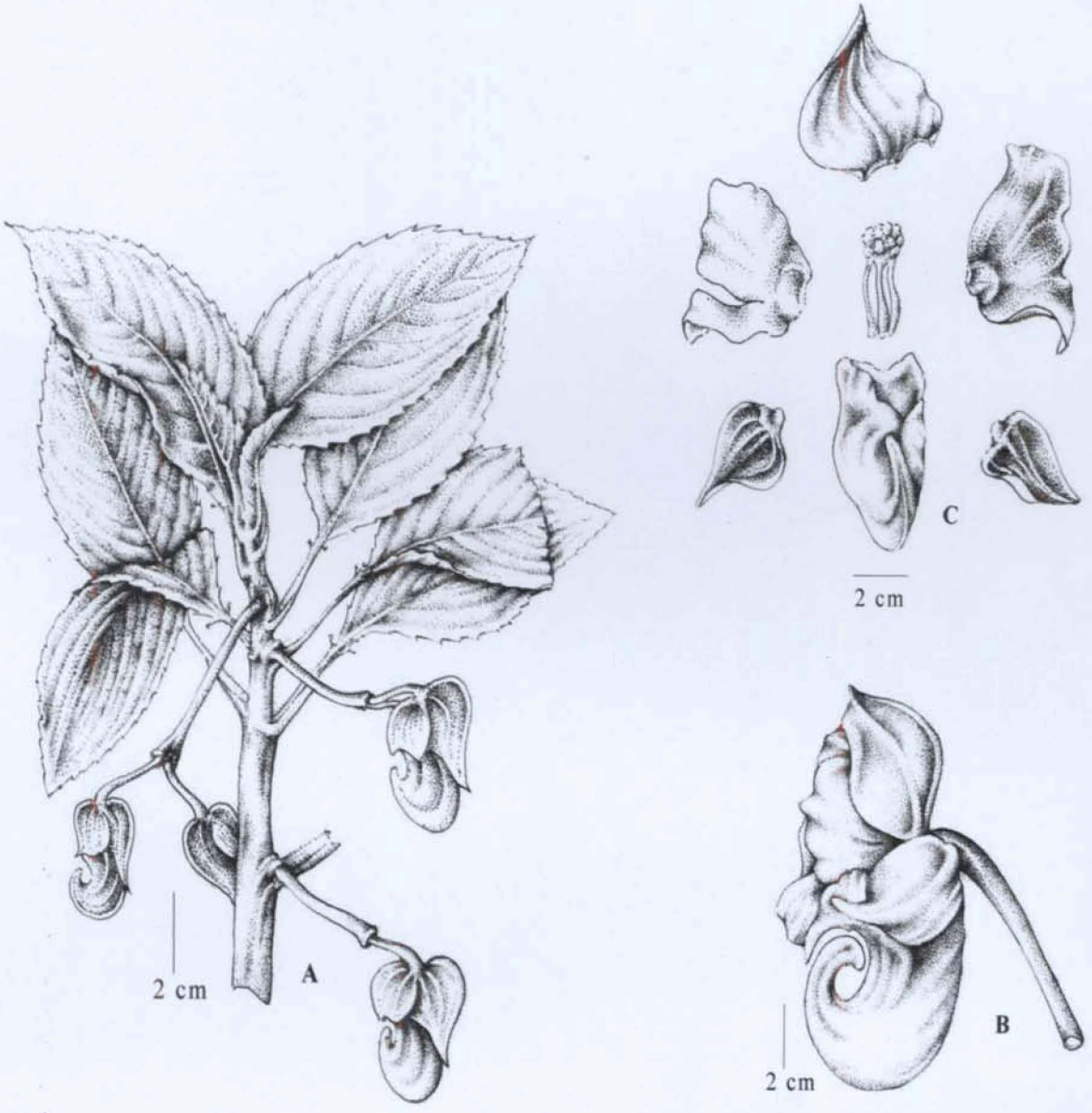

Fig. 27. ***Impatiens coelotropis*** C. Fischer A. Habit; B. Single flower; C. Floral parts.

view of active centers of speciaton of the genus. Owing to the narrow endemic nature, the species warrants critical evaluation to obtain conservation status.

Specimens examined: Idukki district: Kulamavu, ± 750 m, 6 Oct. 1983, *Pandurangan 82037* (Holotype, MH); Peringadavu, ± 1900 m, 17 Oct. 1996, *Rajlal & Shaju 26980* (TBGT).

6. **Impatiens macrocarpa** Hook. f., Bull. Misc. Inform.1911: 355.1911; Gamble, Fl. Pres. Madras 142(101). 1915; Barnes, J. Ind. Bot. Soc. 18: 99. 1939; A. N. Henry *et al.*, J. Bombay Nat. Hist. Soc. 75: 685. 1978 (1979); Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg.194. 1987; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 3: 58. 1990; Vivek. *et al.* in Hajra *et al.*, Fl. India 133. 1997; Sasidh., Biodiver. Doc, Kerala, Part 6, Fl. Pl. 74. 2004; Daniel (ed.), Fl. Kerala 1: 549. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 136. 2006.

Type: Idukki district; Devicolam, 1829 m, *A. Meebold 13426* (BRSL).

Branched undershrubs. Leaves opposite at base, upper whorled, 8-10 cm long, obovate-lanceolate, serrulate. Petioles 3-5 cm long. Flowers solitary or binate, white. Pedicels stout with curved apex, subequal to petiole, 5-8 cm long in fruit. Lateral sepals ovate, cuspidate, acuminate, 0.4-0.6 cm long. Lip cymbiform, c. 0.6 cm long. Spur stout, incurved c.1.2 cm long. Standard obcordate-reniform, cuspidate, 1.5-2 cm across. Wings sessile, bilobed; basal lobes large, oblong-ovate; distal lobes smaller than basal, oblong-ovate. Capsules oblique, ovoid, 1.5-2 cm long. Seeds granulate.

Flowering & Fruiting: Not known.

Habitat: Moist grassy slopes at an altitude of 1800 m.

Note: Known only the type specimen collected by *A. Meebold* (13426, BRSL) in 1910. Based on this single collection J. D. Hooker described the species. Subsequent workers could not recollect even after intensive exploratory surveys in the area. The main cause of its depletion is clearing of forests for plantation crops. Nayar (1997) recorded this species under 'Critically Endandered' Category. With the available literature a brief accout of description is given.

7. **Impatiens munnarensis** Barnes, Bull. Misc. Inform. 1938: 32.1938; A. N. Henry *et al.*, J. Bombay Nat. Hist. Soc. 75: 686.1978 (1979); Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg.194. 1987; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 3: 58. 1990; Vivek. *et al.* in Hajra *et al.*, Fl. India 183. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 74. 2004; Daniel (ed.), Fl. Kerala 1: 551. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 136. 2006.

Type: Munnar, Kannimala, *E. Barnes 1281* (K).

Herbs. Erect or semierect, up to I m high. Stem slender, sparingly branched, often

Plate 17. ***Impatiens coelotropis*** C. E. C. Fischer: Habit; Inset: single flower.

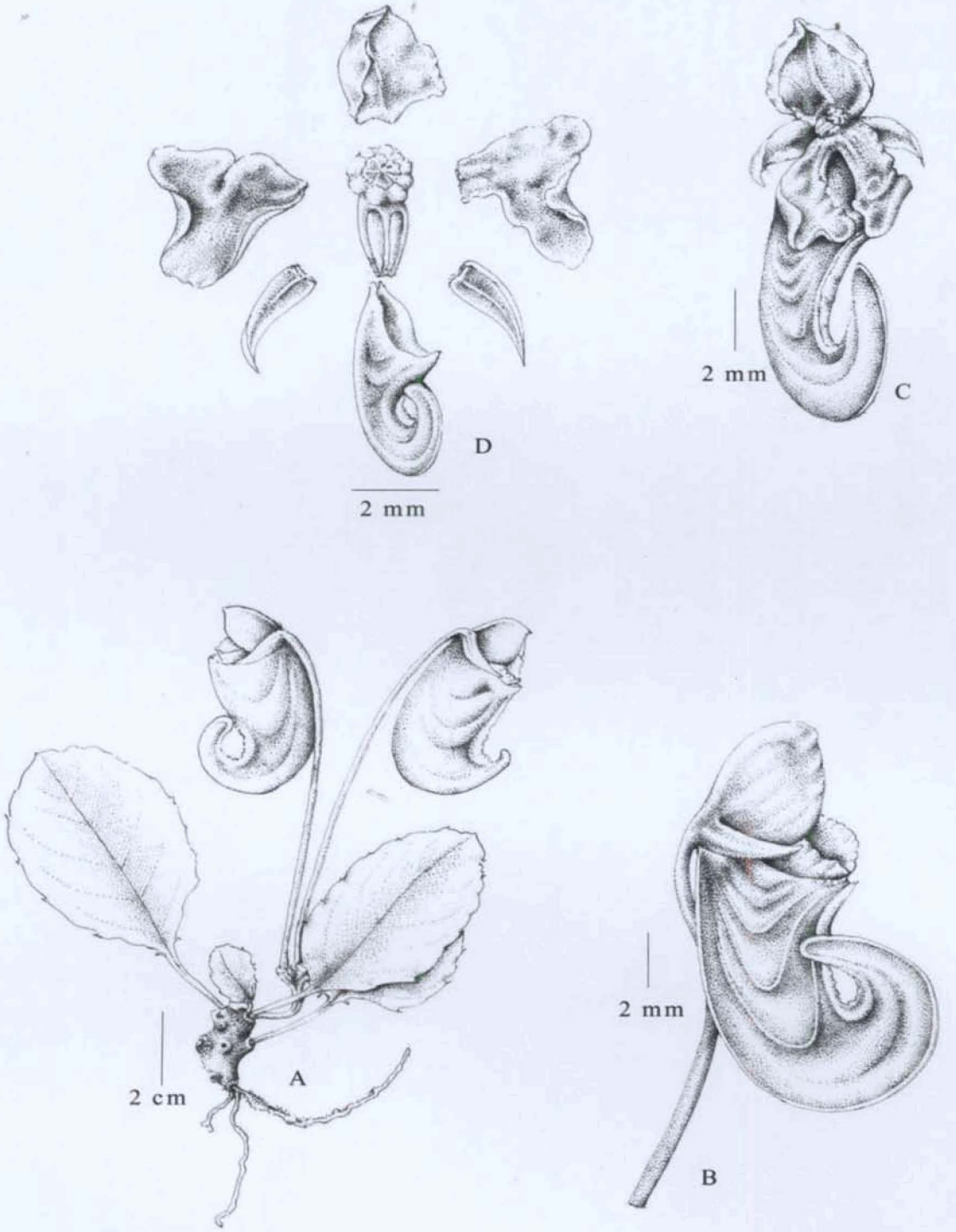

Fig. 28. ***Impatiens kulamavuensis*** Pandurangan & V. J. Nair: A. Habit; B. Single flower; C. Flower - front view; D. Floral parts.

procumbent below, rooting at nodes. Leaves variable, usually lanceolate, shallowly cordate at base, tapering to an acute apex, 5.5 x 1.7 cm, margin distinctly serrate with apiculate teeth. Petioles flattened and decurrent on stems. Pedicels 1-2.5 cm long in flower, reflexed in fruits. Flowers small, 1-1.3 cm long. Lateral sepals filiform, curved, c. 0.6 cm long. Lip cymbiform, white with purple nerves, bottom with a small pit instead of spur, inside convex continued forward as a ridge with a small yellow or orange crest. Standard ovate, keeled. Wings white with lilac or violet markings; basal lobes triangular; distal lobes ovate-triangular. Capsules fusiform, 1-1.5 cm long. Seeds glossy.

Flowering & Fruiting: September-December.

Habitat: Growing in shaded places along stream-sides and tracks and on marshy ground.

Note: *E. Barnes* described and reported this species based on his collections (Nos. 1281, 1282-Kew Herbarium), made during the years 1931-1937. This species is known only from a single locality in Kannimala at Munnar, with an altitude of 4000 ft.; it has not been recollected and reported afterwards from the same locality or elsewhere although the area is well explored. This species may be declined or possibly extinct due to deforestation for cultivation of plantation crops in and around Munnar. Nayar (1997) reported this species under the category of 'Critically Endangered'. With the available literature a brief account of description is attempted.

8. **Impatiens pallidiflora** Hook. f., Bull., Misc. Inform. 1911: 354.1911; Gamble, Fl. Pres. Madras 141(100).1915; Bhaskar & Razi, Ind. J. For. 1: 73.1978; A. N. Henry *et al.*, J. Bombay Nat. Hist. Soc. 75: 685.1978 (1979); Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg.194. 1987; Vivek. *et al.* in Hajra *et al.*, Fl. India 188. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 75. 2004; Daniel (ed.), Fl. Kerala 1: 553. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 137. 2006.

Type: 'Travancore'. Devicolam; 2134 m, *A. Meebold 13,480* (K).

Herbs, slender, 30-50 cm high. Stem branched, pubescent. Leaves opposite, 3-5 cm long, oblong or linear-oblong, base truncate or round, acuminate at apex, margins spinulose-serrate. Flowers in fasicles, c. 2 cm across, rose or pink. Lateral sepals linear, 0.6-0.7 cm long. Lip cymbiform, acute. Spur subequal to limb of lip. Standard orbicular with obscure dorsal keel. Wings c. 1.5 cm long, clawed; basal lobes almost absent; distal lobes dolabriform.

Flowering & Fruiting: May-July.

Habitat: Among the grasses on rocky slopes and marshes at high altitudes.

Note: After Meebold's collection in the year 1910 from Devikolam, Barnes collected this species from Periakanal and Santampara during 1931-'37 (*Barnes 1756*, Barnes Herbarium). This exclusive endemic species is yet to be located after these valuable collections. Therefore Nayar (1997) documented it as an 'endangered' category species. A brief decription based on available literature is included.

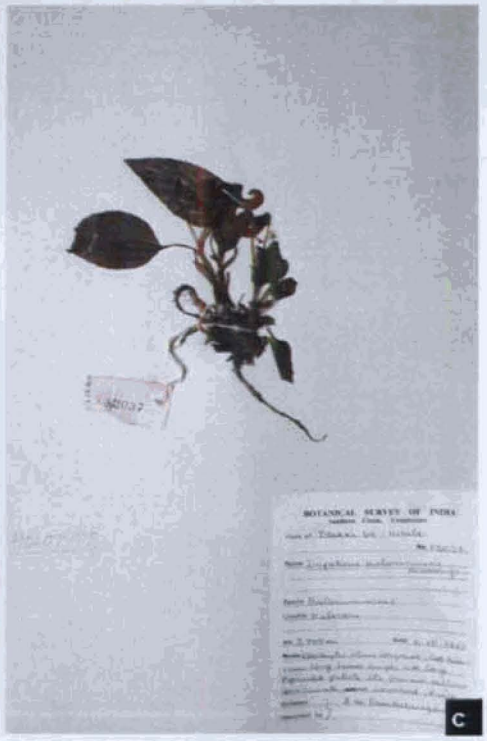

Plate 18. a. ***Impatiens johnii*** Barnes: Habit; Inset: Single flower; b & c. ***Impatiens kulamavuensis*** Pandurangan & V. J. Nair: b. Habit; c. Type specimen at MH.

9. **Impatiens pandata** Barnes, Bull. Misc. Inform. 1938: 33.1938; A. N. Henry *et al.*, J. Bombay Nat. Hist. Soc. 75: 686.1978 (1979); Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg.194. 1987; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 3: 58. 1990; Vivek. *et al.* in Hajra *et al.*, Fl. India 183. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 75. 2004; Daniel (ed.), Fl. Kerala 1: 553. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 137. 2006.

Type: Idukki district: Anaimudi, *E. Barnes 535* (K).

Herbs, succulent, scapigerous. Leaves radical, solitary or few, c.1.5 x 4.5 cm, orbicular-reniform, glabrous, green above, dark purple below, margins shallowly crenate. Petioles c. 2 cm long. Flowers solitary or in few-flowered racemes, up to 20 cm long. Pedicels slender, c. 2.7 cm long. Lateral sepals c. 0.5 cm long, brownish-red. Lip spoon-shaped, spurless. Standard broadly elliptic, c. 1 cm across, concave. Wings 3-lobed, c. 3 cm long; lobes oblong, rounded, white, slightly tinged with purple, stout hairs at the base. Capsules turgid, c. 1.2 cm long, glabrous. Seeds ovoid, covered with white granules.

Flowering & Fruiting: August-September.

Habitat: Fragile herb growing on wet rocks in cushion of moss.

Note: A strict endemic species confined to Anamudi slopes. It was described and reported by E. Barnes (Coll. No. *535, 537* K) based on his collection from Anamudi slopes. In 1967, this species was relocated by Henry and Vivekananthan from the type locality after intensive explorations. The above description is with reference to the specimen deposited at Madras Herbarium (MH).

Specimen examined: Idukki district: Devicolam, Anamudi slopes, Umaiyamala, 2028 m, 6 August 1967, *B. V. Shetty 28319* (MH).

10. **Impatiens platyadena** C. E. C. Fischer, in Bull. Misc. Inform.1934: 390. 1934; Gamble, Fl. Pres. Madras 1871.1936; Barnes, J. Ind. Bot. Soc. 18: 99. 1939; B. V. Shetty & Vivek., Bull. Bot. Surv. India 14(4): 20. 1972; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg.194. 1987; Vivek. *et al.* in Hajra *et al.*, Fl. India 134. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 75. 2004; Daniel (ed.), Fl. Kerala 1: 555. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 138. 2006.

Type: Idukki district: Kadalar valley, Nemakad gap, *E. Barnes 613* (K).

(Plate 19 a-c)

Undershrubs, up to 1 m high. Stem angled. Leaves, alternate, elliptic-lanceolate, 8-17 x 3.5-5.5 cm, crenate-serrate with apiculate crenulates at margins, acuminate at apex. Racemes axillary. Peduncles slender, 3.5-4.5 cm long, patent or slightly drooping. Bracts ovate, 0.8-0.15 cm long, persistent. Flowers c.1.5 cm long. Lateral sepals suborbicular, c. 0.8 cm across, cream-coloured. Lip funnel-shaped, c. 1.5 cm long, pinkish. Spur tubular, upcurved into a semicircle, cream-coloured. Standard ovate, 0.5-0.6 cm long. Wings 2-lobed, 1.5-1.6 cm long; basal lobes

ovate-triangular-ovate, acute or obtuse; distal lobes semi-ovate, subacute, scarlet. Capsules ovoid, c. 0.6 cm long. Seeds pyriform, minutely papillose.

Flowering & Fruiting: December.

Habitat: Growing in moist grassy situations and banks in undisturbed sites.

Note: During the present study few specimens were collected from isolated localities in and around Pettimudi, its type locality and is possibly surviving in a very few fragmented populations scattered in a narrow range. Being subjected to the pressures of habitat destruction, the few remaining populations of this species are on the verge of extinction. This species has been recorded as 'Critically Endangered" by Nayar (1997).

Specimens examined: Idukki district: Kadalar valley, Nemakad gap, *E. Barnes 613* (K); *Ibid.*, Pettimudi, ± 2000 m, 17 Oct. 1996, *Rajlal & Shaju 26981* (TBGT).

11. **Impatiens sholayarensis** M. Kumar & S. Seq., Sida 19: 795. 2001; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 76. 2004; Daniel (ed.), Fl. Kerala 1: 557. 2005; T. S. Nayar *et al.*, Flr. Pl. of Kerala - A Handb. 138. 2006.

Type: Thrissur district: Sholayar, ± 900 m, 9 Oct. 1998, *Sequiera 20620* (KFRI).

Epiphytic glabrous herbs. Leaves crowded towards apex, 2.3-8 x 1.3-3.2 cm long, ovate, elliptic- lanceolate, attenuate at base, crenulate at margin, acute at apex, membraneous, glabrous silvery white beneath. Petioles 3-8 cm long. Racemes 2-flowered. Peduncles 1.5-2 cm long. Pedicels 2.5-5 cm long, filiform. Flowers greenish-yellow-crimson red. Lateral sepals linear-ovate, 0.8-0.2 cm, slightly falcate, glabrous. Lip saccate, 1-3.5 x 0.5-1.1 cm, compressed, glabrous, greenish yellow with crimson red. Spur curved, obtuse, white. Standard erect, 0.6-1.1 x 0.6-0.9 cm long, glabrous, gland- dotted. Wing connate at base, 3-lobed; upper lobes with small spine and pouch. Stamens 5. Ovary elliptic-lanceolate; stigma toothed. Capsule elliptic-lanceolate, c.1.2 cm long, glabrous. Seeds pyriform, ciliate-tipped.

Flowering & Fruiting: December.

Habitat: Evergreen forests.

Note: This species is allied to *I. kulamavensis* Pandurangan & V. J. Nair, but differs in having moniliform stem and crowded glabrous leaves.

Owing to the narrow endemic nature, the species warrants critical evaluation to obtain conservation status.

Specimen examined: Thrissur district: Sholayar, ± 900 m, 9 Oct. 1998, *Sequiera 20620* (Holotype, KFRI).

12. **Impatiens sivarajanii** M. Kumar & S. Seq., Rheedea 6: 51. 1996; Vivek. *et al.* in Hajra *et al.*, Fl. Ind. 4: 532. 1997; Biju in Manoharan *et. al.*, Silent Valley - Whis. Reas., 172. 1999; Sasidh., Biodiver. Doc. Kerala. Part 6, Flr. Pl. 76. 2004; Daniel (ed.), Fl. Kerala 1: 558.

2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 139. 2006.

Type: Palakkad district: Silent Valley, Sispara, ± 1750 m, 26 Aug. 1995, *Stephen 007885* (KFRI).

Epiphytic scapigerous perennial tuberous herbs, c. 10 cm high. Leaves 1 or 2, radical, ovate, obliquely subcordate at base, distantly subcrenate, crenules minutely apiculate, acute or acuminate at apex. Petiole filiform, 4-5 cm long. Racemes 1-3-flowered. Peduncle c. 10 cm long, slender. Bracts linear-lanceolate, 4-4.5 x 1-1.5 cm, acuminate. Pedicels 1.4-1.8 cm long, filiform. Flowers creamy white, c. 2 x 1.25. Lateral sepals ovate-elliptic, 0.5-0.25 cm, acute or acuminate. Lip broadly ovate, acuminate, concave, glabrous. Spur very short, c. 0.2 cm, tip rounded. Standard depressed, 0.75 x 1 cm, obovate, concave. Wings 3-lobbed; basal lobe ovate-oblong, obtuse at apex; distal lobe minutely 2-lobuled. Capsules oblong-ovoid, beaked, glabrous. Seeds elliptic, tufted ciliate.

Flowering & Fruiting: August-October.

Habitat: Moss covered tree trunks.

Note: Creamy white flowers of this epiphytic balsam mainly differentiate this species from its allied species *I. agumbeana* Bhaskar & Razi, and also differs in having glabrous leaves, widely obovate lip and very short spur with rounded tip.

So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimen examined: Palakkad district: Silent Valley, Sispara, ± 1750 m, 26 Aug. 1995, *Stephen 007885* (Holotype, KFRI).

13. **Impatiens tilo** (DC) Suresh in Nicols., Suresh & Manilal, An Interpr. Hort. Malab. 71. 1988; Vivek. *et al.* in Hajra *et al.*, Fl. India. 4: 205. 1997; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 139. 2006; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 76. 2004; Daniel (ed.), Fl. Kerala 1: 557. 2005; *Balsamina tilo* DC, *I. rheedei* Wight & Arn., Prodr. 138. 1834, *non. illeg.* (incl. type of *Balsamina tilo* DC. ,1824); Gamble, Fl. Pres. Madras 140 (100). 1915.

Type: ***Tsjeria-onapu*** Rheede (Hort. Malab. 9: 93, t. 49. 1689). (Plate 20 b)

Annuals, erect. Stem slender, flaccid. Leaves opposite oblong-lanceolate, 7.5-12.5 cm long, attenuate at base, acute at apex, serrate along margin, sparsely hairy. Flowers axillary, solitary or in fascicles, pink with dark streaks. Pedicels 2.5-4 cm long, deflexed in fruits. Lateral sepals ovate-oblong or liner. Lip concave, subequal to petals. Spur longer than flowers, subulate. Wings oblong, clawed, entire or with minute basal lobes. Capsule oblong, up to 1.8 cm long.

Flowering & Fruiting: Not specified.

Habitat: Shady moist places on rocks.

Plate 19. a - c. ***Impatiens platyadena*** C. E. C. Fischer: a. Habit; b. Inflorescence; c. Type specimen at Kew.

Note: First appeared as ***Tsjeria-onapu*** Rheede (Hort. Malab. 9: 93, t. 49. 1689), occuring in Northern Kerala (type locality not specified). Rheede's element was originally recognised with doubt as var. β of *I. fasicularis* Lam. (Ency. 1: 363. 1785); later separated and made the sole basis of *Balsamina tilo* DC).

Cheriya onapu in (Malayalam script on t. 49) of *Hortus Malabaricus* is apparently no longer used; 'Cheriya' means small and 'onapu' refers to *Impatiens* in general. It has not been found in Kerala except for Gamble's report that it occurs in Malabar at low elevations.

14. **Impatiens verecunda** Hook. f. Bull. Misc. Inform. 1911: 354.1911; Gamble, Fl. Pres. Madras 141(100). 1915; A. N. Henry *et al.*, J. Bombay Nat. Hist. Soc. 75: 685.1978 (1979); Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg.194. 1987; Vivek. *et al.* in Hajra *et al.*, Fl. India 188. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 77. 2004; Daniel (ed.), Fl. Kerala 1: 562. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 140. 2006.

Type: Idukki district: 'Travancore', Periyakanal: on steep embankment under trees, 1372 m, *A. Meebold 13125* (BRSL).

Herbs, up to10-15 cm high. Stems branched or not. Leaves alternate, 4-6 cm long, ovate, crenate at margins, acute or acuminate at apex, 4-6 cm long, membraneous. Petiole slender, 2-3 cm long. Bracts lanceolate, 0.3-0.5 cm long. Pedicels 1-2 cm long, deflexed in fruits. Flowers in 2-4-flowered subumbels, c. 2 cm across, rose-coloured. Lateral sepals ovate, truncate at base, 0.6-0.7 cm long. Lip orbicular, 0.5-0.7 cm long. Spur obtuse, less than half as long as limb of lip. Standard orbicular or oblong with blunt or pointed apiculam. Wing sessile, 2-lobed; basal lobes orbicular, minute; distal lobe trigonous or dolabriform, larger than basal ones. Capsules ellipsoid, beaked, 0.8-1.2 cm long. Seeds obovoid or globose, compressed, pubescent.

Flowering & Fruiting: December.

Habitat: On the edges of streams and in marshy places.

Note: Not located after its type collection made by Meebold in 1910. It may be possibily extinct due to massive deforestation. Nayar (1997) included this species in the list of 'Critically endangered' category.

15. **Impatiens violacea** M. Kumar & S. Seq., Sida 19: 798. 2001; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 77. 2004; Daniel (ed.), Fl. Kerala 1: 563. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 140. 2006.

Type: Idukki district: Munnar, Pettimudy, ± 2000 m, 25 Aug. 1998, *Sequiera 20731* (KFRI). (Fig. 29; Plate 20 a)

Epiphytic herbs. Stem thick. Leaves crowded towards apex, lanceolate to ovate-lanceolate, 2-6 x 1.5-3.5 cm, crenate-serrate and violet at margins. Petioles 1.5-2.5 cm long, violet. Racemes 1-4-flowered. Peduncles 1-1.5 cm long. Pedicels 2-4 cm long, violet. Flowers

violet. Lateral sepals linear-lanceolate, 0.8-1 x 0.2-0.3 cm, slightly keeled above, glabrous. Lip saccate, 1.5-2 x 0.5-1 cm, violet, glabrous, wrinkled, with short hook at mouth. Standard erect, 0.5-0.7 x 0.4-0.6, gland-dotted, greenish yellow, deeply hooded. Wing fleshy, gland-dotted, 3-lobed with a small pouch on lateral lobes. Capsule ellipsoid-ovoid, 0.8-1 x 0.3-0.5 cm, glabrous. Seeds tetragonus smooth.

Flowering & Fruiting: December.

Habitat: Shola forests.

Note: This species is different from its closely allied *I. viridiflora* Wight having violet colored petiole, lower sepal wrinkled with a prominent hook at the apex and lateral petals 3-lobed with small pouch in each lateral lobules.

This montane species having narrow destribution with less number of individuals shows its uncertainity of survival in the long run. Therefore, appropriate consevation efforts should be made to protect the still surviving populations in its type locality and adjoining areas in the biotope.

Specimens examined: Idukki district: Munnar, Pettimudy, ± 2000 m, 25 Aug. 1998, *Sequiera 20731* (KFRI); *Ibid.*, ± 1900 m, 10 Sep. 2009, *Geetha Kumary & Shaju 64929* (TBGT).

8. MELIACEAE

Table 28. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
50	550	18	72	8 spp., 1 var.

Kerala

Genus/genera	Species/subsp./var.
14	25 spp., 6 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Aglaia Lour.	*A. elaeagnoidea* var. *bourdillonii* (Gamble) K.K.N. Nair (Tamil Nadu)	*A. malabarica* Sasidh
	A. indica (Hook. f.) Harms (Tamil Nadu)	
	A. perviridis Hiern (Karnataka)	
	A. tomentosa Teijsm. & Binnend (Tamil Nadu)	

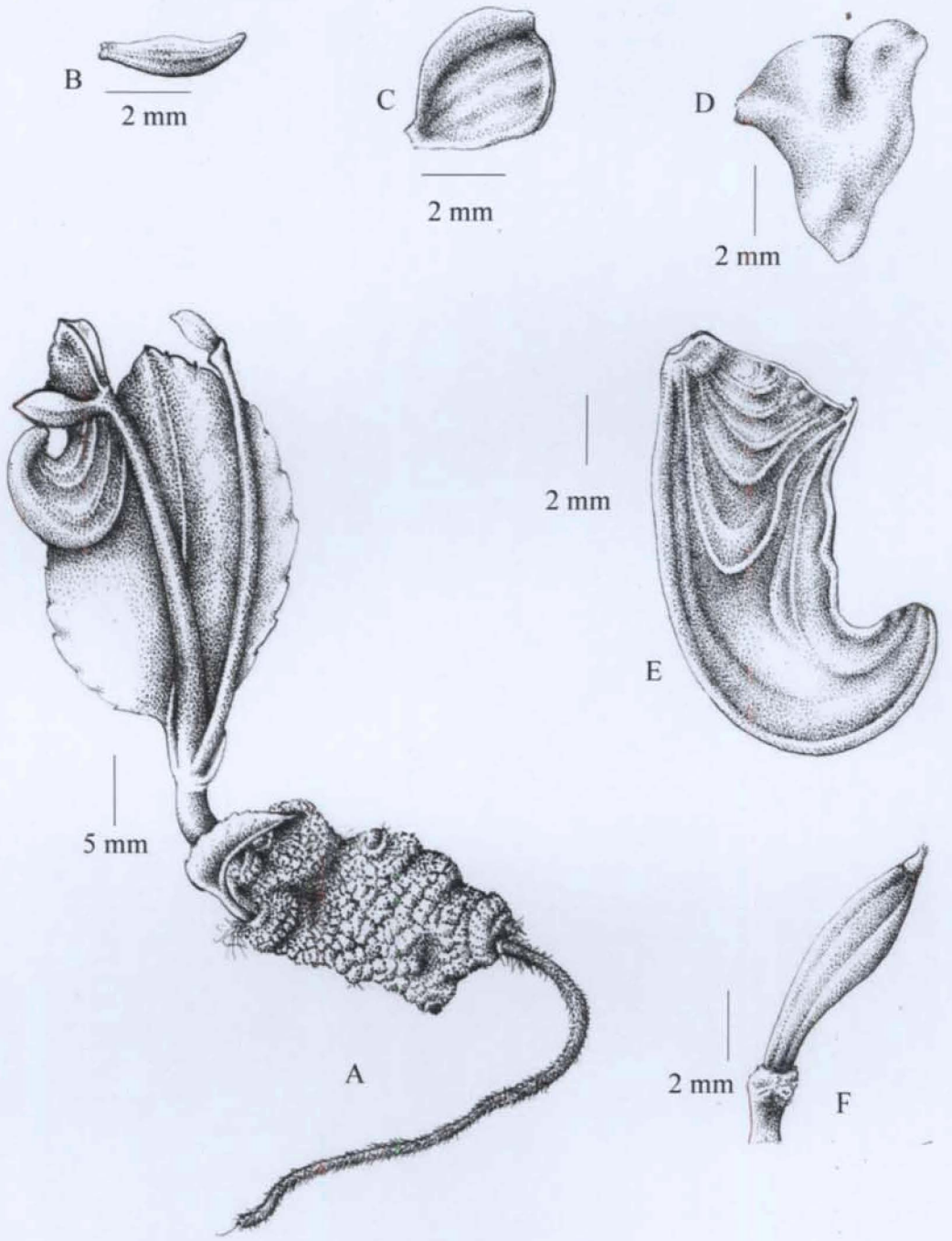

Fig. 29. ***Impatiens violacea*** M. Kumar & S. Seq.: A. Habit; B. Sepal; C. Dorsal petal: D. Lateral petal; E. Lower petal; F. Young fruit.

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Dysoxylum Blume	*D. ficiforme* (Wight) Gamble (Tamil Nadu)	*D. beddomei* Hiern
	D. malabaricum Bedd. ex Hiern (Karnataka & Tamil Nadu)	*D. swaminathanianum* Anil Kumar *et al.*
Reinwardtiodendron Koord.	*R. anamallayanum* (Bedd.) Saldanha (Karnataka & Tamil Nadu)	

Key to the genera

1. Staminal tube cylindric; disc cupule ..... **Dysoxylum**
1. Staminal tube globose; disc annular or obscure ..... **Aglaia**

AGLAIA Loureiro

Fl. Cochinch. 98: 173. 1790, nom. cons.

Aglaia malabarica Sasidh., Kew Bull. Addl. Ser. 16: 369.1992; Sasidh. & Sivar., Flr. Pl. Thrissur For. 91. 1996; Pannell, *Agalia* Monog. 369. 1992; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 88. 2004; Daniel (ed.), Fl. Kerala 1: 644. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 421. 2006. ***Churranakil, Chuvanna cheeralam.***

Type: Thrissur district: Velakettupara, Peechi, ± 500 m, 6 Apr. 1988, *Sasidharan 5531* (KFRI).

(Plate 21 a-c)

Large evergreen trees; Young shoots golden brown. Leaves imparipinnate; leaflets 7-11, 6-20 x 2.5-8 cm, alternate, oblong lanceolate, rounded at base, acuminate at apex. Male inflorescence c. 20 cm, densely covered with peltate scales. Flowers 0.25-0.3 cm. Calyx c. 0. 5 cm, lobes 5, rounded, densely scaly. Petals 5, c. 0.2 cm, rounded. Staminal tube c. 0.2 cm; anthers 5. Female inflorescence c. 5 cm, covered with reddish brown peltate scales. Flowers c. 0.45 cm. Calyx c. 0.35 cm, thick, lobes 5, rounded, densely scaly. Petals c. 0.3 cm. Staminodes 5. Ovary globose, with dense reddish-brown scales; 3-celled; stigma subglobose. Infructescene 8 cm, 1-3 fruits on a stout peduncle; fruits 4-5 x 4 cm, obovoid depressed at apex, indehiscent, pericarp rigid. Seeds surrounded by thin pink aril.

Flowering & Fruiting: December-July.

Habitat: Evergreen forests.

Note: This species shows fairly good population in its type locality and can be easily recognised by its glolden brown younger leaves and thick, irregularly ribbed and granular fruit

Tsjeria-onapu

FIG. 49.

THE third species is called Tilo by the Brahmins. Root the same. The stalks are more reddish.

Leaves are medium among the former species, beset with very minute hairs, especially in the tracts of the veins, at times covered with two small, light green outgrowths.

Flowers approach (come near to) those of the Onapu, but more pale, of four petals; the helmet (galea) is white, the spur green; the head of the petiole is yellow above.

The fruits also sensitive, more oblong and more narrow, from which the seeds bulge out here and there through the inner membrane.

b

Plate 20. a. ***Impatiens violacea*** M. Kumar & S. Seq.: Habit; Inset: Flowers; b. ***Impatiens tilo*** (DC.) Suresh: Reproduction of Illustration (t. No. 49) from *Hortus Malabaricus*.

wall. The recent collection of this species from the forests of Achankovil during the present study further extends the distributional range. The conservation status of this palaeoendemic speceis has been designated as 'Critically endangered' in the IUCN Threatened Plant List of 2008.

Specimens examined: Thrissur district: Velakettupara, Peechi, ± 500 m, 6 Apr. 1988, *Sasidharan 5531* (Isotype, KFRI); Kollam district: Arampa, Achankovil, way to Pulikayam, *Shaju 66789* (TBGT).

DYSOXYLUM Blume

1825 Bijdr. 172.

Key to the species

1. Inflorescence puberulous, less than 5 cm long.
..... 1. *D. beddomei*

1. Inflorescence pubescent, to 15 cm long.
..... 2. *D. swaminathanianum*

1. **Dysoxylum beddomei** Hiern in Hook. f., Fl. Brit. Inida 1: 548. 1875; Bourd., For. Trees Travancore 74. 1908; Rama Rao, Flr. Pl. Travancore 73. 1914; Gamble, Fl. Pres. Madras 178.1915; Sasidh. & Sivar., Flr. Pl.Trissur For. 95. 1996; Jain & Bennet in Hajra *et al.*, Fl. India 4: 485. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 89. 2004; Daniel (ed.), Fl. Kerala 1: 652. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 423. 2006. ***Akil.*** (Plate21 d)

Trees up to 20 m tall, bark flaking off in thin scales, detached by their lower end and attched by upper end, dull yellow inside with aromatic smell. Leaves 30-45 cm long; leaflets usually 9, alternate, ovate-elliptic to oblong, 10-16 x 3.5-5 cm, oblique or cuniate at base, narrowly and obtusely acuminate. Inflorescence axillary, spicate, sometimes branched near the base, 5 cm long. Flowers tetramerous, pubescent, greenish yellow. Calyx very short, short-toothed. Petals creamy white, shortly connate at base. Staminal tube toothed. Disc tubular, longer than ovary. Ovary hirsute, 2-loculed; ovules collateral. Capsule ovoid, c. 7 x 5 cm, ridged. Seeds covered with orange-yellow aril.

Flowering & Fruiting: February-July.

Habitat: Semi-evergreen and evergreen forests at lower elevations.

Note: This medium-sized to large tree was described by Hiern based on the collections of R. H. Beddome from Peerumadu in 1894; the type specimen remains untraceable. The young trees resemble very much like that of *D. malabaricum* Bedd. ex Hiern in the vegetative characters. However, the bark of mature trees is different. The fragrant wood is suitable for

making furniture. Being a palaeoendemic tree species, it is phytogeographically interesting and should get more priotrity in conservational operations. Ahmedullah and M. P. Nayar (1997) included this species in the list of 'rare and threatened' category and the conservation status of this speceis has been designated as 'Endangered' in the IUCN Threatened Plant List of 2008.

Specimens examined: Idukki district: Periyar Tiger Reserve, Thannikudy, ± 1100 m, 8 Aug. 1993, *Jomy 12347* (CALI); *Ibid.*, Malappara, ± 1400 m, 8 Oct. 1993, *Jomy 12582* (CALI); *Ibid.*,.

2. **Disoxylum swaminathanianum** Anil Kumar & Sivad., Rheedea 11: 116. 2001; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 90. 2004; Anil Kumar *et al.*, Fl. Pathanamthitta 122. 2005; Daniel (ed.), Fl. Kerala 1: 557. 2005; T. S. Nayar *et al.*, Flr. Pl. of Kerala - A Handb. 423. 2006.

Type: Pathanamthitta district: Angamoozhy, ± 200 m, 21 Apr. 1990, *Anil Kumar1818* (MH).

Trees up to 10 m tall. Leaves c. 30 cm long; leaflets usually 9, alternate, ovate-elliptic to oblong, oblique or cuneate at base, narrowly and obtusely acuminate. Inflorescence axillary, spicate, sometimes branched near the base, 15 cm long. Flowers 4-merous, pubescent, greenish yellow. Calyx very short, short-toothed. Petals creamy white, shortly connate at base. Staminal tube toothed. Disc tubular, longer than ovary. Ovary hirsute, 2-loculed; ovules collateral. Capsule ovoid, ridged. Seeds covered with orange-yellow aril.

Flowering & Fruiting: April-May.

Habitat: Moist grasslands.

Note: This species is closely allied to *D. binectariferum* but differs in having inflorescence nearly half as long as leaves, 4-5-lobed calyx, cyllindrical staminal tube and constantly 4-locular ovary.

A phytogeographically interesting species, so far known only from its type collection. The type locality and adjacent areas need to be thoroughly explored to address conservation of this palaeoendemic tree species.

Specimen examined: Pathanamthitta district: Angamoozhy, ± 200 m, 21 Apr. 1990, *Anil Kumar 1818* (Isotype, CALI).

9. CELASTRACEAE

Table 29. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
90-100	1300	15	114	19 spp.

Kerala

Genus/genera	Species/subsp./var.
12	38 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Cassine L.		*C. kedarnathii* Sasidh. & Swarupan
Euonymus L.	*E. angulatus* Wight (Karnataka & Tamil Nadu)	
	E. crenulatus Wallich ex Wight & Arn. (Tamil Nadu)	
	E. indicus Heyne ex Wallich (Maharashtra, Karnataka & Tamil Nadu)	
	E. paniculatus Wight ex Lawson(Tamil Nadu)	
	E. serratifolius Bedd. (Tamil Nadu)	
Glyptopetalum Thwaites	*G. grandiflorum* Bedd. (Tamil Nadu)	
Microtropis Wallich	*M. latifolia* Wight ex Lawson ex Meissner (Maharashtra, Karnataka & Tamil Nadu)	
	M. microcarpa Wight (Maharashtra, Karnataka & Tamil Nadu)	
	M. stocksii Gamble (Maharashtra, Karnataka & Tamil Nadu)	
Salacia L.	*S. beddomei* Gamble (Karnataka & Tamil Nadu)	
	S. macrosperma Wight (Maharashtra, Karnataka & Tamil Nadu)	
	S. malabarica Gamble (Karnataka)	

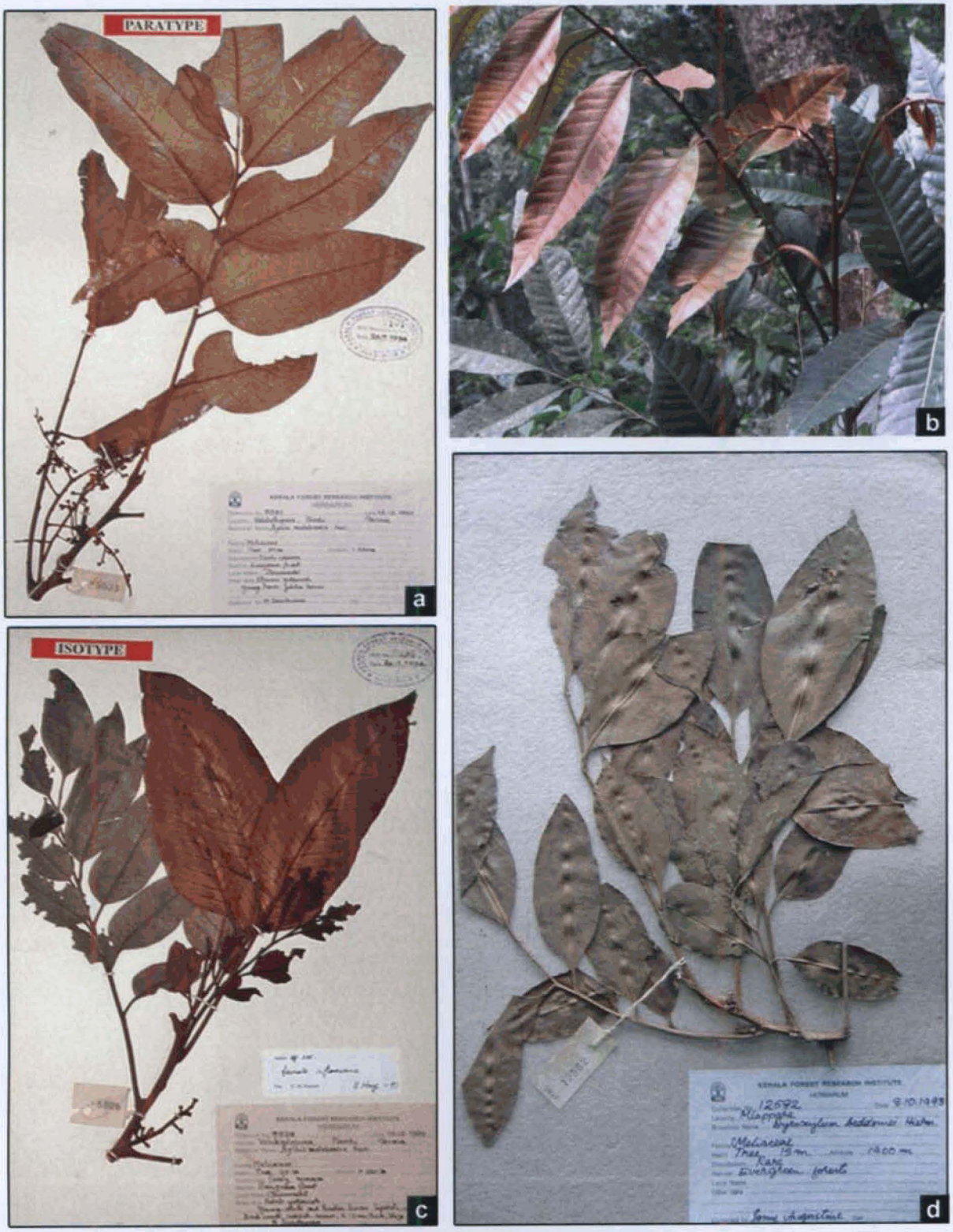

Plate 21. a - c. ***Aglaia malabarica*** Sasidh.: a. Paratype specimen at KFRI; b. A twig; c. Isotype specimen at KFRI; d. ***Dysoxylum beddomei*** Hiern: Herbarium specimen at KFRI.

CASSINE L.

Sp. Pl. 197. 1753.

Cassine kedarnathii Sasidh. & Swarupan., Reinwardtia 2 (1): 29-32.1992; Sasidh. & Anto in Manoharan *et al.*, Silent Valley Whis. Reas., 169. 1999; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 95. 2004; Daniel (ed.), Fl. Kerala 1: 699. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 171. 2006. *Neeral.*

Type: Palakkad district: Silent Valley, ± 800 m, 11 May 1989, *Sasidharan 3689* (MH)

(Fig. 30; Plate 22)

Large trees, up to 30 m tall. Leaves opposite, 5-8 x 2-3.5 cm, elliptic -oblong, obtusely caudate-acuminate, base acute, margin crenate. Cymes dichasial, terminal and axillary. Flowers greenish-yellow. Sepals 5, c. 0.15 x 0.3 cm, broadly ovate, obtuse, glabrous. Petals 5, c. 0.5 x 0.2-0.25 cm, oblong, obtuse, margin slightly revolute. Stamens 5, inserted along the margins of wavy annular disc. Ovary immersed in disc, 2-celled; ovules basal; style short; stigma entire. Drupe 5-6 x 3.5-4.2 cm, ellipsoid, apiculate, green. Seed 1, elliptic, planoconvex, brown.

Flowering & Fruiting: April-June.

Habitat: Evergreen forests.

Note: A palaeoendemic tree species strictly restricted in and around the type locality. Sasidharan and Swarupanandan identified this big tree having a vertical hole on the trunk of the tree, on the way to Sairandhri in Silent Valley National Prak. This, about 1,000 year old giant legendary tree with 40 m height and 13 m girth fell down in September 1998. A few individuals of the species are growing in this area. During the present study a few specimens at flowering and fruiting stages were collected from this area. The large ellipsoid fruit with thick putamen and elliptic oblong acuminate leaves make the species easily distinguished from the other South Indian species. As a palaeoendemic tree species it deserves more consevational and biological studies.

Specimens examined: Palakkad district: Silent Valley National Park, ± 800 m, 11 May 1989, *Sasidharan 3689* (Holotype, MH); Sairandhri, ± 800 m, 8 Mar. 2006, *Jothish 46310* (TBGT); *Ibid.*, 17 Apr. 2007, *Shaju 62712* (TBGT).

10. RHAMNACEAE

Table 30. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
52	900	12	57	3 spp., 2 var

Kerala

Genus/genera	Species/subsp./var.
8	16 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Colubrina Rich. ex Brongn.		*C. travancorica* Bedd.
Smythea Seemann ex A.Gray	*S. bombaiensis* (Dalz.) Banerjee & Mukherjee (Maharashtra, Karnataka & Tamil Nadu)	

COLUBRINA Rich. ex Brongn.

Ann. Sci.Nat. (Paris) 10: 368.1827.

Colubrina travancorica Bedd., Ic. Pl. Ind. Or. 1:43, t. 188. 1874; Lawson in Hook. f., Fl. Brit. India 1: 643. 1875; Rama Rao, Flr. Pl. Travancore 89. 1914; Gamble, Fl. Pres. Madras 224. 1918; Brandis, Ind. Trees 174. 1971; Ahmedullah & Nayar, End. Pl. Ind. Reg.181. 1987; Bhandari & Bhansali in Singh *et al.*, Fl. India 5: 171. 2000; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 111. 2004; Daniel (ed.), Fl. Kerala 1: 724. 2005; Anil Kumar *et al.*, Fl. Pathanamthitta 130. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 496. 2006

(Plate 23)

Shrubs. Young shoots golden silky hairy. Leaves simple, alternate or subopposite, 8-13 x 4-7 cm, oblong-lanceolate, acuminate at apex, rounded at base, margins crenate, thin coriaceous, densely pubescent beneath when young; petioles c. 1 cm long. Cymes very short, axillary. Flowers reddish, 0.5-0.6 cm across, 5-merous; pedicels 0.3-0.6 cm long, golden silk-hairy. Calyx-lobes 5, small, 0.15-0.2 cm long, deltoid, keeled within; tube companulate, sparsely hispid. Petals 5, 0.15-0.2 cm long, obovate, brownish yellow, clawed, hooded. Disc fleshy, 5-angled. Stamens 5, enclosed within the petals. Ovary subglobose, sunk in the disc, 3-locular; ovules 1-2 per locule; style 3-cleft; stigma obtuse, papillose. Fruit subglobose, 0.5-0.7 cm across. Seed obovoid, compressed.

Flowering & Fruiting: November-March.

Habitat: In evergreen forests and occasionally in dense groves in plains.

Note: Beddome (1870) collected the specimen from Cotacarray (= Kottarakkara) and Punalur of Kollam district; type specimen could not be traced except for the description and illustration in the Icon. The species thus warrants typification streamling. The narrow endemic species has been reported from two districts (Thrissur and Pathanamthitta) other than the type locality. Number of individuals is very few in these localities, and its natural

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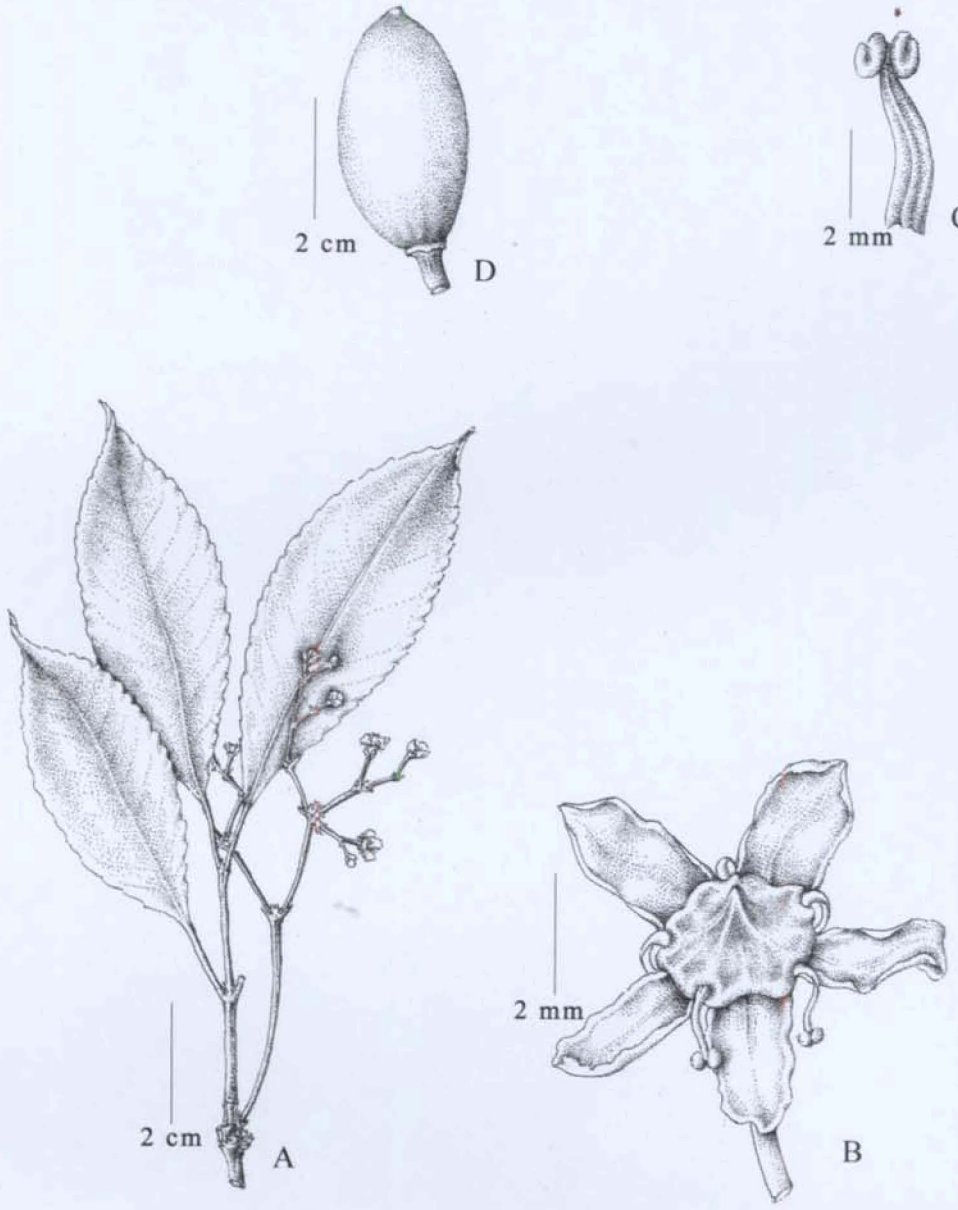

Fig. 30. ***Cassine kedarnathii*** Sasidh. & Swarup.: A. Twig; B. Single flower; C. Stamen; D. Fruit.

habitats remain under severe threats due to developmental activities. As a species of scientific interest on account of its geographical isolation and also as horticulturally promising species, conservation efforts should be made to find out the still surviving populations from its known distributional areas to confirm its status and to introduce into experimental gardens for propagation and reintroduction. Nayar (1997) included this species in the list of 'possibly extinct' categoary.

Specimens examined: Thrissur district: Kaladi Range, ± 100 m, 8 Dec. 1965, *K. M. Sebastine, 26659* (MH); Pathanamthitta district: Ranni R.F., Valiyakavu, ± 200 m, 9 Sep. 1988, *Anil Kumar & Ravi 791* (MH); Kollam district: Kottarakkara, Enathu, ± 30 m, 12 Nov. 2004, *Shaju 62738* (TBGT).

11. ANACARDIACEAE

Table 31. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
82	800	77	700	10 spp.

Kerala

Genus/genera	Species/subsp./var.
9	24 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Buchanania Sprengel		*B. barberi Gamble*
Holigarna Buch.-Ham.	*H. arnottiana* Hook. f. (Maharashtra, Goa, Karnataka & Tamil Nadu)	
	H. beddomei Hook. f. (Karnataka & Tamil Nadu)	
	H. nigra Bourd. (Karnataka & Tamil Nadu)	
Nothopegia Blume	*N. aureo-fulva* Bedd. ex Hook. f. (Tamil Nadu)	
	N. travancorica Bedd. ex Hook. f. (Karnataka & Tamil Nadu)	
Semecarpus L.f.	*S. auriculata* Bedd. (Karnataka & Tamil Nadu)	

Plate 22. ***Cassine kedarnathii*** Sasidh. & Swarupan: Flowering twig; Inset: Single flower

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	S. travancorica Bedd. (Tamil Nadu)	
Spondias L	*S. indica* (Wight & Arn.) Airy Shaw & Forman (Karnataka & Tamil Nadu)	

BUCHANANIA K. P. J. Sprengel

J. Bot. (Schrader) 1800 (2): 234: 1802 ("1801").

Buchanania barberi Gamble, Bull. Misc.Inform. 135.1916; Gamble, Fl. Pres. Madras 259.1918; A. N. Henry *et. al.*, J. Bombay Nat. Hist. Soc. 75: 687.1978; Mukh. & D. Chandra, Bull. Bot. Surv. India 25: 52-61. 1983; Vajr. in Jain & Sastry, Pl. Cons. Bull. 4: 23. 1983; Vajr. & Daniel in Jain & Sastry, Mat. Cat. Threat. Pl. India 15. 1983; Ahmedullah & M. P. Nayar, End. Pl. of Ind. Reg.186. 1987; Vajr. in Nayar & Sastry, Red Data Book Ind. Pl. 2: 10. 1988; M. Mohanan & A. N. Henry, Fl. Thiruvananthapuram 127. 1994; D. Chandra & Mukh. in Singh *et al.*, Fl. India 5: 442. 2000; Santhosh Kumar *et al.*, Rheedea 12: 197. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 111. 2004; Daniel (ed.), Fl. Kerala 1: 799. 2005; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 49. 2006.

Type: Thiruvananthapuram district: Nadarai, 1 Nov. 1904, *Barber 6737* (MH).

(Fig. 31; Plate 24 a-e)

Trees up to 15 m high. Leaves simple, alternate, crowded at apex, 11-14 x 3-4.5 cm, elliptic oblong, obtuse at base, obtuse or shortly acuminate at apex, glabrous above and rusty villous along the nerves at maturity, coriaceous; lateral nerves 16-20 pairs; petiole 2-2.5 cm long, rusty villous. Inflorescence terminal, panicle branched, puberulent, 3-12 cm long. Flowers creamy white, c. 5 mm across; pedicel c. 2.5 mm long, puberulent. Bracts ovate-acute; bracteoles similar to bracts. Calyx lobes 5, creamy-white; lobes triangular, c. 0.8 mm long, outer surface pubescent, inner surface glabrous. Petals 4-5, creamy white, oblong, c. 2.5 x 0.8 mm, rounded at apex, reflexed, glabrous. Stamens 8-10, 2-seriate; filaments 1-3 mm long, glabrous; anthers triangular-ovate, obtuse at apex, pale brown; dehiscing laterally. Disc copular, 10-ridged, pilose. Carpels 4-6, free, immersed in the disc, ellipsoid, one carpel developed, others suppressed; ovary pilose; ovules 1 per cell, pendulous; style lateral, short; stigma obtuse or truncate. Drupes c. 1.5 cm across, sub-globose, slightly compressed laterally, glabrous. Seeds ovoid, curved inward at one end; endosperm copious.

Flowering & Fruiting: October-January.

Habitat: First recorded from coastal area and then rediscovered from the banks of river.

Plate 23. ***Colubrina travancorica*** Bedd.: A flowering twig; Inset: Flowers.

Note: *Buchanania barberi* was described by J. S. Gamble in 1916, based on a single specimen collected by C. A. Barber in 1904 from 'Nadarai', near Varkala in the Thiruvananthapuram district of Kerala state. Since then it has never been colleced either from its type locality or its adjacent areas in spite of the best efforts put forward by the subsequent flora workers (N. Mohanan, 1987; M. Mohanan & A. N. Henry, 1994; Anil Kumar, 1993). Consequently many authors (A. N. Henry *et al.*, 1987; Vajr. & Daniel, 1983; Vajr., 1990) considered it as one among the endangered species of the South India. During the floristic exploration of the Palode Reserve Forests, Santhosh Kumar *et al.* collected an interesting specimen of *Buchanania* from the banks of Vamanapuram river near Palode (2001). On critical study with relevant literature and type specimen at MH, it was identified as *Buchanania barberi* Gamble, an endangered species known only by the type collection. The present collection, after a lapse of 97 years of its first collection is of botanical significance in conservation point of view. J. S. Gamble (I.c.) did not describe the mature fruits of *B. barberi*. He stated "*fructus matures adhuc ignotus*" which means 'mature fruits still unknown'. Hence the present description of the fruits is the first additional information on fruits of this little known species. This rediscovery from the base of the Southern Western Ghats, which is quite away from the coastal area forms additional information about its distribution and has phytogeographical significance. Nayar (1997) recorded this species under 'Rare & Threatened' Category of endemic plants. The consevation status of this palaeoendemic species has been designated as 'Critically endangered' in the IUCN Threatened Plant List of 2008.

The species is at present known only from a single locality where the few surviving populations are under severe threat due to habitat destruction. Conservation measures should be made for *in-situ* conservation in ecologically suitable areas in its distributional range and *ex-situ* conservation in botanical gardens.

Specimens examined: Thiruvananthapuram district: Nadarai, 1 Nov. 1904, *Barber 6737* (MH); Neumangadu Taluk, Palode, ±100 m, 23 Nov. 2001, *Santhosh Kumar 39356* (TBGT); *Ibid.*, 5 Dec. 2001, *Shaju 62754* (TBGT).

12. CONNARACEAE

Table 32. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
12	180	4	16	1 spp.

Kerala	
Genus/genera	Species/subsp./var.
3	6 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Connarus L.		*C. parameswaranii* Ramam. & Rajan

CONNARUS L.

Sp. Pl. 675. 1753.

Connarus parameswaranii Ramam. & Rajan, J. Bombay Nat. Hist. Soc. 85: 390. 1988; Samaddar & Roy, Add. Elem. Ind. Fl. 1: 90. 1997; Mondal in Singh *et al.*, Fl. India. 5: 530. 2000; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 114. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 171. 2006.

Type: Idukki district: Adimali Reserve Forest, ± 1800 m, 29 Mar. 1980, *Ramamurthy 66582* (MH). (Plate 25)

Liana. Branches densely stellate plumose, brown-tomentose. Leaves imparipinnate, 1-2 pairs, brown-tomentose; leaflets 4-14 x 3-7 cm, ovate to obovate, coriaceous, apex abruptly acuminate, base rounded. Panicles c.16 cm long, terminal, brown-tomentose with numerous flowers. Flowers bisexual. Bracts subulate, lanceolate, densely pubescent without, glabrous within. Sepals 5, 0.4-0.5 x 0.1-0.2 cm, connate at base, persistent in fruit. Petals 5, 0.4-0.5 x 0.1-0.2 cm, oblong, glabrous. Stamens 10, connate at base, epipetalous. Ovary hairy; style slender; stigma capitate. Follicles ellipsoid, 1-2.5 x 0.3-1.5 cm, oblique, beaked, brownish tomentose pubescent within. Seed solitary, arillate at base.

Flowering & Fruiting: March.

Habitat: Evergreen forests.

Note: Being a local endemic species, it is of phytogeographical and botanical interests. It is necessary to locate this species from type locality and adjacent areas and efforts should be made for *in-situ* and *ex-situ* conservation.

Specimen examined: Idukki district: Adimali Reserve Forest, ± 1800 m, 29 Mar. 1980, *Ramamurthy 66582* (Isotype, MH).

13. FABACEAE (LEGUMINOSAE)

Table 33. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
730	19400	400-500	982	47 spp., 3 ssp., 17 var.

Kerala	
Genus/genera	Species/subsp./var.
81	335 spp., 4 ssp., 24 var..

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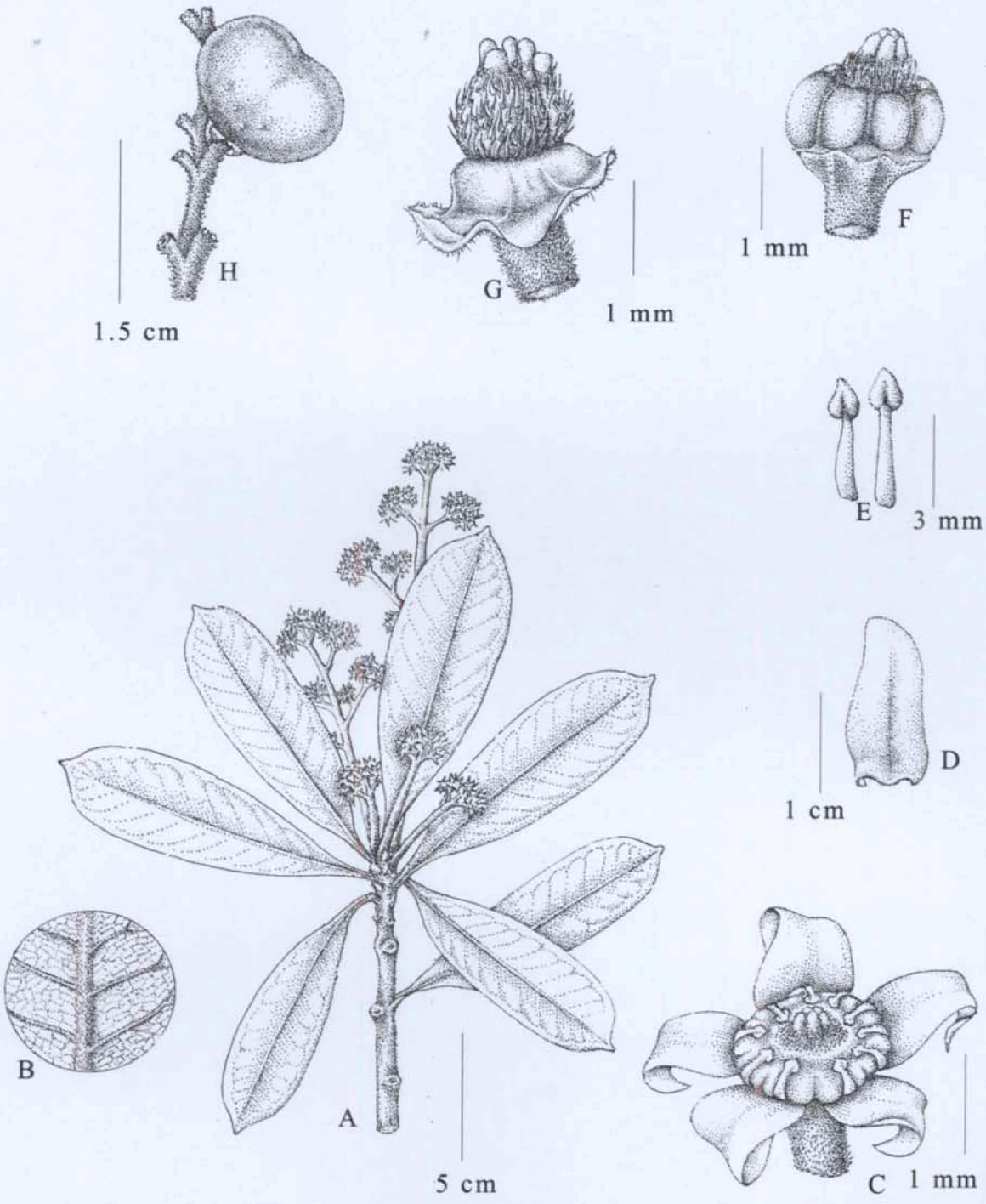

Fig. 31. ***Buchanania barberi*** Gamble: A. Habit; B. A portion of the lower surface of leaf showing rufous pubescence; C. Flower; D. Petal; E. Stamens; F. Pistil with petals and stamens removed showing disc; G. Pistil; H. Fruit.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Aganope Miq	*A. thyrsiflora* var. *eualata* (Bedd.) Thoth. & Das (Karnataka)	
Crotalaria L	*C. barbata* Graham & Wight & Arn. (Tamil Nadu)	
	C. evolvuloides var. *acutifolia* Gamble (Karnataka & Tamil Nadu)	
	C. formosa Graham & Wight & Arn. (Tamil Nadu)	
	C. obtecta var. *glabrescens* (Benth.) Baker (Karnataka & Tamil Nadu)	
	C. peduncularis Graham & Wight & Arn. (Karnataka & Tamil Nadu).	
Dalbergia L.f.	*D. travancorica* Thoth (Tamil Nadu)	*D. beddomei Thoth.*
Derris Lour.	*D. brevipes* var. *travancorensis* Thoth. (Tamil Nadu)	
	D. thothathrii Bennet (Maharashtra, Karnataka & Tamil Nadu)	
Desmodium Desv.	*D. barbatum* (L.) Benth. ssp. *saulieri* (Schindler) H. Ohashi(Karnataka & Tamil Nadu)	
	D. ferrugineum ssp. *wynadense* (Bedd. ex Gamble) H. Ohashi (Tamil Nadu)	
Geissaspis Wight & Arn.	*G. tenella* Benth. var. *tenella* (Maharashtra, Goa & Karnataka)	*G. tenella* var. *malabarica* Sivar. & Babu
Kunstleria Prain	*K. keralensis* C. N. Mohanan & N. C. Nair	
Millettia Wight & Arn.	*M. rubiginosa* Wight & Arn.	

Plate 24. a - e. *Buchanania barberi* Gamble: a. Flowering twig; b. Fruiting twig; c. Single leaf; d. A small portion of dorsal side of leaf enlarged showing rufous pubescence; e. Type specimen at MH.

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	(Tamil Nadu) *M. splendens* Wight & Arn. (Tamil Nadu)	
Mucuna Adans.		*M. pruriens* var. *thekkadiensis* Thoth. & Ravikumar
Ormosia G. Jackon	*O. travancorica* Bedd. (Karnataka & Tamil Nadu)	
Smithia Aiton	*S. etulosa* Dalz (Tamil Nadu)	*S. venkobarowii* Gamble
Tephrosia Pers	*T. canarensis* Drumm. (Maharashtra, Karnataka &	*T. travancorica* Thoth. & Das *T. wynaadensis* Drumm.
Bauhinia L.	*B. phoenicea* Heyne ex Wight & Arn. (Maharashtra, Karnataka & Tamil Nadu)	
Cynometra L.	*C. bourdillonii* Gamble (Karnataka) *C. travancorica* Bedd. (Karnataka & Tamil Nadu)	*C. beddomei* Prain
Dialium L.		*D. travancoricum Bedd*
Humboldtia Vahl	*H. bourdillonii* Prain (Tamil Nadu) *H. brunonis* Wallich (Karnataka & Tamil Nadu) *H. decurrens* Bedd. ex Oliver (Tamil Nadu) *H. unijuga* Bedd. var. *unijuga* (Maharashtra, Karnataka & Tamil Nadu)	*H. unijuga* var. *trijuga* Joseph & V. Chandras. *H. sanjappae* Sasidh. & Sujanapal
Moullava Adans.	*M. spicata* (Dalz.) Nicolson (Maharashtra & Karnataka)	
Inga Benth		*I. cynometeroides* (Bedd.)Bedd. ex Baker

Key to the subfamilies

1. Flowers zygomorphic; perianth imbricate in bud.
   2. Corolla papilionaceous, aestivatio imbricate, descending.....

Plate 25. *Connarus parameswaranii* Ramam. & Rajan: Type specimen at MH.

..... **Faboideae**

2. Corolla caesalpiniaceous, aestivation imbricates ascending.....

..... **Cesalpinioideae**

1. Flowers actinomorphic; perianth valvate in bud..... **Mimosoideae**

13a. FABOIDEAE (PAPILIONOIDEAE)

Key to the genera

1. Twiners, trailers, stragglers or liane.

2. Leaves 3-foliate..... **Mucuna**

2. Leaves 5-α-foliate

3. Flowers white, stamens 9, monadelphous..... **Dalbergia**

3. Flowers purple, stamens 9 + 1, diadelphous..... **Kunstleria**

1. Herbs, erect or subscandent shrubs, trees.

4. Leaves even-pinnate.

5. Bracts foliaceous; stamens 10 or 9 + 1..... **Geissaspis**

5. Bracts not foliaceous; stamens 5 + 5..... **Smithia**

4. Leaves odd-pinnate..... **Tephrosia**

DALBERGIA L. f.

Suppl. Pl. 52, 316. 1781, *nom. cons.*

Dalbergia beddomei Thoth., Proc. Ind. Acad. Sci. (Pl. Sci.). 92: 23. 1983; K. K. N. Nair, J. Econ. Taxon. Bot. 8. 242. 1986; Sanjappa, Leg. India 28. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 125. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 278. 2006.

Type: Palakkad district: Silent Valley, *Beddome 2459A*, (BM).

Creeping shrubs. Leaf imparipinnate, c. 5-7.5 cm long; leaflets 5, ovate to elliptic, 2-2.5 x 1.5-2 cm shortly petiolate, entire, rounded at base, obtuse to acute at apex; stipules prominent. Panicles axillary, c. 2.5-4.5 cm, much branched. Flowers 0.5-0.7 cm. Bracts ovate, pubescent. Bracteoles 2, ovate. Calyx tube campanulate, c. 0.35-0.45 cm, pubescent , 5-toothed; upper 2 teeth connate, lower 3 distinct. Corolla white, 0.8-1 cm long; standard ovate, long clawed. wings oblong. keels connate. Stamens 9, monadelphous. Pistil 0.5-0.6 cm long; ovary stipitate, 2-ovuled; style slender; stigma minute. Pods oblong, 4-4.5 x 1.4-1.5 cm, reddish brown; 1-seeded.

Flowering & Fruiting: January-May.

Habitat: Evergreen forest along stream banks.

Note: This species was described by Thothathri (1983) based on the collection of Beddome from Silent Valley (No. *2459 A*, Holotype, BM). In 1985 K. K. Nair relocated this species from the type locality and revised the original description with the addition of certain important characters. Due to its rare occurence in the area, Nayar (1997) recorded this species under 'Endangered' category.

Specimen examined: Palakkad district: Silent Valley, between Valiyaparathode and South Walppara, ± 1200 m, 15 Feb. 1985, *K. K. N. Nair 3236* (KFRI).

GEISSASPIS R. Wight & Arnott

Prodr. 217. 1834.

Geissaspis tenella var. **malabarica** Sivar. & Babu, J. Econ. Tax. Bot. 5: 941. 1984; Sanjappa, Leg. India 181. 1991; Samaddar & Roy, Add. Elem. Ind. Fl. 1: 168. 1984; Sivar. & Philip Mathew, Fl. Nilambur 175. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 135. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 291. 2006.

Type: Malappuram district: Calicut University Campus, Aug. 1983, *Babu 37408* (MH).

Prostrate or creeping herbs. Stem slender, often rooting at nodes. Leaves 4-foliate, petiolate. Leaflets very shortly petiolued, obovate, obtuse or retuse at apex, serrations on the margins ending in aristae, basely 3-veined. Flowers in long peduncled, axillary, bracteate recemes. Calyx cup deeply 2-lipped. Corolla exceeding the calyx; standard petals suborbicular, shortly clawed, deep maroon within; wings oblong; keels incurved. Stamens 10, monadelphous. Ovary short stalked. Ovules 2; style long incurved; stigma terminal. Pods 1-2-jointed, joints turgid in the middle. Seeds subreniform.

Flowering & Fruiting: September-March.

Habitat: A common weed especially in the crevices of rocks in moist or wet places on the lateritic slopes.

Note: Supposed to be a neoendemic variety, further investigations are necessary to obtain a clear picture of conservation status.

Specimen examined: Malappuram district: University campus, Aug. 1983, *Babu 37408* (Isotype, CALI).

KUNSTLERIA Prain

J. Asiat. Soc. Bengal 66(22): 109.1897.

Kunstleria keralensis Mohanan & Nair, Proc. Ind. Acad. Sci. (Pl. Sci.) 90: 207. 1981; Karthikeyan & Sharma, J. Bombay Nat. Hist. Soc. 80: 66. 1983; Ridder-Numan & Kornet, Blumea 38: 474. 1994; Sasidh. & Sivar., Flr. Pl. Thrissur For. 146. 1996;

Ahmedullah & Nayar, End. Pl. Ind. Reg. 101. 1987; Anil kumar *et al.*, Fl. Pathanamthitta 183. 2005; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 139. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 294. 2006.

Type: Pathanamthitta district: Adoor, Kodumon, 125 m, 30 May 1980, *Mohanan 68348 E* (MH). (Plate 26 a & b)

Leaflets 5-7, 6-16 x 2-5 cm, ovate, elliptic to lanceolate, round at base, acuminate at apex, lamina rugose, nerves prominently veined, sparsely hairy below. Panicle terminal, c. 30 cm long. Calyx campanulate, lobes 5, upper 2 connate. Corolla dark purple, petals clawed. Stamens 9 + 1, vexillary one adnate to the base of standard. Ovary stalked; style curved. Pod strap shaped, tomentose. Seeds flattened.

Flowering & Fruiting: February - December

Habitat: Evergreen, semi-evergreen, deciduous and sacred groves.

Note: According to Nayar (1997) this species is 'rare', but it is having good populations in almost all districts of the state. *Kunstleria* is a small genus with only 12 species, of which five are Malayan, four species are Philippine, two species are Australian and only one species reported from India, which is exclusively endemic to Kerala. As a disjunctly distributed species it assumes particular phyogeographical significance.

Specimens examined: Pathanamthitta district: Adoor, Kodumon, 125 m, 30 May 1980, *Mohanan 68348 E* (Paratype: MH); Thiruvananthapuram district: Agasthyamala, way to Bonacoord, ± 550 m, 3 Feb. 2003, *Shaju 47392* (TBGT).

MUCUNA Adanson

Fam. 2: 325, 579. 1763. *nom. cons.*

Macuna pruriens var. **thekkadiensis** Thoth. & Ravik., J. Econ. Tax. Bot. 21: 703. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 140. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 196. 2006.

Type: Idukki district: Thekkady forests, Periyar Tiger Reserve, 23 Feb. 1996 *Ravikumar and Muralidharan 535 A* (MH). (Plate 26 c)

Climbers. Stem teret, hairy. Leaves trifoliate; petioles 7.5-15-.5 cm long; leaflets of varing sizes, chartaceous, glabrescent above, densely minute, white hairy beneath, unequally cordate, 8-12.5x 4.5-7.5 cm, base truncate, apex acute and slightly mucronate; petiolules c. 1.5 cm long, hairy. Inflorescence c. 20 cm long, shorter than the leaves; rachis desely brown hairy with 8-10 pods, crowded. Pods narrowly oblong, 8.5-9.5 x 1.2-1.5 cm, densely matted with brownish, red, irritant bristles and very minute brown hairs. Seeds 4-5, brown.

Flowering & Fruiting: January-March.

Habitat: Evergreen forests.

Note: A conservation dependent wild variety of *Mucuna pruriens* (L.) DC. So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimen examined: Idukki district: Thekkady forests, Periyar Tiger Reserve, 23 Feb. 1996, *Ravikumar and Muralidharan 535 A* (Holotype, MH).

SMITHIA W. Aiton

Hortus Kew. 3: 496. 1789, *nom. cons.*

Smithia venkobarowii Gamble, Bull. Misc. Inform. Kew 1919: 223. 1919 & Fl. Pres. Madras 330 (233). 1918; Ahmedullah & Nayar, End. Pl. Ind. Reg. 102. 1987; Sanjappa, Leg. India 248. 1991; Sasidh. & Sivar., Flr. Pl.Thrissur For. 153. 1996; Sasidh., Biodiver. Doc. Kerala, Part 6. Flr. Pl. 145. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 303. 2006.

Type: Travancore; Hills at Peermerd; Oct. 1916, *K. Vencoba Rao 3799* (K).

Erect or trailing herbs. Stem hirsute. Leaves to 6 cm long; leaflets 4-6 pairs, oblong-ovate, glabrous, c. 1.7 x 0.8 cm. Stipules lanceolate. Flowers in axillary subcapitate clusters. Peduncle 2-3 cm long. Petals orange yellow. Lomentum 5-6-jointed, glabrous, reticulate.

Flowering & Fruiting: September-December.

Habitat: Grasslands.

Note: This highly endemic species was described by Gamble (1919) based on the specimens collected from Peerumede. After the type collection, it has not been collected and is placed under 'Possibly extinct' category (Nayar, 1997). But this species was rediscovered by Sasidharan from Sholayar region of Thrissur district.

Specimen examined: Thrissur district: Sholayar, Travancore hills, *Sasidharan 3005* (KFRI).

TEPHROSIA Persoon

Syn. Pl. 2: 328. 1807 *nom. cons.*

Key to the species

1. Leaflets 11-19 pairs; stipules ovate.....1. *T. travancorica*
1. Leaflets 7-11 pairs; stipules lanceolate ..... 2. *T. wynaadensis*

1. **Tephrosia travancorica** Thoth. & Das, Rheedea 1: 57. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6. Fl. Pl. 147. 2004; T.S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 306. 2006.

Type: Travancore, 1920, *Narayanaswamy 1121* (CAL).

Plate 26. a & b. ***Kunstleria keralensis*** C. N. Mohanan *et al.*: a. Type specimen at MH; b. Fruiting twig; c. ***Mucuna pruriens*** var. ***thekkadiensis*** Thoth. & Ravikumar: Type specimen at MH.

Undershrub. Leaves imparipinnate, 8-13 cm long; leaflets opposite, 11-19, ovate elliptic to ovate oblong, 1.5- 3 x 0.5-1 cm, acute or retuse at apex, rounded at base, entire, glabrous or minutely puberulous below; petioles 0.1-0.15 cm; stipules ovate. Racemes terminal, c. 1 x 0.6 cm, flowers fairly large, 2-2.4 cm; pedicels 1.7-2 cm long. Calyx companulate, c. 0.3-0.5 cm long , distinctly 5-toothed, unequal. Standard ovate-orbicular, glabrous within and densely brown silky with out; wings oblong; keels boat-shaped. Stamens monadelphous. Ovary linear; syle short; stigma capitate; ovules 4. Pod not known.

Flowering & Fruiting: Not specified.

Habitat: Degraded forest areas.

Note: This species was described by *Thothathri et al.* based on the specimen (No. *1121*, CAL) collected by Narayanaswamy from Travancore in 1920. As herbarium details are not available, a brief description of the species based on protologue is added.

2. **Tephrosia wynaadensis** Drumm. in Gamble, Fl. Pres. Madras 319 (224). 1918; Vajr., Fl. Palghat 175. 1990; Sanjappa, Leg. India 260. 1991; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 102. 1987; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 3: 152. 1990; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 147. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 306. 2006.

Type: Wayanad district: Tambracheri Ghat, 21 Jan. 1903, *C. A. Barber 5684* (MH).

(Plate 27 a)

Erect woody herbs. Leaves 4-6 cm long, thinly hairy; leaflets 7-11, oblong-elliptic, upper side glabrous, lower with thin hairs having a shining appearance. Stipule lanceolate. Racemes axillary or terminal, c. 10 cm long. Flowers c. 2 cm long. Calyx c. 0.5 cm long, lobes twice the length of the tube. Standard petals c. 1.7 x 1.4 cm, broadly ovate, wing petals c. 1.4 x 0.4 cm, keel petals c. 1.5 x 0.5 cm. Pods straight, c. 0.7 x 0.5 cm, compressed, glabrous. Seeds 4-7.

Flowering & Fruiting: October.

Habitat: Moist deciduous forests.

Note: After type collection it has not been collected and is placed under 'Rare' category (Nayar, 1997). As a species of phytogeographical and botanical interests, intensive search should made in and around the type locality to relocate the species, to ascertain present status of its population and to adopt appropriate conservation measures.

Specimen examined: Wayanad district: Tambracheri Ghat, 21 Jan. 1903, *C. A. Barber 5684* (MH).

13b. CAESALPINIOIDEAE

Key to the genera

1. Stamens 2 ..... **Dialium**
1. Stamens 5-10
   2. leaflets constantly 3, ascendingly becoming large..... **Cynometra**
   2. Leaflets varying, not much different in size..... **Humboldtia**

CYNOMETRA Linnaeus

Sp. Pl. 382. 1753.

Cynometra beddomei Prain, J. Asiat. Soc. Bengal 65: 478. 1897; Gamble, Fl. Pres, Madras 414. 1919; Rama Rao, Fl. Pl. Travancore 141. 1914; Sanjappa, Leg. Ind. 26. 1991; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 3: 130. 1990; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 102. 1987; N. Mohanan & Sivad., Fl. Agasthyamala 231. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 154. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 318. 2006.

Type: Wayanad district: 'Tambracherry ghat', *R. H. Beddome s.n. Acc. No. 18530* (CAL).

(Plate 27 b & c)

Medium-sized trees. Stem, petioles and stipules brown pubescent when young. Leaves paripinnate; leaflets 3 pairs, terminal pair larger, 3-6 x 1.5-2.5 cm, obovate-oblong, shortly acuminate at apex, narrowly attenuate at base, oblique; young leaves pinkish, drooping; leaf-buds covered with sheathing bracts, 1.5-2.5 x 0.2-0.5 cm, ovate, caducous, tomentose with tuft of hair at apex; bracteoles unequal. Flowers clustered from imbricating bracts. Calyx tube short; lobes 5, 0.3-0.5 x 0.15-2 cm, oblong-rounded, glabrous. Petals 5, 0.4-0.6 x 0.1 cm, oblong to elliptic-oblong, acute, ciliate towards apex. Stamens 10. Ovary sessile, 2-ovuled; stigma capitate. Pods not known.

Flowering & Fruiting: February-July

Habitat: Evergreen forests.

Note: The species is hitherto known only by one collection of Beddome made in 1870 from 'Thambrachery Ghat', in Wayanad. Nayar and Sastry (1990) reported it to be 'Possibly extinct' after intensive explorations made by them in the area. But this species was recollected by N. Mohanan from two specific localites of Agasthymala, during his floristic studies. This forms more than a century old recollection with a new distibutional record within the state. The conservation status of this species has been designated as 'Endangered' in the IUCN Threatened Plant List of 2008.

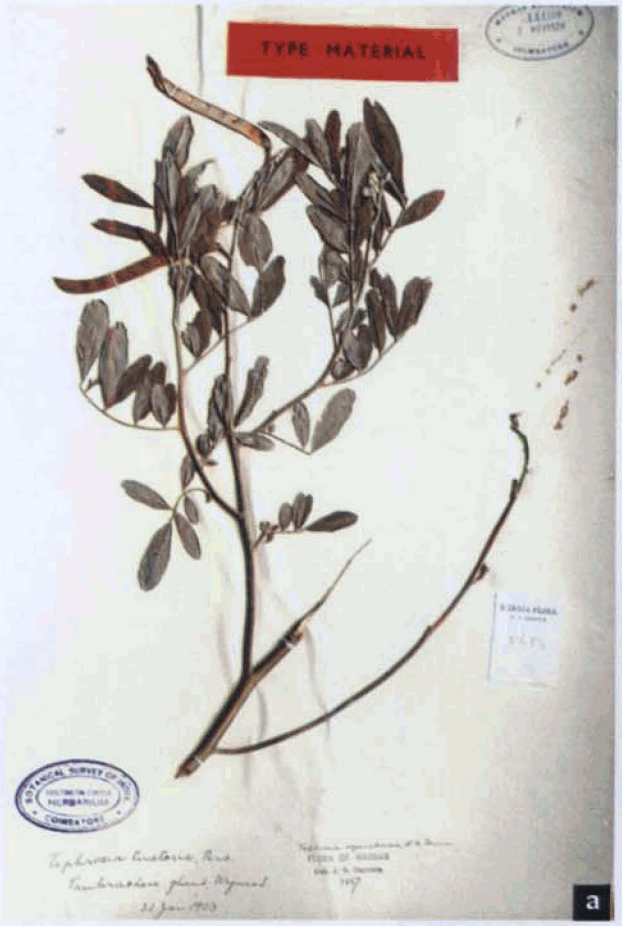

Plate 27. a. ***Tephrosia wynaadensis*** Drumm.: Type specimen at MH; b & c. ***Cynometra beddomei*** Prain: b. Type specimen at CAL; c. Flowering twig.

Specimens examined: Wayanad district: 'Tambracherry ghat', *R. H. Beddome s.n. Acc. No. 18530* (CAL); Thiruvananthapuram district: Agasthyamala, Karamanayar, Meenmutty, *N. Mohanan 10012* (TBGT); *Ibid.*, way to Bonaccord, ± 600 m, 23 Sep. 2008, *Shaju 65076* (TBGT).

DIALIUM Linnaeus

Syst. Nat. ed.12, 2: 56, 7: 324. 1767

Dialium travancoricum Bourd., Ind. For. 30: 243. 1904 & For. Trees Travancore 144. 1908; Rama Rao, Fl. Pl. Travancore 141. 1914; Gamble, Fl. Pres. Madras 404. 1919; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 193. 1987; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 3: 10. 1990; Sanjappa, Leg. India 28. 1991; M. Mohanan & A. N. Henry, Fl. Thiruvananthapuram 167. 1994; Sasidh., High. Pl. Ind. Sub-Cont. 8: 209.1998; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 155. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 319. 2006. ***Malampuli.*** (Plate 28)

Evergreen trees, up to 30 m tall. Bark greyish brown, smooth; branchlets lenticellate. Leaf-rachis up to 15 cm long; leaflets 5-7, sub-opposite or alternate, elliptic or oblong-lanceolate, 8-1 x 3-4.5 cm, caudate-acuminate, base acute or obtuse; lateral veins 10-15 pairs, slender, faint. Panicles up to 20 cm long, tomentose, terminal and from the axils of upper leaves. Flowers sub-sessile. Sepals 5, greenish yellow, subequal, the outer three c. 0.5 x 0.23 cm, ovate-obtuse, tomentose; inner two oblong, obtuse, tomentose. Petals 0. Stamens 2; filaments glabrous; anthers oblong. Ovary medianlly grooved above, tomentose, 2-ovuled; stigma muticous.

Flowering & Fruiting: September-October.

Habitat: The species was recorded from the evergreen forests of Ponmudi–Ariankavu hill range.

Note: This large tree was described by Bourdillon based on the specimens collected in 1898 from Ponmudi, Thiruvananthapuram district and also from Aryankavu in Kollam district. It has not been collected after the type collection (Sanjappa, 1991). Though placed under the indeterminate threat category, Nayar and Sastry (1990) stated that the possibility of its extinction could not be ruled out. Sasidharan (1998) rediscovered this species from the type locality. According to him the species is extremely rare, and only two trees could be located in Ponmudi. Regeneration is very poor; no seedlings or saplings were found near the mature trees. The area occupied is less than 1 sq. km. The consevation status of this narrow endemic species has been designated as 'Critically endangered' in the IUCN Threatened Plant List of 2008.

The main trunk of the tree is reportedly straight, reaching up to 30 m in height with a

girth of about 1 m and has potential for yielding timber. The fruits are perhaps edible as they are known locally as 'Malam Puli' meaning "Hill Tamarind".

Specimen examined: Thiruvananthapuram district: Ponmudi, *Gopalakrishnan Nair 6177* (KFRI).

HUMBOLDTIA M. Vahl

Symb. Bot. 3: 106. 1794, *nom. cons.*

Key to the species/ varieties

1. Racemes to 13 cm long; petals white ..... *1. H. sanjappae*
1. Racemes 2-2.5 cm long; petals crimson ..... 2. *H. unijuga* var. *trijuga*

1. **Humboldtia sanjappae** Sasidh. & Sujanapal, Rheedea 17: 21. 2007.

Type: Idukki district: Neriyamangalam, ± 300 m, 23 Mar. 2005, *N. Sasidharan & Sujanapal 18711* (CALI). (Plate 28 a & b)

Medium-seized trees. Stipule c. 1 x 0.5 cm, obliquely ovate, glabrous. Leaves compound, to 25 cm long; leaflets 4, 5-19 x 3-7.5 cm, elliptic to elliptic-ovate, obtuse or rounded at base, acute or obtusely acuminate at apex, glabrous. Flowers in recemes, axillary or from leaf scars, solitary or in groups, to 13 cm long, greyish-white tomentose. Bracteoles c. 0.4 x 0.4 cm, oblong, villous. Calyx tube 0.25-0.3 cm long, lobes 4, ovate-lanceolate, c. 0.5 x 0.25 cm long, pubescent without. Petals 5, subequal, c. 0.7 x 0.5 cm, glabrous. Stamens 5, sparsely pilose, anthers oblong, versatile. Ovary pilose, ovules 3; style glabrous; stigma capitate. Pod c. 17 x 4 cm, oblong, beaked, compressed, glabrous. Seeds 1-2, orbicular, brown.

Flowering & Fruiting: December-April.

Habitat: Evergreen forests.

Note: The species is very distinct by its elongated recemose inflorescence with smaller flowers and white petals and large glabrous pods. As a narrow endemic tree species, it warrants critical evaluation to obtain conservation status.

Specimen examined: Idukki district: Neriyamangalam, ± 300 m, 23 Mar. 2005, *N. Sasidharan & Sujanapal 18711* (Holotype, CALI).

2. **Humboldtia unijuga** var. **trijuga** J. Joseph & V. Chandras., J. Bombay Nat. Hist. Soc. 81: 729. 1984; Sanjappa, Blumea 31: 338.1986; Sanjappa, Leg. Ind. 26.1991: M. Mohanan & A. N. Henry, Fl. Thiruvananthapuram 169.1994; N. Mohanan & Sivad., Fl. Agasthyamala 234. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6. Flr. Pl. 155. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 320. 2006.

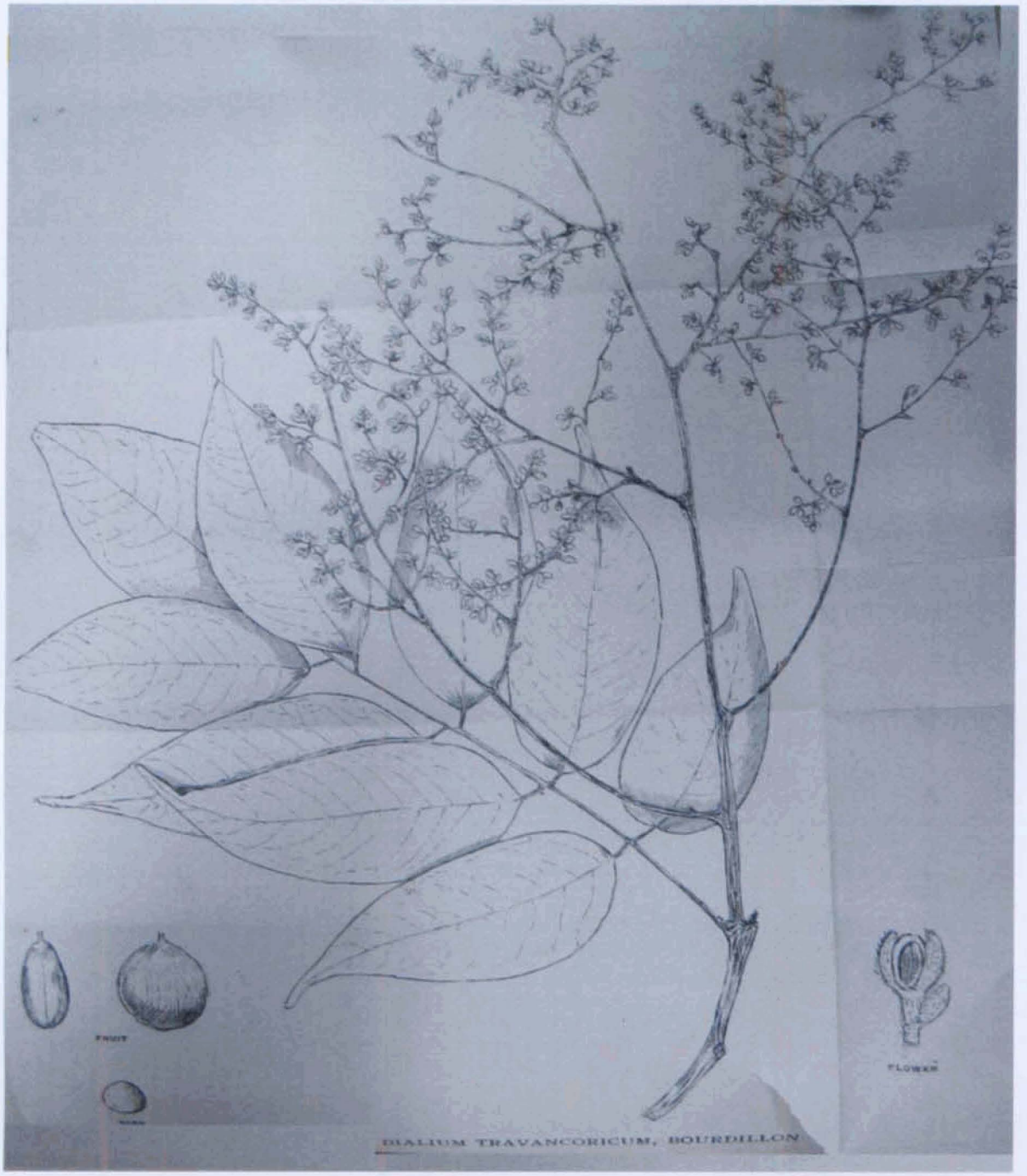

Plate 28. ***Dialium travancoricum*** Bourd.**:** Reproduction of illustration from The Indian Forester Vol. XXX: 243.

Type: Thiruvananthapuram district: Koviltherimala, 2 Oct. 1973, *Joseph 4451* (CAL).

(Fig. 32; Plate 28 c & d)

Medium sized trees. Stipule 1-1.5 x 0.8-1 cm, narrowly ovate, acute, glabrous. Leaves compound, 15-30 cm long; leaflets 6, 8-18 x 3-4.5 cm, elliptic-lanceolate, acuminate at apex, oblique at base, coriaceous, glabrous above, hairy on main nerves below. Flowers in short axillary to lateral recemes or on tubercles from old stem, solitary or in groups, to 2-2.5 cm long. Bracts and bracteoles ovate-lanceolate, 0.5-0.7 cm long, pubescent without. Calyx campanulate, 0.3-0.4 cm long, lobes 4, ovate-lanceolate, 0.5-0.6 cm long, pubescent without. Patals 5, 0.8-1 cm long, obvate-lanceolate, narrowed at base, crimson coloured. Stamens 5. Ovary compressed, pubescent without; style filiform; stigma capitate. Pods compressed, 6-7 x 1-2 cm, oblong, pubescent without. Seeds 1-2, discoid.

Flowering & Fruiting: October-February

Habitat: Evergreen forests of high altitudes.

Note: The highly restricted distribution, significantly low population size and the increasing threats to its natural habitat (Chemunji in Agasthyamala hills) due to the expansion of plantation area and other anthropogenic pressures are factors that could adversely affect the survival of populations of this palaeoendemic species. The conservation status of this taxon has been designated as 'Critically endangered' in the IUCN Threatened Plant List of 2000.

Specimens examined: Thiruvananthapuram district: Agasthyamala, Karamanyar, *N. Mohanan 11154* (TBGT); Chemunji hills, ± 900 m, 4 Nov. 1994, *Shaju 16031* (TBGT).

13c. MIMOSOIDEAE

INGA Willd.

Introd. 298. (1777)

Inga cynometroides (Bedd.) Bedd. ex Baker in Hook. f., Fl. Brit. India 2: 306. 1876; Rama Rao, Fl. Pl. Travancore 155. 1914; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 3: 141. 1990; Gamble, Fl. Pres. Madras 435 (309). 1919; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 163. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 328. 2006. *Calliandra cynometroides* Bedd., Fl. Sylv. t. 317. 1873; Bourdillon, For. Trees Travancore 161. 1908.

Medium-sized trees with thorny branches. Leaves pinnate; leaflets 2, rigidly sub-coriaceous, obliquely oblong, sub-acute. Flowers in axillary, short- peduncled, solitary capitate heads. Calyx and corolla 3-lobed. Stamens numerous, monadelphous. Ovules many; style filiform; stgma capitate. Pods sessile, linear, straight or falcate, compressed, glabrous, sutures thickened, apex with a prominent hook. Seeds 3-6, rhomboid, brown, shining.

Flowering & Fruiting: Throughout.

Habitat: Stream-sides in evergreen forests.

Note: This highly restricted palaeoendemic species was first collected by Beddome in 1870 from Rosemala, Kollam district. The details of the type collction has not been includes due to non availability of the type specimen, except for a brief description and illustration provided in the Icon. After the type collection it has not been collected and is placed under 'indeterminate' category (Nayar & Sastry, 1990) and later to 'Possibly extinct' category by Nayar (1997). After a lapse of 100 years, Sasidharan rediscovered this species from the type locality. He identified 100 mature trees in an area of less than 1 sq. km. It is of phytogeographical and biological interests which deserves more studies emphasised on conservation aspects.

Specimen examined: Kollam district: Shendurny, Rosemala, *Sasidharan 10003* (KFRI).

14. MYRTACEAE

Table 34. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
130-150	5650	*c.* 11	136	24 spp., 3 var.

Kerala

Genus/genera	Species/subsp./var.
4	46 spp., 1 ssp., 2 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Eugenia L.	*E. calacadensis* Bedd.	*E. argentea* Bedd.(Tamil Nadu)
	E. floccosa Bedd. (Tamil Nadu)	
	E. indica (Wight) Chithra (Tamil Nadu)	
	E. rottleriana Wight & Arn. (Tamil Nadu)	
	E. singampattiana Bedd. (Tamil Nadu)	
Meteoromyrtus Reichb.	*M. wynaadensis* (Bedd.) Gamble (Tamil Nadu)	
Syzygium Gaertner	*S. beddomei* (Duthie) Chithra (Tamil Nadu)	*S. bourdillonii* (Gamble) Rathakr.
	S. gambleanum Rathakr. & Chithra (Tamil Nadu)	*S. palghatense* Gamble
		S. periyarensis Jomy & Sasidh

Fig. 32. ***Humboldtia unijuga*** var. ***trijuga*** Joseph & V. Chandras.: A. Habit; B. Flower.

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	S. malabaricum (Bedd.) Gamble (Karnataka & Tamil Nadu)	
	S. mundagam (Bourd.) Chithra Karnataka & Tamil Nadu)	
	S. myhendrae (Bedd. ex Brandis) Gamble (Karnataka & Tamil Nadu)	
	S. occidentale (Bourd.) Gandhi (Karnataka & Tamil Nadu)	
	S. parameswaranii M. Mohanan & Henry (Tamil Nadu)	
	S. ramavarmae (Bourd.) Chithra (Tamil Nadu)	
	S. stocksii (Duthie) Gamble (Maharashtra & Karnataka)	
	S. travancoricum Gamble (Tamil Nadu)	

Key to the genera

1. Calyx tube produced beyoned the ovary..... **Syzygium**
1. Calyx tube not produced beyond the ovary..... **Eugenia**

EUGENIA Linnaeus

Sp. Pl. 470. 1753.

Eugenia argentea Bedd., Fl. Sylv. Anal. Genp. 109. 1872; Hook. f., Fl. Brit. India 2: 503. 1879; Brandis, Ind. Tr. 325. 1906; Gamble, Fl. Pres. Madras 484 (342).1919; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 106. 1987; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 1: 205. 1990; Ramesh & Pascal, Atls. End. Western Ghats 208. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 173. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 445. 2006.

Type: 'Wynad, Thambracherry ghat', *Beddome s.n. Acc. No. K000518029* (K).

(Plate 30 a-c)

Shrubs or small trees. Leaves 10-12 x 3-4 cm, short petioled, elliptic lanceolate, long-acuminate, rounded at base, silvery pubescent beneath. Flowers solitary, axillary; pedicels 2-2.5 cm long, pubescent; bracteoles filiform, exceeding the calyx lobes, silvery pubescent.

Plate 29. a & b. ***Humboldtia sanjappae*** Sasidh.: Paratype & Isotype specimens at CALI; c & d. ***Humboldtia unijuga*** var. ***trijuga*** Joseph & V. Chandras.: c. Flowering twig; d. Fruiting twig.

Fruit globose, shortly appressed pubescent.

Flowering & Fruiting:

Habitat: Evergreen forests.

Note: This species was known only from type collection until few populations were identified recently from type locality and adjacent areas. As a local endemic species, it is found that narrowly distributed significantly small populations occur in the reported areas. It is therefore necessary to identify more areas of its occurrence towards planning further conservation activities. The conservation status of this palaeoendemic and phytogeographically interesting species has been designated as ' Possibly extinct ' by Nayar (1997).

Specimens examined: Wayanad District: 'Wynad, Thambracherry ghat', *Beddome s.n. Acc. No. K000518029* (K); *Ibid., Beddome s.n. Acc. No. 20851* (MH); *Ibid.*, Periya, Way to Banasura Hills, 1200 m, 28 Jan. 2009, *Shareef & Shaju 669306* (TBGT).

SYZYGIUM J. Gaertner

Fruct. 1 : 166. 1788 *nom. cons.*

Key to the species

1. Leaves cordate to round at base ..... 3. *S. periyarensis*
1. Leaves attenuate at base
   2. Calyx campanulate, 0.5-0.6 cm long ..... 1. *S. bourdillonii*
   2. Calyx tube funnel-shaped, 0.8-1.2 cm long ..... 2. *S. palghatense*

1. **Syzygium bourdillonii** (Gamble) Rathakr. & N. C. Nair, J. Econ. Taxon. Bot. 4: 287, 1983; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 107. 1987; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 1: 211. 1990; M. Mohanan & A. N. Henry, Fl. Thiruvananthapuram187. 1994; N. Mohanan, J. Econ. Taxon. Bot. 20: 729. 1996; Sasidh., Biod. Doc. Kerala, Part 6, Flr. Pl. 175. 2004; T. S. Nayar *et al.*, Flr. Pl. of Kerala - A Handb. 448. 2006. *Jambosa bourdillonii* Gamble, Kew Bull. 1918: 239. 1918.

Type: Thiruvananthapuram district: 'Merchiston, Travancore', 2000 ft., 2 Apr.1895, *Bourdillon 596* (MH). (Plate 31 a)

Small trees, 10-20 m high. Leaves 8-15 x 2-4 cm, elliptic-lanceolate, accuminate at apex; nerves 6-10 pairs, distant. Cymes few-flowered, terminal. Peduncles 0.8-1.2 cm long. Pedicels 0.3-0.4 cm long, stout. Flowers 1.5-2 cm across. Calyx campanulate, 0.5-0.6 cm long, 4-lobbed; lobes 0.2-0.3 x 0.4-0.5 cm, broadly orbicular. Petals 4, white, 0.6-0.8 x 0.5-0.6 cm, orbicular ovate. Stamens many. Ovary 2-celled; ovules many in each cell; style 1-1.3 cm long; stigma subulate.

Plate 30. a - c. ***Eugenia argentea*** Bedd.: a. Habit; Inset: Fruiting twig; b. Type specimen at Kew; c. Type specimen at MH.

Flowering & Fruiting: December-March.

Habitat: Riverine evergreen forests.

Note: This species is known only from the type collection made by Bourdillion in 1895. After the type collection, it has not been collected and is placed under ' Endangered or Possibly extinct' category (Nayar & Sastry, 1987). But this species is recollected by N. Mohanan from Agasthymala, during his floristic studies. This forms recollection after a century. The consevation status of this palaeoendemic speceis has been designated as 'Endangered' in the IUCN Threatened Plant List of 2008.

Specimens examined: Thiruvananthapuram district, 'Merchiston, Travancore', 2000 ft., 2 Apr. 1895, *Bourdillon 596* (MH); *Ibid.,* Agasthyamala, Attayar, ± 700 m, 3 Apr.1989, *N. Mohanan 5537* (TBGT).

2. **Syzygium palghatense** Gamble, Kew Bull. 1918: 240. 1918 & Fl. Pres. Madras 480. 1919; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 108. 1987; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 1: 216. 1990; Sujanapal & Sasidh., Rheedea 12: 189. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 178. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 452. 2006.

Type: Palakkad district: Palghat hills, *Beddome 245* (K). (Plate 31 c)

Trees, to 15 m tall. Leaves opposite or sub-opposite, 3.5-8 x 2-3.5 cm, obovate, abruptly obtusely acuminate at apex, cuneate at base, coriaceous, prominently glandular, nerves distant. Flowers in lax terminal and axillary cymes, 2-3 cm long. Calyx tube funnel-shaped, 0.8-1.2 cm long. Petals creamy white, c. 0.25 cm across, calyptrate. Berry 1-1. 3 x 0. 4-0. 5 cm, obconic, with a hollow depression at apex, crowned by persistant calyx, prominently ribbed on drying.

Flowering & Fruiting: January-June.

Habitat: Evergreen forests.

Note: Gamble described *Syzygium plaghatense* based on Bourdillon's collection from Palghat hills during 1860's. After the type collection, it has not been collected and recorded as 'Possibly extinct' category (Nayar & Sastry, 1987; Nayar, 1997). But this species is relocated by Sujanapal and Sasidharan after a lapse of 140 years from its type locality. This forms a collection after more than a century. The consevation status of this palaeoendemic specis has been designated as 'Critically endangered' in the IUCN Threatened Plant List of 2008.

Specimens examined: Palakkad district: Parambikulam Wildlife Sanctuary, 1200 m, 27 May 2000, *Sujanapal 30361* (KFRI); Silent Valley, Poochipara, 23 Mar. 2003, *Shaju 4479* (TBGT).

3. **Syzygium periyarensis** Jomy & Sasidh., Rheedea 9: 155. 1999; Sasidh., Biodiver. Doc. for

Kerala, Part 6, Flr. Pl. 179. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 452. 2006.

Type: Idukki district: Periyar Wildlife Sanctuary, ± 1500 m, 14 Apr. 1994, *Jomy 13570* (CALI). (Plate31 b)

Trees, to 15 m high. Leaves opposite, 11-15 x 7-9 cm, obovate or broadly elliptic, obtusely acute, acumen 0.5 cm long, base acute or obtuse, coriaceous; nerves 7-14 pairs. Cymes corymbose, few-flowered, 5-8 cm across, terminal. Pedicel 0.45 cm long. Calyx tube 1.2 x 1.2 cm, tube above the ovary, lobes 4, c. 0.6 x 1.2 cm, broadly ovate, obtuse. Petals 4, c. 1.3 cm across, white, orbicular. Stamens numerous. Ovary conical; ovules many.

Flowering & Fruiting: March-April.

Habitat: Reverine forests.

Note: This species can be distinguished from its allied species *S. firmum* Thw., by its larger flowers, flat leaf-margins and faint intramarginal nerves. As an endemic tree species with restricted distribution it deserves more conservational and biological studies.

Specimen examined: Idukki district: Periyar Wildlife Sanctuary, Sunderamala, ± 1500 m, 14 Apr. 1994, *Jomy 13570* (Isotype, CALI).

15. MELASTOMATACEAE

Table 35. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
200	4500	*c.* 12	81	29 spp., 11 var.

Kerala	
Genus/genera	Species/subsp./var.
6	64 spp., 6 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Medinilla Gaud.	*M. malabarica* Bedd. (Tamil Nadu)	*M. anamalaiana* Sasidh. & Sujanapal
Memecylon L.	*M. flavescens* Gamble (Tamil Nadu)	*M. agastyamalaianum* Santhosh Kumar *et al.*
	M. heyneanum Benth. ex Wight & Arn. (Maharashtra, Karnataka & Tamil Nadu)	*M. sivadasanii* N. Mohanan *et al.*
	M. lawsonii Gamble (Maharashtra & Tamil Nadu)	*M. wightianum* Triana
	M. molestum (C. B. Clarke)	

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Plate 31. a. ***Syzygium bourdillonii*** (Gamble) Rathakr. *et al.*: a. Herbarium specimen at TBGT; b. ***Syzygium periyarensis*** Jomy & Sasidh.: Type specimen at KFRI; c. ***Syzygium palghatense*** Gamble: Habit.

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	Cogn. (Tamil Nadu)	
	M. talbotianum Brandis (Maharashtra, Karnataka & Tamil Nadu)	
	M. terminale Dalz. (Karnataka)	
Osbeckia L.	*O. aspera* var. *travancorica* (Bedd. ex Gamble) Hansen (Tamil Nadu)	*O. abrahamii* G. S. Giri & Nayar
	O. lawsonii Gamble (Tamil Nadu)	
	O. lineolata var. *anamalayana* G. S. Giri & Nayar (Tamil Nadu)	
	O. mebrana G. S. Giri & Nayar (Tamil Nadu)	
Sonerila Roxb.	*S. devicolamensis* Nayar (Tamil Nadu)	*S. barnesii* C. E. C. Fischer
	S. elegans Wight var. *elegans* (Tamil Nadu)	*S. cannanorensis* G. S. Giri & Nayar
	S. gamblei G. S. Giri & Nayar (Tamil Nadu)	*S. elegans* var. *beddomei* G. S. Giri & Nayar
	S. sadasivanii Nayar (Tamil Nadu)	*S. nemakadensis* C. E. C. Fischer
	S. sahyadrica G. S. Giri & Nayar (Karnataka)	*S. wynaadensis* Nayar
	S. versicolor Wight var. *versicolor* (Karnataka & Tamil Nadu)	
	S. versicolor var. *axillaris* (Wight) Gamble (Karnataka & Tamil Nadu)	
	S. wallichii Bannett (Maharashtra, Karnataka & Tamil Nadu)	

Key to the genera

1. Epiphytic subshrubs..... **Medinilla**
1. Terrestrial herbs, subshrubs or shrubs.
    2. Leaves penninerved; anthers longitudinally dehiscent; ovary 1-celled ..... **Memecylon**
    2. Leaves 3-7-nerved; anthers dehiscent by apical pore; ovary 4-5-celled.
        3. Inflorescence scorpioid; flowers 3-merous..... **Sonerila**
        3. Inflorescence fascicled; flowers 4-5-merous..... **Osbeckia**

MEDINILLA Gaudichaud ex De Candolle

In Freycinet, Voyage Monde Uranie Physicinne Bot. 484. 1830 ("1826").

Medinilla anamalaiana Sasidh. & Sujanapal, Sida 20: 109. 2002; Sasidh., Biod. Doc. for Kerala. Part 6, Flr. Pl. 180. 2004; Sasidh. & Sujanapal, Rheedea 15: 105. 2005; T. S. Nayar *et al.*, Flr. Pl. of Kerala – A Handb. 410. 2006.

Type: Palakkad district: Parambikulam Wildlife Sanctuary, 1200 m, 1 May 1999, *Sujanapal 19431* (KFRI). (Plate 32 a & b)

Epiphytic subshrubs; young shoots reddish brown; stem fleshy, acutely quadrangular or subquadrangular, smooth. Leaves elliptic-oblong, 7-12 x 3-5 cm, membraneous, margin entire, apex obtusely acuminate, base subcordate, 3-ribbed. Flowers 2-5 on a reduced cyme from leafless nodes. Peduncle 0.1-0.3 cm long. Pedicel 0.2-0.4 cm long, brown, terete. Bracteoles minute, filiform. Petals obliquely obovate, 0.4-0.6 x 0.4 cm, minutely apiculate, rose-pink, 4-6-veined. Stamens 8. Hypanthium campanulate, subquadrangular, c. 0.3 cm across, shortly narrowed at mouth with 8 minute teeth. Ovary obovid, 4-celled, connected to hypanthium with 8 membraneous appendages; style short; stigma minutely capitate, papillate. Berries urceolate, c. 0.4 cm across, crowned by a small hypanthial limb. Seeds many, ovoid, smooth.

Flowering & Fruiting: January-June.

Habitat: Evergreen forests of high altitude.

Note: During the present study collections of this species were from the forests of Kulamavu in Idukki district and Thekkuthodu in Konni range of Pathanamthitta district and these are indications of further extended distributional range of the species within these districts.

So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimens examined: Palakkad district: Parambikulam Wildlife Sanctuary, 1200 m, 1

May 1999, *Sujanapal 19431* (Isotype, KFRI); Pathanamthitta district: Goodrical Range, Moozhiyar, 500 m, 23 May 1984, *Sasidharan 3142* (KFRI); *Ibid.*, Konni, Thekkuthodu, 12 Jan. 2009, *Shaju 68215* (TBGT); Idukki district: Periyar Tiger Reserve, Vallakkadavu, 900 m, 3 Jun. 1995, *Jomy Augustine & K. P. Rajesh 15429* (KFRI); *Ibid.*, Kulamavu, 700 m, 16 May 2008, *Shaju 59490* (TBGT).

MEMECYLON Linnaeus

Sp. Pl. 349. 1753.

Key to the species

1. Leaves petioled, linear lanceolate ..... 2. *M. sivadasanii*
1. Leaves sessile or sub-sessile, elliptic.
   2. Flowers fascicled on peduncled tubercles ..... 3. *M. wightianum*
   2. Flowers in umbellate cymes ..... 1. *M. agastyamalaianum*

1. **Memecylon agastyamalaianum** Santhosh Kumar, Raju & Shanavas, Bot. Bull. Acad. Sin. 44: 175. 2003; T.S. Nayar *et al.*, Flr. Pl. of Kerala - A Handb. 410. 2006.

Type: Thiruvananthapuram district: Agasthyamala, Bonaccord, 850 m, 8 Jul. 1999, *Santhosh Kumar 37656* (TBGT). (Fig. 33; Plate 32 c)

Large shrubs or small trees, 2-3.5 m tall. Branchlets acutely 4-angular. Leaves opposite, 1.5-2.5 x 0.5-1 cm, elliptic, cuneate at base, margins entire, obtuse or imarginate at apex; foliar sclereids filiform. Inflorescence axillary, 2-5-flowered umbellate cymes. Peduncle c. 0.5 cm long. Pedicels 0.4-0.5 cm long. Bracts triangular. Calyx pink, campanulate, 0.18-0.22 cm across. shallowly 4-lobed, papillate on the outer surface. Petals 4, c. 0.2 x 0.22 cm, blue, broadly elliptic-ovate, shortly clawed at base, acute or apiculate at apex. Disc shallowly striate. Stamens 8, equal. Ovary unilocular; ovules 4-5. Fruit globose, 0.7-0.8 cm diam., crowned by calyx. Seed 1.

Flowering & Fruiting: June - September.

Habitat: Evergreen forests.

Note: Very few fragmented populations of this narrow endemic species are surviving in certain pockets of the areas. As it is confined to small locality, it warrants more exploration surveys to assign its distribution status for conservation management.

Specimens examined: Thiruvananthapuram district: Agasthyamala, Bonaccord, 850 m, 8 Jul. 1999, *Santhosh Kumar 37656* (Holotype, TBGT); Agasthyamala, Chemunji, ± 1000 m, 23 Oct. 2006, *Shaju 62781* (TBGT).

2. **Memecylon sivadasanii** N. Mohanan, Ravi, Kiran Raj & Shaju, Nord. J. Bot. 21: 493. 2001;

N. Mohanan & Sivad., Fl. Agasthyamala 274. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 182. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 412. 2006.

Type: Thiruvananthapuram district: Agasthyamala, near Boanccord, ± 900 m, 17 Mar. 1993, *N. Mohanan 11313* (TBGT). (Fig. 34; Plate 33 a-c)

Large shrubs or small trees, 1-2.5 m tall; main stem usually single, erect, branching at three fourth the height from the ground; branchlets slender, slightly 4-angled. Leaves opposite, narrowly linear-lanceolate, 6-10 x 0.6 cm, cuneate at base, tapering into a curved caudate-acuminate at apex, recurved on margins; foliar sclereids branched. Inflorescence many-flowered, branched umbels, clustered on tubercles on the main stem, mostly towards basal portion; primary axes 0.1-0.3 cm long, branched into 0.1-0.2 cm long secondary axes or even to tertiary axes; bracts scaly at ramifications; pedicels 0.2-0.35 cm long. Calyx companulate, 0.2-0.25 cm long, lobes 4, broadly triangular, acute to subacute at tip. Petals 4, blue, c. 0.1 x 0.2 cm, broadly rounded, clawed, reflexed. Stamens 8. Ovary 1-celled; ovules 4-6. 0.7-0.8 cm diam., Fruit with persistent calyx tube. Seed 1.

Flowering & Fruiting: January -April

Habitat: Evergreen forests

Note: This species is discovered during the study. Limited populations of this narrow endemic species were observed in this area. Conservation measures should be taken for the survival of this local endemic species, as it is distributed in the threatened habitat.

Specimens examined: Thiruvananthapuram district: Agasthyamala, Kurusumala, near Boanccord, ± 900 m, 17 Mar. 1993, *N. Mohanan 11313* (Holotype, TBGT); *Ibid.*, 1 Feb. 2000, *Shaju & Kiran Raj 41940* (TBGT).

3. **Memecylon wightianum** Triana, Trans. Linn. Soc. London 28: 158. 1871; Ansari & V. J. Nair, J. Econ. Taxon. Bot. 11: 205. 1987; M. Mohanan & A. N. Henry, Fl. Thiruvananthapuram 195. 1994; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 171. 2006; *M. deccanense* Clarke in Hook. f., Fl. Brit. India 2: 560. 1879; Gamble, Fl. Pres. Madras 505 (356). 1919; M. Mohanan & A. N. Henry, Bull. Bot. Surv. India 22: 105. 1980; Subramanian, Fl. Thenmala 138. 1995; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 181. 2004. (Plate 34)

Woody shrubs to small slender trees, up to 3 m high, branchlets subterete. Leaves sub sessile or shortly petioled, oblong-lanceolate or elliptic-oblong, c. 12 x 4.5 cm, acute at apex, rounded or cordate at base. Flowers blue, short pedicelled, fascicled in lateral or axillary tubercles. Pedicels slender, c. 0.25 cm long. Calyx cupular, lobes obscure, pink. Petals blue, c. 0.1 cm long, ovate. Style subulate. Berry globose.

Flowering & Fruiting: April - November.

Habitat: Semi-evergreen forests

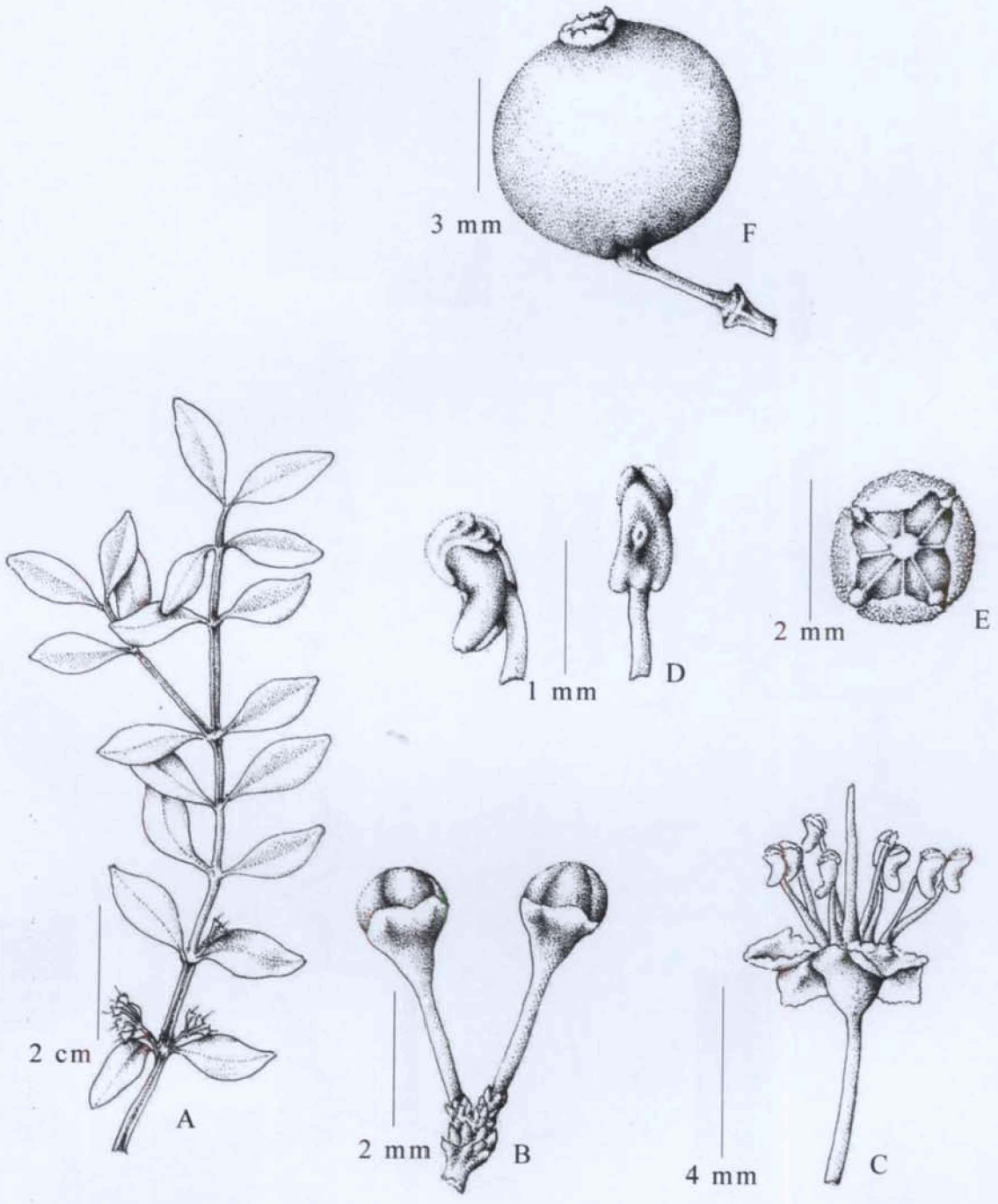

Fig. 33. ***Memecylon agastyamalaianum*** Santhosh Kumar *et al.*: A. Branchlet with flowers; B. Flower buds; C. Single flower; D. Stamens; E. Calyx view form top; F. Fruit.

Note: This species is represented only by type located in the Kew Herbarium (Acc. No. K000357774). Mohanan (1980) relocated this species from Anchunazhigathode, on the way to Agasthyarkudam during his floristic studies. Efforts should be made to find out the still surviving populations from the reported areas to ascertain the conservation status of this narrow endemic species.

Specimen examined: Thiruvananthapuram district: Agasthyarkudam, Anchunazhigathode, *Mohanan 66078* (MH).

OSBECKIA Linnaeus

Sp. Pl. 345. 1753.

Osbeckia abrahamii G. S. Giri & M. P. Nayar, J. Bombay Nat. Hist. Soc. 81: 434. 1984; Samaddar & Roy, Add. Ele. Ind. Fl. 1: 312. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 182. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 414. 2006.

Type: Travancore, *Narayanaswami 1379* (CAL). (Plate33 d)

Erect unbranched herbs, c.1 m tall. Stem terete, thick, covered with short rigid hairs. Leaves simple, opposite, 4.5-6.5 x 1.5-2.5 cm, elliptic or elliptic-lanceolate, base acute, apex shortly acuminate, margin entire, main nerves 3 arising from the base, both surfaces covered by short, stiff appressed hairs. Petioles 0.5-1.2 cm long, appressed hairy. Inflorescence axillary or terminal, few-flowered short panicle. Bracts orbicular, hairy. Flowers bisexual, 5-merous, sessile or short-pedicelled. Calyx tube broadly urceolate, 5-7 x 3.5-5 cm, densely covered with flat, stellate hairs, brownish, lobes 5, truncate, unequally two-lobed at apex. Petals 5, 1.6-2 x 1.2-1.4 cm, obovate, ciliate at margins, pink or purple in colour. Stamens 10, equal, filaments glabrous, anthers twisted, beaked, dehiscence by apical pore. Ovary adnate to the calyx-tube, densely covered with brownish appressed hairs; style glabrous, curved; stigma punctate. Capsules broadly urceolate, 0.7-0.9 cm long. Seeds small, muricate.

Flowering & Fruiting: August-December.

Habitat: Evergreen forests at higher altitude.

Note: Orbicular bracts and densely clothed calyx tube with stellate hairs are the distinguishing characters.

G. S. Giri and M. P. Nayar also reported to have examined the specimens of this narrow endemic species collected from two districts other than the type locality (Palakkad District: Silent Valley, 875 m, 11 Oct. 1965; *Vajravelu 26161*; Thrissur district: Thumbermuzhi, 75 m, 12 Sep. 1976, *Ramamurthy 48476*). Owing to the narrow endemic nature, the species warrants critical evaluation to obtain conservation status.

Specimen examined: Travancore, *Narayanaswami 1379* (CAL)

Plate 32. a & b. ***Medinilla anamalaiana*** Sasidh. & Sujanapal: Habit; Inset: Flower buds; b.Type specimen at KFRI; c. ***Memecylon agastyamalaianum*** Santhosh Kumar *et al.*: Flowering twig.

SONERILA Roxburgh

Fl. Indica 1: 180. 1820 nom. cons.

Key to the species

1. Stem up to 15 cm tall; seeds smooth.
   2. Scorpioid cymes ..... 5. *S. waynaadensis*
   2. Umbels or subumbelled cymes ..... 4. *S. nemakadensis*
1. Stem up to 30 cm; seeds muricate.
   3. Capsule 3-ribbed ..... 3. *S. elegans* var. *beddomei*
   3. Capsule 6-ribbed.
      4. Flowers deep pink-coloured ..... 1. *S. barnesii*
      4. Flowers rose-coloured ..... 2. *S. cannanorensis*

1. **Sonerila barnesii** C. E. C. Fischer, Kew Bull. 8: 32.1938; Ahmedullah & M. P. Nayar, End. Pl. Ind, Reg. 111. 1987; T. S. Nayar *et al.*, Flr. Pl. of Kerala – A Handb. 416. 2006.

Type: Tinnevelli Hills (Travancore), near Nadugani, *E. Barnes 1400* (K).

Erect herbs. Stem up to 24 cm tall, terete at the base, quadrangular and channelled in opposite sides above, rooting near the base. Leaves thinly membranous, 3-7 x 1.8-3.7 cm, ovate, acute or obtuse, base rounded or subcordate, margins finely serrate with the teeth pointing forward, becoming ciliate at the base, scattered bristles on the upper surface, basal ribs 2. Petioles slender, 1-5 cm long, red. Peduncles 1.2-3 cm long. Cymes 4-11- flowered. Pedicels 0.3-0.5 cm long. Calyx tube narrowly funnel-shaped, 0.6 cm long, 6-ribbed with few glandular hairs, lobes ovate, acute, reddish green. Petals broadly ovate, apiculate, 1-ribbed, 0.75-0.85 x 0.5-0.6 cm, very deep-pink, a little deeper in shade on the back. Stamens 3; filaments glabrous; anthers bluntly acuminate. Style slender. Capsules narrowly turbinate, 6-ribbed, 0.7-0.8 cm long, pale brown. Seeds minute, muricate on the rounded apex.

Flowering & Fruiting: November-December.

Habitat: Streamsides, lithophytes.

Note: E. Barnes described this species based on his collections (Coll. No. 1400 – K). This species is known only from its type locality 'Tinnevelli Hills (Travancore)', near Nadugani, 4000 ft. and it has not been recollected and reported afterwards from the same locality or elsewhere, although the area is well explored. This species might have declined in number or possibly become extinct due to deforestation for cultivation. Nayar (1997) reported this species under the category of 'Rare'. With the available literature, a brief account of description is provided.

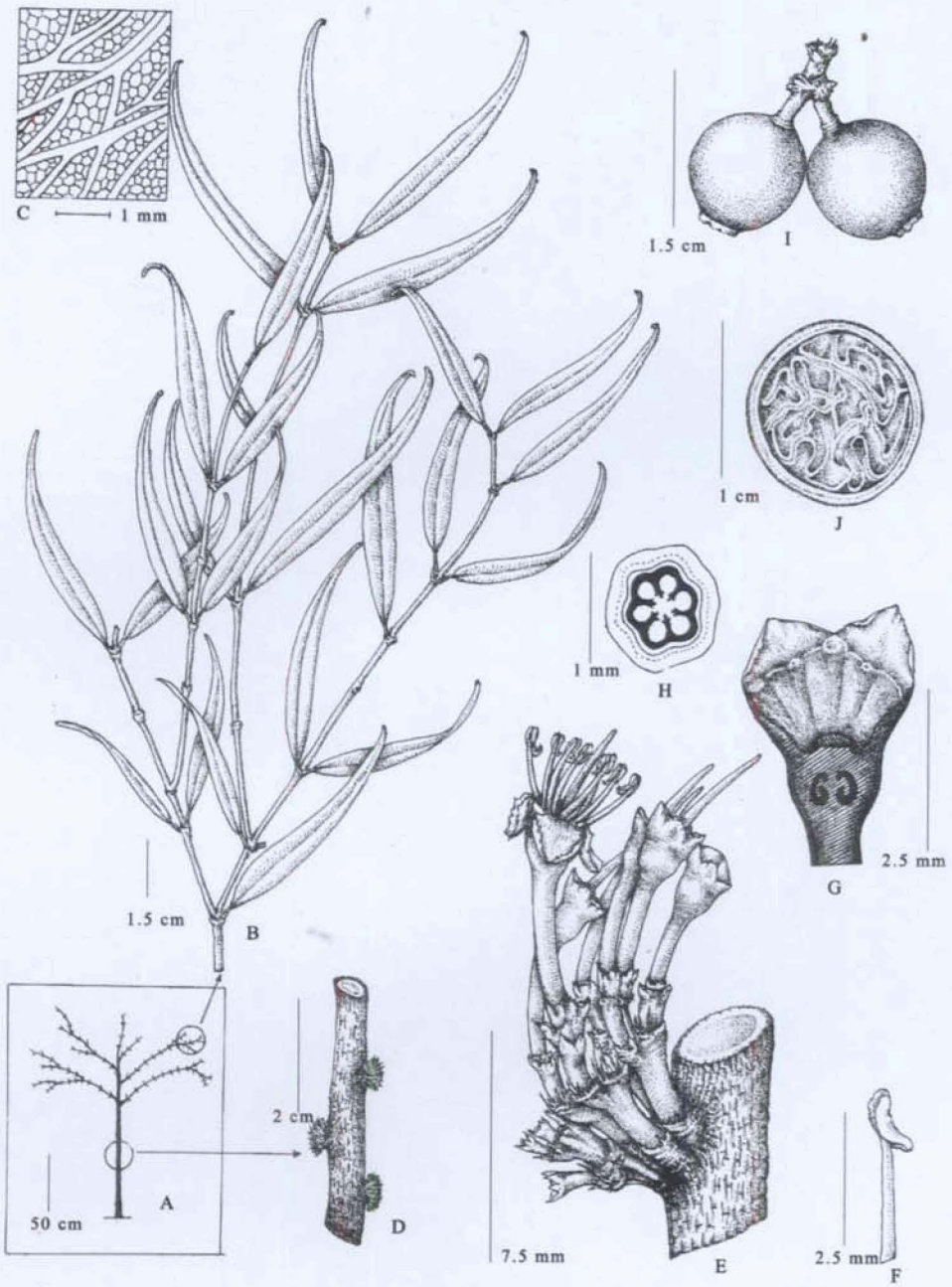

Fig. 34. ***Memecylon sivadasanii*** N. Mohanan *et al.*: A. Habit - schematic representation; B. Branchlet; C. Protion of cleared leaf showing foliar sclereids; D. Portion of main stem showing inflorescence; E. Inflorescence - single cluster enlarged; F. Single stamen; G. L. S. of ovary; H. C. S. of Ovary; I. Fruits; J. C. S. of Fruit showing foliaceous cotyledon.

Plate 34. ***Memecylon wightianum*** Triana: Type specimen at Kew

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2. **Sonerila cannanorensis** G. S. Giri & M. P. Nayar, Bull. Bot. Surv. India 27: 86. 1985; Ramach. & V. J. Nair, Fl. Cannanore 189. 1988; Samaddar & Roy, Add. Ele. Ind. Fl. 1: 396. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6. Flr. Pl. 185. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 416. 2006.

Type: Kannur district: Chandanathode, ± 825 m, 18 Dec. 1979, *Ramachandran 65288* (MH). (Plate 33 e)

Small herbs, 6-30 cm tall. Stem and branches quadrangular, reddish, glabrous, rooting from the upper part of the woody base forming stilting habit. Leaves opposite, decussate, 2-4 x 1-1.5 cm, base distantly unequal, oblique, apex shortly acuminate, margin sharply serrate, scattered whitish hairs on the upper surface. Petioles 1-1.5 cm long, glabrous. Inflorescence axillary or terminal scorpioid raceme, 4-10-flowered. Peduncle 1-1.25 cm long, glabrous, Bracts reddish, minute. Flowers 3-merous, purple, 1-2.5 cm long, glabrous. Pedicels indistinct. Calyx tube urceolate, 0.4-0.5 cm long, lobes broadly triangular. Petals obovate, 0.6-0.8 x 0.3-0.4 cm, midrib dorsally with scattered hairs. Stamens 3; anthers broadly ovate, apex acute. Ovary glabrous; style slender; stigma capitate, papillose. Capsule 0.4-0.5 cm long, indistinctly 6-ribbed. Seeds many.

Flowering & Fruiting: November-December.

Habitat: Evergreen forests.

Note: As a narrow endemic species, it warrants critical evaluation to obtain conservation status.

Specimen examined: Kannur district: Chandanathode, ± 825 m, 18th Dec. 1979, *Ramachandran 65288* (Isotype, MH).

3. **Sonerila elegans** var. **beddomei** G. S. Giri & M. P. Nayar, Bull. Bot. Surv. India 27: 72. 1985; Samaddar & Roy, Add. Ele. Ind. Fl.1: 396. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 185. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 417. 2006.

Type: Palghat hills, Kerala, *Beddome s. n.* (CAL).

Erect herbs, rarely decumbent, base woody, branches subquadrangular. Leaves opposite, 6-9 x 3.5-4.5 cm, ovate to ovate-lanceolate, base rounded to subcordate, apex acute, glabrous, 2-3 pairs of nerves arising from the base of the lamina. Petioles 2-5 cm long, glabrous. Inflorescence branched or unbranched scorpioid cymes. Primary peduncles 6-8 cm long, glabrous; secondary peduncles 0.5-2 cm long. Bracts small ovate-acute. Flowers 4-10. Pedicels 4-6 cm long. Calyx tube glabrous, 0.7-0.9 x 0.35-0.4 cm, urn-shaped, faintly ridged, lobes triangular or ovate. Petals ovate-orbicular, 1.3-1.5 x 1-1.2 cm, purple, midrib prominent, apiculate or mucronate. Stamens 3; filaments filiform, glabrous, anthers oblong. Style slender; stigma capitate. Capsules turbinate, 1-1.2 cm long, glabrous, 3-ribbed. Seeds many, muricate.

Flowering & Fruiting: November-April.

Plate 33. a - c. ***Memecylon sivadasanii*** N. Mohanan *et al.:* a. Leafy twig; b. A portion of main stem showing cauliflory; c. Type specimen at TBGT; d. ***Osbeckia abrahamii*** G. S. Giri & M. P. Nayar: Type specimen at CAL; e. ***Sonerila cannanorensis*** G. S. Giri & M. P. Nayar: Type specimen at CAL.

Habitat: Grasslands of higher altitude.

Note: A narrow endemic variety differs from the var. *elegans* by its glabrous peduncles, calyx tubes and capsules. The variety is named after its collector R. H. Beddome who first noted these distinguishing characeters. Thus the specimen collected by Beddome from Palghat hills in 1878 was designated as Holotype and the collection of Fischer (Karimalai shola, South Malabar, 5000' (1520 m), 21.1.1910, *C. E. C Fischer 1646*) other than holotype is deposited in CAL. Nayar (1997) documented it as 'Rare' category species.

Specimen examined: Palakkad district: Poovancholai, 29 Apr. 1980, *V. J. Nair 67348* (MH).

4. **Sonerila nemakadensis** C. E. C. Fischer, Kew Bull. 1935: 157. 1935; Gamble, Fl. Pres. Madras 1874. 1936; A. N. Henry *et. al.*, J. Bombay Nat. Hist. Soc. 75: 688. 1987; Ahmedullah & M. P.Nayar, End. Pl. Ind, Reg. 111. 1987; Sasidh., Biodiver. Doc. Kerala, Part 6. Flr. Pl. 186. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 417. 2006.

Type: Idukki district, Naimakad Gap, *E. Barnes 103* (CAL).

Herbs, 10-13 cm tall, glabrous. Stem succulent, once branched. Leaves ovate to ovate lanceolate, base rounded, 2.5-5.5 x 1.2-3 cm, 5-ribbed from base, margins deeply serrate, minutely pubescent on both surfaces. Petioles 3-4 cm long, channelled. Flowers in terminal umbels or sub-umbelled short scorpioid, 5-7-flowered racemes. Peduncle 2-5 cm long. Bracts minute, setaceous. Pedicels 0.4-0.6 cm long. Calyx narrowly funnel-shaped or urceolate, 0.7-1 cm long, lobes ovate, acute. Petals orbicular, 1.6-2.3 cm long, minutely apiculate, shortly clawed, pinkish purple. Stamens 3; filaments slender; anthers attenuate, curved. Style inclined; stigma capitate. Capsules turbinate, 0.6-0.8 cm long. Seeds oblong or narrowly obovate.

Flowering & Fruiting: November-April.

Habitat: Evergreen forests.

Note: Not located after its type collection made by *E. Barnes*. Possibly it might have become extinct due to massive deforestation. Ahmedullah & Nayar (1987) included this species in the list of 'Rare & Threatened' category.

Specimen examined: Idukki district: Naimakad Gap, *E. Barnes 103* (CAL).

5. **Sonerila waynaadensis** M. P. Nayar, J. Ind. Bot. Soc. 48: 321.1969; A. N. Henry *et. al.*, J. Bombay Nat. Hist. Soc. 75: 684. 1978; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 187. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 419. 2006.

Type: Wayanad district, *R. H. Beddome s.n., Acc. No. 21466* (MH).

Erect herbs, 10-15 cm tall. Stem robust, glabrous, covered with leaf scars. Leaves opposite, ovate-suborbiculate, 3-4.5 x 3-3.5 cm wide, base cordate, apex obtuse or subrotundate, margin serrate, upper surface punctuate and glabrous, membraneous, 7-9-

nerved. Petiole 3-4.5 cm long, glabrous. Inflorescence axillary or terminal, glabrous. Peduncle 5-6 cm long, stout, glabrous. Flowesr in scorpioid cymes. Pedicel 0.5-0.8 cm long. Capsule obconic, 0.6-0.7 cm long, glabrous. Seeds cuneate, smooth.

Flowering & Fruiting: Not known.

Habitat: Grasslands.

Note: A distinct species having erect stem, non-radical leaves, longer capsule and smooth seeds. But this species is known only by the type specimen collected by R.H. Beddome. Subsequent workers could not recollect even after intensive exploratory surveys in the area.

So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimen examined: Wayanad district, *R. H. Beddome* s.n., *Acc. No. 21466* (MH).

16. LYTHRACEAE

Table 36. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
32	500-600	8	59	5 spp.

Kerala

Genus/genera	Species/subsp./var.
6	25 spp., 1 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Rotala L.	*R. malampuzhensis* R. V. Nair ex C. D. K. Cook (Maharashtra & Karnataka)	*R. cookii* Joseph & Sivar. Joseph & Sivar. *R. malabarica* Pradeep, *R. vasudevanii* Joseph & Sivar.

ROTALA Linnaeus

Mant. Pl. 143, 175. 1771.

Key to the species

1. Leaves monomorphic ..... 3. *R. vasudevanii*
1. Leaves dimorphic.
   2. Flowers 4-merous ..... 1. *R. cookii*
   2. Flowers 5-merous ..... 2. *R. malabarica*

1. **Rotala cookii** Joseph & Sivar., Pl. Syst. Evol. 159. 1988; Joseph, Obser. Aquat. Ang. Malabar 108. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 188. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 393. 2006.

Type: Malappuram district: Parappanangadi, Sea level, 10 Dec. 1983, *K. T. Joseph 38967*(MH).

Aquatic annuals, submerged. Stem up to 40 cm long, creeping and rooting below. Leaves in whorls of 7-10, dimorphic, submerged leaves capillary, reflexed, c. 0.15 cm long; aerial leaves broader, spreading, linear, 0.5-0.6 cm long, bimucronate at apex, narrowed towards base. Bracts leaf-like. Bracteoles linear. Flowers on submerged shoot, cleistogamous, normal on emergent branches, 2-4 in each node. Calyx tube companulate, c. 0.1 cm long, 4-lobed, deltate. Petals 4, 0.06-0.08 cm long, obovate-obtuse, white, alternating with calyx lobes. Stamens 4. Nector scales 4. Ovary globose; style simple, short, persistant on fruit; stigma capitate. Capsule globose, c. 0.12 cm across, opening by valves. Seeds 4-5, semi-ellipsoidal.

Flowering & Fruiting: July-October.

Habitat: Grows abundantly in flooded paddy fields during rainy season, associated with *Hydrilla, Limnopoa* and *Nymphoides.*

Note: Being a local endemic species, It is necessary to locate this species from type locality and adjacent areas and efforts should be made for *ex-situ* conservation.

Specimen examined: Malappuram district: Parappanangadi, Sea level, 10 Dec. 1983, *K. T. Joseph 38967* (Isotype, MH).

2. **Rotala malabarica** Pradeep, Joseph & Sivar. Bot. Bull. Acad. Sin. 31: 59. 1990; Joseph, Obser. Aquat. Ang. Malabar. 117. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 189. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 394. 2006.

Type: Kannur district: Aduthila, Payangadi, 1 July 1989, *Pradeep 435* (MH). (Plate 35 a)

Aquatic annual. Stemup to 50cm long. Leaves in whorls of 9-12 monomorphic, sessile, linear. Bracts leaf-like; bracteoles 2. Flowers towards branch tips,monomorphic sessile in the axils of bracts. Calyx tube companulate,triangular-acute, appendages absent. Petals 4, obovate, pink. Nector scales 4. Ovary globose; style simple; stigma capitate. Capsule subglobse, pening by 2 valves. Seeds 3-4, ellipsoid.

Flowering & Fruiting: July-September.

Habitat: On wet rock pockets and along the margin of shallow ponds.

Note: supposed to be a neoendemic species , further investigations are necessary to obtain a clear picture of conservation status.

Specimens examined: Kannur district, Aduthila, Payangadi, 1 July 1989, *Pradeep 435* (Holotype, MH); *Ibid. 5139* (Isotype, CALI).

3. **Rotala vasudevanii,** Joseph & Sivar., Proc. Ind. Acad. Sci. (Pl. Sci.) 99: 195. 1989; Vasudevan, J. Bombay Nat. Hist. Sco. 61: 718. 1964; Joseph, Obser. Aquat. Ang.

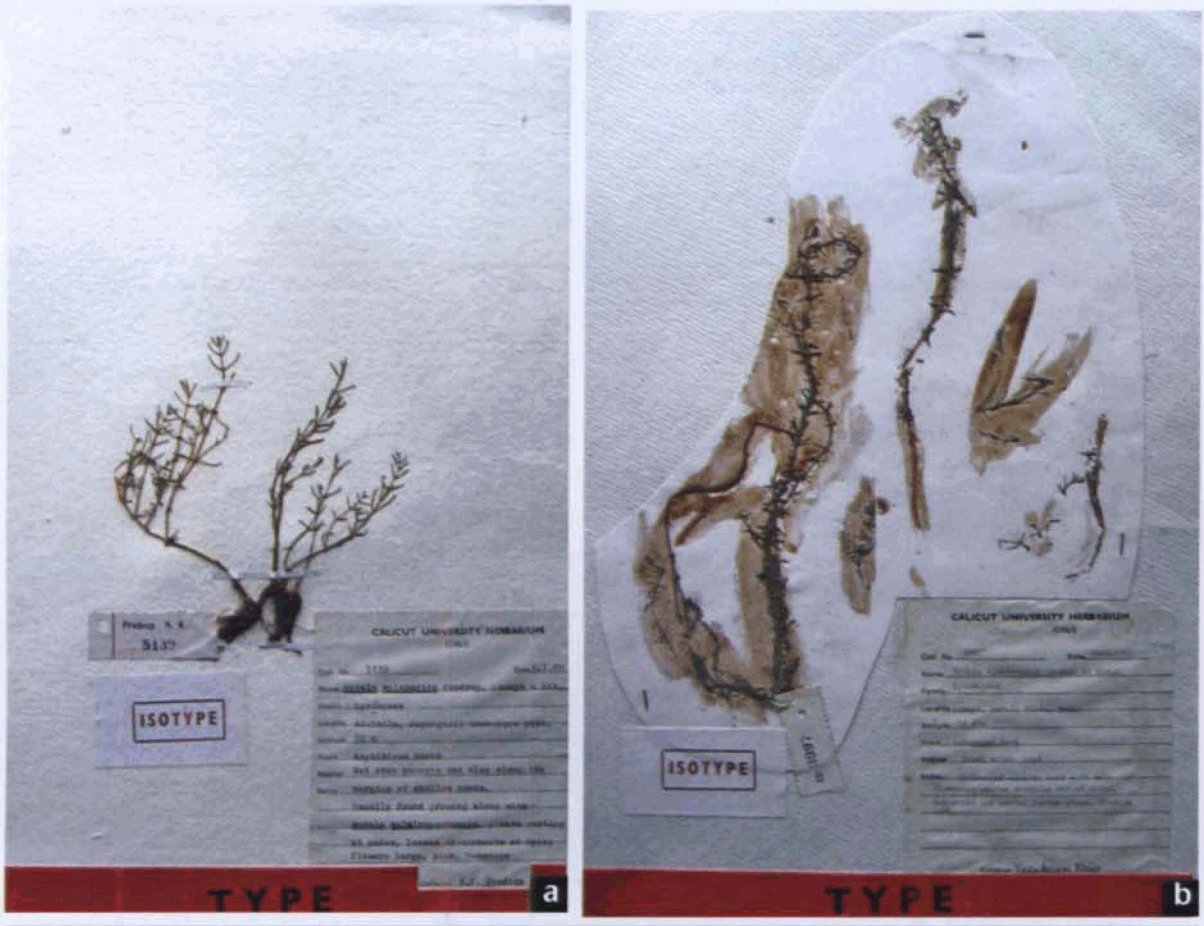

Plate 35. a. ***Rotala malabarica*** Pradeep, Joseph & Sivar.: Type specimen at CALI; b. ***Rotala vasudevanii*** Joseph & Sivar.: Type specimen at CALI.

Malabar. 125. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 390. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 395. 2006.

Type: Ernakulam district, Alwaye, 20 m, Sep. 1965, *Vasudevan Nair 3997* (Z). (Plate 35 b)

Aquatic annual. Stem up to 50cm long. Leaves in whorls of 9-12 monomorphic, sessile, linear. Bracts leaf-like; bracteoles 2. Flowers towards branch tips, monomorphic sessile in the axils of bracts. Calyx tube companulate, triangular-acute, appendages absent. Petals 4, obovate, pink. Stamens 4. Nector scales 4. Ovary globose; style simple; stigma capitate. Capsule subglobse, pening by 2 valves. Seeds 3-4, ellipsoid.

Flowering & Fruiting: August-October.

Habitat: Growing in fresh water ponds, associated with *Nymphaea* and *Hydrilla.*

Note: Preservation of this species in plant conservatories are very essential because of the higly vulnerable habitats of this narrow endemic species.

Specimen examined: Ernakulam district, Alwaye, 20 m, Sep. 1965, *Vasudevan Nair 3997* (Isotype, CALI).

17. CUCURBITACEAE

Table 37. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
125	960	37	*c.* 100	6 spp., 4 var.

Kerala

Genus/genera	Species/subsp./var.
20	34 spp., 7 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Cucumella Chiov.		*C. silentvalleyii* Manilal *et al.*
Cucurbita (Tourn.) L.		*C. maxima* var. *badagarensis* C. R. Mudaliar
Luffa Miller		*L. umbellata* (Klein) M. Roemer
Melothria L.	*M. ritchei* Chakrav. (Maharashtra)	
Zehneria Endl.	*Z. angulata* (Chakrav.) Ellis (Karnataka)	*Z. maysorensis* var. *oblonga* Prasad & Miniprasad

Key to the genera

1. Tendrils simple.

2. Large climbing herbs; very large solitary flowers..... **Cucurbita**

2. Slender climbing herbs; flowers small in clusters or racemes.

3. All stamens 2-celled, connectives and filaments ciliate ..... **Zehneria**

3. All stamens not 2-celled, connectives and filaments glabrous..... **Cucumella**

1. Tendrils branched..... **Luffa**

CUCURBITA Linnaeus

Sp. Pl. 1010. 1753 & Gen. Pl. ed. 5, 441. 1754.

Cucurbita maxima var. **badagarensis** C. R. Mudaliar, J. Bombay Nat. Hist. Soc. 49: 242. 1952; Sebastine, Bull. Bot. Surv. India 4: 221. 1962; T.S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 207. 2006. ***Vellari mathan.***

Type: 'Malabar, Badagara', 15 Mar. 1945, *Mudaliar 93177* (MH). (Plate 36 a)

Annual trailing herbs, 3-3.5 5 m long, stem cylindrical, slender, slightly prickly inthe younger parts, glabrous when mature. Leaves orbicular, c. 12 x 14 cm, indistinctly lobed, margin denticulate and slightly serrate near the base. Flowers medium seized, light yellow, monoecious. Pedicel 2-3 cm in male flowers and 5.5-7.5 cm in female flowers. Calyx tube short, lobes linear c. 0.6 cm. Corolla of pistillate floewer, tubular, c. 3 cm across; ovary long and linear or globose. Staminate flower, comparatively small, c. 2 cm across. Fruit long, or short and rounded, slightly ribbed, lemon yellow when tender, ripening to orange with stripes of light buff colour in the grooves. Seeds flat, smooth.

Note: Cucurbita maxima, is a common cultivated species in Malabar region, but the var. *badagarensis* differs in some characters like, the size, colour and shape of fruit, both when tender and ripe, the time of flowering and the maturity of the fruit. The variety is named after the place, Badagara (= Vadakara, now in Kozhikode District) where it is largely grown.

So far not figured in any of the IUCN category; as a horticulturally promising, narrow endemic variety, its distributional status should be analysed for further assignment of status and conservation efforts.

Specimen examined: 'Malabar, Badagara', *Mudaliar 93177 & 93178* (MH).

CUCUMELLA Chiovendra

Fl. Somala 1: 183. 1929

Cucumella silentvalleyii Manilal, T. Sabu & Philip Mathew, Acta. Bot. Ind. 13: 283. 1985; Manilal, Fl. Silent Valley 115. 1988; Anil Kumar *et al.*, Fl. Pathanamthitta 234, 2005;

Sasidh., & Sivar., Flr. Pl. Thrissur For. 199. 1996; Sivar. & Philip Mathew, Fl. Nilambur 287. 1997; Biju in Manoharan *et al.*, Silent Valley Whis. Reas. 172. 1999; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 194. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 207. 2006.

Type: Palakkad district: Silent Valley, Poochapara, ±1370 m, 20 Aug. 1982, *Sabu 10662* (CALI). (Plate 36 b)

Branched climbers. Stem angular, pilose. Leaves suborbicular, 3-5- angulated, base cordate, 4.5 x 5.5 cm, apex obtuse or acute. Petiole c. 6 cm long. Flowers monoecious. Male flowers in 5-7 axillary clusters. Petals yellow, glabrous. Anthers free with linear connectives which are produced into a prominent hood. Fruits oblong-fusiform with cuspidate apex, c. 2.5 x 1 cm, Seeds silky.

Flowering & Fruiting: September-March.

Habitat: Moist deciduous and semi-evergreen forests.

Note: This species can be easily identified by its male flowers having free anthers with narrow connectives produced in to a bulbous hood and oblong fusiform fruits.

After the type collection by Manilal *et al.*, from Silent Valley in 1985, it was reported from Pathanamthitta district (Anil Kumar *et al.*, 2005) and Thrissur district (Sasidh. & Sivar., 1996). As a wild relative of cultivated species, distribution and status of this exclusive endemic species should be studied.

Specimen examined: Palakkad district: Silent Valley, Poochapara, ±1370 m, 20 Aug. 1982, *Sabu 10662* (Isotype, CALI).

LUFFA Miller

Gard. Dict. Abridg. ed. 4. 1754.

Luffa umbellata (Klein) Roem. Syn. Monogr. 2: 63. 1846; Gamble, Fl. Pres. Madras 534 (377). 1919; *Cucurbita umbellata* Klein in Willd. Sp. Pl. 4: 608. 1805. Chakrav., Fasc. Fl. India 2: 75.1982; Sasidh., Biod. Doc. Kerala, Part 6, Flr. Pl. 196. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 209. 2006.

Type: Kerala, Mirittupadu, *Klein 769* (K).

Slender climbers. Stem elongate, sulcate, glabrous. Petioles 6-12 cm long, slender, glabrous or puberulous. Leaves 5-7-lobed, 3-5 cm long, orbicular or broadly ovate, margin shallowly dentate, base cordate, apex acuminate. Tendrils puberulous, bifid. Flowers white, monoecious, male and female on the same axil. Male flowers in racemes; peduncles 15-28 cm long; 4-10 flowered, usually slender, glabrous; petals 5; stamens 3, inserted near calyx tube. Female flowers solitary; ovary oblong; ovules many. Fruit small, densely long spinous, spines woolly. Seeds thinly verrucose.

Flowering & Fruiting: July-August

Habitat: Along bushes and hedges.

Note: As a wild relative of cultivated species, distribution and status of this exclusive endemic species should be studied. Ahmedullah and Nayar (1987) categorised the species as 'Rare and threatened'.

ZEHNERIA Endlicher

Prodr. Fl. Norfolk. 1: 69. 1833.

Zehneria maysorensis var. **oblonga** V. P. Prasad & Mini, J. Econ. Taxon. Bot. 17: 471. 1993; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 199. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 212. 2006.

Type: Idukki district: Lower camp to Kumily area, 26 Dec. 1974, *Vivekananthan 45710* (MH).

Climbing monoecious shrubs. Stem slender, glabrous. Leaves broadly ovate or subdeltoid, base subtruncate, margin denticulate, apex acuminate, apiculate, membranous, shallowly 3-angled, 1-8 x 6.5-6.8 cm, minutely and densely punctuate above. Petioles 2-3 cm long, glabrous or hispid, tendrils simple. Male flowers subumbellate, peduncle 2-4 cm long. Pedicel c. 0.2 cm long. Calyx tube companulate, c. 3.5 cm long, glabrous out side, hairy inside; lobes minute teeth-like.Corolla lobes obovate, c. 2.5 x 1.5 cm. Stamens 3. Female flowers solitary, axillary. Calyx and corolla as in male flowers. Ovary oblong; style and stigma spreading. Disc 3-lobed, staminodes 3. Fruit oblong, c. 1.7 x 1.1 cm, finely reticulate. Seeds smooth, flattened.

Flowering & Fruiting: December-February.

Habitat: Evergreen forests.

Note: As a horticulturally promising narrow endemic species, its distribution status should be analysed for further assignment of status and conservation efforts.

Specimen examined: Idukki: Lower camp to Kumily area, 26 Dec. 1974, *Vivekananthan 45710* (MH).

18. BEGONIACEAE

Table 38. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
2	1400	1	*c.* 45	3 spp.

Kerala	
Genus/genera	Species/subsp./var.
1	11 spp.

Plate 36. a. ***Cucurbita maxima*** var. ***badagarensis*** Mudaliar: Type specimen at MH; b. ***Cucumella silentvalleyii*** Manilal *et al.*: Type specimen at CALI.

149 820

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Begonia L.	*B. canarana* Miq. (Karnataka)	*B. malabarica* Lam.

BEGONIA Linnaeus

Sp. Pl. 1056. 1753.

Begonia malabarica Lam., Encycl. 1: 393. 1785; Clarke in Hook. f. Fl. Brit. India 2: 655. 1879; Gamble, Fl. Peres. Madras 546. 1919; Smith *et al.*, Smith. Contrib. Bot. 60: 196. 1986. *B. malabarica* var. *rheedii* A. DC., Prodr. 15. 1: 392. 1864.; Santhosh *et al.*, The Begonian, 72: 135. 2002. ***Parapuli.***

Type: ***Tsjeria-narinampuli*** Rheede, Hort. Mal. IX: 167, t. 86. 1689. (Plate 37)

Slender herbs, 20-40 cm high. Stem suberect, branched, cylindric, pilose. Leaves 4-11 x 1.5-6 cm, oblong, shortly asymmetric, the larger side cordate at base, the outer side rounded, shortly acuminate at apex, margin serulate and doubly irregularly crenate, 6-9-veined, upper surface dark green with white spots, sparsely pilose above, densely so along the nerves beneath; Petioles c. 2 cm long, densely pilose. Stipules 0.5-1 cm, ovate-lanceolate. Inflorescence 2-5-flowered cymes. Male flowers: pedicels to 1 cm long, breacteoles 2-3, ovate, pilose; tepals 2+2, creamy white, outer perianth suborbicular, cordate at base, glabrous within, pilose without; inner perianth oblong-ovate; stamens 30-50, shortly monadelphous. Female flowers: pedicels to 0.4 cm long; tepals 2+1, creamy-white, ovary pilose, 3-winged, wings sub-equal, ciliate; placenta simple ; ovules numerous; styles 3, free. Capsules 1-1.5 cm, winged, truncate at apex. Seeds ellipsoid.

Flowering & Fruiting: May-January.

Habitat: Rheophytic herb in semi-shaded habitats.

Note: A critical study on the identity of *Begonia malabarica* Lamk. by E. S. Sanathosh Kumar *et al.* (2002), revealed that Rheeds's *Tsjeria-naranampuli* is *B. malabarica* Lamk. This species is apparently endemic to Kerala state. As a species of taxonomic and ethnobotanic interest, it deserves conservation importance.

Specimens examined: Pathanamthitta District: Pampavalley, ± 200 m, 23 Sep. 2002, *Santhosh Kumar 45818* (TBGT); Sabarigiri hills, 1000 m, *Santhosh Kumar 45860* (TBGT).

19. ARALIACEAE

Table 39. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
47	1325	4	*c.* 60	5 spp., 3 var.

Kerala

Genus/genera	Species/subsp./var.
4	12 spp., 2 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Schefflera Forster & Forster f.	*S. bourdillonii* Gamble (Tamil Nadu) *S. capitata* (Wight & Arn.) Harms (Karnataka & Tamil Nadu) *S. rostrata* (Wight) Harm var.*rostrata*(Tamil Nadu) *S. rostrata* var. *micrantha* (C. B. Clarke) Maheshw. (Karnataka & Tamil Nadu) *S. venulosa* var. *obliquinervia* Gamble (Tamil Nadu)	*S. chandrasekharanii Ramam. & Rajan*

SCHEFFLERA J. R. Forster & J. G. A. Forster

Charact. Gen. Pl.: 23. 1776.

Schefflera chandrasekharanii Ramam. & Rajan, J. Bombay Nat. Hist. Soc. 79: 163. 1982; Ahmedullah & M. P. Nayar, End. Pl. Ind, Reg. 112. 1987; Shanavas & Santhosh Kumar, J. Econ. Taxon. Bot. 19. 543. 1995; Sasidh., Biod. Doc. Kerala, Part 6, Flr. Pl. 207 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 78. 2006.

Type: Idukki district, Munnar-Kumily road, ± 1800 m, 26 Mar. 1980, *Ramamuthy 66388* (MH). (Plate 38)

Small trees. Leaves alternate at the end of branchlets digitate 1-2- foliate; leaflets 5-10 x 3-4 cm, ovate coriaceous. Flowers bisexual in terminal umbellate panicles, up to 2 cm long. Calyx cup-shaped, not lobed, adnate to ovary. Petals 5, ovate acuminate; stamens 5, alternating with petal. Ovary inferior, 5-loculed.

Flowering & Fruiting: March-May.

Habitat: Evergreen forests.

Note: As a local endemic tree species of phytogeographical and biological importance, specific survey for its collection is required to ascertain its distribution status.

Specimens examined: Idukki district, Munnar-Kumily road, ± 1800 m, 26 Mar. 1980, *Ramamurthy 66388* (Isotype, MH); Neymakkadu, ± 1700 m, 17 Oct. 1992, *Shanavaskhan 7565* (TBGT).

Plate 37. ***Begonia malabarica*** Lam.: Habit; Inset: With flower.

NB 5995

20. RUBIACEAE

Table 40. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
611	13000	*c.* 76	*c.* 286	83 spp., 6 var.

Kerala

Genus/genera	Species/subsp./var.
47	231 spp., 1 ssp., 17 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Acranthera Arn. ex Meissner	*A. anamallica* Bedd. (Tamil Nadu)	
	A. grandiflora Bedd. (Tamil Nadu)	
Argostemma Wallich	*A. courtallense* Arn. (Goa, Karnataka & Tamil Nadu)	
Byrsophyllum Hook. f.	*B. tetrandrum* (Bedd.) Hook.f. ex Bedd.(Tamil Nadu)	
Canthium Lam.	*C. neilgherrense* Wight (Tamil Nadu)	
	C. travancoricum (Bedd.) Hook. f. (Tamil Nadu)	
Hedyotis L.	*H. albo-nervia* Bedd. (Tamil Nadu)	
	H. anamalayana (Gamble) R. Rao & Hemadri (Maharashtra & Tamil Nadu)	
	H. articularis R. Br. ex W. & Arn. (Karnataka & Tamil Nadu)	
	H. barberi (Gamble) A. N. Henry & Subram. (Tamil Nadu)	
	H. beddomei Hook f. (Tamil Nadu)	
	H. bourdillonii (Gamble) R. Rao & Hemadri (Tamil Nadu)	
	H. buxifolia Bedd. (Tamil Nadu)	
	H. devicolamensis Deb &Dutta (Tamil Nadu)	
	H. eualata A. N. Henry & Subram. (Tamil Nadu)	

Plate 38. ***Schefflera chadrasekharanii*** Ramam. & Rajan: Type specimen at MH.

NB 5495 152

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	H. eualata var. *agastyamalayana* A. N. Henry & Subram. (Tamil Nadu)	
	H. purpurascens var. *pallida* (Gamble) M. Mohanan (Tamil Nadu)	
	H. ramarowii (Gamble) R. Rao & Hemadri (Tamil Nadu)	
	H. stylosa R. Br. ex Wight & Arn. (Karnataka & Tamil Nadu)	
	H. travancorica Bedd. (Tamil Nadu)	
	H. villosostipulata (Gamble) R. Rao & Hemadri (Tamil Nadu)	
	H. viscida Bedd. (Tamil Nadu)	
	H. wynaadensis (Gamble) R. Rao & Hemadri (Tamil Nadu)	
Hymenodictyon Wallich	*H. obovatum* Wallich (Maharashtra, Karnataka & Tamil Nadu)	
Ixora L.	*I. beddomei* T. Hussain & S. R. Paul (Tamil Nadu)	*I. agasthyamalayana* Sivad. & N. Mohanan
	I. elongata Heyne ex G. Don (Maharashtra, Karnataka & Tamil Nadu)	*I. johnsoni* Hook. f.
	I. gamblei Ramach. & V. J. Nair (Karnataka & Tamil Nadu)	*I. sivarajiana* Pradeep
	I. lawsonii Gamble (Karnataka)	
	I. polyantha Wight (Maharashtra & Karnataka)	
Knoxia L.	*K. sumatrensis* var. *linearis* (Gamble) Bhattacharjee & Deb (Tamil Nadu)	
Lasianthus Jack	*L. acuminatus* Wight (Karnataka & Tamil Nadu)	
	L. blumeanus Wight (Tamil Nadu)	
	L. ciliatus Wight (Tamil Nadu)	
	L. cinereus Gamble (Tamil Nadu)	

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	L. coffeoides Fyson(Karnataka & Tamil Nadu)	
	L. dichotomus Wight (Tamil Nadu)	
	L. jackianus Wight (Tamil Nadu)	
	L. oblongifolius Bedd. (Tamil Nadu)	
	L. obovatus Bedd. (Tamil Nadu)	
	L. parvifolius Wight (Karnataka & Tamil Nadu)	
	L. strigillosus Hook. f. (Tamil Nadu)	
Morinda L.	*M. reticulata* Gamble (Tamil Nadu)	
Mycetia Reinw	*M. acuminata* (Wight) Kuntze (Karnataka & Tamil Nadu)	
Neanotis W. H. Lewis	*N. montholonii* (Hook. f.) W. H. Lewis (Maharashtra & Karnataka)	
Nostolachma T. Durand	*N. crassifolia* (Gamble) Deb & Lahiri (Tamil Nadu)	
Ochrenauclea Ridsd. & Bakh. f.	*O. missionis* (Wallich & G. Don) Risd. (Maharashtra & Karnataka)	
Octotropis Bedd.	*O. travancorica* Bedd. (Tamil Nadu)	
Ophiorrhiza L.	*O. eriantha* Wight (Tamil Nadu)	*O. barnesii* Fischer
		O. brunonis var. *johnsonii* Hook. f.
		O. caudata Fischer
		O. munnarensis Fischer
		O. nairii Ramam. & Rajan
		O. shendurunii Shanavas *et al.*
Pavetta L.	*P. calophylla* Bremek. (Tamil Nadu)	*P. bourdillonii* Sivad. & N. Mohanan
	P. praeterita Bremek. (Tamil Nadu)	
	P. siphonantha Dalz. (Maharashtra & Karnataka)	*P. nemoralis Bremek.*
		P. oblanceolata Bremek.
	P. wightii Hook. f. (Tamil Nadu)	*P. travancorica* Bremek.
Pleiocraterium Bremek.	*P. verticillare* (Wight & Arn.) Bremek. (Tamil Nadu)	
Psilanthus Hook. f.	*P. malabaricus* Sivar. *et al.*	
Psychotria L.	*P. anamallayana* Bedd. (Karnataka & Tamil Nadu)	*P. keralensis* Deb & Gangop.

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	P. globicephala Gamble (Tamil Nadu)	
	P. johnsonii Hook. f. (Tamil Nadu)	
	P. macrocarpa Hook f. (Tamil Nadu)	
	P. nigra var. *peninsularis* (Hook.f.) Deb & Gangop. (Karnataka & Tamil Nadu)	
	P. nilgiriensis Deb & Gangop. (Tamil Nadu)	
	P. nudiflora Wight & Arn. (Karnataka & Tamil Nadu)	
Saprosma Blume	*S. corymbosum* (Bedd.) Bedd. (Maharashtra, Karnataka & Tamil Nadu)	
	S. foetens (Wight) Schumann (Tamil Nadu)	
	S. fragrans (Bedd.) Bedd. (Tamil Nadu)	
Spermacoce L.	*S. malabarica* (Sivar. & Manilal) Sivar. *et al.*	
Tarenna Gaertner	*T. canarica* (Bedd.) Bremek. (Karnataka & Tamil Nadu)	*T. trichurensis* Sasidh. & Sivar.
	T. monosperma (Wight & Arn.) Raju (Tamil Nadu)	
	T. nilagirica (Bedd.) Beremek. (Karnataka & Tamil Nadu)	
Tricalysia A. Rich. ex DC.	*T. apiocarpa* (Dalz.) Gamble (Maharashtra, Karnataka & Tamil Nadu)	
	T. sphaerocarpa (Dalz.) Gamble (Maharashtra, Karnataka & Tamil Nadu)	

Key to the genera

1. Herbs, sometimes woody.
   2. Ovary 1-2(6)-celled; ovules many in each cell ..... **Ophiorrhiza**
   2. Ovary 2-celled; ovule 1 in each cell ..... **Spermacoce**
1. Trees or shrubs.

3. Ovule 1-per locule.

4. Flowers 4-merous.

5. Style much longer than corolla ..... **Pavetta**

5. Style equal to corolla ..... **Ixora**

4. Flowers 5-merous ..... **Psychotria**

3. Ovules many per locule.

6. Style glabrous ..... **Psilanthus**

6. Style hairy ..... **Tarenna**

IXORA Linnaeus

Sp. Pl. 110. 1753.

Key to the species

1. A pair of reduced leaves absent at the base of the peduncle.....
..... 2. *I. johnsoni*

1. A pair of reduced leaves present at the base of the peduncle.

2. Lateral nerves 12-15 pairs ..... 3. *I. sivarajiana*

2. Lateral nerves 18-20 pairs..... 1. *I. agasthyamalayana*

1. **Ixora agasthyamalayana** Sivad. & N. Mohanan, Bot. Bull. Acad. Sin. 32: 313. 1991; N. Mohanan & Sivad., Fl. Agasthyamala 322. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 218. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 519. 2006.

Type: Thiruvananthapuram district: Agasthyamala, Athirumala, ± 1000 m, 5 Feb. 1988, *N. Mohanan 8968* (TBGT). (Plate 39 a)

Small trees. Leaves 15-22 x 6-8 cm, elliptic-oblong, acute at apex, attenuate at base. Stipules ovate-lanceolate, laterally joined half way, densely hairy within. Corymbs long-peduncled; peduncles 10-15 cm long, branches and pedicels articulated at ramifications. Bracts and bracteoles triangular ovate. Flowers sessile and pedicelled. Calyx tube 0.15-0.2 cm long; lobes 0.05 cm long, triangular. Corolla tube 1.25-1.5 cm long; lobes 0.4-0.5 cm long, few silky hairy on lobes within. Style slender; stigma 2-lobed. Berry didymous, 0.8-1.2 cm diam. Seeds 2.

Flowering & Fruiting: August- Febuary

Habitat: Evergreen forests.

Note: A narrow endemic species known only from Agasthyamala hospot area. Its beautiful flowers are the attention for cultivation as an ornamental species. As a horticulturally promising narrow endemic species, its distribution status should be analysed for further assignment of status and conservation efforts.

Specimen examined: Thiruvananthapuram district: Agasthyamala, Athirumala, ± 1000 m, 5 Feb. 1988, *N. Mohanan 8968* (Isotype, TBGT).

2. **Ixora johnsoni** Hook. f., Fl. Birt. India 3: 139. 1880; Gamble, Fl. Pres. Madras 630 (444). 1921; Mathew Dan *et al.*, Rheedea 7: 73. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 219. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 520. 2006.

Type: Kerala: Wennamala, Cochin, *Johnson 1066* (K). (Plate 39 b & c)

Undershrubs. Leaves 9-22 x 4-13 cm, elliptic-obovate, acute-mucronate at apex, cuneate at base, greyish-white patches radiate from the mid rib. Stipules broadly triangular, laterally joined half way from base forming a tube, hairy on the inner surface. Inflorescence short-peduncled, sparsely puberulous; branchlets and pedicels articulated at ramifications. Bracts and bracteoles triangular ovate. Flowers sessile to shortly-pedicelled; pedicel 0.1-0.5 cm long. Calyx lobes 4, linear-triangular, acute at tip, 0.5-0.6 cm long, puberulous, reddish brown. Corolla white, tubular, slender, glabrous, 1.5-3 cm long; lobes 4, 0.5-0.9 cm long, oblong, naked at the throat. Stamens 4. Ovary 2-celled; style slender; stigma 2-lobed. Fruits a didymous berry, bright red when ripe, 0.5-0.6 cm in diam. Seeds 2.

Flowering & Fruiting: September-April.

Habitat: Evergreen and deciduous forests. Also found in sacred groves and plantations.

Note: A narrow endemic species occasionally distributed in central Kerala. Growing as perennial undershrub in rubber and teak plantations. Changes in the land-use pattern, habitat alterations and modernization of agricultural practices have resulted in an increased pressure on the environment and existing natural vegetaion, especially for the surviving population of this critically endangered species. The narrow distributional range and unprotected area of occurence have led this species to the verge of extinction. The consevation status of this speceis has been designated as 'Critically endangered' in the IUCN Threatened Plant List of 2008.

Specimens examined: Kottayam district, Mookenpetty, 4 Dec.1991, *Mathew Dan 13414* (TBGT); *Ibid.*, 10 Jan. 1993, *Santhosh Kumar 17051* (TBGT); Pathanamthitta district: Ulunkal, Moozhiyar, ± 600 m, 21 Feb.2008. *Shaju 66730* (TBGT).

3. **Ixora sivarajanii** Pradeep, Nordic J. Bot. 17. 315 1997; Sasidh., Biodiver. Doc. Kerala. Part 6. Flr. Pl. 220. 2004; T. S. Nayar *et al.*, Flr. Pl. of Kerala – A Handb. 521. 2006.

Type: Kozhikkode district: Vellarimala, ± 2240 m, 10 Apr. 1995, *Pradeep 5365* (CALI). (Plate 39 d & e)

Small trees. Leaves elliptic-oblong, c. 12 x 5 cm, obtuse, base acute to attenuate, glabrous, lateral nerves12-15 pairs. Inflorescence multiflorus, pendulus. Peduncles 2-4.5 cm long. Flowers caramine pink. Calyx lobes tube 0.1-0.15 cm long. Corolla tube 0.9-1.2 cm long, lobes 0.2-0.25 cm long, glabrous. Stamens attached at throat. Style slender; stigma 2-lobed. Berry

didymous, 0.4-0.5 cm diam. Seeds 2.

Flowering & Fruiting: April-May.

Habitat: Shola forests.

Note: A local endemic tree species having ornamental value. As a horticulturally promising species, distribution status of this exclusive endemic species should be studied.

Specimens examined: Kozhikkode district: Vellarimala, ± 2240 m, 10 Apr. 1995, *Pradeep 5365* (Isotype, CALI); Wayanad district: Pakshipathalam, Garudappara, 16 Feb. 1987, *Balakrishnan 42845* (Paratype, CALI).

OPHIORRHIZA Linnaeus

Sp.Pl. 150 1753.

Key to the species

1. Subshrubs.
   2. Bracts and bracteoles glabrous..... 6. *O. shendurunii*
   2. Bracts and bracteoles hairy..... 5. *O. nairii*
1. Herbs.
   3. Corlla tube puberulous outside..... 2. *O. brunonis* var. *johnsonii*
   3. Corolla tube glabrous outside.
      4. Calyx lobes triangular..... 4. *O. munnarensis*
      4. Calyx lobes ovate-lanceolate.
         5. Inflorescence terminal capitate cymes..... *O. caudata*
         5. InflorescenceAxillary, trichotomous corymbose cyme
            .....1. *O. barnesii*

1. **Ophiorrhiza barnesii** C. E. C. Fischer, Bull. Misc. Inform. 1939: 248. 1939; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 1: 331. 1990; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 226. 2004; T.,S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 530. 2006.

Type: 'Travancore High Range', Kallar Valley, Sep. 1937, *Barnes 1754* (K). (Plate 40 a)

Perennial herbs. Leaves 5-13 x 1-4 cm, ovate-lanceolate to lanceolate, caudate acuminate at apex, attenuate at base. Stipules subulate. Inflorescence axillary trichotomous corymbose cymes, 1-1.75 cm across, branchlets short, glabrous. Flowers 0.9-1.1 cm long, glabrous. Bracts and bracteoles similar, linear acuminate, glabrous. Calyx lobes ovate-lanceolate, acute, glabrous. Corolla infundibuliform, 0.8-1 cm long, glabrous outside, lobes 0.27-0.32 x 0.15-0.18 cm, ovate, acute, glabrous. Stamens 5, inserted. Ovary ovoid, 2-loculed, ovules many; style filiform; stigma 2-lobed. Capsule 0.15-0.3 x 0.45-0.8 cm, glabrous, locules ovate-oblong. Seeds

5-8-angular, glabrous.

Flowering & Fruiting:.September.

Habitat: Evergreen forests.

Note: This highly endmic species has not been seen after its orginal discovery in 1937. It might have been possibily become extinct due to massive deforestation. Nayar (1997) included this species in the list of 'Critically endangered' category.

Specimen examined: 'Travancore High Range', Kallar Valley, Sep. 1937, *Barnes 1754* (Holotype, K).

2. **Ophiorrhiza brunonis** var. **johnsonii** Hook. f., Fl. Brit. India 3: 80. 1880; Deb & Mondal, Bull. Bot. Surv. India 39: 34. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 226. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 530. 2006.

Type: Cochin, *Johnson s.n. Acc. No. 00031150* (K). (Plate 40 b)

Herbs, 10-25 cm tall. Stem puberulous. Leaves 8-14 x 3-5 cm, lanceolate, acuminate at apex, acute at base. Stipules subulate, entire, puberulous. Inflorescence terminal corymbose of helicoid cymes. Flowers 1.2-1.7 cm long. Bracts and bracteoles linear or filiform. Calyx lobes subulate. Corolla tube long, narrow, puberulous outside, villous within, lobes white, funnel-shaped, ribbed lobes 5. Stamens 5, inserted. Disc epigynous, glandular. Ovary 2-loculed, ovules many; style filiform; stigma 2-lobed. Capsule obovoid, compressed.

Flowering & Fruiting: Not known

Habitat: Shola forests.

Note: This narrowly distributed exclusive endemic variety has not been collected after its type collection; so it presumed to be 'extinct'. So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimen examined: Kerala: Cochin, *Johnson s. n. Acc. No. 00031150* (K).

3. **Ophiorrhiza caudata** C. E. C. Fischer, Bull. Misc. Inform. 1938: 125. 1938; Deb & Mondal, Bull. Bot. Surv. India 39: 34. 1997; Sasidh., Biodiver .Doc. Kerala, Part 6, Flr. Pl. 226. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 530. 2006.

Type: 'Travancore High Range', Kallar, *E. Barnes* 1560 (K).

Herbs, 38-78 cm tall. Leaves 5-12 x 1.5-3.5 cm, elliptic-lanceolate, caudate-acuminate at apex, acuminate at base. Stipules ovate-lanceolate. Inflorescence terminal capitate cymes. Bracts and bracteoles similar, ovate-lanceolate, oblique. Calyx lobes ovate-lanceolate, acute, slightly keeled at back, glabrous. Corolla infundibuliform, glabrous outside, lobes ovate, acute, glabrous outside, minutely papillose within. Stamens 5, inserted. Ovary obovoid; style slender, glabrous; stigma 2-lobed. Capsule glabrous.

Flowering & Fruiting: May.

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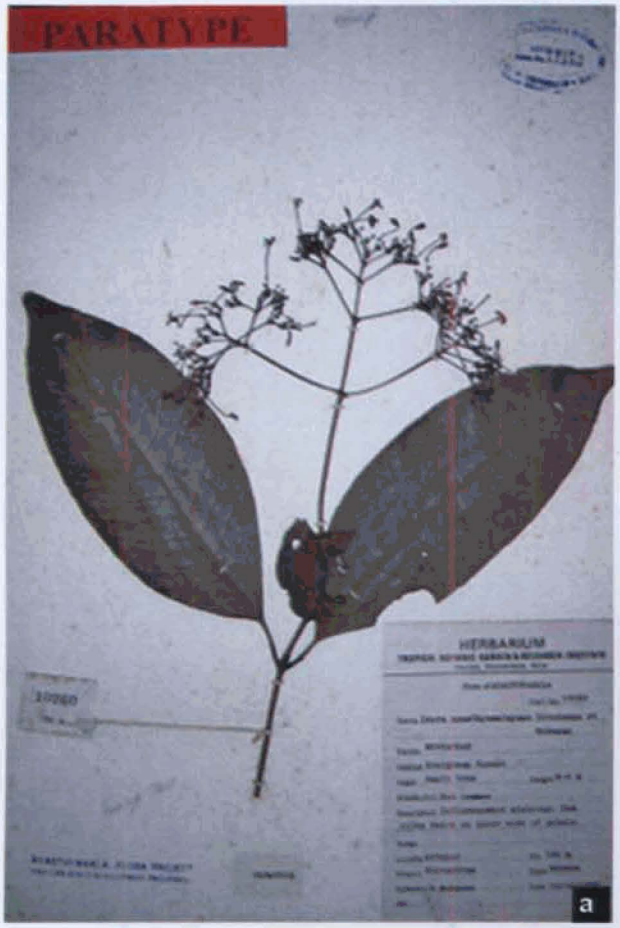

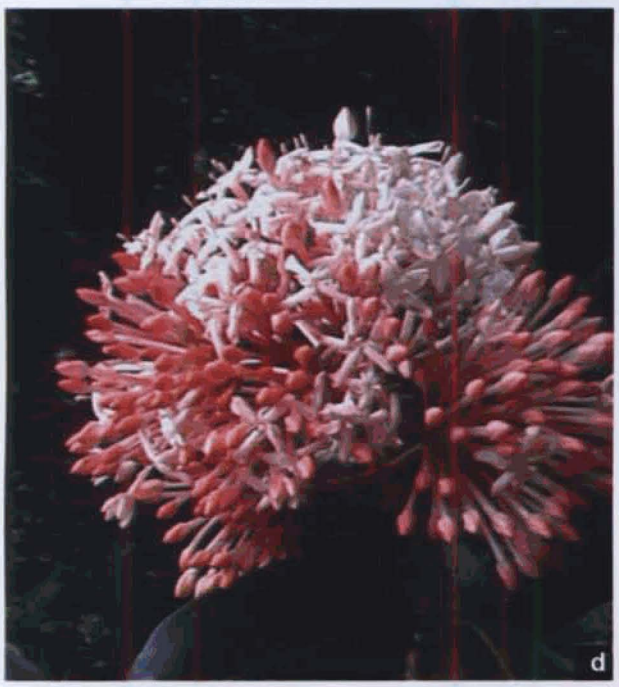

Plate 39. a. ***Ixora agasthyamalayana*** Sivad. & N. Mohanan: Type specimen at TBGT; b & c. ***Ixora johnsoni*** Hook. f.: Inflorescence; c. Infructescence; d & e. ***Ixora sivarajiana*** Pradeep: d. Inflorescence; e. Type specimen at CALI.

Habitat: Evergreen forests in high mountains.

Note: After the type collection in 1937, this very narrow endemic species has not been collected, and is placed under 'indeterminate category' (Nayar & Sastry, 1987) and later to 'Possibly extinct' category by Nayar (1997).

Specimen examined: 'Travancore High Range', Kallar, *E. Barnes* 1560 (K).

4. **Ophiorrhiza munnarensis** C. E. C. Fischer, Bull. Misc. Inform. 1938: 35. 1938; Deb & Mondal, Bull. Bot. Surv. India 39: 73. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 227. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 531. 2006.

Type: 'Travancore High Range', Munnar Ghat Road, Sep. 1935, *E. Barnes 2005* (K).

(Plate 40 c)

Herbs, 5-16 cm tall. Leaves 2.5-6.5 x 1-2 cm, lanceolate, acute to caudate acuminate at apex, shortly decurrent at base. Stipules ensiform. Inflorescence terminal capitate cymes. Bracts and bracteoles similar, linear-lanceolate. Calyx tube triangular, acute, glabrous. Corolla infundibuliform, glabrous outside with a villous ring at the middle of the corolla tube, lobes broadly ovate, acute, glabrous. Stamens 5, slightly exserted. Disc epigynous, glandular. Ovary 2-loculed, ovules many; style filiform; stigma 2-lobed. Capsule ovate-oblong. Seeds angular glabrous.

Flowering & Fruiting: September-December.

Habitat: Evergreen forests.

Note: This local endemic species has not been recollected although its reported area of occurence was well botanised. This species might have been lost due to habitat destruction. Nayar (1997) reported it as an 'Critically endangered' category species. The brief description provided is based on available literatue.

Specimen examined: 'Travancore High Range', Munnar Ghat Road, 1200-1500 m, Sep. 1935, *E. Barnes 2005* (K).

5. **Ophiorrhiza nairii** Ramam. & Rajan, J. Bombay Nat. Hist. Soc. 82: 174. 1985; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 227. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 531. 2006.

Type: Idukki district, Adimali Reserve Forests, ± 1800 m, 28 Mar. 1980, *Ramamurthy 66561* (MH). (Plate 40 d)

Undershrubs. Leaves 10-15 x 4-7 cm, elliptic-lanceolate, acuminate at apex, attenuate at base. Stipules linear, broad at base, bilobed. Inflorescence terminal corymb like, flowers in each peduncle with distinct helicoid arrangement. Bracts and bracteoles many, linear, subulate, hairy. Calyx tube terete, lobes lanceolate. Corolla funnel-shaped, ribbed, villous within, corlla tube lobed. Stamens 5, inserted. Ovary 2-loculed, ovules many; style filiform;

stigma 2-lobed. Fruits ovoid, pilose.

Flowering & Fruiting: March.

Habitat : Evergreen forests.

Note: So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimen examined: Idukki district, Adimali Reserve Forests, ± 1800 m, 28 Mar. 1980, *Ramamurthy 66561*(Isotype, MH).

6. **Ophiorrhiza shendurunii** Shanavas, Santhosh Kumar & Pushpangadan, J. Bombay Nat. Hist. Soc. 95: 317. 1998; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 228. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 532. 2006.

Type: Kollam district, Pandimotta, ± 1180 m, 27 Jan. 1995, *Santhosh Kumar 23271* (TBGT). (Plate 40 e & f)

Undershrubs. Leaves 8-12 x 3-5 cm, ovate to elliptic lanceolate, acuminate at apex, attenuate at base. Stipules linear. Inflorescence terminal corymbose of helicoid cymes. Bracts and bracteoles many, linear, glabrous. Calyx tube terete, pubescent, lobes 5, triangular. Corolla white, funnel- shaped, ribbed, lobes 5. Stamens 5, inserted. Disc epigynous, glandular. Ovary 2-loculed, ovules many; style filiform; stigma 2-lobed. Capsule obovoid, compressed.

Flowering & Fruiting: Throughout the year.

Habitat: Evergreen forests.

Note: A 'piont endemic' species so far known only from the type locality. So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimen examined: Kollam district, Pandimotta, ± 1180 m, 27 Jan. 1995, *Santhosh Kumar 23271* (Holotype, TBGT).

PAVETTA Linnaeus

Sp. Pl. 110. 1753

Key to the species

1. Inflorescence axillary.
   2. Small trees; leaves with 4-6 pairs of lateral nerves..... 1. *P. bourdillonii*
   2. Shrubs; leaves with 10-12 pairs of lateral nerves..... 4. *P. travancorica*
1. Inflorescence terminal.
   3. Calyx lobes keeled ..... 3. *P. oblanceolata*
   3. Calyx lobes not keeled ..... 2. *P. nemoralis*

Plate 40. a. ***Ophiorrhiza barnesii*** Fischer: Type specimen at Kew; b. ***Ophiorrhiza brunonis*** var. ***johnsonii*** Hook. f.: Type specimen at Kew; c. ***Ophiorrhiza munnarensis*** Fischer: Type specimen at Kew; d. ***Ophiorrhiza nairii*** Ramam. & Rajan: Type specimen at MH; e & f. ***Ophiorrhiza shendurunii*** Shanavas *et al.*: e. Type specimen at TBGT; f. flowering twig.

NB 5995

1. **Pavetta bourdillonii** Sivad. & N. Mohanan, Bot. Bull. Acad. Sin. 40: 61. 1999; N. Mohanan & Sivad., Fl. Agasthyamala 345. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 228. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 533. 2006.

Type: Thiruvananthapuram District: Agasthyamala Hills, Attayar, 700 m, 27 Jun 1994, *Mohanan 12442* (K). (Plate 41 a)

Small trees. Leaves 6-12 x 2-3.5 cm, elliptic-lanceolate, attenuate at both ends, acuminate at apex; nerves 4-6 pairs. Stipules interpetiolar, ovate, broader than long, villous within. Flowers white, in axillary 3-4-flowered cymes. Calyx lobes 4, 0.15-0.2 cm long, lanceolate. Corolla tube 1.5-2 cm long, villous on the inner side, lobes 4, 0.8-1 x 0.25-0.3 cm, ovate-lanceolate, acute at apex. Stamens 4, linear. Ovary crowned by annular disc; 2-celled; ovule 1 in each cell. Berry 1-2, 0.3-0.4 x 0.2-0.25 cm, ovoid, smooth. Seeds 1-2.

Flowering & Fruiting: June-August

Habitat: Evergreen forests

Note: A palaeoendemic tree species known only from the type locality. Owing to its comparatively recent discovery, the species has not been figured in any of the IUCN category. However, in consideration of its narrow distribution, the species assumes conservation significance.

Specimens examined: Thiruvananthapuram district, Agasthyamala Hills, Attayar, 700 m, 27 Jun 1994, *Mohanan 12442* (Isotype, TBGT); *Ibid.*, 14 May 1985, *Mohanan 966* (TBGT); *Ibid.*, 19 May 1991, *Mohanan 10821* (TBGT).

2. **Pavetta nemoralis** Bremek., Repert. Spec. Nov. Regni Veg. 37: 94. 1934; Fl. Pres. Madras 1878 (1300). 1936; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 164. 1987; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 229. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 534. 2006.

Type: Kerala, Kavalay, *Meebold 12228* (B).

Undershrubs. Leaves petiolate or subsessile, 4.5-16 x 1.6-6.5 cm, narrowly obovate, acuminate at apex, acute at base, coriaceous, glabrous, lateral nerves 8-9 pairs. Stipules persistent, triangular. Inflorescence terminal, sessile, trichotomously branched corymbose cymes on slender axillary branches. Bracts cuspidate, membranous. Flowers white. Calyx lobes 4, broadly triangular, acute at apex, puberulous out side, glabrous within. Corolla tube 1.5-2 cm long, villous on the inner side, lobes 4, ovate-lanceolate, acute at apex. Stamens 4, linear. Ovary crowned by annular disc; 2-celled; ovule 4, 1 in each cell. Fruits not seen.

Flowering & Fruiting: Not known.

Habitat: Evergreen forests.

Note: This species is represented by type collection only. After the type collection by A. Meebold in 1910, the plant has not yet been collected later. Therefore Nayar (1997) documented it as a 'Possibly extinct' category species. The brief decription is based on

available literature.

Specimen examined: Kerala, Kavalay, *Meebold 12228* (Isotype, CAL).

3. **Pavetta oblanceolata** Bremek., Repert. Spec. Nov. Regni Veg. 37: 91. 1934; Gamble, Fl. Peres. Madras 1878 (1300). 1936; Ahmedullah & M. P. Nayar, End. PI. Ind. Reg. 164. 1987; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl 229. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 535. 2006.

Type: Kerala, Attraymallay, *R. H. Beddome 3920* (BM). (Plate 41 b)

Small trees. Leaves 11-25.5 x 1.8-4.5 cm, oblanceolate, acute or acuminate at apex, attenuate at base, membranous, glabrous, lateral nerves 9-14 pair. Petioles 1-4 cm long, slender, glabrous. Stipules persistent, triangular at base, subulate above, subcoriaceous. Inflorescence terminal, sessile, trichotomously branched corymbose cymes on slender axillary branches. Bracts triangular, cuspidate, membranous. Flowers white. Calyx tube broader above, lobes 4, narrowly triangular, acute at apex, glabrous. Corolla tube 1.5-2 cm long, villous on the inner side, lobes 4, 0.8-0.9 x 0.3 cm, ovate-lanceolate, acute at apex. Stamens 4, linear. Ovary 2-loculed with 1 pendulous ovule in each cell. Disc annular. Style stout, puberulous; stigma slightly 2-lobed. Fruits not seen.

Flowering & Fruiting: April.

Habitat: Evergreen forests.

Note: Earlier known only from the type collections made by R. H. Beddome in 1847 from 'Attraymallay'. Recently, a herbarium specimen of this 'Critically endangered' (Nayar,1997) species has been studied from the Tropical Botanic Garden and Research Institute herbarium (TBGT), collected by Shanavavas and Santhosh Kumar from Valiyaparathodu, Silent Valley, Palakkad district. A photograph of the specimen is included.

Specimen examined: Palakkad district, Silent Valley, Valiyaparathodu, 9 Feb. 1991, *Shanavas 13021* (TBGT).

4. **Pavetta travancorica** Bremek., Repert. Spec. Nov. Regni Veg. 37: 113. 1934; Gamble, Fl. Peres. Madras 1877(1299). 1931; Ahmedullah & M. P. Nayar, End. PI. Ind. Reg. 164. 1987; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 230 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 535. 2006.

Type: 'Travancore', *Wight 1485* (K).

Small trees. Leaves 6-12 x 2-3.5 cm, elliptic-lanceolate, attenuate at both ends, acuminate at apex; nerves 4-6 pairs. Flowers white, in axillary 3-4 flowered cymes. Calyx lobes 4, lanceolate. Corolla tube 1.5-2 cm long, villous on the inner side, lobes 4, ovate-lanceolate, acute at apex. Stamens 4, linear. Ovary crowned by annular disc; 2-celled; ovule4 1 in each cell. Berry 1-2, ovoid, smooth.

Flowering & Fruiting: Not known.

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Habitat: Evergreen forests.

Note: This species is known only from the type specimen collected by Wight in 1835. The population of this species might have been declined or possibly become extinct due to deforestation. Nayar (1997) reported this species under the 'Possibly extinct' category. With the available literature a brief account of description is attempted.

PSILANTHUS J. D. Hooker

in Bentham & Hooker, Gen. Pl. 2: 23, 115. 1873, *nom. cons.*

Psilanthus malabaricus Sivar., Biju & Philip Mathew, Bot. Bull. Acad. Sin. 33: 219. 1992; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 230. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 536. 2006.

Type: 'Malabar', *Wight 1431* (K).

Shrubs. Leaves apparently bifarious, membranous, glabrous, drying black, narrowly elliptic to oblanceolate, 5-9 x 2-3 cm, acute or subacute at apex, cuneate or attenuate at base. Petioles 0.5-0.8 cm, glabrous. Stipules truncate, shortly aristate at apex. Flowers white, solitary or occationally 2-3. Bracts two pairs, almost similar, glabrous. Bracteoles linear- lanceolate. Calyx 0.15-0.2 cm long, cup-shaped, 5-lobed. Corolla slightly pubescent out side, tube cylindric, 2-5 cm long, lobes 5, ovate or oblong, acute, 1-1.3 x 0.3-0.4 cm, Stamens 5. Style glabrous; stigma bifid. Fruit not seen.

Flowering & Fruiting: Not reported

Habitat : Evergreen forests.

Note: This species was recognised based on century old collection of Wight from Malabar, but the specific location of collection was not cited. Therefore the known distributional areas need to be thoroughly explored to asses conservation status of this rare species. From the allied *Psilanthus travencorensis* (Wt. & Arn.) Leroy, this species can be distinguished by its membranous, apparently bifarious leaves and 1-3-flowered inflorescence at the tips of branches and also in every axil. With the available literature a brief account of description is attempted.

PSYCHOTRIA Linnaeus

Syst. Nat. ed. 10, 929, 1364. 1759

Psychotria keralensis Deb & M. Gangop., Bull. Bot. Surv. India 25: 213.1983 (1985); J. Econ. Taxon. Bot. Addl. ser. 7, 48. 1989; V. S. Ramach. & V. J. Nair, Fl. Cannanore 232. 1988; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 232. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 537. 2006.

Type: Kannur district, Chandanathode, *J. L. Ellis 26357* (MH). (Plate 41 c)

Shrubs. Leaves 15-19 x 4.5-6 cm, elliptic-oblong or obovte, acuminate at apex, cuneate at base. Stipules caducous, ferruginous, villous at the stipular scars. Inflorescence terminal peduncled panicles of cymose heads. Bracts deciduous; bracteoles ovate-lanceolate, acute or acuminate. Calyx persistent, lobes 5, obovate, obtuse, glabrous. Disc shallow, groved towards the apex. Fruit minutely stalked, ellipsoid ovoid.

Flowering & Fruiting: November-December.

Habitat: Evergreen forests.

Note: This species is botanically interesting due to its narrow distribution. It is necessary to locate this species from type locality and adjacent areas and efforts should be made for conservation.

Specimen examined: Kannur district, Chandanathode, ± 800 m, 1 Nov. 1965, *J.L.Ellis 26357* (Holotype, MH).

SPERMACOCE Linnaeus
Sp. Pl. 102. 1753

Spermacoce malabarica (Sivar. & Manilal) Sivar., R.V. Nair & Ahmed Kunju, Proc. Ind. Acad. Sci. (Pl. Sci.) 97: 355. 1987; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 235. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 542. 2006. *Borreria malabarica* Sivar. & Manilal, Bull. Bot. Soc. Uni. Sagar 19: 31. 1972; Manilal & Sivar., Fl. Calicut 136. 1982.

Type: Kannur district: Kottampara, 12 Aug. 1970, *Sivarajan 374* (CALI). (Plate 41 d & e)

Erect, branched hispid herbs; Stem 4-angled. Leaves linear-lanceolate, c. 3 x 0.3 cm, margin strongly revolute. Flowers pink in axillary few-flowered clusters. Calyx pubescent, lobes ovate-acuminate, c. 0.1 cm long, Corolla funnel-like. Capsule hispid.

Flowering & Fruiting: August-December.

Habitat: On grassy slopes of lateritic hills.

Note: As a local endemic species, it is found that narrowly distributed significantly small populations occur in the reported areas. It is therefore necessary to identify more areas of its occurrence towards planning further conservation activities.

Specimens examined: Kannur district: Kottampara, 12 August 1970, *Sivarajan 374* (Holotype, CALI); Kozikode district: Atholi, Elitottimala, *Shaju* 43217 (TBGT).

TARENNA J. Gaertner
Fruct. 1: 139. 1788

Tarenna trichurensis Sasidh. & Sivar., J. Econ. Taxon. Bot. 243: 1990; Flr. Pl. Thrissur For. 240.1996; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 237. 2004; T. S. Nayar *et al.*, Flr.

Plate 41. a. ***Pavetta bourdillonii*** Sivad. & N. Mohanan: Type specimen at TBGT; b. ***Pavetta oblanceolata*** Bremek.: Herbarium specimen at TBGT; c. ***Psychotria keralensis*** Deb & Gangop.: Type specimen at MH; d. & e. ***Spermacoce malabarica***: (Sivar. & Manilal) Sivar. *et al.*: d. Type specimen at CALI; e. Habit; f. ***Tarenna trichurensis*** Sasidh. & Sivar.: Type specimen at KFRI.

NB 5995

Pl. Kerala - A Handb. 544. 2006.

Type: Thrissur district: Peechi, Vengappara, ± 40 m, 21 Mar. 1989, *Sasidharan 4835* (CALI).

(Plate 41 f)

Shrubs, branchlets terete. Leaves elliptic to oblanceolate, acuminate, base acute, 6-11 x 3.5-5.5 cm, margins entire. Petiole c. 1.2 cm long. Stipule ovate. Flowers in short terminal pubescent, corymbose cymes. Calyx above the ovary, pubescent, 5-lobed, lobes subequal, obtuse. Corolla creamy white, tube c. 0.5 cm long, sparsely hairy at mouth, lobes 5, oblong, c. 0.5 cm long, reflexed, glabrous. Stamens 5. Ovary 2-celled; style slender; stigma fusiform. Fruits subglobose, c. 1 x 0.8 cm, shortly apiculate. Seeds 2.

Flowering & Fruiting: November-December.

Habitat: Semi-evergreen forests.

Note: A local endemic species with very limited distribution. So far not figured in any of the IUCN category; owing to narrow distribution, it warrants critical evaluation to obtain conservation status.

Specimen examined: Thrissur district: Peechi, Vengappara, ± 40 m, 21 Mar. 1989, *Sasidharan 4835* (Hotype, CALI).

21. ASTERACEAE

Table 41. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
1600	23000	138	723	39 spp., 9 var.

Kerala

Genus/genera	Species/subsp./var.
64	179 sp., 1 ssp.,15 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Adenoon Dalz.	*A. indicum* Dalz. (Maharashtra, Karnataka & Tamil Nadu)	
Anaphalis DC.	*A. beddomei* Fischer (Tamil Nadu)	*A. barnesii* Fischer
	A. bournei Fyson (Tamil Nadu)	
	A. elliptica DC. (Tamil Nadu)	
	A. leptophylla (DC.) DC. (Tamil Nadu)	
	A. meeboldii W. Smith (Tamil Nadu)	
	A. neelgerryana (Schultz-Bip. ex	

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	DC.) DC. (Tamil Nadu)	
	A. notoniana (DC.) DC. (Tamil Nadu)	
Blumea DC.	*B. membranaceae* var. *gracilis* Hook. f.	
Emilia Cass.	*E. ramulosa* Gamble (Karnataka & Tamil Nadu)	
Helichrysum Miller	*H. perlanigerum* Gamble (Tamil Nadu)	
	H. wightii Clarke ex Hook. f. (Tamil Nadu)	
Phyllocephalum Blume	*P. courtallense* (W.) Narayana (Karnataka & Tamil Nadu)	*P. rangacharii* (Gamble) Narayana var. *agastyamalyanum* Geetha Kumary *et al.*
	P. rangacharii (Gamble) Narayana (Tamil Nadu)	
	P. sengaltherianum (Narayana) Narayana (Tamil Nadu)	
Senecio L.	*S. ansteadii* Tadul. & Jacob (Tamil Nadu)	
	S. lawsonii Gamble (Tamil Nadu)	
	S. lessingianus (Wight & Arn.) Clarke (Tamil Nadu)	
	S. multiceps Balakr. (Tamil Nadu)	
Tricholepis DC	*T. amplexicaulis* Clarke (Maharashtra & Karnataka)	
Vernonia Schreber Vivek.	*V. anamallica* Bedd. ex Gamble (Tamil Nadu)	*V. anaimudica* Shetty & *V. beddomei* Hook. f.
	V. bourdillonii Gamble (Tamil Nadu)	*V.multibracteata* Gamble
	V. dalzelliana Drumm. & Hutch. (Karnataka & Tamil Nadu)	
	V. gossypina Gamble (Tamil Nadu)	
	V. heynei Bedd. ex Gamble (Tamil Nadu)	
	V. meeboldii W. Smith (Tamil Nadu)	
	V. membranacea Bedd. ex S. Moore (Tamil Nadu)	
	V. peninsularis var. *kodayarensis* A. N. Henry & Gopalan (Tamil Nadu)	
	V. ramaswamii Hutch. (Tamil Nadu)	

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	V. saligna var. *nilghirensis* Hook. f. (Tamil Nadu)	
	V. travancorica Hook. f. (Karnataka & Tamil Nadu)	
Youngia Cass.	*Y. nilgiriensis* Babcock (Tamil Nadu)	

Key to the genera

1. Capitula homogamous.
   2. Involucre bracts leafy above, scarious below; pappus 1 seriate..... **Phyllocephalum**
   2. Involucre bracts neither leafy above, nor scarious below; pappus usually with an outer row of short bristles ..... **Vernonia**
1. Capitula heterogamous.
   3. Branchlets white-pilose; leaf margin entire..... **Anaphalis**
   3. Branchlets not pilose; leaf margin serrate..... **Blumea**

ANAPHALIS A. P. de Candolle

Prodr. 6: 271.1838.

Anaphalis barnesii C. E. C. Fischer, Kew Bull. 5: 249. 1939; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 197. 1987; Uniyal in Hajra *et al.*, Fl. India 13: 55. 1995; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 239. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 99. 2006.

Type: 'Travancore High Range', *E. Barnes 1703* (K).

Herbs, to 75 cm high. Stem woody, sparsely branched. Leaves sessile, 1-1.3 x 0.5 cm, erect, lanceolate, margins folded back, greyish tomentose on both sides. Heads 0.6-1 cm diam., terminal, corymbs, sessil or peduncled. Involucral bracts 5-6 seriate; outer most white with a brown median stripe on lower half and white with greenish or olivaceous marking on upper half, ovate, densely long-silky tomentose on the back; inner most spathulate, obtuse or subacute; marginal florets yellow, c. 0.25 cm long, 4-toothed. Disc floret with slender corolla, slightly swollen at base and expanded at mouth, toothed. Achenes narrowly oblong, c. 0.15 cm long, apex truncate, faintly and bluntly 4-angled, glabrous. Pappus white.

Flowering & Fruiting: September

Habitat: Grasslands of higher altitudes.

Note: This species is known only by the collection of E. Barnes from the Travancore High ranges. It has not been recollected and reported afterwards. Population of this species

might have been declined or possibly extinct due to habitat distruction. Nayar (1997) treated this species under the category of 'Endangered'. With the available literature a brief account of description is provided.

BLUMEA A. P. de Candolle

Arch. Bot. (Paris) 2: 514. 1833

Blumea membranacea var. **gracilis** Hook. f., Fl. Brit. India 3: 265. 1881; Gamble, Fl. Pres. Madras 687 (483). 1921; Uniyal in Hajra *et al.*, Fl. India 13: 134. 1995; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 243. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 104. 2006.

Type: Wallich herbarium, Fiche No. 34, Cat. No. 3064.

Annual herbs. Leaves ovate-lanceolate or obovate, base tapering, acute, margin serrate-dentate, c. 4-18 x 1.6 cm. Heads in terminal lax panicles. Involucral bracts puplish-tinged, slightly longer than florets. Corolla of bisexual flowers yellow, tubular, 5-lobed; corolla of female florets filiform, 2-3-lobed. Achenes brown, oblong, ribbed, pubescent, pappus white.

Flowering & Fruiting: January-April.

Habitat: Evergreen forests.

Note: *Blumea membranacea* Wallich ex DC. is a very variable species. Ramachandran and V.J.Nair reported this narrow endemic variety from Ambayathodu, Brahmagiri hills of Kannur district. As herbarium details are not available, a brief description of the variety based on available literature is added.

PHYLLOCEPHALUM Blume

Bijdr. 888. 1826.

Phyllocephalum rangacharii var. **agastyamalayanum** Geetha Kumary, Santhosh Kumar & Pandurangan, *Ind. J. For.* 31(1): 119. 2008.

Type: Thiruvananthapuram district: Ponmudi, + 800 m, 3 Dec. 2003, *M. P. Geetha Kumary & Pandurangan 49495* (TBGT). (Plate 42)

Erect slender herbs, c. 35 cm high, branches spreading. Stems semiterete or on faintly striate, villous by dark purple septate hairs. Leaves alternate, narrowly elliptic-lanceolate, c. 3 x 1 cm, sessile or shortly petioled, cuneate at base, acuminate at apex, margin crenate-serrate, densely hirsute above, white tomentose beneath. Capitula 1-3 globose, 0.8-1 cm across, axillary or terminal, pedunculate, subtended by a single or rarely two leafy lanceolate bracts, c. 1.4 cm long; peduncles slender, 0.7 -1 cm long, villous. Involucral bracts 4-5 series; outer phyllaria obovate, c. 0. 55 x 0. 25 cm, acuminate at apex, hirsute; middle phyllaria the longest, c. 1.1 x 0.3 cm; basal portion scarious, glabrous, upper portion ovate, hirsute, acuminate, faintly nerved; inner phyllaria linear, c. 1 x 0.15 cm, scarious, shortly acuminate or mucronate. Receptacles flat and areolate. Corolla infundibuliform, purple; tube c. 0. 35 cm long; lobes

recurved, c. 0. 2 cm long. Anthers linear, shortly sagittate. Ovary oblong or obovoid, glabrous, 10-ribbed, c. 0.18 cm long; pappus 0 or vary rarely 1, c. 0.15 cm long, ascending by barbellate setae; style arms 2, linear, subulate. Achenes cylindric, c. 0. 3 cm long, pale brown, 10-ribbed.

Flowering & Fruiting: October- February

Habitat: Grasslands.

Note: Supposed to be a neoendemic variety, further surveys are necessary to obtaoin a clear picture of distributional status.

Specimen examined : Thiruvananthapuram district: + 800 m, 3 Dec. 2003, Ponmudi, *Geetha Kumary & Pandurangan 49495* (Holotype, TBGT).

VERNONIA Schreber

Gen. 2: 514. 1791.

Key to the species

1. Achenes winged..... 3. *V. multibracteata*
1. Achenes not winged.
   2. Achenes glandular, 10-ribbed..... 1. *V. anaimudica*
   2. Achenes eglandular, 5-ribbed..... 2. *V. beddomei*

1. **Vernonia anaimudica** B. V. Shetty & Vivek., Bull. Bot. Surv. India 12: 266. 1970; Gamble, Fl. Peres. Madras 675 (475). 1921; Ahmedullah & M. P. Nayar, End. PI. Ind. Reg. 199. 1987; Uniyal in Hajra *et al.*, Fl. India 13: 353. 1995; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 256 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 122. 2006.

Type: Idukki district: Rajamally, ± 1950 m, 19 Nov. 1965, *Shetty & Vivekanandan 26550* (MH). (Plate 43 a)

Shrubs, up to 2.5 m tall. Stem teret, brown tomentose. Leaves alternate, ovate, ovate-lanceolate, margin crenulate-serrulate, white tomentose beneath. Heads terminal corymbose or in the axils of upper leaves. Involucral bracts green, 5-6 seriate, mucronate, outer ovtae tomentose, inner linear puberulous. Florets fragrant. Corolla glandular. Achenes 3.5 mm long, 10-ribbed, glandular between the ribs.

Flowering & Fruiting: November-February

Habitat: Rocky grasslands

Note: Considering its endemicity and rarity Nayar (1987) treated this species as 'Vulnerable'.

Specimens examined: Idukki district: Rajamally, ± 1950 m, 19 Nov. 1965, *Shetty & Vivekanandan 26550* (Paratype, MH); *ibid.*, 2 Feb. 1970, *Shetty & Vivekanandan 31786* (Isotype, MH).

Plate 42. ***Phyllocephalum rangacharii*** var. ***agastyamalayanum***
Geetha Kumary *et al.*: Type specimen at TBGT.

NB 5995 170 A

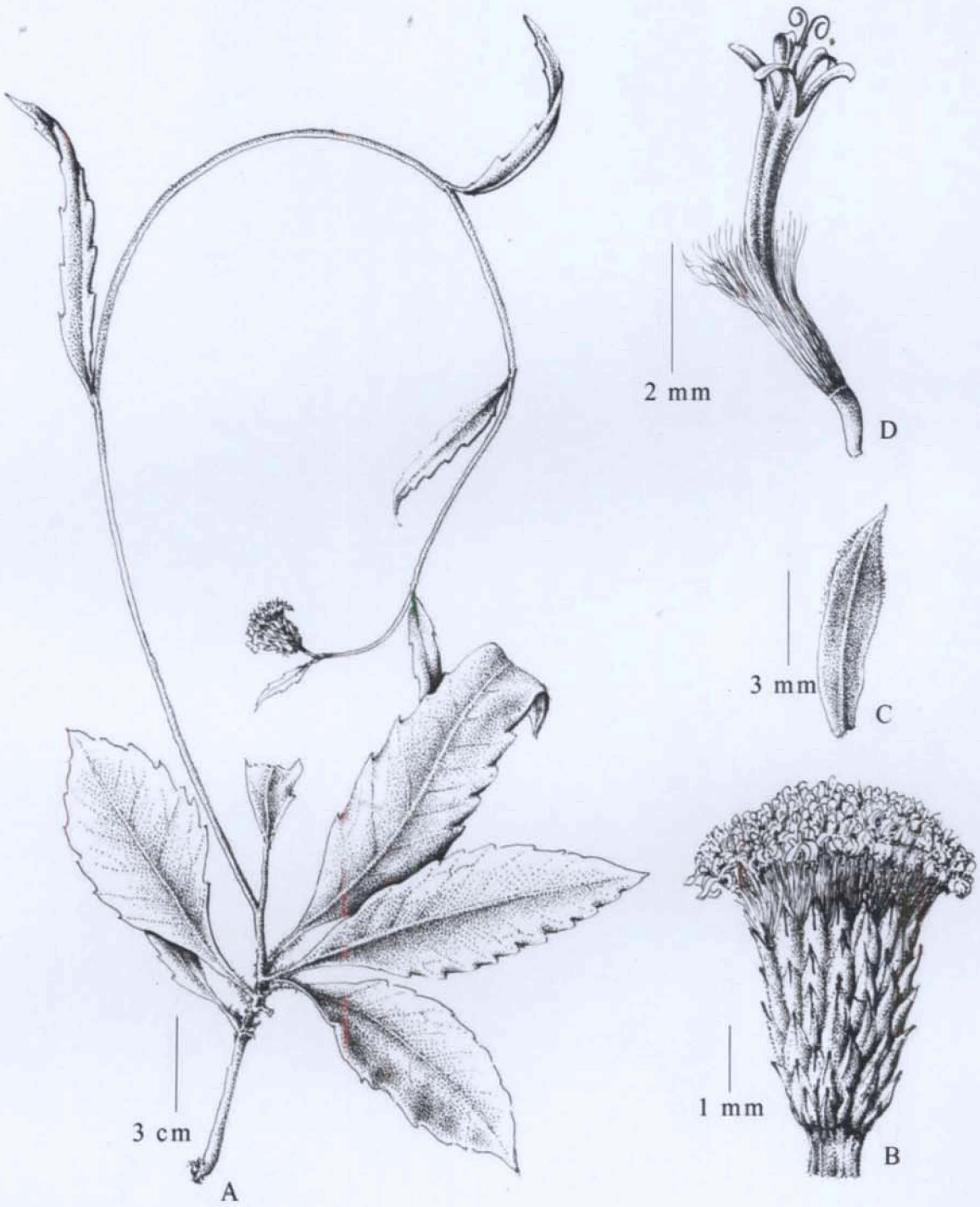

Fig. 35. ***Vernonia beddomei*** Hook f.: A. Habit; B. Capitulum; C. Involucral bract; D. Disc floret.

NB 5495 170B

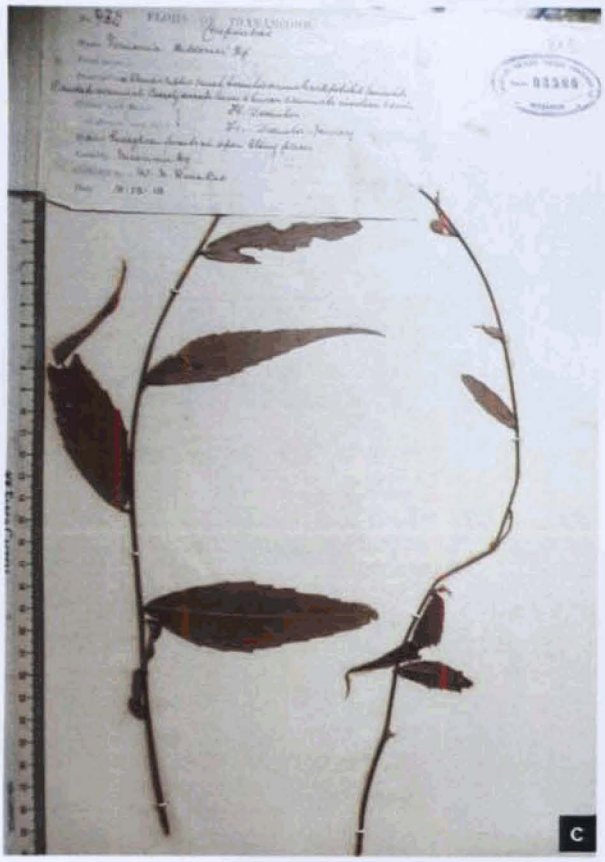

Plate 43. a. ***Vernonia anaimudica*** Shetty & Vivek.: Type specimen at MH; b & c. ***Vernonia beddomei*** Hook. f.: b. Type specimen at MH; c. Herbarium specimen at TBGT, collected by Rama Rao in 1912.

170 C

ND 5995

Plate 44. *Vernonia multibracteata* Gamble: Type specimen at Kew.

NB 5995 170 D

2. **Vernonia beddomei** Hook. f., Fl. Brit. India 3: 231. 1881; Gamble, Fl. Peres. Madras 674 (474). 1921; N. C. Nair & C. N. Mohanan, J. Econ. Taxon. Bot. 3: 576. 1982; Ahmedullah & M. P. Nayar, End. PI. Ind. Reg. 199. 1987; Uniyal in Hajra *et al.*, Fl. India 13:360. 1995; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 257. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 122. 2006.

Type: Travancore, *Beddome s.n., Acc. No. 27058* (MH) (Fig. 35; Plate 43 b & c)

Erect or straggling herb up to 1 m high; stem and branches angled, glabrous. Leaves c. 14 x 3.5 cm, linear-lanceolate to ovtate-lanceolate, caudate, acuminate at apex, obtuse to acute at base, margins coarsely serrate, glabrescent above and pubescent beneath. Heads solitary on filiform peduncle. Involucral bracts many-seriate glabrous; outer most subulate; inner most linear-oblong. Achene about 2.5 cm, villous, 5-ribbed. Pappus hairs white, in 2 rows.

Flowering & Fruiting: October-February.

Habitat: Grasslands.

Note: This palaeoendemic species is having restricted distribution in the intermittent low altitude grasslands of deciduous forests of Thriuvananthapuram and Kolllam districts. Due to deforeststion and human interference in its natural habitats, this species has become limited in its population. Because of its restricted occurrence Ahmedullah and Nayar (1997) ttreated it as 'Rare & Threatened'.

Specimens examined: Travancore, Meenmutty, 10 Dec. 1912, *M. Rama Rao 724* (TBGT); Aruvikattumalai, 9 Jan. 1913, *M. Rama Rao 772* (TBGT); *Kollam* district: Thenmala, Rosemala, 9 Feb. 2006, *Geetha Kumary & Shaju 53109* (TBGT).

3. **Vernonia multibracteata** Gamble, Bull. Misc. Inform. 1920: 340. 1920: Fl. Peres. Madras 675(475). 1921; Ahmedullah & M. P. Nayar, End. PI. Ind. Reg. 200. 1987; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 1: 90. 1990; Uniyal in Hajra *et al.*, Fl. India 13: 374. 1995; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 259. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 125. 2006.

Type: 'Travancore, Peermerd', 1000 m, Dec. 1887, *Beddome s. n.* (K). (Plate 44)

Shrubs, branches white lanate. Leaves lanceolate, apex acuminate, margin crenulate, c. 26 x 6 cm, densely white tomentose beneath. Heads in terminal corymbs. Involucral bracts lanceolate, outer long acuminate, inner most smaller, mucronate. Achene tetragonous, angles winged. Pappus hair biseriate.

Flowering & Fruiting: December.

Habitat: Grasslands

Note: Not located after its type collection made by Beddome in 1887. It may be possibily extinct due to massive deforestation. The conservation status of this species has been designated as 'Possibly extinct' (Nayar, 1997).

Specimen examined: 'Travancore, Peermerd', 1000 m, Dec. 1887, *Beddome s. n.* (K).

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22. MYRSINACEAE

Table 42. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
35	1000	10	*c.* 115	5 spp.

Kerala

Genus/genera	Species/subsp./var.
7	23 spp., 1 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Antistrophe A. DC.		*A. glabra* Pandurangan & V. J. Nair
Ardisia Sw.	*A. sonchifolia* Mez (Tamil Nadu)	*A. stonei* Sasidh. & Sivar.
Embelia Burm. f.	*E. gardneriana* Wight (Tamil Nadu)	
Maesa Forsskal		*M. velutina* Mez
Rapanea Aubelt	*R. thwaitesii* Mez (Tamil Nadu)	

Key to the genera

1. Flowers in panicles; fruits many seeded..... **Maesa**
1. Flowers not panicle; fruits 1-seeded:
   2. Under shrubs; flower solitary or 1-2..... **Antistrophe**
   2. Small trees; flowers inumbels..... **Ardisia**

ANTISTROPHE A. P. de Candolle

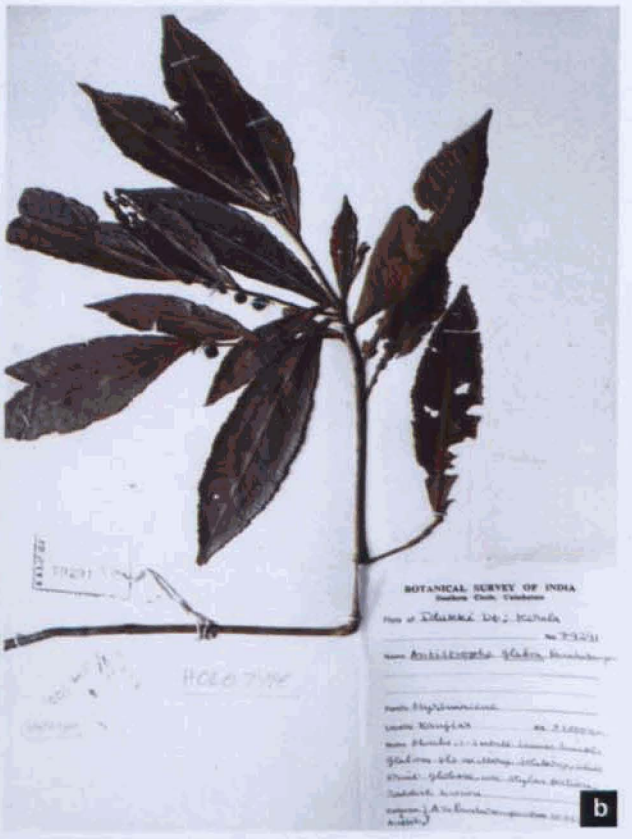
Ann. Sci. Nat. Bot. Ser. 2, 16: 79, 84. 1841.

Antistrophe glabra Pandurangan & V. J. Nair, Nordic J. Bot. 17: 367. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 264. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 442. 2006.

Type: Idukki district: Kanjiar, ± 1000 m, 10 Oct. 1983, *Pandurangan 79291* (MH)

(Plate 45 a & b)

Shrubs. Leaves simple, 8-12 x 2-3.5 cm, alternate, blades linear- elliptic, cuneate at base, acuminate at apex, irregularly denticulate along margins, membranous, gland-dotted. Petioles 0.3-0.5 cm long. Flowers axillary, solitary. Pedicels c. 0.2 cm long, rusty puberulous. Sepals tubular, saucer-shaped, c. 0.1 cm across, chartaceous, puberulous, limbs 5, valvate. Petals 5, imbricate, oblanceolate, c. 0.15 x 0.1 cm, margins ciliate, glabrous, white, fragrant. Stamens 5,



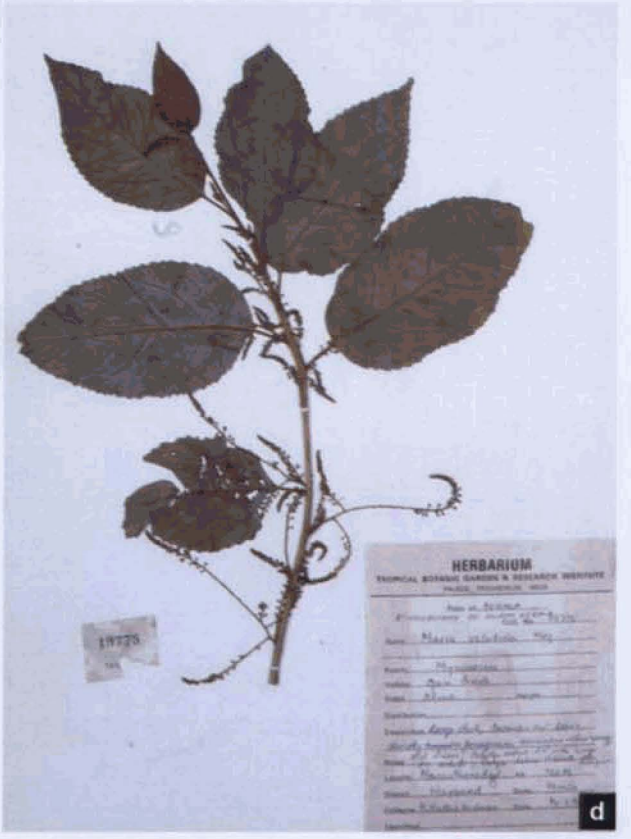


Plate 45. a & b. ***Antistrophe glabra*** Pandurangan *et al.*: a. Habit; b. Type specimen at MH; c. ***Ardisia stonei*** Sasidh. & Sivar.: Type specimen at KFRI; d. ***Maesa velutina*** Mez.: Herbarium specimen at TBGT.

NB 5495

attached to the throat of the petals; filaments free; anthers basi-fixed. Ovary globose, 1-loculed; styles filiform; stigma simple. Berry globose, with persistent stylar portion, c. 0.5 cm across, reddish brown. Seed 1.

Flowering & Fruiting: October-December

Habitat: Moist evegreen forests.

Note: A narrow endemic species, so far known only from the type locality. During the study it was collected from Silent Valley of Palakkad district and forms a record of its extended distribution outside its type locality.

So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimens examined: Idukki district: Kanjiar, ± 1000 m, 10 Oct. 1983, *Pandurangan 79291* (Holotype, MH); Palakkad district: Silent Valley, way to Puchippara, 23 March 2003, *Shaju 4418* (TBGT).

ARDISIA O. Swartz

Prodr. 3. 48. 1788.

Ardisia stoneii Sasidh. & Sivar., Rheedea 4: 116. 1994, Flr. Pl. Thrissur For. 260.1996; Sasidh., Biodiver Doc. Kerala, Part 6, Flr. Pl. 265. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 443. 2006.

Type: Thrissur district, Peechi, Valiyamedu, ± 575, 18 Sep. 1990, *Sasidharan 5179* (KFRI). (Plate 45 c)

Subshrubs. Leaves 7-4 x 2-5 cm, elliptic oblong or obovate, acute to acuminate at pex, cuneate and unequally cordate at base, chartaceous, margin denticulate to subentire, punctate on the under surface. Flowers axillary, solitary or in 2-4-flowered pendulous recemes. Peduncle c. 0.3 cm long, brown-tomentose. Bracts cymbiform. Calyx lobes imbricate, c. 0.2 x 0.1 cm, narrowly ovate-acuminate, tomentose. Corolla pink or pale purple, deeply lobed, tube very short; lobes 0.6-0.7cm long, ovate-lanceolate acuminate, pubescent except along the hyaline margins. Stamens 5, spreading; filaments short, basally united; anthers basifixed. Ovary glabrous, 1-celled; ovules 9-10; style slender; stigma punctiform. Drupe globose, red, c. 0.7 across, subtended by erect, persistent calyx. Seed one.

Flowering & Fruiting: Throughout the year

Habitat: Evergreen forests

Note: So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimen examined: Thrissur district: Peechi, Valiyamedu, ± 575, 18 Sep. 1990, *Sasidharan 5179* (Isotype, KFRI).

MAESA Forsskal

Fl. Aegypt.-Arab. 66. 1775.

Mesa velutina Mez in Engl., Pflanzenr. IV 236(9): 35. 1902; Gamble, Fl. Pres. Madras 749 (527). 1921; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 266. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 444. 2006; Santhosh Kumar *et al.*, Rheedea 18. 39. 2008.

Type: *Gibson s. n.* (L, holo, *sh. 900. 211-447*; CAL). (Plate 45 d)

Small trees. Branches and leaves densely ferruginous-tomentose when yong, later on pilose. Leaves 5-10 x 5-7 cm, elliptic to obovte, acute to shortly acuminate at apex, round to broadly obtuse at base, margins coarsely serrate. Inflorescence a paniculate raceme, axillary or lateral, sometimes cauliflorus, 2-15 cm long. Bracts ovate, pilose. Pedicel c. 0.2 cm long, densely pilose. Bracteoles ovate. Sepals ovate, suborbicular, 0.10-0.15 cm long, margins ciliate, apex obtuse. Corolla tube up to 0.1 cm long, lobes ovate, 0.1-0.13 x 0.1-0.15 cm, margins sparsely ciliate. Stamens 5. Ovary 1-celled; ovules many. Berry globose or subglobose, 0.35-0.4 cm in diam.

Flowering & Fruiting: January- February

Habitat: Deciduous forests.

Note: This local endemic species is so far known only by the type collection until it is relocated from the type locality in 1995, and it is listed as an 'Endangered' species (IUCN, 2008).

Specimen examined: Wayanad district: Mananthvady, ± 720 m, 14 Jan. 1999, *Radhakrishnan 19775* (TBGT).

23. SAPOTACEAE

Table 43. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
65	800	c. 11	31	4 spp.

Kerala

Genus/genera	Species/subsp./var.
7	18 spp., 1 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Isonandra Wight	*I. stocksii* Clarke (Tamil Nadu)	*P. ravii* Sasidh.
Palaquium Blanco	*P. bourdillonii* Brandis (Karnataka & Tamil Nadu)	
	P. ellpticum (Dalz.) Baillon (Maharashtra, Karnataka & Tamil Nadu)	

Plate 46. *Palaquium ravii* Sasidh. & Vink .: Type specimen at TBGT.

NB 174-B

PALAQUIUM Blanco

Fl. Filip. 403. 1837

Palquium ravii Sasidh. & Vink, Blumea 35: 385. 1991; Sasidh. & Sivar., Flr. Pl. Thrissur For. 267. 1996; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 269. 2004; V. S. Ramach. & Swarup., J. Econ. Taxon. Bot. 30: 225. 2006; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 565. 2006. ***Pali.***

Type: Thrissur district: Peechi, 21 Apr. 1988, *Sasidharan 5062* (MH). (Plate 46)

Trees. Leaves clustered towards tip of branchlets, 7-13 x 3.5-6.5 cm, obovate, apex obtuse or rounded, base attenuate, coriaceous, appressed pubescent on both surfaces, glabrescent. Petiole 1.5-2.5 cm long, pubescent. Flowers solitary or 2-8 in axillary clusters. Pedicels 0.7-0.9 cm long, greyish brown tomentose. Sepals 6, biseriate, obtuse to acute, minutely brownish, tomentose outside; outer sepals ovate, 0.4-0.5 x 0.25-0.3 cm; inner ovate-oblong. Petals creamy white, tube c. 0.3 cm long, lobes oblong, c. 0.2 x 0.5 cm acute to rounded or truncate. Stamens 12, biseriate, connective bifid at apex. Ovary globose, hirsute, slightly 12-ribbed, 6-celled; style glabrous; stigma muticous. Fruits obovoid, c. 2 x 1.5 cm, glabrous. Seeeds 1 or 2, elliptic or orbicular.

Flowering & Fruiting: April-February

Habitat: Evergreen forests

Note: As a narrow endemic species of the genus *Palaquium* Blanco, a typical example for local vicariance and local endemism, it is of phytogeographical and botanical interest. The species has been designated as 'Endangered' (IUCN, 2008).

Specimens examined: Thrissur district: Peechi, 21 Apr. 1988, *Sasidharan 5062* (Holotype, MH); Idukki district: Mlappara, Periyar Tiger Reserve, 21 Apr. 1994, *Jomy Agustine 13616* (KFRI).

24. EBENACEAE

Table 44. Profile of Distribution and Endemism

India

Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
2	500	1	47	5 spp.

Kerala

Genus/genera	Species/subsp./var.
1	30 spp., 1 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Diospyros L.	*D. bourdillonii Brandis* (Karnataka & Tamil Nadu)	*D. sulcata Bourd.*

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Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	D. courtallumensis Bahadur & Gaur (Tamil Nadu)	
	D. saldanhae Kosterm. (Maharashtra, Goa, & Karnataka)	

DIOSPYROS Linnaeus

Sp. Pl. 1057.1753.

Diospyros sulcata Bourd., For. Trees Tavancore 225. 1908; Gamble, Fl. Pres. Madras 777(546). 1923; Sasidh., Biodiver. Doc. for Kerala, Part 6, Flr. Pl. 272. 2004; V. Singh, Monogr. Ind. *Diospyros* 229. 2005; T.,S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 225. 2006. ***Kari.***

Type: Travancore, Kallar River, *Bourdillon 1323* (K).

Trees, up to 10 m high. Leaves alternate, 10-23 x 5-10 cm, oblong or oblong-lanceolate, abruptly acuminate at apex, tapering at base. Male flowers sessile, tomentose, in many-flowered axillary clusters; 5-merous. Stamens 10-12, anthers lanceolate, apiculate-acuminate. Female flowers 5-merous, sessile, solitary. Calyx thick, coriaceous, densely velvety, deeply-lobed; lobes 5, triangular, auricled. Corolla tomentose. Staminodes 5. Ovary densely brown tomentose, 10-celled cells, 1-ovuled; style and stigma 5, glabrous. Fruit a truncate cone, covered with rusty tomentum when young, glabrous with age, marked with 8-10 deep longitudinal groove. Seeds 10.

Flowering & Fruiting: February-March.

Habitat: Valleys of evergreen and secondary forests at low elevations.

Note: A 'possibly extinct' palaeoendemic tree species which could not be located after its type collection. Earlier, Brandis (1906) examined the specimens of Bourdillon (No. *1323* and *1584*–K) and concluded that they belong to a new species, but could not name it because of imperfect meterials. Later Bourdillon (1908) named it as *Diospyros sulcata* Bourd., based on the above mentioned specimens. After Bourdillon, no other workers could report this species from the reported area. So Nayar (1997) included this species under 'Possibly extinct ' category of endemic plants.

25. SYMPLOCACEAE

Table 45. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
2	320	2	45	7 spp., 7 ssp.

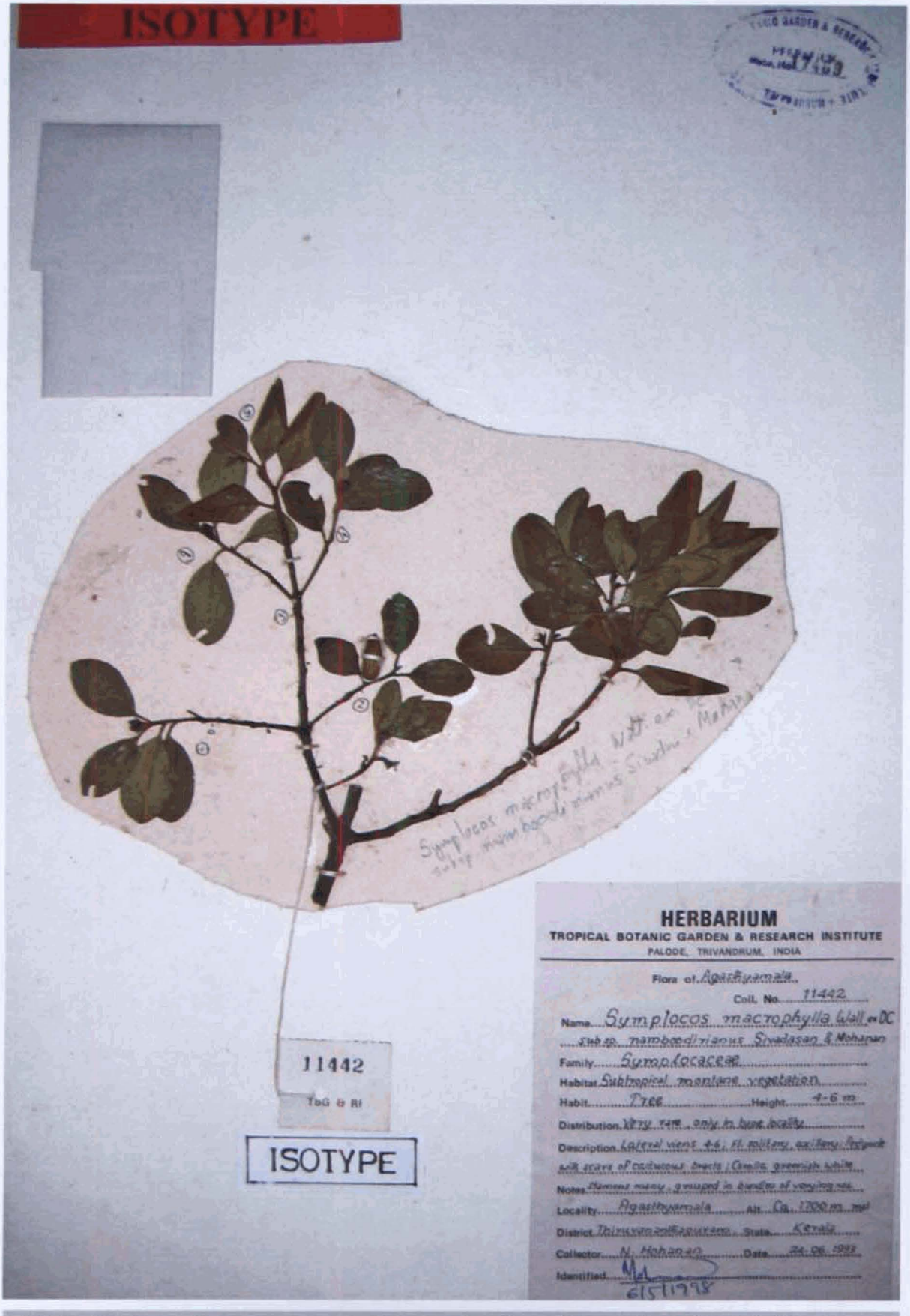

Plate 47. ***Symplocos macrophylla*** ssp. ***namboodirianus*** Sivad. & N. Mohanan: Type specimen at TBGT.

NB5995. 176.A

Kerala

Genus/genera	Species/subsp./var.
1	14 spp., 6 ssp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Symplocos Jacq.	*S. macrocarpa* Wight ex Clarke ssp. *macrocarpa* (Tamil Nadu)	*S. macrophylla* ssp. *namboodirianus* Sivad. & N. Mohnan
	S. macrocarpa ssp. *kanarana* (Talbot) Nooteb.(Karnataka & Tamil Nadu)	
	S. macrophylla ssp. *microphylla* (Wight) Nooteb. (Tamil Nadu)	
	S. macrophylla ssp. *rosea* (Bedd.) Nooteb. (Karnataka & Tamil Nadu)	
	S. monantha Wight (Tamil Nadu)	
	S. nairii Henry *et al.* (Tamil Nadu)	
	S. oligandra Bedd. (Tamil Nadu)	
	S. pulchra Wight ssp. *pulchra* (Karnataka & Tamil Nadu)	
	S. pulchra ssp. *villosa* (Brand) Nooetb. (Karnataka)	
	S. wynadense (Kuntze) Nooteb. (Tamil Nadu)	

SYMPLOCOS N. J. Jaquin

Enum. Pl. Carib. 5, 24. 1760.

Symplocos macrophylla ssp. **namboodirianus** Sivad., & Mohanan, Rheedea 7: 89. 1997, Fl. Agasthyamala 421. 2002; Sasidh., Biod. Doc. for Kerala, Part 6, Flr. Pl. 274. 2004; T. S. Nayar *et al.*, Flr. Pl. of Kerala – A Handb. 569. 2006.

Type: Thiruvananthapuram district: Agasthyamala, ± 1700 m, 24 Jun. 1993, *N. Mohanan 11442* (TBGT). (Plate 47)

Small bushy trees, 4-6 m high. Leaves 2-4 x 1-2.5cm, elliptic to ovate, obtuse to shortly acute at apex, attenuate at base, margins entire, glabrous, usually recurved at the upper half, lateral veins 4-6. Flowers solitary, axillary. Calyx tube 0.15-0.2 cm long, lobes 5, 0.2-0.25 x 0.1-0.15 cm, ovate. Corolla greenish-white, rotate, lobes 5, 0.4-0.5 x 0.1-0.15 cm, ovate-lanceolate,

shortly connate at base. Stamens many, grouped in bundles, adnate to corolla tube at base. Disc 5, conical, pilose. Ovules 1-2 in each cell. Drupe oblong, 1.2-1.5 x 0.5-0.6 cm, cylindric with persistent calyx.

Flowering & Fruiting: May-July

Habitat: Montane vegetation.

Note: A narrow endemic subspecies known only from its type locality. It is differentiated from other related species by having small leaves usually with 4-6 pairs of lateral veins and solitary axillary flowers.

Distribution status of this phytogeographically interesting woody plant is not fully established. So further explorations must be made to locate the species in its known distributional areas to confirm its conservation status.

Specimen examined: Thiruvananthapuram district: Agasthyamala, ± 1700 m, 24 Jun. 1993, *N. Mohanan 11442* (Isotype, TBGT).

26. OLEACEAE

Table 46. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
24	600	3	c. 33	3 spp., 2 var.

Kerala	
Genus/genera	Species/subsp./var.
5	29 spp., 6 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Choinanthus L.	*C. courtallensis* Bedd. (Tamil Nadu)	
	C. linocieroides (Wight) Bennet ex Raiz. (Tamil Nadu)	
Jasminum L.	*J. azoricum* var. *trvancorense* (Gamble) Mohanan (Tamil Nadu)	*J. agastyamalayanum* Sabeena *et al.*
	J. cordifolium Wallich ex G. Don (Karnataka, Tamil Nadu)	*J. rottlerianum* var. *glabrior* Clarke

JASMINUM Linnaeus

Sp. Pl. 7. 1753.

Key to the species

1. Leaves simple; cymes many fowered..... 1. *J. rottlerianum* var. *glabrior*

Plate 48. a - c. J***asminum agastyamalayanum*** Sabeena *et al.*: a. Flowers; b. Fruits; c. Type specimen at TBGT.

1. Leave3-foliate; cymes 3-5 flowered ..... 2. *J. agastyamalayanum*

1. **Jasminum agastyamalayanum** Sabeena, Asmitha Mulani, Santhosh Kumar & Sibin, Ind. J. For. 30(1):123.2007.

Type: Thiruvananthapuram district: Agasthyamala, ± 1500 m, 17 Feb. 2005, *N.T. Sibin 57285* (TBGT). (Plate 48 a - c)

Climbing shrubs. Leaves trifoliate, terminal leaflet ovate-elliptic, 5.5-7 x 3-3.5 cm, rounded at base, apex acuminate, entire at margin, membranous, glabrous; lateral leaflets ovate, 4.5-6 x 2-3 cm, rounded, obtuse or subequal at the base, acuminate at apex. Inflorescence a short axillary cyme, usually 1-3 together from the node, to c. 5 cm long, with 3-5 flowers. Flowers white, fragrant. Calyx glabrous, 5-toothed, to 0.3 cm long. Corolla tube c. 3 cm long; lobes 6, to 1.2 x 0.6 cm, elliptic oblong, acute at apex. Stamens 2. Ovary cylindrical; style glabrous; stigma bifid. Fruit a berry, ovoid, single or often paired.

Flowering & Fruiting: August - March

Habitat: Evergreen forests.

Note: A 'point endemic' species known only from its type locality. As a horticulturally promising species, conservation efforts should be made to find out the still surviving populations from its known distributional areas. This is to confirm its status and introduce in the experimental garden.

Specimen examined: Thiruvananthapuram district: Athirumala, ± 1500 m, 17 Feb. 2005, *N.T. Sibin 57285* (Holotype, TBGT).

2. **Jasminum rottlerianum** var. **glabrior** C. B. Clarke in Hook. f., Fl. Brit. India 3: 593. 1882; Manilal, Fl. Silent Valley 171.1988; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 278. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 463. 2006.

Type: 'Travancore' *Wight* (Wallich Cat. No. 2865, microfiche No.318).

Climbing shrubs. Leaves simple, ovate-lanceolate, 6-11 x 2-5 cm, base truncate or rounded, apex acuminate, apiculate, hairy on the nerves beneath, chartaceous. Cymes many flowered, dense, axillary, shortly pubescent; bracts prominent white, pubescent. Calyx lobes 5, subulate. Corolla white, tube c. 2.5 cm long, lobes 6 narrowly-oblong, acute, to 1 x 0.25 cm. Berry subglobose.

Flowering & Fruiting: January-March

Habitat: Evergreen forests.

Note: Manilal (1988) reported this local endemic variety of ornamental species *J. rottlerianum* Wallich ex A. DC. from Silent Valley. It can be distinguished by glabrous adult leaves and slight pubescent nature of inflorescence. A brief description of the variety based on available literature is added.

As a horticulturally promising narrow endemic variety, its distributional status should be analysed for further assignment of status and conservation efforts.

Specimen examined: Palakkad district: Silent Valley, Damsite, Aruvanpara, *Satheesh 11108* (CALI).

27. ASCLEPIADACEAE

Table 47. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
348	2900	39	*c.* 209	33 spp., 2 var.

Kerala

Genus/genera	Species/subsp./var.
27	82 spp., 8 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Bidaria Decne.	*B. indica* Rahman & Wilcock (Karnataka & Tamil Nadu)	
Ceropegia L.	*C. ciliata* Wight (Tamil Nadu)	*C. beddomei* Hook. f.
	C. fimbriifera Bedd. (Karnataka & Tamil Nadu)	
	C. metziana Miq. (Maharashtra, Karnataka & Tamil Nadu)	
	C. omissa Huber (Tamil Nadu)	
	C. schumanniana Swarup. & Mangaly (Tamil Nadu)	
	C. vincaefolia Hook. f. (Maharashtra)	
Gymnema R. Br.	*G. montanum* (Roxb.) Hook. f. (Maharashtra, Karnataka & Tamil Nadu)	
Heterostemma & Arn.	*H. beddomei* (Hook. f.) Swarup.& Mangaly (Karnataka & Tamil Nadu)	*H. vasudevani* Swarup. & Mangaly
	H. deccanense (Talbot) Swarup. & Mangaly (Maharashtra)	
Hoya R. Br.	*H. kanyakumariana* Henry & Swamin. (Tamil Nadu)	
Janakia Joseph & V.	*J. arayalpathra* Joseph &	

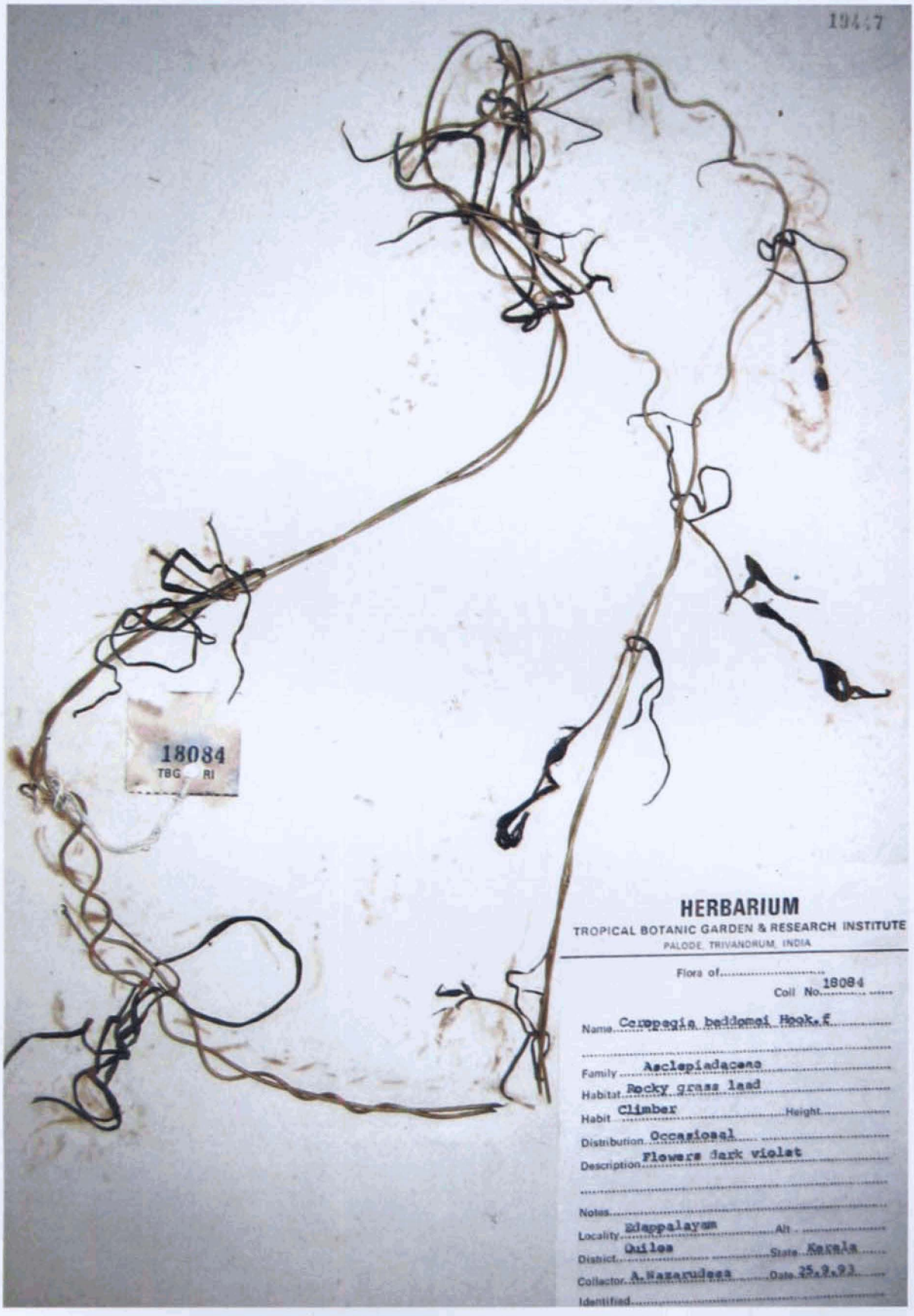

Plate 49. *Ceropegia beddomei* Hook. f.: Herberium specimen at TBGT.

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Chandras.	V. Chandras. (Tamil Nadu)	
Marsdenia R. Br.	*M. raziana* Yogan. & Subram. (Karnataka)	
	M. tirunelvelica A. N. Henry & Subram. (Tamil Nadu)	
Toxocarpus Wight & Arn.	*T. beddomei* Gamble (Tamil Nadu)	
	T. palghatensis Gamble (Tamil Nadu)	
Tylophora R. Br.	*T. subramanii* A. N. Henry (Tamil Nadu)	
Utleria Bedd.	*U. salicifolia* Bedd. ex Hook. f. (Tamil Nadu)	

Key to the genera

1. Leaves linear-lanceolate; corolla dark purple ..... **Ceorpegia**
1. Leaves ovate; corolla grey purple ..... **Heterostemma**

CEROPEGIA Linnaeus

Sp. Pl. 211. 1753.

Ceropegia beddomei Hook. f., Fl. Brit. India 4: 75. 1883; Gamble, Fl. Pres. Madras 859 (604). 1923; Ansari, Fasc. Fl. India 16: 10. 1984; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 287. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 84. 2006.

Type: Idukki district: 'Peermade', 750 m, *Beddome s.n.* (K). (Plate 49)

Perennial herbs. Stem twining. Leaves linear-lanceolate, long acuminate. Calyx lobes 5, linear. Corolla dark purple, tube slightly inflated at base, white within at base, purple with white markings within the tube, lobes green with purple lines and hairy within, Anther without appendages. Ovary 2; style appex truncate. Fruits not seen.

Flowering & Fruiting: June- September

Habitat: Grassy slopes of rocky hills.

Note: A narrow endemic species shows restricted distribution in Idukki and Kollam districts. Due to its rare occurrence Nayar (1997) treated this species under the 'Endangered' category.

Specimens examined: Idukki district: Calvery mount, ± 700 m, 5 Oct. 1983, *Pandurangan 79620* (MH); Kollam district: Edapalyam, 25 Sep.1993, *Nazarudeen 18084* (TBGT).

HETEROSTEMMA R. Brown

On Asclepiad. 31. 1810.; Mem. Wern. Nat. Hist. Soc. 1: 42. 1811.

Heterostemma vasudevanii Swarupan. & Mangaly, J. Linn. Soc. Bot. 101: 257. 1989: Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 290. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 90. 2006.

Type: Idukki district: Sabarimala, ± 590 m, 1976, *Swarupanandan 13716A* (MH).

Twining undershrubs. Stem twining. Leaves ovate, 9-13 x 6-8.5 cm, abruptly acuminate, base cordate or subcordate, 5-nerved from the base. Inflorescence extra-axillary, c. 2.5 x 1.5 cm, subumbellate. Flowers 20-25. Sepals 5, 0.1-0.15 x 0.1 cm, ovate, obtuse at tip, margin pellucid, puberulent without. Corolla grey-purple without, dark purple or deep pink within, c. 0.7 x 1.3 cm, lobes short, deltoid. Anther with cordiform appendage. Carpels oblong-ovate. Follicles thin, straight, terete, pointed.

Flowering & Fruiting: August-September.

Habitat: Evergreen forests.

Note: So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimen examined: Pathananmthitta district: Sabarimala, ± 590 m, 1976, *Swarupanandan 13716B* (Isotype, CALI).

28. GENTIANACEAE

Table 48. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
78	1225	15	*c.* 147	7 spp., 4 var.

Kerala

Genus/genera	Species/subsp./var.
7	28 spp., 1 ssp., 6 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Canscora Lam.	*C. pauciflora* Dalz.(Maharashtra, Goa & Karnataka)	
	C. perfoliata Lam. (Maharashtra, Goa, Karnataka & Tamil Nadu)	
Exacum L.	*E. atropurpureum* Bedd.	*E. courtallense* var.

Plate 50. a & b. ***Exacum courtallense*** var. ***boneccordensis*** M. Mohanan: a. Habit; b. Flowers.

NB 5495 182.17

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	(Tamil Nadu)	*boneccordensis* M. Mohanan
	E. courtallense Arn. var. *courtallense* (Tamil Nadu)	
	E. lawii Clarke (Maharashtra, Karnataka & Tamil Nadu)	
	E. pumilum Griseb. (Maharashtra, Goa, Dadra, Karnataka & Tamil Nadu)	
	E. travancoricum Bedd. (Tamil Nadu)	
Swertia L.	*S. beddomei* Clarke (Karnataka & Tamil Nadu)	
	S. lawii (Wight ex Clarke) Burkill (Maharashtra & Karnataka)	

EXACUM Linnaeus

Sp. Pl. 112. 1753.

Exacum courtallensis var. **boneccordensis** M. Mohanan & A. N. Henry, Fl. Thiruvananthapuram 305. 1994; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 298. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala–A Handb. 171. 2006.

Type: Thruvananthapuram district: Agasthyamala, Bonaccord, *Mohanan 63225* (MH). (Plate 50 a & b)

Undershrubs, 30-50 cm tall. Leaves 6-8 x 2-4 cm, glabrous, membranous, sessile, narrowly elliptic-lanceolate, acumunate at apex, attenuate at abse, faintly 3-nerved. Flowers solitary, axillary. Pedicels slender, c. 3.5 cm long. Calyx tube c. 0.4 cm long, 5-lobed, c. 0.6 cm long, lanceolate, winged at base. Corolla tube o.4-0.5 cm long; lobes obovate or oblanceolate, blue, 1.5 x 0.7 cm. Stamens 5. Ovary glabrous, 2-loculed, ovules many. Capsule oblong, 0.8-0.1 x 0.3-0.4 cm, style persistent.

Flowering & Fruiting: April-August.

Habitat: In moist areas.

Note: As a horticulturally promising local neoendemic variety, its distribution status should be analysed for planning further conservation activities.

Specimens examined: Thruvananthapuram district: Agasthyamala, Bonaccord, *Mohanan 63225* (Isotype, MH); *Ibid.*, ± 600 m, 15 Oct. 2009, *Shaju & Geetha Kumary 67929* (TBGT).

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29. MENYANTHACEAE

Table 49. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
5	60-70	1	8	3 spp.

Kerala

Genus/genera	Species/subsp./var.
1	7 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Nymphoides Seguier		*N. krishnakesara* Joseph & Sivar.
		N. macrospermum Vasudevan
		N. sivarajanii Joseph

NYMPHOIDES J. Hill

Brit. Herbal 77. 1756

Key to the species

1. Flowers bisexual..... 3. *N. sivarajanii*
1. Flowers unisexual.
   2. Anthers blue..... 1. *N. krishnakesara*
   2. Anthers yellow or pale purple..... 2. *N. macrospermum*

1. **Nymphoides krishnakesara** Joseph & Sivarj., Nordic J. Bot. 10: 21. 1990; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 300. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 431. 2006.

Type: Kannur distrct: Madaipara, Payangadi, ± 30 m, 25 Oct. 1988, *Joseph 43001* (CAL).

(Plate 51 a - c)

Annual or perennial, dioecious, rhizomatous herbs. Rhizome c. 5 cm long, non-stoloniferous. Branches monomorphic, all fertile, petiole like, uniphyllous. Leaves dimorphic; sterile leaves submerged and in rosettes, spathulate; petiole winged; lamina ovate or oblong, c. 4 cm long. Fertile leaves floating, shortly petoled, ovate to orbicular, rounded, deeply cordate at base, c. 9 x 6 cm, entire. Flowers in umbellate clusters of 40 or more, unisexual, 1-1.5 cm across. Bracts ovate-acute. Pedicels 2-5 cm long. Male flowers: calyx lobes-

Plate 51. a - c. ***Nymphoides krishnakesara*** Joseph & Sivar.: a. Habit; b. Type specimen at CALI - Male; c. Type specimen at CALI - Female; d. ***Nymphoides macrospermum*** Vasudevan : Habit.

NB 5995 184A

5, c. 0.6 x 0.15 cm, oblong, obtuse or sub-acute. Corolla white, rotate, deeply 5-lobed, c. 1 x 0.2 cm, obtuse, shallowly fimbriate marginal and median wings. Stamens 5, inserted, anthers blue, longer than filaments. Pistillode prominent. Female flower: Calyx and corolla as in male. Pistil bottle-shaped; stigma sessile. Staminodes prominent. Capsule oblong, c. 1 cm long, beaked. Seeds 5-10, obovoid, compressed.

Flowering & Fruiting: August- November.

Habitat: Growing in shallow, temporary ponds on the rocky lateritic hillocks.

Note: Supposed to be a neoendemic species, further surveys are necessary to obtain a clear picture of distribution status.

Specimen examined: Kannur distrct: Madaipara, Payangadi, ± 30 m, 25 Oct. 1988, *Joseph 43001* (Isotype, CALI).

2. **Nymphoides macrospermum** Vasudevan, Kew Bull. 22: 101. 1968; Sivar. & Joseph, Aquatic Bot. 45: 162. 1993; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 300. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 431. 2006; Sunil & Sivad., Fl. Alappuzha 454. 2009.

Type: Kannur district: Badagara, *Joseph 38636* (CAL). (Plate 51 d)

Annual or perennial, dioecious, rhizomatous herbs. Rhizome 1-2 cm long, stoloniferous. Branches dimorphic, all fertile; primary branches petiole like, uniphyllous; secondary branches arising from the nodes of primary barnches, sympodial. Leaves ovate-orbicular, rounded at apex, deeply cordate at base, c. 16 cm across, entire; leaves on secondary branches smaller. Pedicels 2-6 cm long. Flowers unisexual, in umbellate clusters of 25-50 at nodes. Bracts articulate, ovate-obtuse. Pedicels 2-6 cm long. Male flowers: calyx lobes-5, 0.25-0.1 cm, oblong-obtuse. Corolla white, 1-15 cm across, lobes 5, oblong or elliptic, hairy at base and with fimbriate wings along the margins. Stamens 5, anthers pale purple or yellow. Pistillode bottle- shaped with lobed apex. Female flowers: calyx and corolla as in male. Pistil bottle-shaped without a distinct style; stigma yellowish, bifd, lobes fimbriate. Capsule ovoid, c. 0.8 cm long. Seeds 2-6, ovoid-ellipsoid.

Flowering & Fruiting: September-December

Habitat: Flooded paddy fields and low-running streams along the coastal areas.

Note: This species is supposed to be neoendemic because of its extensive distribution and close resemblance with *Nymphoides indica*, a pantropical species. Vasudevan (1968) and Ornduff (1970) also support this view. So further explorations must be made to locate the species in its known distributional areas to confirm its conservation status.

Specimen examined: Kozhikkode district: Badagara, *Joseph 38636* (Holotype, CAL); Kozhikode district, Olavanna, 22 July 2004, *Shaju* 48998 (TBGT).

3. **Nymphoides sivarajanii** Joseph, Willdenowia 20: 135, 1991; Sivar. & Joseph, Aquatic Bot.

45: 167. 1993; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 300. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 431. 2006; Sunil & Sivad., Fl. Alappuzha 455. 2009.

Type: Malappuram district: Chettipadi, *Joseph 30243* (MH).

Annual or perennial, rhizomatous herbs. Rhizome c. 6 cm long, non-stoloniferous. Branches monomorphic, all fertile, petiole like, uniphyllous. Leaves dimorphic; sterile leaves submerged and in rosettes; petiole 0.8-0.15 cm long; lamina ovate or rhomboid, obtuse at apex. Fertile leaves broadly ovate to orbicular-rounded, deeply cordate at base, sinulate, 2-5 x 2-4 cm, entire, pinkish. Flowers bisexual, in umbellate clusters of 5-15 at nodes. Pedicels 2-4 cm long. Calyx lobes 5, 0.4 x 0.1 cm, linear or oblong, pinkish. Corolla white, throat yellow with a ring of long white hairs, lobes 5, c. 0.8 cm long, densely fimbriate along margin. Stamens 5, anthers oblong. Pistil bottle-shaped; style short; stigma single, resembling bottle mouth. Capsule oblong, c. 0.6 cm long. Seeds 15-20, discoid.

Flowering & Fruiting: August-October.

Habitat: Flooded lowlands during rainy season.

Note: Being a local endemic species further explorations are necessary to assess its distribution status.

Specimen examined: Malappuram district: Chettipadi, *Joseph 30243* (Holotype, MH).

30. CONVOLVULACEAE

Table 50. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
60	1650	20	161	13 spp.

Kerala

Genus/genera	Species/subsp./var.
16	74 spp., 3 ssp., 2 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Argyreia Lour.	*A. nellygherrya* Choisy (Karnataka & Tamil Nadu)	
Lepistemon Blume		*L. verdcourtii* Philip Mathew & Biju
Stictocardia Hallier f.		*S. sivarajanii* Biju *et al.*

Key to the genera

1. Corolla urceolate..... **Lepistemon**
1. Corolla funnel-shaped..... **Stictocardia**

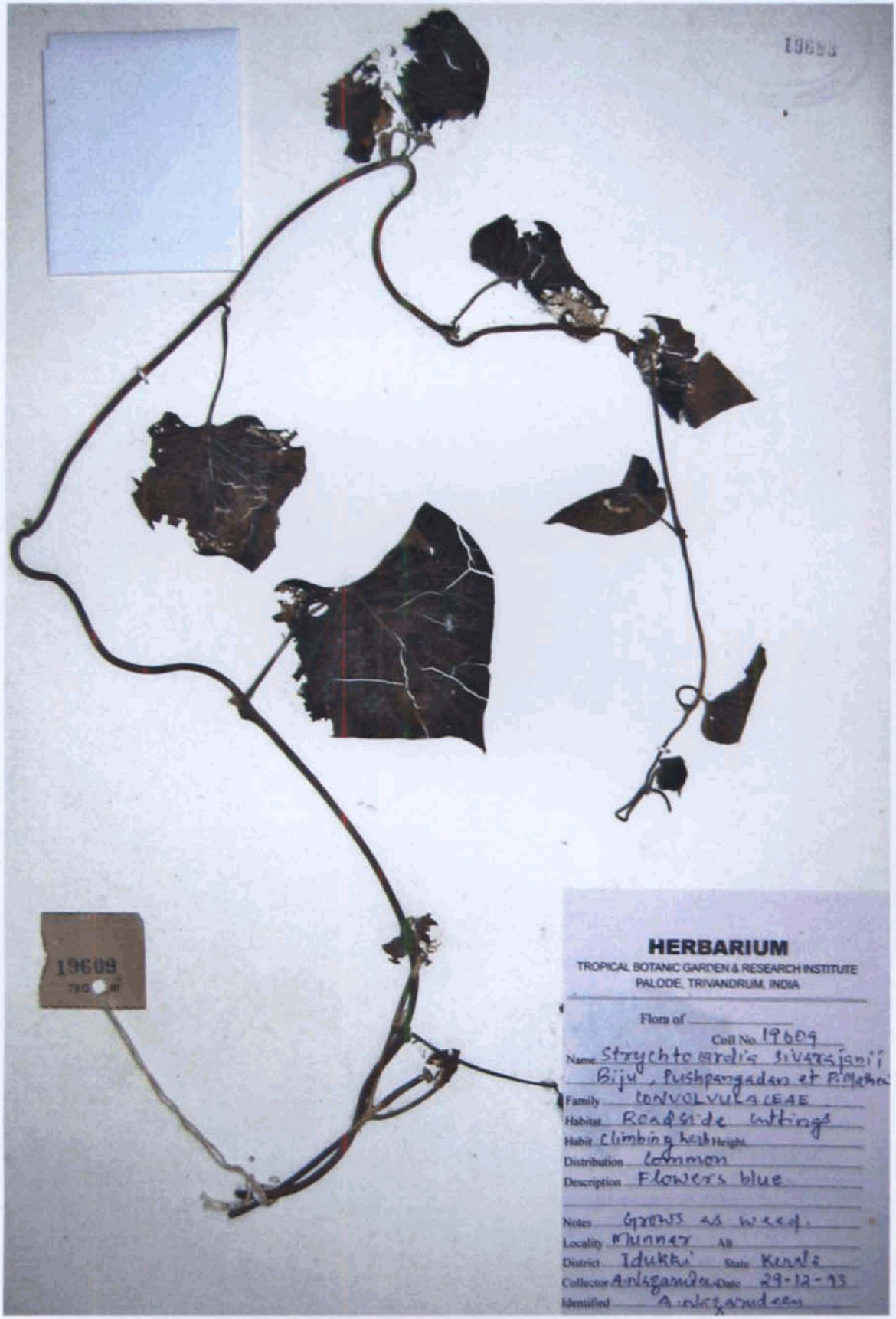

Plate 52. *Stictocardia sivarajanii* Biju *et al.*: Herberium specimen at TBGT.

LEPISTEMON Blume

Bijdr. 722. 1826.

Lepistemon verdcourtii Philip Mathew & Biju, Kew Bull. 46: 560. 1991; Sasidh. & Sivar., Flr. Pl.Trissur For. 311. 1996; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 311. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 199. 2006.

Type: Pathanamthitta district: Konni, *Biju 42198* (CALI).

Large herbaceous twiner. Leaves alternate, long petioled; petiole to 7-5 cm long; lamina ovate-acuminate, mucronate, deeply cordate or hastate at base, 4-9 x 2.5-5 cm, brown-tomentose on both surfaces. Flowers 10-24 in dense, axillary, umbellate, peduncled cymes. Peduncle 2.5-3.5 cm long, densely hairy. Pedicels 0.7-0.8 cm long, glabrous; Bracts small. Calyx 5-partite, lobes ovate, subequal, c. 0.3 x 0.35 cm, obtuse, margins entire, glabrous,. Corolla urceolate, light yellow, tube 1.4-1.6 cm long, inflated at base; lobes 5, short, strongly plaited, glabrous. Disc of 5 scales. Stamens 5, attached to the base of the disc-lobes. Ovary conical, 2-celled, 4-ovuled; style short; stigma 2-lobed, papillose. Capsule dorsoventrally compressed, 2-3.5 x 5-6 cm, deeply-4 lobed. Seeds 4, ovoid, greyish brown-tomentose.

Flowering & Fruiting: January-April.

Habitat: Among reeds in semi-evergreen forests.

Note: It is necessary to locate this species from the type locality and adjacent areas for further assignment of status and conservation efforts.

Specimen examined: Pathanamthitta district: Konni, *Biju 42198* (Isotype, CALI).

STICTOCARDIA Hallier f.

Pl. Coromandel 2: 1802.

Stictocardia sivarajanii Biju, Pushpangadan & Philip Mathew, Novon 9: 147. 1999; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 313. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 202. 2006.

Type: Idukki district, Kallar, ± 4000 m, *Biju 22013* (TBGT) (Plate 52)

Twining shrub. Leaves ovate to ovate-deltoid, shortly mucronate, to 20 x 17 cm, dorsal surface purplish violet. Flowers axillary or 2-3 flowered cymes. Peduncle up to 15 cm long. Bracts 2, smll, ovate-elliptic. Calyx 5, subequal, outer 2 larger, 1-1.5 x 0.7-1 cm, ovate to orbicular with non-ciliate margins, gland dotted, sparsely pubescent; middle 2 medium-sized, ovate-elliptic; inner one small, suborbicular. Corolla reddish puple with a dark centre, funnel shaped, tube up to 3.5 cm long, limb slightly lobed 5-7 cm across. Stamens inserted; filaments attached above the corolla base, filiform, purplish red ciliolate at base. Disc small, annular. Ovary conical; style subexerted; stigma biglobose, papillose. Fruits capsular, 1-1.5 x 0.8-1 cm,

indehiscent, depressed globose. Seeds 1- 4, globose, covered with minute hairs.

Flowering & Fruiting: October-February.

Habitat: Near stream sides in the semi-evergreen fortests and road sides.

Note: Being a local endemic species further explorations must be made to locate the species in its known distributional areas to confirm its conervation status.

Specimens examined: Idukki district: Kallar, ± 4000 m, *Biju 22013* (Paratype, TBGT); *Ibid.*, Munnar, 29 Dec. 1993, *Nazarudeen 19609* (TBGT).

31. SCROPHULARIACEAE

Table 51. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
275	5000	57	*c.* 353	14 spp., 2 var.

Kerala

Genus/genera	Species/subsp./var.
25	68 spp., 2 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Adenosma R.Br.		*A. malabaricum* Hook. f.
Limnophilla R. Br.	*L. glandulifera* Philcox (Tamil Nadu)	
Lindernia All.	*L. manilaliana* Sivar. (Karnataka)	*L. tenuifolia* var. *pygmaea* Sivar. & Philip Mathew
Pedicularis L.	*P. perrottetti* Benth. (Tamil Nadu)	
Rhamphicarpa Benth.	*R. longiflora* (Arn.) Benth. (Maharashtra &Karnataka)	
Torenia L.	*T. lindernioides* Saldanha (Karnataka)	

Key to the genera

1. Stamens 2; staminodes 2..... **Lindernia**
1. Stamens 4; Staminodes 0..... **Adenosma**

ADENOSMA R. Brown

Prodr. 442.1810.

Adenosma malabaricum Hook. f., Fl. Brit. India 4: 264.1884; Gamble, Fl. Pres. Madras 949

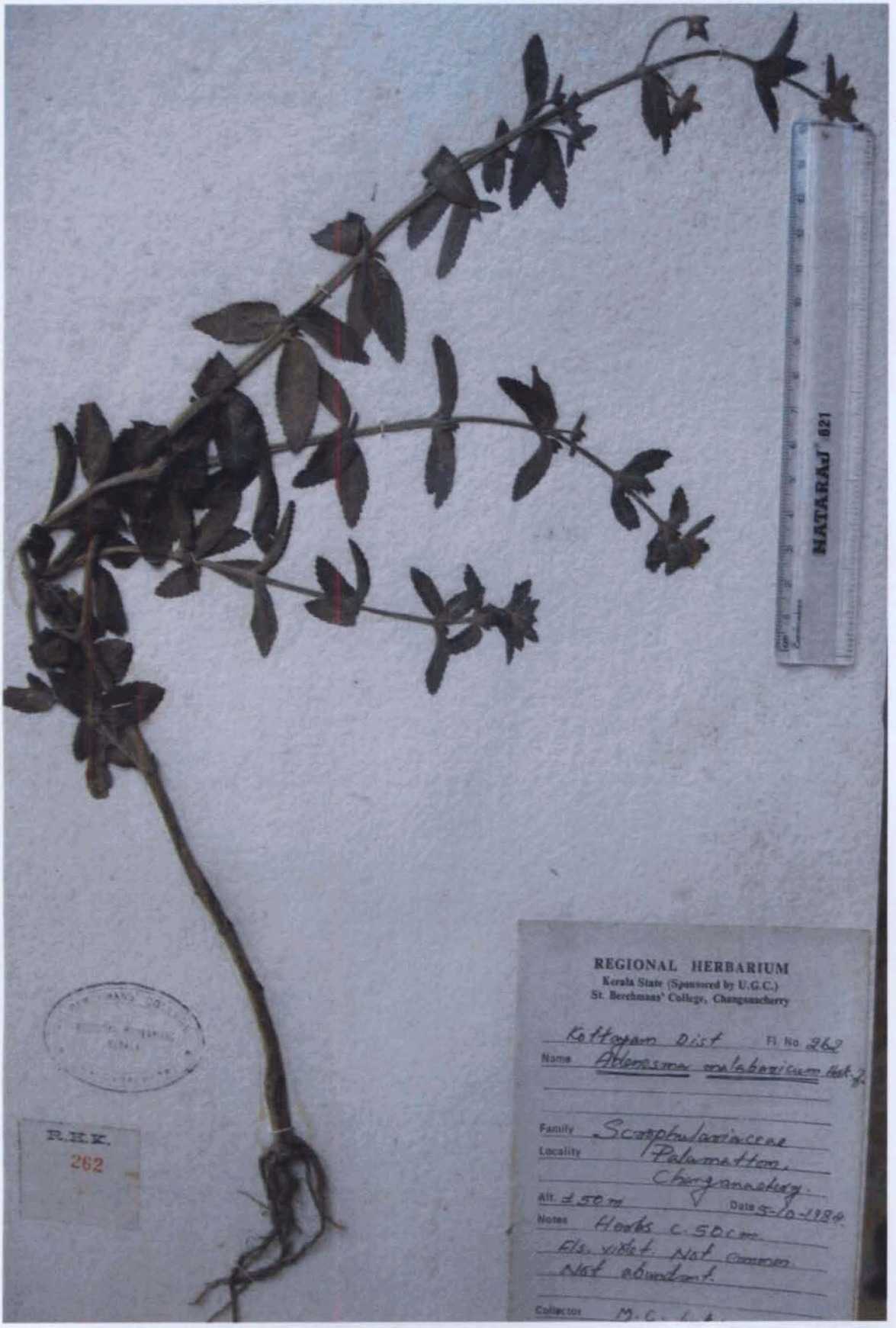

Plate 53. ***Adenosma malabaricum*** Hook. f.: Herbarium specimen at CMS College.

NB 5495

(666). 1923; V. S. Ramach. & V. J. Nair, Fl. Cannanore 314.1988; Antony, Fl. Kottayam 277. 1998; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 319. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 567. 2006.

Type: 'Malabar' *Wight s.n.* (K) (Plate 53)

Erect herbs, up to 25 cm tall. Leaves up to c. 3 x 1.3 cm, ovate, acute, cuneate, sparsely ciliate. Flowers axillary below, upper most in leaefy heads. Calyx lobes c. 1.7 cm long, lanceolate, hirsute. Capsule c. 1.5 cm long, ellipsoid. Seeds minutely dotted in lines.

Flowering & Fruiting: August-October.

Habitat: Reverine

Note: First collected by Wight from Malabar region; detais of the type collection has not be included due to nonavailability of type specimen. The species was relocated by Antony (1984) from Kottayam district. An extremely rare low wetland species, which is botanically interesting due to its narrow endemic characteristics and habitat specificity. The species warrants further treatment inorder to streamline typification process and to assign conservation status.

Specimen examined: Kottayam district: Changanassery, Palamattom, ± 50m, 5 Oct. 1984, *Antony 262* (S B College herbarium).

LINDERNIA Allioni

Melanges Philos. Math. Soc. Roy.
Turin. (Misc. Taur.) 3(1): 178.1766.

Lindernia tenuifolia var. **pygmaea** Sivar. & Philip Mathew, J. Bombay Nat. Hist. Soc. 80: 135. 1983; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 325. 2004; T. S. Nayar *et al.*, Flr. Pl. of Kerala - A Handb. 574. 2006.

Type: Kozhikode district: Kallai, *Sivarajan 1368* (CAL).

Erect tufted herbs, 3-5 cm long. Leaves linear, apparently acicular. Flowers axillary or leaf-opposed, solitary, pale blue, much smaller than of the typical form; pedicels almost as long as capsule, deflexed in fruit. Caspsule linear, c. 0.5 cm long.

Flowering & Fruiting: July-September.

Habitat: Marshy areas.

Note : A neoendemic wetland variety known only from type collection, further studies are necessary to ascertain its conservational status.

Specimen examined: Kozhikode district: Kallai, *Sivarajan, 1368* (Isotype, CALI).

32. OROBANCHACEAE

Table 52. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
90	2000	9	*c.* 55	5 spp.

Kerala

Genus/genera	Species/subsp./var.
2	8 spp

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Christisonia Gardner	*C. calcarata* Wight (Maharashtra)	*C. keralensis* Erady
		C. indica Anilkumar

CHRISTISONIA G. Gardner

Calcutta J. Nat. Hist. 8: 153. 1847.

Key to the species

1. Inflorescence 2-3-flowered; peduncles up to 4 cm long ..... 1. *C. indica*

1. Inflorescence 5-10-flowered; peddunclesl 10-20 cm long ..... 2. *C. keralensis*

Christisonia indica Anilkumar, J. Econ. Taxon. Bot. 30: 285. 2006.

Type: Idukki district: Mannavan shola, Onnamkurukku, 1850 m, 2 Oct. 1995, *Anilkumar 104824* (MH).

Parasitic herbs. Stem solitary or branched, up to 18 cm high; scales alternate, acute or subacute. Inflorescence racemose, 3-4-flowered, erect or curved; peduncles c. 4 cm long; bracts ovate to oblong. Flowers hypogynous, zygomorphic, bisexual, few, c. 3.1 x 2.6 cm. Calyx campanulate, broader, conceals most of corolla-tube, straight c. 3.2 cm long, including lobes; tube c. 2.5 cm long, ivory-coloured, partly enclosing corolla tube; lobes 5, free, valvate, ovate, c. 0.07 x 0.07 cm, acute, glabrous. Corolla infundibuliform, slightly curved, 5-lobed; lobes free, subequal, c. 2 x 1.5 cm; posterior petal obscurely 2-lipped, usually yellowish white or pale rose, rounded; upper 2 suberect; lower spreading, glabrous. Stamens 4, included, didynamous; filaments stout; anthers dorsifixed; spur of the longer stamen erect, acuminate at apex; of shorter stamen spurred, comma or sickle-shaped. Ovary unilocular, pyriform, glabrous; style

terete; stigma bilobed; ovules numerous. Disc not distinct. Fruit a capsule, pyriform, c. 1.4 x 1.8 cm, unilocular, enclosed in persistent calyx. Seeds minute, numerous.

Flowering & Fruiting: July-September.

Habitat: Parasitic on roots of *Strobilanthes kunthiana,* in wet and moist areas.

Note: Known to occur only in small populations. It is therefore necessary to identify more areas of its occurrence towards planning further conservation management.

Specimen examined: Idukki district: Mannavan shola patches and 3rd mile, Onnamkurukku, 1850 m, 2 Oct. 1995, *Anilkumar 104824* (Holotype, MH)

Christisonia keralensis Erady, J. Bomby Nat. Hist. Soc. 64: 10. 1967; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 328. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 469. 2006.

Type: Palakkad district: Nelliampathy, ± 500 m, 17 Aug. 1960, *N.A.Erady 1117* (Govt. Victoria College, Herbarium).

Parasitic herbs. Rhizome 2-8 cm long, irregularly cylindrical with small sparsely arranged deltoid scale leaves which become progressively large above. Inflorescence solitary and terminal or rarely 2-3 arising from the axils of scale leaves. Racemes 5-10-flowered. Peduncle 20-30 cm long, light brownish pink. Bracts 1-1.5 x 0.5-0.8 cm, glabrous. Pedicels 1.5-3 cm long. Flowers 3.5-5 cm long, ebracteolate, bisexual, hypogynous and zygomorphic. Calyx 2.5-3.8 x 1.2-1.5 cm, brownish pink, glabrous, tubular, companulate, tube split at the tip into 5 subequal triangular valvate lobes with acute apex. Corolla tube 3.5-5 x 1-1.3 cm, creamy white, glandular hairy on both sides, prolonged much above the level of the calyx lobes, slightly bent towards the anterior side, lower surface closely appressed to the ovary, upper half inflated, yellowish throughout with orange tinge, tube expanding into a sub-bilabiate 5- lobed limb; lobes bright violet, orbicular. Stamens 4, imperfectly didynamous; filaments light purplish, glandular hairy through out; anthers 2-celled, pale purplish. Ovary 2; ovules many; style glabrous; stigma peltate.

Flowering & Fruiting: August-September.

Habitat: Parasitic on roots of *Ficus asperrima.*

Note: The type specimen (*N. A. Erady 1117)* of this species was deposited in the Herbarium of Govt. Victoria College, Palakkad and it was mentioned in the protalouge. But the specimen could not be located there. With the available literature a brief account of description is provided.

So far not figured in any of the IUCN category; owing to narrow distribution assumes conservation status.

33. LENTIBULARIACEAE

Table 53. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
3	245	2	32	7 spp.

Kerala

Genus/genera	Species/subsp./var.
1	24 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Utricularia L.	*U. cecillii* P. Taylor (Karnataka)	*U. subramanii* Janarth. & A. N. Henry
	U. lazulina P. Taylor (Goa & Karnataka)	
	U. malabarica Janarth. & A. N. Henry (Maharashtra & Goa)	
	U. nayarii Janarth. & A. N. Henry (Taiml Nadu)	
	U. smithiana Wight (Karnataka & Tamil Nadu)	
	U. wightiana P. Taylor (Karnataka & Tamil Nadu)	

UTRICULARIA Linnaeus

Sp. Pl. 18. 1753.

Utricularia subramanii Janarth. & A. N. Henry, J. Bombay Nat. Hist. Soc. 87: 441. 1990; Janarth. & A. N. Henry, Bladd. India 112.1992; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 331. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 383. 2006.

Type: Kollam district: Pathanamthitta, 30 Jul 1978, *C. N. Mohanan 58342* (MH (Plate 54)

Herbs. Rhizoids up to c. 0.8 cm long, thick at base, tapering towards apex, glandular; stolons filiform; Racemes up to c. 15 cm long, erect, glabrous, 2-5-flowered; scales c. 0.12 x 0.08 cm, basifixed, ovate, 3-nerved, acute to acuminate at apex; bracts c. 0.15 x 0.12 cm, basifixed, ovate, 3-nerved, acuminate at apex; bracteoles c. 0.1 cm long, subulate to linear. Flowers up to 0.07 cm long; pedicels up to 0.25 cm long, shorter than calyx lobes, erect, winged. Calyx lobes subequal, ovate, denticulate; upper lobe c. 0.3 x 0.22 cm, acute to acuminate at apex; lower lobe c. 0.24 x 0.2 cm, 2-4 dentate at apex. Corolla yellow, upper lip c. 0.3 cm long, cucullate, crested

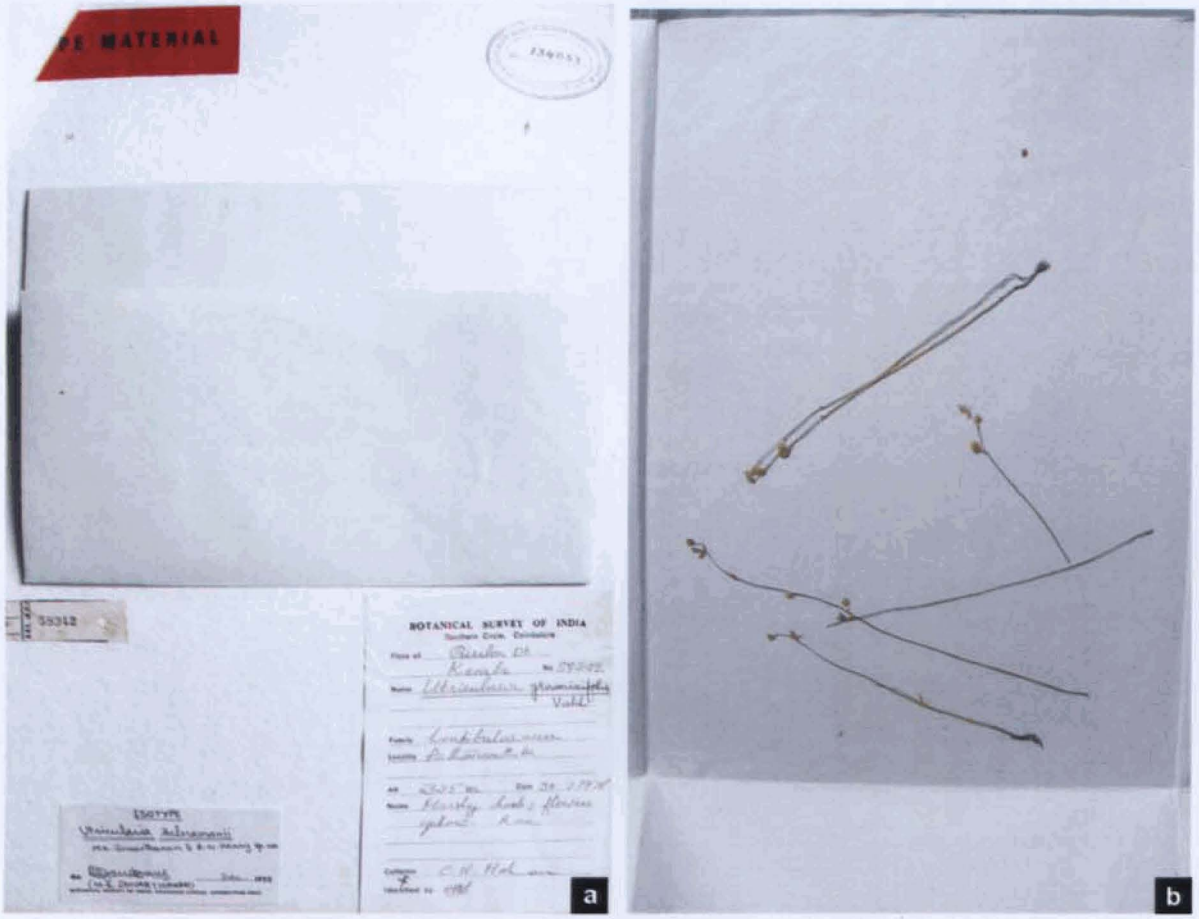

Plate 54. a & b. ***Utricularia subramanii*** M. K. Janarth. & A. N. Henry: Type specimen at MH: a. Herbarium with label and folded paper packet containing specimens; b. Paper packet opened showing specimens.

CNB-5995

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at middle on ventral side, hairy along the margins, obtuse at apex; lower lip obovate, c. 0.3 x 0.2 cm, gibbous at base, rounded at apex, ligulate, ligule fimbriate along margin. Spur conical, acute. Stamens short; filaments linear; anther thecae distinct. Ovary ovoid; style thick; stigma 2-lipped. Capsule ovoid, c. 0.25 x 0.18 cm, membranous. Seeds oblongoid.

Flowering & Fruiting: September-December.

Habitat: Marshy areas.

Note: This species was collected by C. N. Mohanan in 1978 from Pathanamthitta, which was part of erstwhile Kollam district, and originally identified as *Utricularia graminifolia* Vahl, during his floristic studies of Kollam district. Janarthanam and Henry, during the study of bladderworts of India, came across this specimens and found that they represent a distinct taxon closely related to *Utricularia bifida* L.; but the presence of ligule on lower lip of corolla, made them to recognise as a new species (Janarthanam and Henry, 1988). This species has not been collected after the type collection. It is necessary to locate this species from its possible localities and assess its status and take appropriate conservation measures.

Specimen examined: Kollam district: Pathanamthitta, 30 Jul. 1978, *C. N. Mohanan 58342* (Holotype & Isotype, MH).

34. GESNERIACEAE

Table 54. Profile of Distribution and Endemism

India

Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
150	3200	20	114	7 spp.

Kerala

Genus/genera	Species/subsp./var.
6	15 spp., 1 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Didymocarpus Wallich	*D. fischeri* Gamble (Tamil Nadu)	*D. macrostachya* Barnes
	D. missionis Wallich ex R. Br. (Tamil Nadu)	
	D. ovalifolia Wight (Tamil Nadu)	
	D. repens Bedd. (Tamil Nadu)	
	D. wightii (Clarke) Gamble (Tamil Nadu)	
Jerdonia Wight	*J. indica* Wight (Karnataka & Tamil Nadu)	

DIDYMOCARPUS Wallich

Edinburgh Philos. J. 1: 378. 1819, nom. cons.

Didymocarpus macrostachya Barnes, Bull. Misc. Inform. Kew 1938: 37. 1938; Sebastine, Bull. Bot. Surv. India 4: 221. 1962; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 332. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 343. 2006.

Type: Munnar, Ottaparai Ridge, 5500 ft., *E. Barnes 1264* (K).

Perennial scapigerous herbs. Leaves radical in rosette, oblong to narrowly ovate, tapering or abruptly narrowed to the base without any definite petiole, 11-17 x 4-7 cm, apex rounded, margins obscurely crenate, dull-green and velvety with a dense mat of curved hairs above, pale brown below; lateral nerves 5-6 pairs. Scapes 1 or more, rather stout, erect, grooved on 2 opposite sides, up to c. 44 cm long, densely pale brown tomentose. Calyx lobes ovate, obtuse, c. 0.6 x 0.3 cm, narrow, glabrous within, densely tomentose without. Corolla broadly companulate, c. 1 x 1.9 cm, mouth oblique; lobes orbicular, pale-blue, downy without and dotted with small, sessile, yellow glands. Stamens included. Ovary tomentose. Capsules linear, stout, up to 1.5 cm long, light-brown, tomentos. Seeds minute, ovoid, flattened.

Flowering & Fruiting: September.

Habitat: Exposed rocks at higher altitudes.

Note: This species was described by E. Barnes (Coll. No. *1264*-K) based on his collection from Ottaparai Ridge, at an alt. 5500 ft., near Munnar. Subsequent workers could not recollect even after intensive exploratory surveys in this area. The main cause of its depletion is clearing of forests for plantation crops. Nayar (1997) treated this species under 'Possibly extinct' Category. With the available literature a brief account of description is provided.

35. BIGNONIACEAE

Table 55. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
116-120	650-750	12	65	1 var.

Kerala	
Genus/genera	Species/subsp./var.
6	9 spp., 1 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Stereospermum Cham.		*S. colais* var. *shendurunii* Sasidh.

STEREOSPERMUM Chamisso

Linnaea 7: 720. 1833 ('1832').

Stereospermum colais var. **shendurunii** Sasidh., Sujanapal & Binoy, Rheedea 16: (1): 37. 2006.

Type: Kollam district: Kulathupuzha, Sangili, 19 Mar. 1993, *Sasidharan 10300* (KFRI) (Plate 55 a & b)

Trees. Leaves imparipinnate, opposite, rachis 10-30 cm long; leaflets 7-9, opposie or subopposite; lamina 8-18 x 3-7 cm, elliptic-lanceolate, ovate, ovate-oblong, base obliquely cuneate or rounded, apex acuminate or caudate-acuminate, midrib pubescent. Panicle terminal, erect, peduncle stout, to 30 cm long. Flowers c. 5 cm across. Calyx companulate, lobes 4-5, unequal, tube 1.2-1.5 cm long. Corolla, c. 5 cm across, 5-lobed, 3 dorsal lobes with 3 red lines, 2 ventral lobes partially united, a purple blotch at the mouth of the corolla tube, throat yellowish inside, tube dark pink outside. Stamens 4, didynamous; filaments unequal, simple and glandular hairs below; anthers basifixed. Ovary oblong, glabrous; style terminal; stigma bilobed, clavate. Capsule, 20-80 cm long, pendulous, 4-angled, smooth, tapering at both ends, epicarp thick and woody. Seeds many, 2-winged.

Flowering & Fruiting: March-August.

Habitat: Reverine forests.

Note: This variety of *Stereospermum colais* (Buch.-Ham. ex Dillwyn) Mabberly, is characterised by larger and pink corolla, ovate-acute calyx and simple, glandular haired filaments.

Being a palaeoendemic tree variety, it is phytogeographically interesting and which should get more priority in conservational operations.

Specimen examined: Kollam district: Kulathupuzha, Sangili, 19 Mar. 1993, *Sasidharan 10300* (Isotype, KFRI).

36. ACANTHACEAE

Table 56. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
250	2500	70	344	64 spp., 20 var.

Kerala	
Genus/genera	Species/subsp./var.
36	173 spp., 17 var.

Plate 55. a & b. ***Stereospermum colais*** var. ***shendurunii*** Sasidh. *et al.*:
a. Type specimen at CALI - Flowering twig;
b. Type specimen at CALI - Fruiting twig.

DIB 5995. 195 A

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Andrographis Wallich ex Nees	*A. atropurpurea* (Dennst.) Alston ex Mabb. (Karnataka & Tamil Nadu)	*A. chendurunii* Santhosh Kumar *et al.*
	A. explicata (Clarke) Gamble (Maharashtra, Karnataka & Tamil Nadu)	
	A. lawsonii Gamble (Karnataka & Tamil Nadu)	
	A. neesiana Wight (Karnataka & Tamil Nadu)	
	A. producta (Clarke) Gamble (Karnataka & Tamil Nadu.	
Asystasia Blume	*A. trvancorica* Bedd. (Tamil Nadu)	
Blepharis Juss.	*B. lawsonii* G. S. Giri & R. N. Banerjee (Tamil Nadu)	
Calacanthus T. Anderson ex Benth. & Hook. f	*C. grandiflorus* (Dalz.)Radlk. (Maharashtra, Goa, Karnataka & Tamil Nadu)	
Diotacanthus Benth.	*D. albiflorus* (Bedd.) Benth. (Karnataka & Tamil Nadu)	
	D. grandis (Bedd.) Benth. (Karnataka & Tamil Nadu)	
Ecbolium Kurz		*E. ligustrinum* var. *arayankavensis* Remadevi & Binojkumar
Eranthemum L	*E. capense* var. *concanense* (Clarke) Santapau (Karnataka)	
	E. roseum (Vahl) R. Br. (Maharashtra, Goa, Nagar Haveli, Karnataka & Tamil Nadu)	
Gymnostachyum Nees	*G. canescens* (Nees) T. Anderson (Karnataka & Tamil Nadu)	*G. febrifugum* var. *bracteatum* Ramach.
	G. febrifugum Benth. var.*febrifugum* (Karnataka)	*G. latifolium* var. *decurrens* Gamble
	G. latifolium (Dalz.) T. Anderson	*G. sahyadricum* C. N.

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	var. *latifolium* (Maharahtra, Goa, Karnataka & Tamil Nadu)	Mohanan *et al.*
	G. polyanthum Wight(Karnataka & Tamil Nadu)	
Haplanthodes Kuntze	*H. neilgherryensis* (Wight) R. Majumdar (Maharahtra, Goa, Karnataka & Tamil Nadu)	
	H. plumosus (T. Anderson) Panigr. & G. C. Das (Maharashtra, Karnataka & Tamil Nadu)	
Justicia L.	*J. trinervia* Vahl (Maharashtra, Goa, Karnataka & Tamil Nadu)	*J. ekakusuma* Pradeep & Sivar.
	J. wynadensis (Nees) Heyene ex T. Anderson (Karnataka)	*J. pathanamthittiensis* Remadevi & Binojkumar
Lepidagathis Willd.		*L. keralensis* Madhus. & N. P. Singh
		L. balakrishnanii Remadevi & Binojkumar
Ruellia L.		*R. sivarajanii* Sreedevi *et al.*
Rungia Nees	*R. crenata* T. Anderson (Maharashtra, Goa, Karnataka & Tamil Nadu)	
Stenosiphonium Nees	*S. setosum* T. Anderson (Karnataka & Tamil Nadu)	
	S. wightii Bremek. (Tamil Nadu)	
Strobilanthes Blume	*S. amabilis* Clarke (Tamil Nadu)	*S. dupenii* Bedd.
	S. anamallica Wood (Tamil Nadu)	*S. barbatus* var. *bonaccordensis* Santhosh Kumar *et al.*
	S. andersonii Bedd. (Tamil Nadu)	
	S. aurita Wood (Karnataka)	*S. pushpangadanii* Santhosh Kumar *et al.*
	S. decurrens Nees (Karnataka & Tamil Nadu)	
	S. gambeli Carine *et al.* (Karnataka)	
	S. integrifolius Kuntze (Maharashtra & Karnataka)	
	S. newii Bedd. ex Clarke (Karnataka)	
	S. papillosus T. Anderson (Tamil Nadu)	

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	S. rubicundus (Nees) T. Anderson (Karnataka & Tamil Nadu)	
	S. sessilis var. *sessiloides* (Wight) Clarke (Maharashtra, Karnataka & Tamil Nadu)	
	S. sexennis var. *homotropa* (Nees) Wood (Tamil Nadu)	
	S. violacea Bedd. (Tamil Nadu)	
	S. warrensis Dalz. (Maharashtra & Karnataka)	
	S. wightianus Nees (Tamil Nadu)	
Thunbergia Retz	*T. bicolor* (Wight) Lindau (Tamil Nadu)	

Key to the genera

1. Fertile stamens 4.
   2. Bracts many, spine-tipped..... **Lepidagathis**
   2. Bracts few, non spine-tipped.
      3. Flowers in spikes or panicles..... **Strobilanthes**
      3. Flowers in dichasial cymes..... **Ruellia**
1. Fertile stamens 2.
   4. Ovules 3-10 per locule; seeds 4-6 or more per capsule.
      5. Capsule cylindric or subterete..... **Gymnostachyum**
      5. Capsule compressed..... **Andrographis**
   4. Ovules 2 or 1-per locule. Seeds 1-2 per capsule
      6. Anther cells divergent or superposed; connective broad ..... **Justicia**
      6. Anther cells parallel, connective narrow ..... **Ecbolium**

ANDROGRAPHIS Wallich ex C.G.D. Nees

in Wallich, Pl. Asiat. Rar. 3: 77, 116.1832.

Andrographis chendurunii Santhosh Kumar, Shanavas & Seema, Nordic J. Bot. 22: 683.2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 10. 2006.

Type: Kollam district: Pandimotta, ± 950 m, 11 Jan. 1994, *Santhosh Kumar 19173* (TBGT).

(Plate 56 a)

Perennial herbs. Stem creeping, quadrangular. Leaves 6-12 x 2-5 cm, broadly ovate-obovate or elliptic-oblanceolate, acute to cuneate at base, acute to shortly acuminate at apex, glabrous. Petiole c. 2 cm long. Flowers in branched terminal panicles, 20-45 cm long. Peduncle stout, minutely hairy. Baracts and bracteoles ovate-subulate. Pedicels slender, glandular hairy. Calyx 5-lobed to the base, lobes 0.25-0.3 cm long, glandular hairy without and glabrous within. Corolla greenish white, tubular, tube c. 0.65 cm long, 2-lipped; upper 2-lobed, lower lower lip 3-lobed, c. 0.5 x 0.35 cm, ovate-oblong obtuse or rounded at apex, all spotted reddish brown at base. Stamens 2, exerted; filaments not dilated; anther cells glabrous. Ovary ovate-oblong; style slender; stigma bifid. Capsule linear-obovate, c. 0.7 cm long, glabrous, dorsally compressed. Seeds 4-6.

Flowering & Fruiting: December-February.

Habitat: Evergreen forests.

Note: A local endemic species with significantly small populations occur in the reported area. It is therefore necessary to identify more areas of its occurrence towards planning further conservation management.

Specimen examined: Kollam district: Pandimotta, ± 950 m, 11 Jan. 1994, *Santhosh Kumar 19173* (Holotype & Isotype, TBGT)

ECBOLIUM S. Kurz.

J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 40: 755.1875.

Ecbolium ligustrinum var. **aryankavensis** Remadevi & Binoj Kumar, J. Econ. Taxon. Bot. 27: 1189. 2003; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 18. 2006.

Type: Kollam district, Aryankavu, , 22 Sep. 2001, *Remadevi 325* (MH).

Shrubs. Stem woody. Leaves elliptic, c. 17 x 6 cm, glabrous, entire, acute at apex, attenuate at base. Inflorescence terminal in fascicles. Bract lanceolate, elliptic, dark purple, entire, mucronate, acute, margin ciliate. Calyx lobes 5, 0.4-0.6 x 0.1 cm, basal part green and upper part reddish brown, ciliate and glandular hairs present. Corolla pale yellowish green, tube c. 4 cm long, lobes of lower lip c.1.5 x 0.9 cm. Stamens 2, attached near the throught of the tube, filaments sparsely hairy. Ovary 2-ovuled; style filiform, ciliate; stigma 2-fid. Capsule ellipsoidal, compressed ciliate, 2-2.5 x 1-1.5 cm. Seeds 2.

Flowering & Fruiting: December-January.

Habitat: Dry-deciduous forests.

Note: As a local endemic species, distribution status of this exclusive endemic species should be studied.

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Specimen examined: Kollam district, Aryankavu, 22 Sep. 2001, *Remadevi 325* (Isotype, SDCH).

GYMNOSTACHYUM C.G.D. Nees

in Wallich, Pl. Asiat. Rar. 3: 76, 106.1832.

Key to the species

1. Scapigerrous herbs..... 1. *G. febrifugum* var. *bracteatum*
1. Subshrubs.
   2. Leaves decurrent at base..... 2. *G. latifolium* var. *decurrens*
   2. Leaves not decurrent at base..... 3. *G. sahyadricum*

1. **Gymnostachyum febrifugum** var. **bracteatum** V. S. Ramach. & V. J. Nair, Fl. Cannanore 336. 1988; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 342. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 19. 2006.

Type: Kannur district; Kannoth, ± 250 m, 19 Aug. 1979, *Ramachandran 64012* (MH).

Scapigerous herbs. Leaves large, broadly ovate, 30 x 11 cm, rounded at the base, decurrent on the petiole, margin subentire or undulate, crenulated, lineolate above, nearly glabrous. Petioles c. 9 cm long. Panicles up to 25 cm long. Flowers solitary or in short recemes, 2.5-3 cm long. Bracts ovate-cordate, foliaceous, conspicuous. Calyx lobes c. 0.3 cm long, puberulous. Corola pink, yellow at mouth, c. 2.5 cm long, upper half inflated. Stamens 2. Ovary 2-locular. Capsule c. 2 cm long, glabrous.

Flowering & Fruiting: August-September.

Habitat: Undergrowth in evergreen forests.

Note: Supposed to be a local endemic variety, further explorations are necessary to obtaoin a clear picture of its distribution status.

Specimen examined: Kannur district: Kannoth, ± 250 m, 19 Aug. 1979, *Ramachandran 64012* (Holotype, MH).

2. **Gymnostachyum latifolium** var. **decurrens** Gamble, Fl. Pres. Madras 1053(738). 1924; V. S. Ramach. & V. J. Nair, Fl. Cannanore 337. 1988; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 343. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 19. 2006.

Type: Kannur district, Chandanathode, Kottiyoor, ± 800 m, 13 Nov. 1979, *Ramachandran 64048* (MH).

Undershrubs. Leaves c. 20 x 5 cm, broadly ovate, acute, truncate at base. Flowers pale greenish yellow in axillary recemes or panicles. Calyx lobes small, decurrened at base. Capsule up to c. 2 cm long, lnear, bluntly pointed, glabrous.

Flowering & Fruiting: November-December.

Habitat: Undergrowth of evegreen forests.

Note: It is necessary to locate this narrow endemic variety from type locality and adjacent areas and efforts should be made for conservation activities.

Specimen examined: Kannur district: Chandanathode, Kottiyoor, ± 800 m, 13 Nov. 1979, *Ramachandran 64048* (MH).

3. **Gymnostachyum sahyadricum** C. N. Mohanan, Remadevi & Binojkumar, J. Econ. Taxon. Bot. 26: 38. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 343. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 19. 2006.

Type: Kollam district: Chokkampatty hills, 23 Mar. 1990, C. N. *Mohanan 73469* (MH).

Subshrubs; branchlets quadrangular, glandular hairy. Leaves opposite 4-16 x 3-3.5 cm, ovate, acuminate at apex, tapering toward base, subcoriaceious, margin entire glabrous, lateral veins 8-9 pairs. Panicles c. 3 cm long, axillary and terminal, first trichotomously branching and then as unilateral cymes. Bracts and bractioles c. 1.5 cm long, linear-lanceolate, pubescent. Calyx linear-lanceolate, pubescent on both surfaces, glandular outside. Corolla lobes subequal. Stamens 2. Ovary 2-celled. Capsule c.1.2 cm, linear, glandular, c.16-seeded; retinacula curved.

Flowering & Fruiting: February-April.

Habitat: Montane forests.

Note: As a neoendemic species, further explorations must be made to locate the species in its known distributional areas to confirm its conservation status.

Specimen examined: Kollam district: Mokkampatty hills, *Mohanan 73469* (Holotype, MH).

JUSTICIA Linnaeus

Sp. Pl. 15. 1753

Key to the species

1. Leaves ovate or elliptic; flowers axillary ..... 1. *J. ekakusuma*
1. Leaves linear-elliptic; flowers terminal ..... 2. *J. pathanamthittiensis*

1. **Justicia ekakusuma** Pradeep & Sivar., Rheedea 1: 40. 1991; Sasidh., Biodive. Doc. Kerala, Part 6, Flr. Pl. 345. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 22. 2006.

Type: Kannur district: Payangadi, Madaipara, ± 50 m, 30 June 1990, *Pradeep 50401* (MH). (Plate 56 b)

Small, erect, branched annual herb. 5-7 cm tall. Leaves 0.5-0.6 x 0.4-0.5 cm, ovate or elliptic, entire, glabrous or with scattered, minute hairs, acute or subacute at apex, cuneate at

base. Petiole short, minutely puberulous. Flowers sessile, axillary, solitary. Bracteoles 2, glabrous, linear or spathulate. Calyx divided nearly to base, segments 4, c. 0.3 cm long, linear-lanceolate. Corolla pink , 0.4 cm long; tube 0.2 cm; upper lip erect, ovate, 0.2 x 0.15 cm, bilobed at apex; lower lip 0.2 x 0.2 cm, minutely 3-lobed. Stamens 2, filaments flattened. Ovary ellipsoid. Capsules 0.4-0.5 cm long, black at maturity, cylindric with a constriction near the middle. Seeds 2, ovate, prominently ribbed.

Flowering & Fruiting: August-September.

Habitat: Growing in wet lateritic rocks.

Note: As local neoendemic species, it deserves further evaluation to obtain conservation status.

Specimen examined: Kannur district: Payangadi, Madaipara, ± 50 m, 30th June 1990, *Pradeep 50401* (Holotype, MH).

2. **Justicia pathanamthittiensis** Remadevi & Binojkumar, J. Econ. Taxon. Bot. 32: 660. 2008.

Type: Pathanamthitta district: Thannithode, 23 Nov. 2003, *Ramadevi 61* (CALI).

Herbs; stem straggling, branched from base, quadrangular, minutely pubescent or glabrous; petioles c. 0.5 cm long. Leaves linear-elliptic, 3.5-4.5 x 1-1.2 cm, attenuate, margin entire, acute, hirsute. Inflorescence terminal spikes, 0.5-1.5 cm long, sessile or subsessile; bract foliaceous, obovate, highly hirsute; bracteoles 2, lanceolate, acute, hirsute. Calyx divided nearly to base, segments 4, c. 0.3 cm long, linear-lanceolate. Sepals 4, c. 0.1 x 0.1 cm, green-banded along the midrib, white-membranous along margins, hirsute. Corolla bilipped; lobes pale pink; corolla tube cream-coloured, bristle-like hairs on the top of the lobes. Stamens 2. Ovary 0.2-0.3 cm long, glabrous; stigma capitate.

Flowering & Fruiting: November-April.

Habitat: Gravelly soil in moist areas and in teak plantations.

Note: Supposed to be a local endemic species, further explorations are necessary to obtaoin a clear picture of its distribution status.

Specimen examined: Pathanamthitta district: Thannithode, 23 Nov. 2001, *Ramadevi 61* (Isotype, SDCH).

LEPIDAGATHIS Willdenow

Sp. Pl. 3(1): 400. 1800

Key to the species

1. Capsule linear, puberulous; seeds 4..... 1. *L. balakrishnanii*
1. Capsule conical, glabrous; seeds 2..... 2. *L. keralensis*

1. Lepidagathis balakrishnanii Remadevi & Binojkumar, J. Econ. Taxon. Bot. 32: 554. 2008.

Type: Kottayam district: Changanacherry, Perunna, 14 Dec. 2000, *Remadevi 210A* (MH).

Herbs, prostrate to straggling, 15-25 cm high, rooting at nodes; stem subterete, glabrous. Leaves lanceolate-elliptic, 1.5-2-5 x 1.5-2 cm, cuneate at base, mucronate at apex, margin serrate, glabrous. Inflorescence terminal, a bunch containing 2-3 spikes, 0.5-1.5 cm long; bracts foliaceous, lanceolate-elliptic, acute; bracteoles 2, linear-elliptic, acuminate. Calyx lobes 5, subequal, c. 0.5-0.7 x 0.1 cm, united at basal half, hispid. Corolla-tube 0.4-0.6 cm long, pubescent, pale white with pink dots, bilipped; lower lip 0.3-0.4 cm long; upper lip 0.2-0.3 cm across. Stamens 4. Ovary 1-2 cm long; style filiform; stigma simple. Capsule linear, 0.4-0.5 cm long, compressed, ellipsoid, glabrous or puberulous. Seeds 4, orbicular, c. 0.1 cm across, glabrous; retinacula straight.

Flowering & Fruiting: December-January.

Habitat: Crevices of rocks.

Note: The distribution status and habitat preferences of this supposed to be neoendemic species yet tobe ascertained.

Specimen examined: Kottayam district: Changancherry, Perunna, 14 Dec. 2000, *Remadevi 210B-C* (Isotypes, SDCH).

2. Lepidagathis keralensis Madhus. & N. P. Singh, Kew Bull. 47: 301. 1992; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 348. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 26. 2006.

Type: Kannur district: Madayippara, 40 m, 12 Mar. 1988, *Madusoodanan 29323* (MH).

Perennial, prostrate, woody herbs. Stem glabrous, quadrangular, winged, much branched to mat forming, rooting at the nodes. Leaves narrowly oblong-lanceolate, acute or blunt acuminate at apex, c. 1 x 0.3 cm, dark green with purple margins, rigid, plicate. Spikes 1-3, terminal, procumbent, c. 2 cm long. Flowers sessile, c. 1 cm long. Bracts many, spine-tipped. Calyx villous, deeply 5-lobed, lobes unequal, c. 1-0.4 cm, persistant. Corolla c. 1 cm long, tube cylindric, 2-lipped; upper lip 2-lobed, erect or rereflexed, pink; lower lip 3-lobed, pink with white to yellow palate. Stamens 4, didynamous, sparsely hairy, purple to deep violet. Disc annular. Ovary compressed, ovoid, 2-celled; style slender; stigma capitate. Capsule compressed, conoid, c. 0.6 cm long, glabrous. Seeds 2, hairy with white aril.

Flowering & Fruiting: December-April.

Habitat: Lateritic rocky areas.

Note: As a neoendemic species, further explorations must be made to locate the species in its known distributional areas to confirm its conservation status.

Specimen examined: Kannur district: Madayippara, 40 m, 12 Mar. 1988, *Madusoodanan CU 29323* (Holotype, MH).

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RUELLIA Linnaeus

Sp. Pl. 15. 1753

Ruellia sivarajanii Sreedevi, Remadevi & Binoj Kumar, J. Econ. Taxon. Bot. 27: 1186. 2003.
Type: Alappuzha district: Alappuzha, 15 Dec. 2000, *Sreedevi 168* (CAL).

Herbs. Stem quadrangular, dark red in colour. Leaves linear-elliptic, 12-15 x 0.5-1 cm, decurrent on the petiole to form sheathing base, apex acute, base attenuate, margin entire, glabrous. Inflorescence axillary, trichotomously branched dichasial cyme. Peduncle 6-8 cm long. Bract and bracteoles lanceolate, glabrous. Calyx 5, segments lanceolate, filamentous, c. 0.8 x 0.1 cm, glabrous. Corolla lobes 5, subequal, 1.5-2 x 1-1.5 cm, obovate, blue or pale violet. Stamens 4, didynamous. Ovary simple. Capsule pointed at both ends, 1.5-2 cm long. Seeds 12-16, orbicular.

Flowering & Fruiting: August-December.

Habitat: Marshy areas.

Note: As a local neoendemic species, it deserves further evaluation to obtain conservation status.

Specimen examined: Alappuzha district: Alappuzha, 15 Dec. 2000, *Sreedevi 168* (Isotype, SDCH).

STROBILANTHES Blume

Bijbr. 781, 786. 1822.

Key to the species

1. Stamens 4; seeds glabrous..... 1. *S. barbatus* var. *bonaccordensis*
1. Stamens 2; seeds hairy.
   2. Bracts 4-ranked, reddish..... 2. *S. dupenii*
   2. Bracts not 4-ranked, greenish..... 3. *S. pushpangadanii*

1. **Strobilanthes barbatus** var. **bonaccordensis** Santhosh Kumar & Raj Vikraman, J. Econ. Taxon. Bot. 25: 742. 2001; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 352. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 32. 2006.

Type: Thiruvananthapuram district: Agasthyamala, Bonaccord, ± 600 m, 21 Mar. 1996, *Santhosh Kumar 25413* (TBGT). (Plate 56 c)

Shrubs. Leaves anisophyllus, 7-18 x 3-7 cm, elliptic or ellipti-ovate, long decurrent at base, acut or caudate- acuminate at apex, margins crenate-serrulate. Flowers in capitate heads,

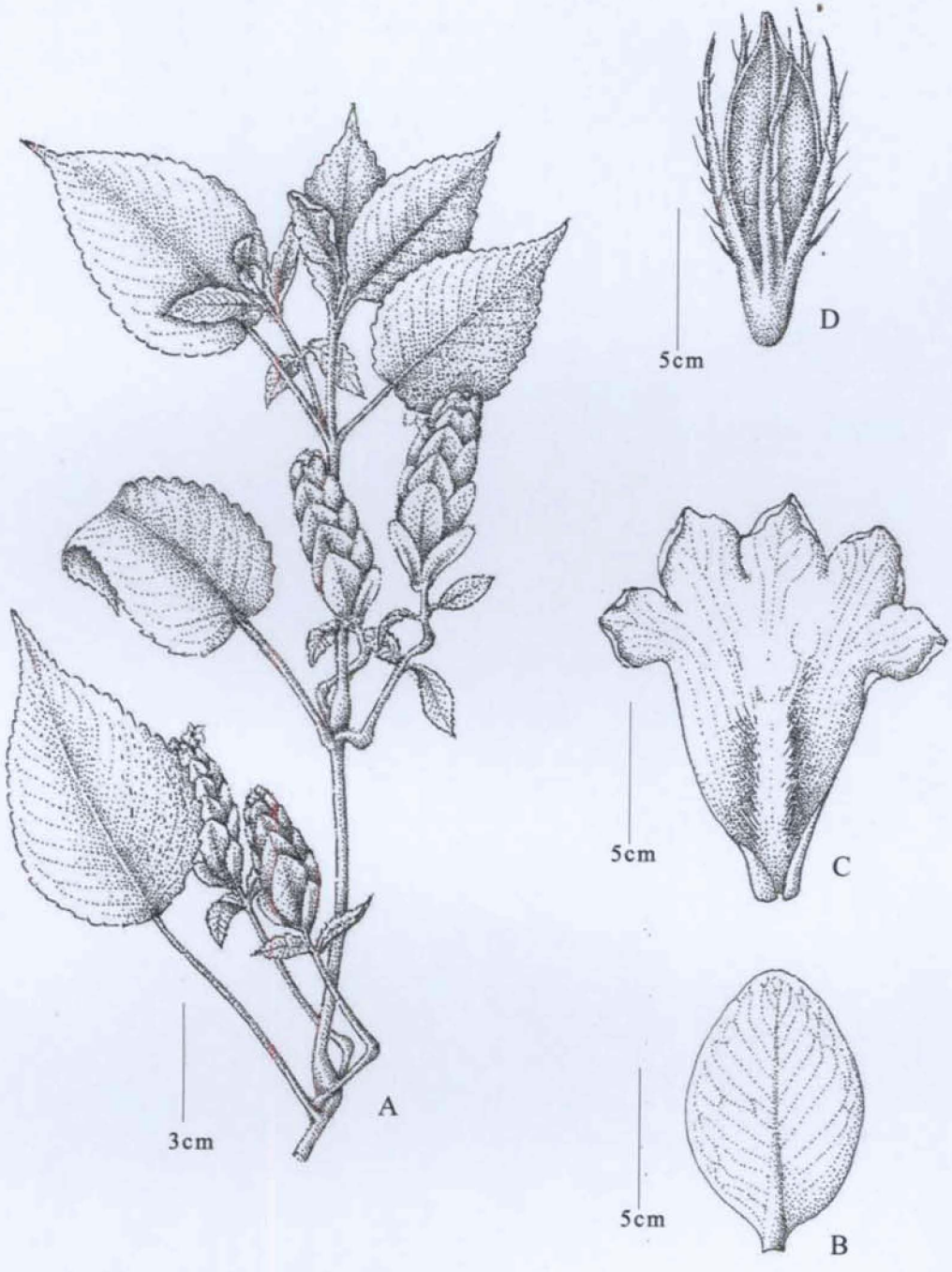

Fig. 36. ***Strobilanthes dupenii*** Bedd. ex Clarke: A. Branchlet; B. Bract; C. Corolla - cut opend; D. Fruit.

DB. 5995. 204.17

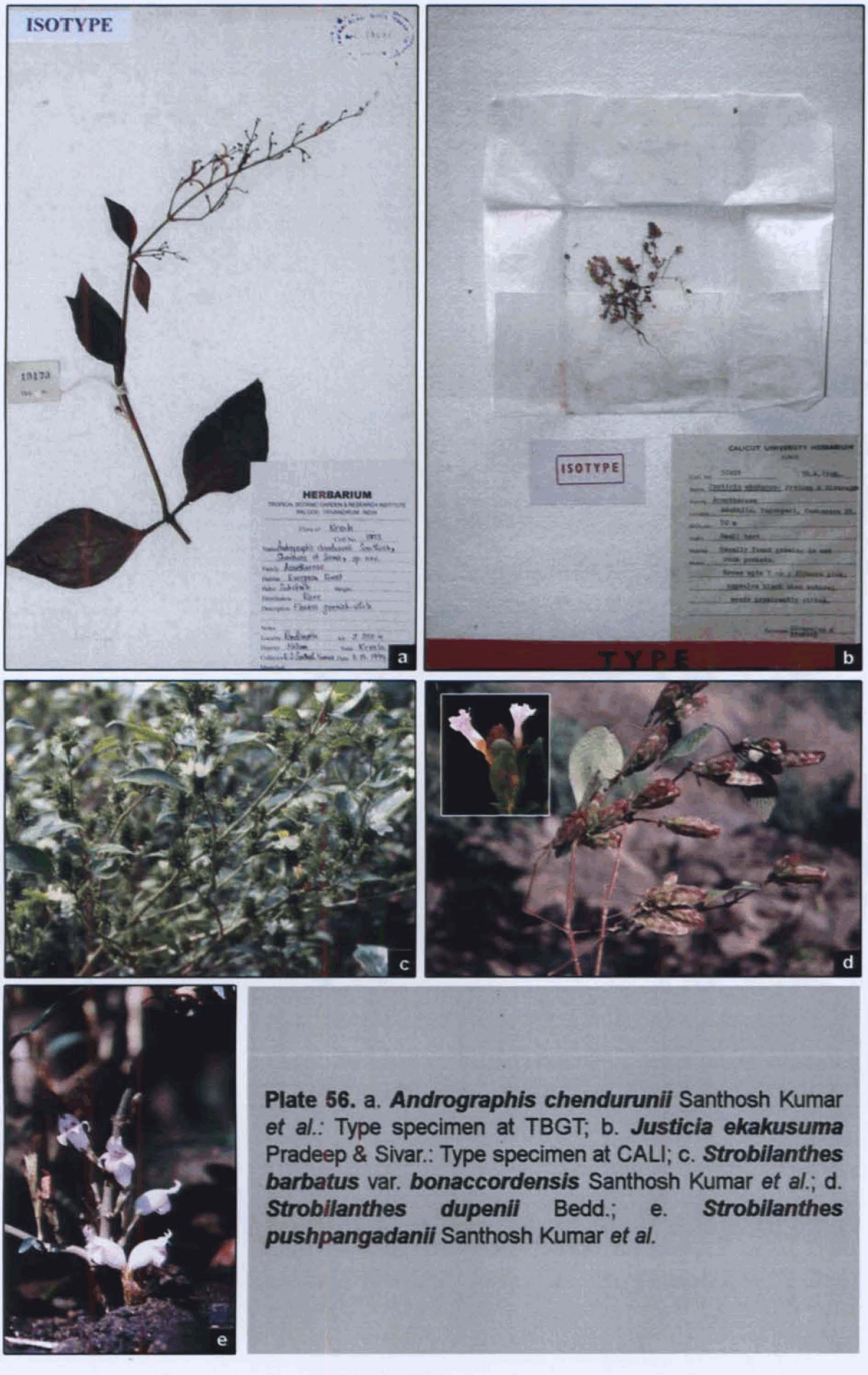

Plate 56. a. ***Andrographis chendurunii*** Santhosh Kumar *et al.*: Type specimen at TBGT; b. ***Justicia ekakusuma*** Pradeep & Sivar.: Type specimen at CALI; c. ***Strobilanthes barbatus*** var. ***bonaccordensis*** Santhosh Kumar *et al.*; d. ***Strobilanthes dupenii*** Bedd.; e. ***Strobilanthes pushpangadanii*** Santhosh Kumar *et al.*

NB 5995 204·B

subsessile or on a peduncle, not winged. Bracts ovate cuspidate with decurved apex; bracteoles narrow, decurved. Calyx lobes 5, united, lobes unequal, glabrous. Corolla white, ciliate at margins and villous on the palate. Stamens 4, didynamous. Ovary sessile, glabrous. Style slender.

Flowering & Fruiting: Once in 6 years. November-March.

Habitat: Semi-evergreen and evergreen forests.

Note: A point endemic variety, so far known only from the type locality. Therefore, further explorations must be made to locate the species in its known distributional areas to confirm its conservation status.

Specimens examined: Thiruvananthapuram district: Agasthyamala, Bonaccord, ± 600 m, 21 Mar. 1996, *Santhosh Kumar 25413* (Holotype, TBGT); *Ibid.*, 29 May 2001, *Shaju 45456* (TBGT).

2. **Strobilanthes dupenii** Bedd. ex Clarke in Hook. f., Fl. Brit. India 4: 453. 1884; Gamble, Fl. Pres. Madras 1043 (731). 1924; Nayar & Sastry, Red Data Book Ind. Pl. 3: 6. 1990; Henry *et. al.*, J. Bombay Nat. Hist. Soc. 75. 693. 1979; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 353. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 33. 2006.

Type: Palakkad district: Anamalais, top of Nelliampatti, Jan. 1881, *Beddome 212* (BM). (Fig. 36; Plate 56 d)

Shrubs. Leaves 7-12 x 3-8 cm, ovate, acuminate at apex, subcordate at base, margin crenate, bristly pubescent on both surfaces. Petioles 2-5 cm long. Spikes c. 6 cm long, large, subtetragonous-oblong, terminal and lateral on short peduncles, dense viscous, slightly hairy. Bracts 4-ranked, ovate, obtuse, reddish, closely imbricate, subscarious, decurrent at base; bracteoles small, lanceolate. Calyx deeply 5-lobed, c. 1.5 cm long, lobes linear, green, acuminate. Corolla large, blue. Stamens equal, united in pairs in a short sheath at base. Capsule ellipsoid, c. 1 cm long, sessile, glabrous. Seeds 4, hairy.

Flowering & Fruiting: August-October.

Habitat: Evergreen forests of higher ghats.

Note: This species was first collected by Beddome from Anamalais of Nelliampathy. As a narrow endemic species Nayar (1997) listed it under 'Rare' category.

Specimen examined: Idukki district: Puyankutty, Mettanappara, ± 600 m, 27 Jun. 2001, *Shaju 46136* (TBGT).

3. **Strobilanthes pushpangadanii** Santhosh Kumar, Jabbar & Shanavas, Rheedea 12: 73. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 355. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 35. 2006.

Type: Thiruvananthapuram district: Mankayam Hills, ± 800 m, *Santhosh Kumar 14722* (TBGT). (Plate 56 e)

Woody shrubs, young parts and leaves cinnamomus woolly. Leaves equal, 3-12 x 1-4.5 cm, elliptic-ovate, cuneate at base, acuminate-caudate at apex, denticulate at margin, coriaceious, sparsely pilose above, wooly beneath. Inflorescence a simple or branched spike, axillary and terminal. Peduncle 3-6.5 cm long, cinnamomus woolly. Flowers arranged in opposite pairs. Bracts ovate; bracteoles 2, linear. Calyx lobes 5, 0.4-0.6 x 0.1-0.15 cm, linear-lanceolate, acute-obtuse at apex. Corolla c. 2 cm long, light pink with dark purple nervation, bilipped, lobes 5, ovate, 0.6-0.7 x 0.3-0.4 cm, acute at apex. Stamens 2, included. Ovary 2-celled, glabrous; style slender. Capsule c. 1 cm long, clavate, glabrous. Seeds 4, hairy near along the margins.

Flowering & Fruiting: December-March.

Habitat: Rocky cliffs of grasslands.

Note: A local endemic species known only from the type locality; owing to narrow distribution, assumes conservation significance.

Specimens examined: Thiruvananthapuram district: Mankayam Hills, ± 800 m, *Santhosh Kumar 14722* (Holotype, TBGT); *Ibid.*, 18 Feb. 2007, *Shaju 48956* (TBGT).

37. LAMIACEAE

Table 57. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
253-263	6900-7200	64	*c.* 340	28 spp., 11 var.

Kerala

Genus/genera	Species/subsp./var.
22	103 spp., 8 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Anisochilus Wallich ex Benth.	*A. robustus* Hook .f. (Tamil Nadu)	
	A. suffruticosus Wight (Tamil Nadu)	
	A. wightii Hook. f. (Tamil Nadu)	
Anisomeles R. Br.	*A. heyneana* Benth. (Maharashtra, Nagar Haveli, Karnataka & Tamil Nadu)	
Eusteralis Raf.	*E. gracilis* (Dalz.) Panigr. (Maharashtra & Karnataka)	
Gomphostemma Wallich ex Benth.	*G. eriocarpon Benth.* (Tamil Nadu)	
	G. heyneanum var. *rottleri* Prain	

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	(Maharashtra, Nagar Haveli, Karnataka & Tamil Nadu)	
	G. keralensis Vivek., *et al.*	
Leucas R. Br.	*L. lamifolia* Desf. (Tamil Nadu)	*L. beddomei* (Hook. f.) Sunojkumar & Philip Mathew
	L. rosmarinifolia Benth. (Tamil Nadu)	*L. vestita* var. *devicolamensis* Shetty & Vivek
		L. sebaldiana Sunojkumar
Orthosiphon Benth.	*O. comosus* Wight ex Benth. (Tamil Nadu)	
	O. rubicundus var. *hohenackeri* Hook. f. (Tamil Nadu)	
Plectranthus L' Heritier	*P. nilgherricus* Benth. (Karnataka & Tamil Nadu)	
	P. rivularis Wight ex Hook. f.	
	P. stocksii Hook. f. (Maharashtra, Goa, Karnataka & Tamil Nadu)	
Pogostemon Desf.	*P. atropurpureus* Benth. (Tamil Nadu)	*P. peethapushpum* Pradeep
	P. gardneri Hook. f. (Tamil Nadu)	*P. travancoricus* var. *devicolamensis* Shetty & Vivek.
	P. paludosus Benth. (Tamil Nadu)	
	P. purpurescens Dalz. (Maharashtra, Goa, Karnataka & Tamil Nadu)	
	P. speciosus Benth. (Karnataka & Tamil Nadu)	
	P. travancoricus Bedd. var. *travancoricus* (Tamil Nadu)	

Key to the genera

1. Calyx-teeth 8-10; upper lip of corolla hooded..... **Leucas**
1. Calyx-lobes 5; upper lip of corolla straight or spreading..... **Pogostemon**

LEUCAS R. Brown

Prodr. 504. 1810.

Key to the species

1. Calyx lower half glabrous, upper half bent..... 2. *L. sebaldiana*
1. Calyx fully ciliate, straight.
   2. Leaves up to 10 cm long, elliptic, obtuse, base angustate..... 1. *L. beddomei*
   2. Leaves up to 7 cm long, broadly ovate, base rounded or cordate..... 3. *L. vestita* var. *devicolamensis*

1. **Leucas beddomei** (Hook. f.) Sunojkumar & Philip Mathew, Rheedea 12: 170. 2002; *Leucas hirta* (Roth) Spreng. var. *beddomei* Hook. f., Fl. Brit. India 4: 687. 1885; Gamble, Fl. Pres. Madras1153. 1915; Mukherjee, Rec. Bot. Surv. India 14 (1): 176. 1940; Singh, Monogr. Indian *Leucas* 93. 2001; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 368. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 354. 2006.

Type: Wayanad district: Chembra peak, 5000 ft., *Beddome s.n.* – type of *Leucas hirta* var. *beddomei* Hook. f. (K). (Plate 57 a & b)

Erect undershrubs, 45-100 cm tall, softly villous with spreading long golden brown hairs. Leaves opposite decussate, 5-10 x 2-3 cm, elliptic, obtuse, base angustate, densely ciliate, margin crenulate. Inflorescence in upper several axies, dense and many-flowered. Bracts as long as calyx, linear elliptic, ciliate. Calyx c. 0.8 cm long, densely ciliate, straight; teeth 10. Corolla 10-10.5 cm long; upper lip densely-bearded with brownish yellow white hairs arranged oppositely; lower lip white , 3-lobed. Stamens didynamous, filaments with slender hairs. Style slender; stigma: lower lobe subulate, upper lobe minute. Disc 4-lobed. Nutlets triquetrous, c. 0.3 cm long, tip rounded, light brown.

Flowering & Fruiting: September-March.

Habitat: Chembra peak hills.

Note: So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimen examined: Wayanad district: Chembra peak, ±1770 m, 10 Nov. 2003, *Sunojkumar CU 49631* (CALI).

2. **Leucas sebaldiana** Sunojkumar. Candollea 60(1): 233. 2005.

Type: Wayanad district: Chembra peak, c. 1394 m, 7 Oct. 2000, *Sunojkumar CU 49630* (K) (Plate 57 c)

Straggling herbs, 100-150 cm long, hispid with golden brown hairs. Leaves opposite decussate, ovate to lanceolate, 3-8 x 3-5.5 cm, subacute, sometimes obtuse, base rounded to obtuse, margin serrate, lower surface hirsute, upper glandular punctate. Petiole 1-2 cm long. Inflorescence a terminal solitary verticillaster, 2.5-3.5 cm across, subglobose, dense, many-flowered. Bracteoles forming an involucre below the flowers. Flowers 15-25; pedicel c. 0.1cm long. Calyx tubular, 1.5-2 cm long, upper half bent; teeth 10, narrowed below. Corolla 2.2-2.4 cm long, slightly bent and fully included in the calyx; lower lip white, upper lip yellowish brown. Stamens fully included, didynamous, filaments hairy; anthers reddish colured. Disc 4-lobed. Carpels rounded; style slender; stigma lobes unequal. Nutlets obtusely triangular, c. 0.3 cm long, oblong, tip rounded, black.

Flowering & Fruiting: September-February.

Habitat: Shady margins of grasslands in shola forests.

Note: A local endemic species with restricted population reported only from a single locality. Therefore, it is necessary to identify more areas of its occurrence towards planning further conservation activities.

Specimen examined: Wayanad district: Chembra peak, ± 1770 m, 7 Oct. 2000, *Sunojkumar CU 49630* (Isotype, CALI).

3. **Leucas vestita** var. **devicolamensis** B. V. Shetty & Vivek., Bull. Bot. Surv. India 10: 236. 1968; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 371. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 358. 2006.

Type: Idukki district: Upper Vagavurrai, Devicolam, ± 1930 m, 11 Aug. 1967, *Shetty & Vivekananthan 28372 A* (CAL). (Plate 57 d)

Woody subshrubs, 30-100 cm long, spreading hairs. Leaves opposite decussate, 1.5-7 x 1.5-3 cm, ovate to broadly ovate, base rounded or cordate, margin serrate, villous on both surfaces. Petiole 0.3-1.6 cm long. Inflorescence terminal, solitary, rarely 2, dense with many flowers. Bracts as long as calyx, linear, densely ciliate. Calyx c. 1.2 cm long, fully ciliate, straight, teeth 10, short. Corolla large, c. 1.5 cm, bilabiate; lower lip white, spreading, 3-lobed; upper lip erect, concave, densely bearded with rufous-brown hairs. Stamens didynamous, filaments with slender hairs. Disc 4-lobed. Ovary 4-partite; style slender, subulate at apex with rufous upper lip. Nutlets triquetrous, obovoid, 0.2-0.3 cm long, brownish black.

Flowering & Fruiting: August.

Habitat: Grasslands

Note: The type locality and adjacent areas need to be thoroughly explored to address conservation of this narrow endemic variety.

Specimen examined: Idukki district: Upper Vagavurrai, Devicolam, ± 1930 m, 11 Aug. 1967, *Shetty& Vivekananthan 28372 A* (Isotype, MH).

POGOSTEMON Desfontaines

Mem. Mus. Hist. Nat. 2: 154. 1815.

Key to the species

1. Corolla yellow ..... 1. *P. peethapushpum*
1. Corolla violet ..... 2. *P. travancoricus* var. *devicolamensis*

1. **Pogostemon peethapushpum** Pradeep, Candollea 53: 419. 1998; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 375. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 363. 2006.

Type: Kozhikode district: Vellarimala, Olichuchattam, ± 820 m, 12 Jan.1997, *Pradeep 5489* (K) (Plate 57 e)

Scandent shrubs, c.150 cm tall. Stem and branches quadrangular. Leaves opposite, deccussate, 6-12 x 5-7 cm, subcoriaceious, acute to acuminate at apex, truncate at base, margin doubly serrate-dentate. Petiole 5-8 cm long, slender, glabrous. Inflorescence a few-flowered, axillary cymose panicle, 5-9 cm long. Bracts subulate, sparsely hairy. Bracteoles linear, sparsely hairy. Flowers erect; pedicel 0.1-0.6 cm long, glabrous. Calyx tubular, 0.8-I cm long, 6-nerved, glabrous, 5-toothed, subequal, triangular, long acuminate. Corolla yellow, funnel-shaped, 0.8-0.9 cm long; upper lip 3-lobed, lobes subequal, rotund, glabrous inside, densely hispid outside; lower lip entire, ovate-lanceolate. Stamens 4, exserted, didynamous. Disc subentire, glabrous. Ovary 4-partite, oblong, glandular; style slender; stigma bifid at apex, lobes equal. Nutlets not seen.

Flowering & Fruiting: January-March.

Habitat: Undergrowth of evergreen forests.

Note: As it is confined to small pockets in the locality, it warrants more exploration surveys for to obtain its distributional status for conservation management.

Specimen examined: Kozhikode district: Vellarimala, Olichuchattam, ± 820 m, 12 Jan.1997, *Pradeep 5489* (Isotype, CALI).

2. **Pogostemon travancoricus** var. **devicolamensis** B. V. Shetty & Vivek., Bull. Bot. Surv. India 15: 157. 1973; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 376. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 364. 2006.

Type: Idukki district: Devicolam, Lower Vaguvara, 1900 m, 5 Feb. 1970, *Shetty & Vivekanathan 33420* (CAL). (Plate 57 f)

Undershrubs, 100-150 cm tall, deep purple in colour. Stem and branches obscurely quadrangular. Leaves opposite, 3-8-18.6 x 1.3-6cm, ovate to elliptic, acute at apex, unequally

Plate 57. a & b. ***Leucas beddomei*** (Hook. f.) Sunojkumar *et al.*: a. Habit; b. Type specimen at CALI; c. ***Leucas sebaldiana*** Sunojkumar: Type specimen at CALI; d. ***Leucas vestita*** var. ***devicolamensis*** Shetty & Vivek.: Type specimen at MH; e. ***Pogostemon peethapushpum*** Predeep: Type specimen at CALI; f. ***Pogostemon travancoricus*** var. ***devicolamensis*** Shetty & Vivek.: Type specimen at MH.

DUB 5495

rounded at base, margin doubly crenate, serrate. Petiole 0.8-8 cm long. Raceme up to 33 cm long. Bracts and bracteoles linear. Pedicel slender, 0.1 cm long. Calyx tubular, 0.45-0.55 cm long. slightly narrowed towards the base, teeth 5, subequal, hirsute within. Corolla greenish pale yellow, 0.7-0.85 cm long, usub-bilabiate; upper lip 3-lobed, lateral lobes rounded, middle acute; lower lip entire, acute. Stamens 4, subequal; filaments with white hairs at base; anthers reniform. Disc subentire. Ovary 4-partite, glandular; style filiform; stigma bifid. Nutlets 4, c. 0.1 cm long, rounded.

Flowering & Fruiting: February-April.

Habitat: Open area in evergreen forests.

Note: This local endemic variety deserves conservation importance; because its areas of occurrence are under severe habitat threat due to nearest plantation area.

Specimen examined: Idukki district: Devicolam, Lower Vaguvara, ± 1900 m, 5 Feb. 1970, *Shetty & Vivekanath an 33420* (Isotype, MH).

38. PODOSTEMACEAE

Table 58. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
50	250	9		7 spp.

Kerala

Genus/genera	Species/subsp./var.
9	18 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Cladopus Muell.	*C. hookeriana* (Tul.) C. Cusset (Maharashtra, Goa, Karnataka)	
Farmeria Willis ex Trimen	*F. indica* Willis (Tamil Nadu)	
Podostemon Michaux		*P. munnarense (Nagendran & Arekal)* Mathew & Satheesh
Willisia Warm.	*W. selaginoides* (Bedd.) (Warm. ex Willis (Tamil Nadu)	*W. arekaliana* Shivamurthy & Sadanand
Zeylanidium (Tul.) Engl.		*Z. maheshwarii* Mathew & Satheesh

Key to the genera

1. Capsule isolobus.....**Podostemon**
1. Capsule anisolobus
  2. Capsule smooth.....**Willisia**
  2. Capsule ribbed.....**Zeylanidium**

PODOSTEMON Michaux

Fl. Bor. Amer. Ii:164, t. 44.

Podostemon munnarense (Nagendran & Arekal) Mathew & Satheesh, Aqua. Bot. 57: 225. 1997; *Polypleurum munnarense* Nagendran & Arekal, Bot. Notiser 132: 49. 1979 & Bull. Bot. Surv. India 23: 232. 1981; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 386. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 484. 2006.

Type: Idukki district: Munnar, Marayur river, *Satheesh 223* (UCC) (Plate 58 a & b)

Thallus attached at the base and other parts near the base with free floating upper parts, c. 25 cm long. Vegetative shoots very short, distichous, marginal, alternate. Leaves 5-6(-8), to 6 cm ong, distichous. Bracts 5-6. Flowers terminal, zygomorphic, Pedicels, c. 2 cm long. Tepals half the length of the ovary. Stamens 2. Ovary ellipsoid, I-locular. Capsule 2-3 mm long.

Flowering & Fruiting: January-February.

Habitat: On rocks in flowing streams.

Note: Conservation measures should be taken for the survival of this local endemic species , as it is distributed in the threatened habitat.

Specimen sexamined: Idukki district: Munnar, Marayur river, 2 Jan.1994, *Satheesh 223* (UCC).

WILLISIA Warming

Kongel. Danske. Vidensk.-Skr. Ser. 6, 11: 58, 65. 1910.

Willisia arekaliana Shivamurthy & Sadanand, Kew Bull. 52: 243. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 387. 2004; T.S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 484. 2006.

Type: Palakkad district, Silent Valley, Kunthipuzha river, near dam site, 30 Jan. 1994, *Shivamurthy & Sadanand 118* (CAL).

Submerged herbs. Thallus crustose, tufted, firmly attached on the rocks, extensively branched. Secondary shoots erect, 1-18 cm long, simple or rarely branched, arising mostly near the margin of the thallus, singly or rarely 2-3 together. Leaves on secondary shoots 0.1-0.15 x 0.08-0.12 cm, lax, in 6 rows. Apical leaves 0.15-0.18 x 0.12-0.12 cm, triangular, apically unequally tridentate with a filiform extension arising between the three apical teeth. Flowers

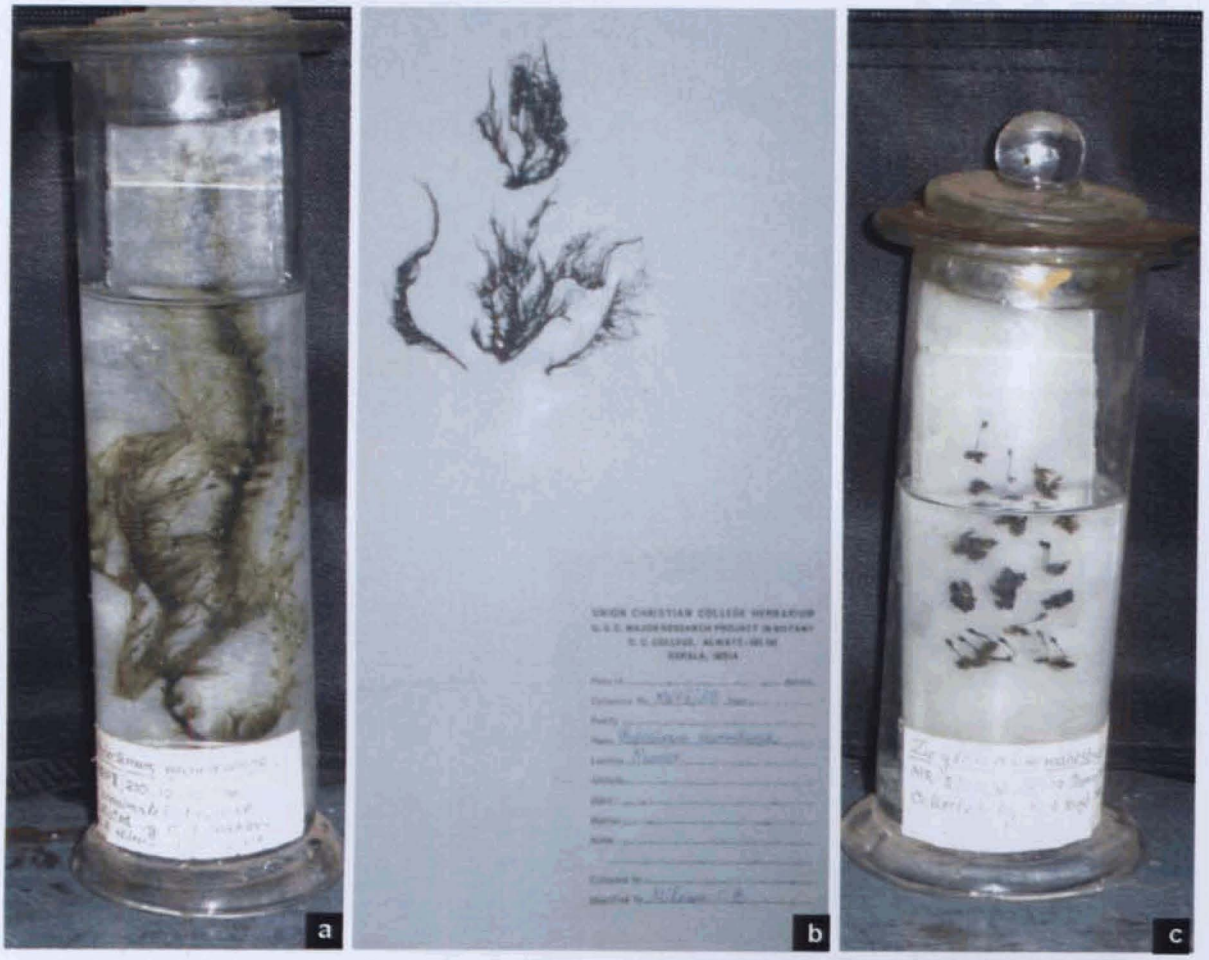

Plate 58. a & b. ***Podostemon munnarense*** (Nagendran & Arekal) C. J. Mathew & V. K. Satheesh: a. Pickled specimen; b. Herbarium specimen at U.C. College; c. ***Zeylanidium maheshwarii*** C. J. Mathew & V. K. Satheesh: Pickled specimen at U.C. College.

NB 5495 212

terminal on secondary shoots, solitary c. 0.3 x 0.2 cm. Spathella urceolate with a cup-like tip unequally bilobed at apex, which becomes detached at anthesis. Androecium monadelphous with 2 lateral staminodes and 2 stamens, filaments fused almost to apex. Ovary subspherical; stigmas 2. Fruit a subspherical capsule, c. 0.3 cm diam., dehiscing into 2 valves. Seeds numerous.

Flowering & Fruiting: January-February.

Habitat: Submerged rocks in fast-flowing stream.

Note: So far not figured in any of the IUCN category; efforts should be made to find out the still surviving populations from the reported areas to ascertain the conservation status of this narrow endemic species.

Specimen examined: Palakkad district: Silent Valley, Kunthipuzha river, near dam site, 30 Jan. 1994, *Shivamurthy & Sadanand 118* (Holotype, CAL)

ZEYLANIDIUM (Tulsane) Engler

in Engler at Prantl, Nat. Pflanzenfam. 2. 18a.: 61. 1930.

Zeylanidium maheshwarii Mathew & Satheesh, Aqua. Bot. 54: 73. 1996; Mathew & Satheesh, Aqua. Bot. 57: 269. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 388. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 485. 2006.

Type: Idukki district: Muvattupuzha, Thommenkuthu, 5 Dec. 1991, *Satheesh 111* (UCC).

(Plate 58 c)

Thalls crustaceous, tightly attached to the rocks by the haptera on lower surface. Vegetative shoots arising from the dorsal surface. Leaves 4-6, with persistent sheathing bases. Bracts 4-6. Flowers zygomorphic, pedicelled, basally enclosed by sheathing spathes. Tepals 1.3-1.6 mm long. Stamens 2. ovary obovoid, . Stigma multi-lobed. Capsule obovoid, 3-ribbed, anisolobus.

Flowering & Fruiting: November-January.

Habitat: Exposed rocks in streams.

Note: As a local endemic species, it deserves conservation efforts.

Specimen examined: Idukki district: Muvattupuzha, Thommenkuthu, 5 Dec. 1991, *Satheesh 111* (UCC).

39. ARISTOLOCHIACEAE

Table 59. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
8	400	4	21	8 spp.

Kerala

Genus/genera	Species/subsp./var.
2	11 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Aristolochia L.	*A. krisagathra* Sivar. & Pradeep (Tamil Nadu)	*T. abrahamii* Mathew Dan *et al.*
Thottea Rottb.	*T. barberi* (Gamble) Din Hou (Tamil Nadu)	*T. idukkiana* Pandurangan & V. J. Nair
	T. dinghoui Swarup. (Tamil Nadu)	*T. ponmudiana* Sivar.
	T. ducharteri Sivar. *et al.* (Tamil Nadu)	*T. sivarajanii* Santhosh Kumar *et al.*

THOTTEA Rottboell

Nye Saml. Kongel. Danske Vidensk. Selsk. Skr. 2: 529. 1783.

Key to the species

1. Inflorescence a receme; stamens 20- 25 ..... 1. *T. abrahamii*
1. Inflorescence cymes. Stamens 6-12.
   2. Herbs; stamens 12 ..... 2. *T. idukkiana*
   2. Shrubs; stamens 6-9.
      3. Flowers yellow with dark purple eyes; stamens 9 ..... 3. *T. ponmudiana*
      3. Flowers deep purple; stamens 6-8 ..... 4. *T. sivarajanii*

1. **Thottea abrahamii** Mathew Dan, Mathew, Unnithan & Pushpangadan, Kew Bull. 51:179. 1996; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 389. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 80. 2006.

Type: Thiruvananthapuram district: Braemore, ± 850 m, 16 Dec. 1992, *Dan & Mathew 13486* (TBGT). (Plate 59 a & b)

Undershrubs. Leaves alternate, 15-20 x 4-7 cm, lanceolate to elliptic-lanceolate, glabrous above, puberulous beneath, acute at apex, attenuate at base, veins in 5-8 pairs. Inflorescence a raceme, arising from the basal nodes, ascending or trailing on ground. Peduncle 10-25 cm long, pubescent. Bracts oblanceolate, pubescent. Pedicels 1-1.2 cm long, cylindric, hairy. Flowers 2-5 per peduncle, 1-1.2 cm across, exterior pale brown, interior yellow. Perianth lobes 3, free, c. 0.5 x 0.5 cm, orbicular-obovate, apex acuminate, hairy outside, glabrous inside, recurved when old. Stamens yellow, 20-25, free, biseriate. Ovary linear; ovules numerous; stylar column

Plate 59. a & b. ***Thottea abrahamii*** Mathew Dan *et al.*: a. Habit; b. Type specimen at TBGT; c & d. ***Thottea idukkiana*** Pandurangan & V. J. Nair: c. Habit; d. Type specimen at MH.

NB 5495

much reduced or absent; stigma simple, 6-9 lobes. Siliqua brown, 4-6 cm long, puberulous. Seeds strongly rugose, beaked.

Flowering & Fruiting: October-December.

Habitat: Understorey of evergreen forests.

Note: This species is characterised by 2-seriate stamens. A phytogeographically significant species *Thottea dinghoui* Swarup. was the first report of the genus with 2-seriate stamens in India. Other species of the genus with 2-seriate stamens are distributed in S E. Asia. Hence the discovery of this species further substantiates the floristic affinities between Indian subcontinent and S. E. Asia, as suggested by Nayar (1977). Conservation measures should be extended to the existing populations in natural habitats (*in-situ*) in consideration of its phytogeographical, biological, medicinal and palaeoendemic interests.

Specimens examined: Thiruvananthapuram district: Braemore, ± 850 m, 16 Dec. 1992, *Dan & Mathew 13486* (Holotype & Isotypes, TBGT); *Ibid.*, 27 Oct. 1993, *Mathew et al. 14531*(Paratype, TBGT); *Ibid.*, 23 Nov. 2001, *Shaju 464572* (TBGT).

2. **Thottea Idukkiana** Pandurangan & V. J. Nair, J. Econ. Taxon. Bot. 17. 465. 1993; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 389. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 81. 2006.

Type: Idukki district: Kanjiar, 1000 m, 29 Dec. 1983, *Pandurangan 62571* (MH).(Plate 59 c & d)

Undershrubs. Leaves simple, alternate, 15-20 x 3-7 cm, elliptic-lanceolate or oblong, glabrous above, hispid or puberulous below, acute at apex, attenuate at base, lateral nerves 4-6 pairs. Cymes axillary. Peduncles short or absent. Bracts ovate or elliptic, the upper smaller. Pedicels 0.35 cm lobg, puberulent. Flowers 1-3, 1-1.3 cm across. Perianth lobes 3, 0.9 x 0.5 cm, triangular-ovate, connate at base, puberulous out side, glabrous inside, white or pale yellow. Stamens 12, arranged in 3 groups, alternating with staminodes. Ovary linear, hairy; ovules many; style short; stigma in 2 rows, glandular hairy. Siliqua 4-angled, 1-1.3 cm long, puberulous. Seeds trigonous.

Flowering & Fruiting: October-December.

Habitat: Undergrowth in decideous and semi-evergreen forests.

Note: A narrow endemic species occationaly seen in decideous and semi-evergreen forests of Southern Kerala. It is necessary to identify more areas of its occurance, to ascertain present status of its population and to adopt appropriate conservation measures.

Specimens examined: Idukki district: Kanjiar, 1000 m, 29 Dec. 1983, *Pandurangan 62571* (Holotype, MH); Pathanamthitta district: Gurunathanmannu, 600 m, 21 Dec. 2002, *Shaju 48995* (TBGT).

3. **Thottea ponmudiana** Sivar., Pl. Syst. Evol. 105: 201. 1985; Sasidh., Biodiver. Doc. Kerala,

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Part 6, Flr. Pl. 389. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 81. 2006.

Type: Thiruvananthapuram district: Ponmudi hills, *Sivarajan 16410* (CALI). (Plate 60 a)

Shrubs. Leaves alternate, simple, shortly-petioled, c. 17 x 6 cm, elliptic-lanceolate to oblanceolate, acuminate at tip, sparsely hairy on the upper surface, densely granulate and prominently reticulate on the lower, 3-nerved from the base, lateral nerves 2-3 pairs. Flowers axillary, bracteate peduncled cymes. Peduncle 1-1.2 cm long. Bracts ovate or elliptic, the upper smaller. Pedicels 0. Flowers yellow with dark purple eyes, 0.8-1 cm across. Perianth lobed to the base, lobes 3, broadly orbicular, rounded or obtuse at apex, broader than long, c. 0.7 x 1 cm, margins strongly reflexed. Gynostegium minutely puberulous. Stamens 9, uniseriate, triadelphous. Ovary linear; ovules numerous; style absent; stigmatic lobes 9. Siliqua 7-9 cm long, green, glabrescent, sharply 4-angled. Seeds many, trigonous, rugose.

Flowering & Fruiting: Throughout the year.

Habitat: Common reverine evergreen vegetation.

Note: A local endemic species seen in type locality and adjacent Agasthyamala regions. So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimens examined: Thiruvananthapuram district: Ponmudi hills, *Sivarajan 16410* (Holotype, CALI); Agasthyamala, Attayar, ± 700 m, *N. Mohanan 9551, 9574* (TBGT).

4. **Thottea sivarajanii** Santhosh Kumar, Shanavas & Binu, Rheedea 10: 117. 2000; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 398. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 81. 2006.

Type: Wayanad district: Periya, ± 500 m, 6 Dec. 1994, *Santhosh Kumar 232118* (TBGT). (Plate 60 b & c)

Shrubs. Leaves alternate, bifarious, 13-22 x 2.5-6 cm, narrowly elliptic-lanceolate, acuminate at apex, glabrous above, pubescent underneath, base obtuse, rounded or acute, veins prominent, strongly 3-nerved from the base, lateral nerves 2-3 pairs. Petiole 0.3-0.5 cm long, pubescent. Flowers in axillary, sessile bracteate peduncled cymes. Peduncle 1.5-2 cm long. Bracts ovate-oblong, densely hairy. the upper smaller. Flowers deep purple, darker at the centre, c. 1 cm across. Perianth lobes 3, lobed to the base, 0.6-0.8 x 0.5-0.6 cm, broadly ovate or sub-orbicular, acuminate or apiculate at apex, strigosely hairy without and multicellular hairs within, margins strongly reflexed. Gynostegium pubescent with uncinate multicelluar hairs. Stamens 6-8 in 3 groups, alternating with staminodes. Ovary linear, 4-5-angled, pubescent; stigma 4-6-lobed. Siliqua 5-7 cm long, green, glabrescent, 4-angled. Seeds many, trigonous, irregularly or transversely corrugated.

Flowering & Fruiting: Round the year.

Habitat: Semi-evergreen and evergreen forests.

Plate 60. a. ***Thottea ponmudiana*** Sivar.: Type specimen at CALI; b & c. ***Thottea sivarajanii*** Santhosh Kumar *et al.*: b. Habit; c. Herbarium specimen at TBGT.

NB 5995 216 A

Note: As a local endemic species, it is found that narrowly distributed significantly small populations occur in the reported areas. It is therefore necessary to identify more areas of its occurrence towards planning further conservation activities.

Specimens examined: Wayanad district: Periya, ± 500 m, 6 Dec. 1994, *Santhosh Kumar 232118* (Holotype, TBGT); Kozhikkod district: Thushargiri, ± 800 m, 17 Jan. 2008, *Shaju 59495* (TBGT).

40. PIPERACEAE

Table 60. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
12	3000	3	51	13 spp., 1 var.

Kerala

Genus/genera	Species/subsp./var.
3	22 spp., 1 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Piper L.	*P. barberi* Gamble (Tamil Nadu)	*P.nigrum* var. *hirtellosum* R. Asokan & P. N. Ravindran
	P. galeatum (Miq.) DC. (Karnataka & Tamil Nadu)	*P. silentvalleyensis* P. N. Ravindran *et al.*
	P. hapnium Buch.-Ham. ex Hook.f. (Tamil Nadu)	
	P. pseudonigram Velayudhan & Amalraj (Karnataka & Tamil Nadu)	
	P. schmidtii Hook. f. (Karnataka & Tamil Nadu)	
	P. trichostachyon (Miq.) Cass. (Maharashtra, Karnataka & Tamil Nadu)	

PIPER Linnaeus

Sp. Pl. 28. 1753.

Key to the species

1. Fruiting spikes globose..... 1. *P. nigrum* var. *hirtellosum*

1. Fruiting spikes not globose..... 2. *P. silentvalleyensis*

1. **Piper nigrum** var. **hirtellosum** Asokan Nair & Ravindran, J. Econ. Taxon. Bot. 10: 167. 1987; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 392. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 479. 2006.

Type: Palakkad district, Silent Valley, 24 Apr. 1986, *Asokan Nair & Ravindran 386* (MH).

Robust shrubby climbers. Stem terete, entirely glabrous. Leaves alternate, broadly ovate-elliptic, coriaceous and glabrous on both sides, 7-18 x 3-10 cm, base almost unequal, oblique, obtuse or cordate, acuminate at apex, prominently ribbed, often 2 pairs. Petiole 1.2-2.5 cm long, glabrous and furrowed. Stipules lanceate, deciduous. Fruiting spikes long, drooping, 5-17 cm long. Peduncle glabrous except for one or two stripes of hairs. Bracts adnate to rachis, upper part cup-like , with a decurrent base, hirtellosus on the outer side. Flowers more or less distantly distributed. Ovary single, spherical, astylocarpellous with 3-4 papillate stigmatic lobes. Fruit a drupe, c. 0. 7 cm diam., pungent. Seed single, globose with floury endosperm.

Flowering & Fruiting: March-May.

Habitat: Evergreen forests.

Note: Known only from the type locality. As a wild variety of cultivated species, distribution and status of this exclusive endemic taxa should be studied.

Specimen examined: Palakkad district: Silent Valley, 24 Apr. 1986, *Asokan Nair & Ravindran 386* (Holotype, MH).

2. **Piper silentvalleyensis** Ravindran, M. K. Nair & Asokan Nair, J. Econ. Taxon. Bot. 10: 167. 1987; Sasidh. Biodiver. Doc. Kerala, Part 6, Flr. Pl. 392. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 479. 2006.

Type: Palakkad district: Silent Valley, 8 Apr. 1981, *Ravindran186* (MH).

Slender extensively branched climbers. Stem swollen at nodes, branches terete, entirely glabrous. Leaves alternate, elliptic-lanceolate, 5-8.5- x 2-3.5 cm, coriaceous, glabrous on both sides, base acute, more or less asymmetric, tip caudate, acumunate, prominentely ribbed. Petiole very short, 0.3-0.5 cm long, glabrous. Stipules small, hirsute, deciduous. Spikes 2.5-5.5 cm long, ascending. Peduncle short, glabrous. Bracts orbicular, peltate, stalked. Flowers bisexual. Stamens 2, short; anthers 2-lobed, reniform, attached transversely at the tip of the filament. Ovary globoid, astylocarpellous; stigma minute, 3-lobed. Fruit a small drupe, mature ones c. 0.1 cm diam., obovate, pungent.

Flowering & Fruiting: March-May.

Habitat: Evergreen forests.

Note: So far known from the type locality. As a wild relative of cultivar, this species is

collected from its known locality and conserved in experimental gardens.

Specimen examined: Palakkad district: Silent Valley, 8 Apr. 1981, *Ravindran 186* (Holotype, MH).

41. LAURACEAE

Table 61. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
55	200	17	*c.* 163	29 spp., 4 var.

Kerala

Genus/genera	Species/subsp./var.
11	60 spp., 6 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Actinodaphne Nees	*A. campanulata* Hook. f. var. *campanulata* (Tamil Nadu)	
	A. campanulata var. *obtusa* Gamble (Tamil Nadu)	
	A. lanata Meissner (Tamil Nadu)	
	A. lawsonii Gamble (Tamil Nadu)	
	A. salicina Meissner (Tamil Nadu)	
	A. tadulingamii Gamble (Karnataka & Tamil Nadu)	
Cinnamomum Schaeffer	*C. chemungianum* M. Mohanan & A. N. Henry (Tamil Nadu)	*C. nicolsonianum* Manilal & Shylaja
	C. filipedicellatum Kosterm. (Tamil Nadu)	*C. palghatensis Gangop.*
	C. heyneanum Nees (Karnataka)	
	C. keralense Kosterm. (Tamil Nadu)	
	C. riparium Gamble (Karnataka & Tamil Nadu)	
	C. walaiwarense Kosterm. (Tamil Nadu)	
Litsea Lam.	*L. floribunda* (Blume) Gamble (Karnataka & Tamil Nadu)	*L. trvancorica* Gamble
	L. ghatica Saldanha (Karnataka &	*L. beei* N.Mohanan & Santhosh Kumar

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	Tamil Nadu)	
	L. laevigata(Nees) Gamble (Karnataka)	
	L. mysorensis Gamble (Karnataka & Tamil Nadu)	
	L. nigrescens Gamble (Tamil Nadu)	
	L. stocksii var. *glabrescens* (Meissner) Hook. f. (Tamil Nadu)	
Neolitsea (Benth.) Merr.	*N. fischeri* Gamble (Karnataka & Tamil Nadu)	

Key to the genera

1. Flowers bisexual; anthers both extrorse and introrse ..... **Cinnamomum**
1. Flowers unisexual: anthers all introrse ..... **Litsea**

CINNAMOMUM Schaeffer

Bot. expend. 74. 1760, *nom. cons.*

Key to the species

1. Basal lateral veins reaching the leaf tip ..... 1. *C. nicolsonianum*
1. Basal lateral veins not reaching the leaf tip ..... 2. *C. **palghatensis***

1. Cinnamomum nicolsonianum Manilal & Shylaja, Bull. Bot. Surv. India 28: 111. 1986; Sasidh., Biodiver. Doc. Kerala, Partr 6. Flr. Pl. 396. 2004; T.S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 371. 2006.

Type: Kozhikkode district: Peruvannamuzhi, *Shylaja 26217* (CALI). (Plate 61 a)

Trees up to 15 m. Leaves opposite, hairy on the under surface, sparsely hairy above, elliptic, large,19-20 x 7-9 cm long, apex obtuse, base cuneate, 3 ribbed, from base to apex, transverse nervules more prominent on lower surface. Panicles axillary, much smaller than the leaves, up to 10 cm long. Flowers few on upper part of the long slender panicle. Pedicels shoprt. Tepals 0.2-0.33 cm long, tomentose. Fruit ellipsoid, cup deep.

Flowering & Fruiting: February.

Habitat: In deciduous forests.

Note: This species can easily be distinguished by its related species *C. malabatrum* (Burm. F.) Bl., sparsely hairy opposite leaves and axillary few flowered panicles. As a narrow endemic wild relative of cinnamon, it deserves more consevation studies.

Specimen examined: Kozhikkode district: Peruvannamuzhi, 2 Feb. 1980, *Shylaja 26217* (Holotype, CALI).

2. Cinnamomum palghatensis M. Gangop. Bangladesh J. Plant Taxon. 15(2): 89, 2008.

Type: Palakkad district: Singampatti to Vattapari forest, Siruvani western slopes, 625 m, 29 May 1979, *E. Vajravelu 62860* (MH).

Trees, 12-15 m high. Leaves subopposite, thinly coriaceous, greenish-brown above, paler beneath, narrow oblong-lanceolate to oblong-elliptic, 15-22 × 2.8-4.0 cm, acute at base, slightly decurrent to extreme base, margin entire, thin, almost flat along margin, apex broken tending to broad acumen; trinerved, central one prominent, raised and stout on both surfaces, lateral nerves of the central one sub- prominent and distant, that of accessories forming faint loops along margin; tertiary nerves parallel, faint above, obscure beneath; minor nervules faintly reticulate above, obscure beneath; petioles 1.0-1.5 cm long, puberulous. Flowers not seen. Infructescences solitary, axillary, c. 15 cm long; peduncles c. 5.5 x 0.15 cm wide, terete, puberulous; rachis flattened, densely puberulous. Fruits green with large oblong perianth c. 2.2 × 1.6 cm, obtuse and projected at apex, pericarp blackish, glabrous, muriculate; fruit cup thick, c. 0. 3 × 1.2-1.5 cm, margin slightly undulate, tepal lobes deciduous.

Flowering & Fruiting: May-June.

Habitat: Hilly slopes.

Note: As a narrow endemic wild relative of cinnamon, it deserves more consevation studies.

Specimen examined: Palakkad district: Singampatti to Vattapari forest, Siruvani western slopes, 625 m, 29 May 1979, *E. Vajravelu 62860* (Isotype, MH).

LITSEA Lamarck

Encycl. 3: 574. 1792, *nom. cons.*

Key to the species

1. Flowers in axillary sessile umbellules ..... 2. *L. travancorica*
1. Flowers in axillary or lateral peduncled umbellules..... 1. *L. beei*

1. **Litsea beei** N. Mohanan & Santhosh Kumar, Nordic J. Bot. 23: 611. 2004.

Type: Thiruvananthapuram district: Agasthyamala Hills, Attayar, ± 700 m, 27 Jun. 1994, *N. Mohanan 12439* (TBGT). (Plate 61 b & c)

Small trees, 5-8 m high. Leaves alternate, 8-12 x 2-4.5 cm, elliptic-oblong, acute to caudate-acuminate at apex, acute to acuminate at base, glabrous. Inflorescence globose umbellules, 0.2-0.35 cm in diam., 2-6 clustered in axillary and lateral subrecemes. Flowers dioecious. Involucral bracts usually 4, broadly ovate, 0.4-0.5 x 0.3-0.35 cm, concave, creamy-white, glabrous. Male flowers 4-6 in an umbellule. Pedicels 0.2-0.3 cm long. Tepals 6, 0.25-0.3 x 0.1-0.15 cm, ovate, narrowed at base. Stamens 12 in 4 rows. Female flowers smaller than male.

Tepals 6. Ovary 1-celled; ovule 1; style thick; stigma irregularly 2-3-lobed. Staminodes 6. Berry subglobose, 0.6-0.8 cm in diam., style persistent on fruit. Seed 1.

Flowering & Fruiting: June-July

Habitat: Evergreen vegetation.

Note: A local endemic species, hitherto known only from the Agasthyamala hills. As an endemic tree species with restricted distribution, it deserves conservation efforts.

Specimens examined: Thiruvananthapuram district: Agasthyamala Hills, Attayar, ± 700 m, 27 Jun. 1994, *N. Mohanan 12439* (Holotype, TBGT); Bonaccord, ± 650 m, 27 Jun. 1994, *Rajkumar 11760* (Paratype, TBGT); Attayar, ± 700 m, 11 Jan. 1996, *Santhosh Kumar 26836* (Paratype, TBGT); Kurusumala, ± 750 m, 12 Feb 2008, *Shaju 59488* (TBGT).

2. **Litsea travancorica** Gamble, Bull. Misc. Inform. Kew 132. 1925; Gamble, Fl. Pres. Madras 1237. 1925; N. C. Nair & C. N. Mohanan, J. Econ. Taxon. Bot. 3(2): 576. 1982; Vajr. & Daniel, Mat. Cat. Thr. Pl. Ind. 34. 1983; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 66. 1987; M. Mohanan & A. N. Henry, Fl. Thiruvananthapuram 396. 1994; Anil Kumar *et al.*, Fl. Pathanamthitta 425. 2005; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 400. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 375. 2006.

Type: 'Colatoorpolay' (= Kulathupuzha), 29.11.1893, *M.A. Lawson s.n.*, (MH). (Plate 61 d)

Small trees, 5-10 m high; young parts ferruginous tomentose. Leaves sub-opposite, 10-20 x 4-8 cm, oblong-obovate, acuminate at apex and obuse at base, glabrous above and fulvous reddish tomentose beneath, brown when dry. Flowers in axillary sessile umbellules. Bracts orbicular, ferruginous. Ovary ovoid, glabrous. Fruits in axillary clusters with cup-like dull yellow calyx, c. 1 cm across, globose, glabrous.

Flowering & Fruiting: April-June.

Habitat: Semi-deciduous forests and along the margins of tropical fresh-water swamps.

Note: Gamble described this taxon based on the collections of M. A. Lawson made in 1893. After the type collection, it has not been collected and is placed under 'Rare' category (Nayar, 1987). But this species is recollected by C. N. Mohanan (1979) from the semi-decidious forests of Kulathupuzha (type locality). Present study also resulted in the collection of this species from Agasthyamala at Thiruvananthapuram district with very limited individuals. The conservation status of this palaeoendemic speceis has been designated as 'Endangered' in the IUCN Threatened Plant List of 2008.

Specimens examined: Kollam district: 'Colatoorpolay' (Kulathupuzha), 29.11.1893, *M.A. Lawson s.n.*, (MH); *Ibid*, Chandanakavu, 19 Feb. 1979, *C. N. Mohanan 61148* (MH); Kulathupuzha, 8 Jun. 1979, *C. N. Mohanan 63143* (MH); Thenmala, 23 Jul. 2002, *Shaju 48994* (TBGT); Thruvananthapuram district: Agasthyamala, Kurusumala, ± 800 m, 27 Feb. 2008, *Shaju 59497* (TBGT).

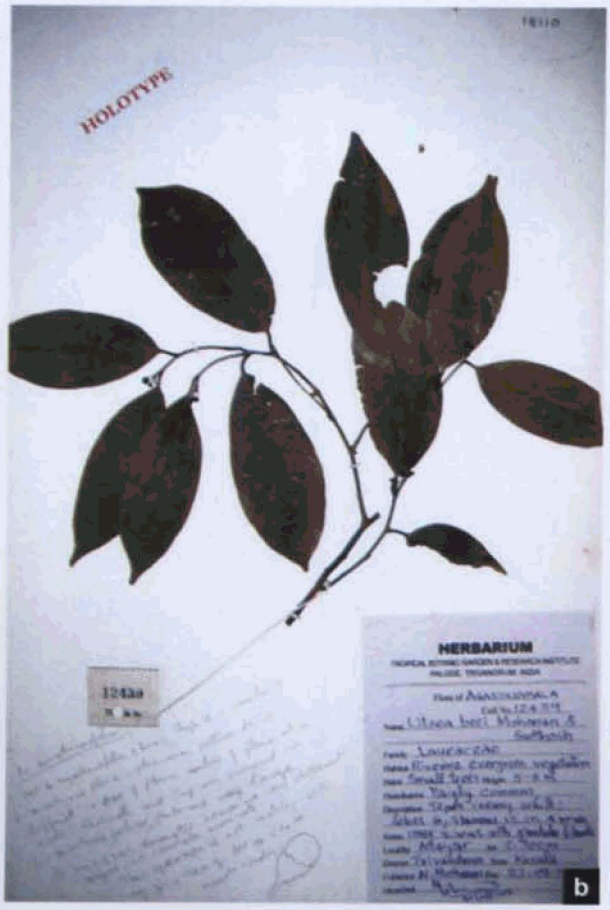

Plate 61. a. ***Cinnamomum nicolsonianum*** Manilal & Shylaja: Type specimen at CALI; b & c. ***Litsea beei*** Santhosh kumar *et al.*: b. Type specimen at TBGT; c. Fruiting twig; d. ***Litsea travancorica*** Gamble: Fruting twig.

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42. EUPHORBIACEAE

Table 62. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
300	7500	73	410	41 spp., 1 ssp.,

Kerala	
Genus/genera	Species/subsp./var.
46	165 spp., 11 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Antidesma L.		*A. keralense* Chakrab. & Gangop.
Aporusa Blume		*A. bourdillonii* Stapf
Baccaurea Lour.	*B. courtallensis* (Wight) Mull.-Arg. (Karnataka & Tamil Nadu)	
Blachia Baillon	*B. calycina Benth.* (Karnataka & Tamil Nadu) *B. denudata* Benth. (Maharashtra, Goa & Karnataka)	
Chamaesyce Gray		*C. katrajensis* var. *kasaragodensis* (V. J. Nair, Binojkumar & Ansari) Raju
Caloxylon A. Juss	*C. anomalum* Hook. f. (Tamil Nadu) *C. beddomei* Hook. f. (Tamil Nadu)	
Cleitanthus Hook. f. ex Planchon	*C. malabricus* (Muell.-Arg.) Muell.- Arg. (Maharashtra, Karnataka & Tamil Nadu) *C. trvancorensis* Jabl. (Karnataka & Tamil Nadu)	*C. sankunnianus* Sivar. & Balach.
Croton L.	*C. caudatus* var.*obovoideus* Balakr. & T. Chakrab. (Karnataka & Tamil Nadu) *C. malabaricus* Bedd. (Karnataka & Tamil Nadu)	
Dimorphoclayx	*D. beddomei (Benth.)*Airy Shaw	

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Thwaites	(Tamil Nadu)	
	D. glabellus var. *lawianus* (Hook. f.) Chakrab. & Balakr. (Maharashtra, Karnataka & Tamil Nadu)	
Drypetes Vahl	*D. confertiflora* (Hook. f.) Pax & Hoffm. (Karnataka)	
	D. malabarica (Bedd.) Airy Shaw (Tamil Nadu)	
	D. venusta (Wight) Pax & Hoffm. (Maharashtra, Karnataka & Tamil Nadu)	
Euphorbia L.	*E. santapaui* A. N. Henry (Tamil Nadu)	
	E. vajravelui Binojkumar & Balakr. (Tamil Nadu)	
	Glochidion Foster & Foster f.	
	G. bourdillionii Gamble (Karnataka & Tamil Nadu)	
	G. hohenackeri var. *johnstonei* (Hook. f.) T. Chakrab. & Gandop. (Maharshtra & Karnataka)	
Mallotus Lour.	*M. beddomei* Hook. f. (Karnataka & Tamil Nadu)	
Meineckia Baillon	*M. longipes* (Wight) Webster (Tamil Nadu)	
Phyllanthus L.	*P. beddomei* (Gamble) M. Mohanan (Tamil Nadu)	
	P. fimbriatus (Wight) Muell.- Arg. (Tamil Nadu)	
	P. gageanus (Gamble) M. Mohanan (Tamil Nadu)	
	P. megacarpa (Gamble) Kumari & T. Chardrb.(Tamil Nadu)	
Pseudoglochidion Gamble	*P. anamalayanum* Gamble (Tamil Nadu)	
Sauropus Blume	*S. gour-maitii* T. Chakrab. & Gangop. (Tamil Nadu)	

Key to the genera

1. Inflorescence a cyathium..... **Chamaesyce**
1. Inflorescence other than cyathium.
   2. Perianth 2-seriate..... **Cleistanthus**
   2. Perianth 1-seriate.
      3. Ovary 1-locular..... **Antidesma**
      3. Ovary 3-many locular..... **Aporusa**

ANTIDESMA Linnaeus

Sp. Pl. 1072. 1753.

Antidesma keralense Chakrab. & M. G. Gangop., J. Econ. Taxon. Bot. 24: 23. 2000; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 409. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 234. 2006.

Type: Thiruvananthapuram district: Agasthyamala, Way to Chemunji, 1200 m, 19 May 1979, *M.Mohanan 61834* (MH). (Plate 62 b)

Shrubs, c. 3 m high, branchlets greyish or pale brownish, entirely glabrous. Leaves elliptic to oblong-elliptic, 7-13 x 2.5-5 cm, acute or sometimes rounded at base, caudate or acuminate, acumen 1.5-2 cm long at apex, reddish brown or often greenish brown when dry. Flowers not seen. Infructescence axillary, simple, 5-16 cm long, rachis adpressed, yellow puberulous or glabrous. Fruits obliquely ovoid-ellipsoid, comporessed, 0.9-1 x 0.5-0.7 cm, alveolate, black brown when dry.

Flowering & Fruiting: May.

Habitat: Evergreen forests.

Note: As a wild edible narrow endemic species, conservation measures should be extended to the existing populations in natural habitats (*in-situ*).

Specimens examined: Thiruvananthapuram district: Agasthyamala, Way to Chemunji, 1200 m, 19 May 1979, *M. Mohanan 61834* (Isotype, MH); *Ibid.*, 16 Apr. 2003, *Shaju 48987* (TBGT).

APORUSA Blume

Bijdr. 514. 1825-1826

Aporusa bourdillonii Stapf in Hook.'s Ic. 23, t. 2204. 1892; Gamble, Fl. Pres. Madras 1309. 1925; Bourd., Forests Trees Travancore 362. 1908; Mandal & Panigrahi, Bull. Bot. Surv. India 26: 42. 1984; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 173. 1987; Chakrab. & M. G. Gangop., J. Econ. Taxon. Bot. 17: 155. 1993; Sasidh. & Sivar., Flr. Pl. Trissur For.

393. 1996; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 410 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 234. 2006. ***Malavetti***.

Type: 'Travancore', 10 Dec. 1904, *Bourdillon 1568* (K). (Fig. 37; Plate 62 a)

Tree, 5-8 m high; young shoot adpressed tawny-pilose. Leaves oblong to elliptic-oblong, 10-17 x 3-5.5 cm, caudate-acuminate (acumen 1-2 cm long), base rounded, glabrous above and tomentose along midrib below and petiole, lateral nerves 7-9 pairs, arching along the margin; petioles 1-2 cm long; stipules lanceolate-oblong. Male inflorescence 1 -1.5 cm long. Flowers: sepals 3, ovate-oblong, c. 0.01 x 0.05 cm; stamens 2-3. Female inflorescence 1-few together; peduncle 0.5-1 cm long; 1-flowered, tawny-hirsute; bracts at intervals on axis. Flowers: sepals 4, oblong-lanceolate, 0.4-0.5 x 0.15-0.2 cm; ovary ovoid, 3-locular; styles 3, trifid, thick, hirtellous. Capsule ovoid, 1.5-2 x 1.5-2 cm, 3-locular, processes linear; up to 0.3 cm long. hirtellous.

Flowering & Fruiting: March-April.

Habitat: Among the second storey of reverine vegetation.

Note: A narrow endemic species with limited distribution in the evergreen forests of Idukki and Thrissur districts. Being a palaeoendemic tree species with wild edible fruits, it is phytogeographically and economically interesting. Consevation status of this palaeoendemic species has been designated as 'Endangered' in the IUCN Threatened Plant List of 2008.

Specimens examined: Idukki district: Pooyankutty, Knachery, 29 Jun. 2000, *Shaju 46401* (TBGT); Thrissur district: Vazhachal, 18 Oct. 2007, *Shaju 59489* (TBGT).

CHAMAESYCE Gray

Chamaesyce katrajensis var. **Kasaragodensis** (V. J. Nair, Binojkumar & Ansari) Raju, J. Econ. Taxon. Bot. 28. 91. 2004; *Euphorbia katrajensis* var. *Kasaragodensis* Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 417. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 238. 2006.

Type: Kasaragod district: Bela, 1 Oct. 1982, *Ansari 74431* (MH).

Herbs, erect, up to 10 cm high; stem unbranched. Leaves opposite, linear oblong to linear lanceolate, oblique at base, entire or 5-distantly serrate, acute-apiculate at apex. Petioles c. 0.I cm long, glabrous. Stipules oblong, fimbriate. Cyathia solitary, axillary or apparently terminal, glabrous outside, puberulous inside, involucral lobes 4, triangular, laciniate. Glands 4. Male florets many, pedicelled; anthers subglobose. Female florets with gynophore 0.2 cm long. Ovary glabrous; style 3; stigma capitate. Capsules 3.

Flowering & Fruiting: September-October.

Habitat: Lateritic rocky open areas.

Note: A local endemic variety with very limted distribution. It deserves conservation efforts.

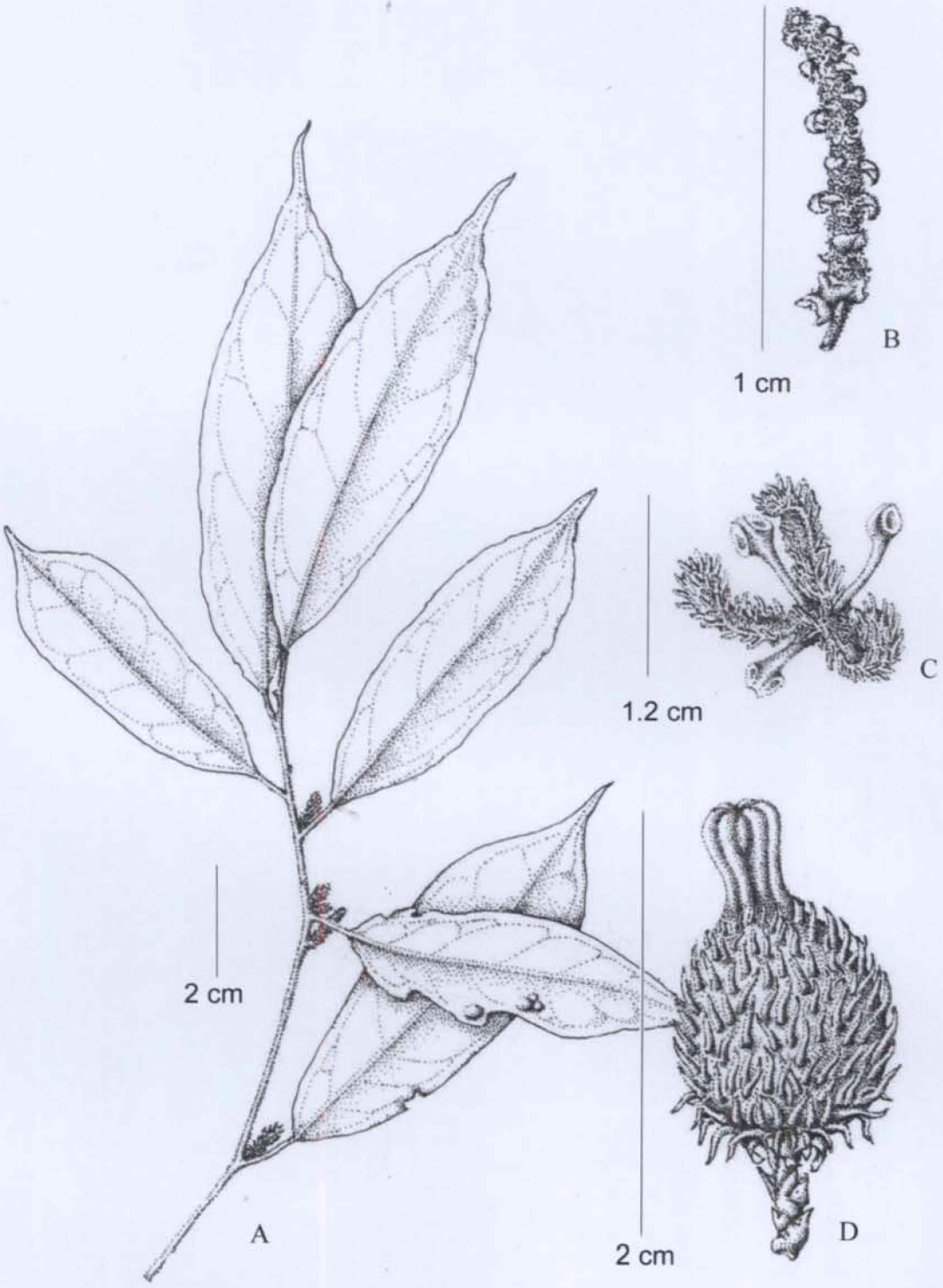

Fig. 37. ***Aporusa bourdillonii*** Stapf: A. Flowering twig; B. Male inflorescence; C. Male flower; D. Fruit.

226 A

DB 5995

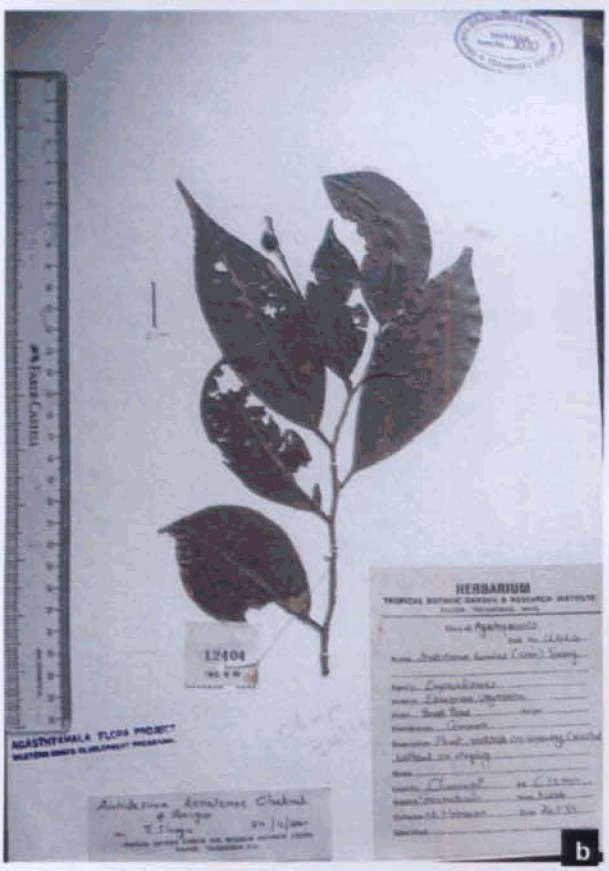

Plate 62. a. ***Aporusa bourdillonii*** Stapf: Habit; Inset: Fruiting twig; b. ***Antidesma keralense*** Chakrab. & Gangop.: Herbarium specimen at TBGT; c. ***Cleistanthus sankunnianus*** Sivar. & Balach.: Type specimen at CALI.

NB 5995

226 B

Specimens examined: Kasaragod district: Bela, 1 Oct. 1982, *Ansari* 74431 (Isotype, MH); *Ibid.*, 30 Sep.1989, *Binojkumar 85075* (Paratype, MH).

CLEISTANTHUS J. D. Hooker ex Planchon

Icon. Pl. 779.1848.

Cleistanthus sankunnianus Sivar. & Balach., Kew Bull. 40 (1): 121. 1985; Chakrab., *et al.*, J. Econ. Taxon. Bot. 26: 234. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 413. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 240. 2006; Udayan & Balach. Bull. Bot. Surv. India 48: 217. 2006.

Type: Malappuram district, Kottakkal Arya Vaidya Sala Herbal Garden - Original source not known, *Indubalachandran 1486* (CALI). (Plate 62 c)

Woody shrubs, profusely branched. Leaves elliptic or elliptic lanceolate, acute or shortly acuminate, c. 8 x 3 cm, base cuneate, glabrous. Petiole 0.2-0.3 cm long, rusty villous. Male and female flowers in few-flowered axillary or extra axillary sessile glomerules. Bracts and bracteoles minute. Male flowers sessile, 0.2-0.5 cm across. Calyx lobes 5, ovate, united below the middle, c. 0.1 cm long, glabrous. Petals minute, clavate or obovate, irregularly lacerate at tip, glabrous. Disc cup-shaped, fused with the calyx tube. Stamens 5, filaments united into a tube; anthers ellipsoid; pistillode 3-fid, as long as the staminal coloumn. Female flowers short-pedicelled. Calyx 5-lobed; petals and disc as in male flowers. Ovary sessile, ovoid, 3-lobed, glabrous; styles 3, bifid at apex. Capsule deeply 3-lobed, glabrous; dehicing into three 2-valved cocci. Seed 1 in each locule.

Flowering & Fruiting: Almost throughout the year.

Habitat: Shady localities of semi-evergreen forests.

Note: An *ex-situ* conserved species with unknown nativity was reported by Sivarajan and Indubalachandran (1985) based on specimens collected from the Herbal Garden of the Kottakkal Arya Vaidyasala. Recently Udayan *et al.* (2006) reported significant populations of this species from the Kottavasal forests near Achenkovil in Kollam district. This forms the first report on its natural habitat.

Specimen examined: Malappuram district: Kottakkal Arya Vaidyasala Herbal Garden, *Indubalachandran 1486* (Isotype, CALI).

43. BURMANNIACEAE

Table 63. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
12	100	2	7	3 spp.

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Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)

Kerala

Genus/genera	Species/subsp./var.
2	7 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Burmannia L.		*B. indica* Jonker
		B. stricta Jonker
Haplothismia Airy Shaw		*H. exannulata* Airy Shaw

Key to the genera

1. Saprophytic herbs ..... **Haplothismia**
1. Autophytic herbs ..... **Burmannia**

BURMANNIA Linnaeus

Sp. Pl. 287. 1753.

Key to the species

1. Herbs to 25 cm long ..... 1. *B. indica*
1. Herbs to 15 cm long ..... 2. *B. stricta*

1. **Burmannia indica** Jonker, Meded. Bot. Mus. Herb. Rijks. Univ. Utrecht 51: 156. 1938; Hajra, Fasc. Fl. India 19: 12.1988; Karth. *et al.*, Fl. Ind. Enu. Monogr. 22. 1989; Sebastine, Bull. Bot. Surv. India 221. 1962; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 492. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 656. 2006.

Type: 'Travancore', Southern Kerala, *Meebold 12915* (BRSL).

Slender herbs. Stem 10-25 cm tall, filiform, simple. Leaves 0.1-0.4 cm long, linear-lanceolate, acuminate. Bracts 0.1-0.25 cm long, lanceolate, acute. Inflorescence 1-flowered or 3-5-flowered, bifid-cincinnus. Flowers 0.8-0.9 cm long, subsessile, purplish, prominently 3-winged; outer perianth lobes 0.1-0.2 cm long, erect, triangular, acute with thick swollen margins; inner lobes 0.5-1 cm long, linear, acute, thick, swollen; connective trapeziform with two divergent, obtuse, curved, apical crust and a basal obtuse spur. Ovary obovid or obconical; style short; stigma 3, sessile, curved, funnel-shaped, sub-bilabiate. Capsule 0.3-0.5 cm long, obovoid or orbicular.

Flowering & Fruiting: December.

(KFRI) 30476

KERALA FOREST RESEARCH INSTITUTE
HERBARIUM

Collection No 30476 Date 19-10-2000
Locality Vengoli, Parambikulam WLS, Palakkad Dist.
Botanical Name Haplothismia exannulata Airy Shaw

Family Burmanniaceae
Habit Saprophytic herb Altitude ± 700 m
Distribution Rare
Habitat Evergreen forest
Local Name
Other data Plant reddish coloured muddy brown
A fungus, Ramaria sp. is found associated
with the Haplothismia
Collected by N. Sasidharan & P. Sujanapal Det

Plate 63. ***Haplothismia exannulata*** Airy Shaw: Herbarium specimen at KFRI.

NP 5995

2287

Habitat: Moist grasslands.

Note: This species is known only by a single collection of Meebold from 'Travancore', Southern Kerala. It has not been recollected after it was first collected and described, and remains untraceable. Due to developmental activities its orginal habitats have undergone changes leading to the probable 'extinction' of this species.

2. **Burmannia stricta** Jonker, Meded. Bot. Mus. Herb. Rijks. Univ. Utrecht 51: 156. 1938; Hajra, Fasc. Fl. India 19: 14.1988; Karth., *et al.*, Fl. Ind. Enu. Mono. 22. 1989; Sebastine, Bull. Bot. Surv. India. 221. 1962; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 492. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 657. 2006.

Type: Ernakulam district: Cochi, *Meebold 12337* (BRSL).

Slender herbs. Stem 5-15 cm tall, unbranched. Leaves 0.5-0.15 cm long, scale-like, lanceolate, acuminate. Bracts c. 0.1 cm long, lanceolate, obtuse. Inflorescence 1-2-flowered. Flowers 0.6-1.2 cm long, subsessile, prominently 3-winged; outer perianth lobes c. 0.1 cm long, triangular, acute, margin involute; inner ones c. 0.5 cm long, linear, acute. Perianth tube 0.3-0.4 cm long, cylindrical; connective with two divergent, obtuse crest at apex and two short lateral arms, bearing thecae; spur tapering at base, hanging. Ovary ellipsoid-obovoid; style thick, filiform; stigma 3, cristate, funnel-shaped. Capsule ellipsoid- obovoid.

Flowering & Fruiting: November.

Habitat: Moist grasslands.

Note: This species is so far known from its type collection by Meebold. It might have become 'extinct' due to rapid destruction of the area for habitation.

HAPLOTHISMIA Airy Shaw

Kew Bull. 2: 277. 1952

Haplothismia exannulata Airy Shaw, Kew Bull. 2: 277. 1952; Hajra in Fasc. Fl. India 19: 15. 1988; A. N. Henry *et al.*, J. Bomby. Nat. Hist. Soc. 75: 695. 1978; Vajr. & Daniel, Mat. Cat. Thr. Pl. India 36. 1983, Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 242.1987; Karth. *et al.*, Fl. Ind. Enu. Monogr. 22.1989; Sasidh. & Sujanapal, Rheedea 10:131. 2000; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 493. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 657. 2006.

Type: 'Trvancore' Cochin, 25 Oct. 1951, *A. Abraham & K. C. Jacob* (UCT). (Plate 63)

Annual saprophytic herbs. Stem 7-15 cm tall, simple or branched, brown-coloured. Roots tuberous, clustered. Leaves reduced to scales, more or less sheathing the stem, distichous, membraneous; lower ones small, c. 0.5 x 0.4 cm, ovate, glabrous; upper ones to c. 1.2 x 0.5 cm, membraneous, puberulous. Inflorescence pseudo-recemose, puberulous, 2-6-flowered; pedicels 4-5.5 cm long, from the axils of upper scales. Flowers 1.5 cm long, perianth lobe infundibular, base adnate to the ovary, c. 1 cm across at the mouth, free at apex. Stamens 6, opposite to the

perianth segments; filaments basally attached to the perianth-hypanthium tube and free at apex; anthers pendulous, ovate. Ovary inferior, obovate, unilocular; ovules numerous; style very short; stigma trilobed. Fruit a loculicidal capsule. Seeds many.

Flowering & Fruiting: October.

Habitat: Evergreen forests.

Note: The plant was first collected from Parambikulam, in the erstwhileTravancore-Cochin State by Prof. A. Abraham and K. C. Jacob in October 1951 and it was deposited in the Herbarium of University College, 'Trivandrum' (Thiruvananthapuram). After the type collection, Sebastine and Ramamoorthy (1966) studied the flora of Parambikulam-Aliyar project area during 1962-'63 and they could not locate this taxon and reported that " further collection from this region is impossible as the area is going under water" due to the construction of Parambikulam dam. As all the previous attempts to relocate *H. exannulata* were unsuccessful, Nayar (1997) assigned the status 'Extinct' to this taxon. During the floristic studies in Parambikulam Wildlife Sanctuary, Sasidharan and Sujanaplal located this possibly extinct species from two restricted localities. The present discovery is significant in the context of conservation as the collection localities belong to areas under protection.

Ecological characters of this saprophytic species is very distinct. It grows in humus-rich soil in the evergreen forest at an altitude of c. 700 m., during the end of north-east monsoon. Life period of this ephemeral is directly influenced by the moisture content of the soil. This species is not easily distinguished from its surroundings, because of its peculiar colour. A fungus is often associated with this species.

Specimen examined: Palakkad district: Parambikulam Wildlife Sanctuary, Vengoli, ± 700 m, 16 Oct. 2000, *Sujanapal 30387*; *ibid.*, 19 Oct. 2000, *Sasidharan & Sujanapal 30476* (KFRI).

44. ORCHIDACEAE

Table 64. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
880	22000	186	1141	84 spp.

Genus/genera	Species/subsp./var.
79	252 spp., 3 ssp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Acampe Lindley		*Acampe congesta* (Lindley) Lindley
Aenhenrya Gopalan	*A. rotundifolia* (Blatter) Sath.	

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	Kumar & Rasmussen (Tamil Nadu)	
Aerides Lour.	*A. maculosa* Lindley (Maharashtr, Goa, Karnataka & Tamil Nadu)	
Brachycorythis Lindley	*B. wightii* Summerh. (Tamil Nadu)	
Bulbophyllum Thouars	*B. acutiflorum* A. Rich. (Karnataka & Tamil Nadu)	*B. keralensis* M. Kumar & S. Seq.
	B. aurem (Hook. f.) J.J.Smith (Tamil Nadu)	*B. orezii* Sath. Kumar
	B. elegantulum (Rolfe) J. J.Smith (Karnataka & Tamil Nadu)	*B. rosemarianum* Sath. Kumar *et al.*
	B. fimbriatum (Lindley) Reichb.f. (Maharashtra & Karnataka)	*B. silentvalliensis* Sharma & Srivastava
	B. fuscopurpureum Wight (Karnataka & Tamil Nadu)	
	B. mysorense (Rolfe) J.J.Smith (Karnataka)	
	B. tremulum Wight (Karnataka & Tamil Nadu)*Cheirostylis* Blume	
Cheirostylis Blume		*C. seidenfadeniana* Sath.Kumar & Rasmussen
Dendrobium Sw.	*D. anamalayanum* Chandrab. *et al.* (Tamil Nadu)	
	D. barbatulum Lindley (Maharashtra, Goa, Karnataka & Tamil Nadu)	
	D. diodon subsp. *kodayarensis* Gopalan & A.N.Henry (Tamil Nadu)	
	D. heyneanum Lindley (Karnataka & Tamil Nadu)	
	D. jerdonianum Wight (Karnataka)	
	D. pandratum subsp. *villosum* Gopalan & A. N. Henry (Tamil Nadu)	
Eria Lindley	*E. muscicola* var. *brevilinguis* Joseph & V.Chandras. (Karnataka & Tamil Nadu)	*E. tiagii* Manilal *et al.*

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Gastrochilus D. Don.	*G. flabelliformis* (Blatter & Mc Cann) Saldanha (Maharashtra & Karnataka)	
Habenaria Willd.	*H. barnesii* Summerh. ex Fischer (Tamil Nadu)	*H. flabelliformis* Summerh. ex Fischer
	H. cephalotes Lind. (Tamil Nadu)	*H. periyarensis* Sasidh. *et al.*
	H. elwesii Hook. f. (Karnataka & Tamil Nadu)	
Ipsea Lindley		*I. malabarica* (Reichb. f.) Hook. f.
Kingidium P. Hunt	*K. mysorensis* (Saldanha) Sath. Kumar (Karnataka)	*K. niveum* Sath. Kumar
Liparis Rich.	*L. platyphylla* Ridley (Karnataka & Tamil Nadu)	*L. walakkadensis* M. Kumar & S. Seq.
Lusia Gaudich	*L. evangelinae* Blatter & McCann (Karnataka)	
Oberonia L	*O. anamalayana* Joseph (Tamil Nadu)	*O. agastyamalayana* Sath. Kumar
	O. brachyphylla Blatter & McCann (Karnataka)	*O. wynadensis* Sivad. & Balakr.
	O. brunoniana Wight (Maharashtra, Karnataka & Tamil Nadu)	
	O. chandrasekharanii V. J. Nair *et al.* (Karnataka & Tamin Nadu)	
	O. Josephii Saldanha (Karnataka)	
	O. nayarii R. Ansari & Balakr. (Karnataka & Tamil Nadu)	
	O. platycaulon Wight (Tamil Nadu)	
	O. santapaui Kapadia (Maharahtra, Karnataka & Tamil Nadu)	
	O. sebastina Shetty & Vivek. (Tamil Nadu)	
	O. seidenfadeniana Joseph & Vajr. (Tamil Nadu)	
Pachystoma Blume	*P. hirsutum* (Joseph & Vajr.) Sath. Kumar & Manilal (Tamil Ndu)	

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Paphiopedilum Pfitzer	*P. druryi* (Bedd.) Stein (Tamil Nadu)	
Porpax Lindley	*P. jerdoniana* (Wight)Rolf (Karnataka & Tamil Nadu)	
Pteroceras Hassk.		*P. monsooniae* Sasidh. & Sujanapal
Rhytionanthos Garay & Hamer	*R. indicum* Sath. Kumar & Garay (Tamil Nadu)	
	R. rheedeii (Manilal & Sath.Kumar) (Karnataka)	
Schoenorchis Reinw.		*S. manilaliana* M. Kumar & S. Seq.
Seidenfadeniella Sath. Kumar	*S. rosea* (Wight) Sath. Kumar (Karnataka &Tamil Nadu)	
Smithsonia Saldanha	*S. viridiflora* (Dalz.) Saldanha (Maharashtra & Karnataka)	
Taeniophyllum Blume		*T. scaberulum* Hook. f.
Thrixspermum Lour.	*T. muscaeflorum* var. *nilagiricum* Joseph & Vajr. (Tamil Nadu)	
Trias Lindley	*T. bonaccordensis* Sath. Kumar (Karnataka & Tamil Nadu)	
Vanda Jones ex R. Br.	*V. wightii* Reichb. f. (Karnataka & Tamil Nadu)	
Xenikophyton Garay		*X. seidenfadenianum* M. Kumar & S. Seq.

Key to the genera

1. Epiphytic herbs.
   2. Leaves ensiform; midrib absent .. **Oberonia**
   2. Leaves not ensiform; midrib presnt.
      3. Lip spurred.
         4. Leaves not articulated on sheaths.
            5. Leaf-apex unequally cleft ..... **Acampe**
            5. Leaf-apex acute ..... **Schoenorchis**
         4. Leaves articulated on sheaths
               6. Spur with ridges ..... **Pteroceras**

6. Spur without ridge ..... **Xenikophyton**

3. Lip not sprrued.

7. Flowers with a mentum..... **Kingidium**

7. Flowers without a mentum.

8. Inflorescence lateral racemes..... **Bulbophyllum**

8. Inflorescence simple racemes..... **Eria**

1. Terrestrial herbs.

9. Flowers with spur..... **Habenaria**

9. Flowers without spur.

10. Leaves purple..... **Cheirostylis**

10. Leaves greenish.

11. Inflorescence lateral..... **Ipsea**

11. Inflorescence terminal ..... **Liparis**

ACAMPE Lindley

Folia Orchid. Fasc. 4. 1853.

Acampe congesta (Lindl.) Lindl., Fol. Orch. Acampe 2. 1833; Gamble, Fl. Pres. Madras 1447 (1012).1928; Sath. Kumar, End. Orch. Western Ghats 51. 1986; Manilal & Sath. Kumar, Orch. Mem.163. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 443. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 723. 2006: *Vanda congesta* Lindl., Bot., Reg. Misc. 94.1839; *Saccolabium congestum* (Lindl.) J. D. Hook., Fl. Brit. India 6: 63.1890; *S. papillosum* Wight, Ic. 5(1): 9, t. 1672.1851.

Type: 'Malabar', *Wight 1019* (K).

Epiphytes. Stems short, stout. Leaves narrowly strap shaped, apex unequally 2-lobed with usually a mucro in between. Racemes short, capitate. Bracts broadly ovate, acute. Flowers white with yellow and purple tinges. Sepals and petals fleshy, linear, ovate, obtuse. Spur shortly conical or saccate, hairy within. Lip saccate; lateral lobes very small; mid-lobe rhomboid with acute angles, papillose above.

Flowering & Fruiting: Unknown.

Habitat: Epiphytic on trees in moist deciduous forests.

Note: *Acampe congesta* (Lindl.) Lindl. is a little known taxa known from only one collection from 'Malabar' made by Wight in 1836. Wight gives no precise locality, and it is not known to have been located again during the last 180 years. The possibility of its extinction cannot be ruled out in this case. Nayar (1987) also remarked it as 'Possibly extinct'. In the absence of authentic herbarium details of the species, brief description based on available literature has been provided.

BULBOPHYLLUM Du Petit-Thouars

Hist. Pl. Orch., Tabl. Esp. 3. 1822, *nom. cons.*

Key to the species

1. Inflorescence longer than leaves.
   2. Flowers with fruity smell..... 3. *B. rosemarianum*
   2. Flowers without fruity smell..... 4. *B. silentvalliensis*
1. Inflorescence shorter than leaves.
   3. Lateral sepals free..... 1. *B. keralensis*
   3. Lateral sepals connate at upper edges ..... 2. *B. orezii*

1. **Bulbophyllum keralensis** M. Kumar & S. Seq., J. Bombay Nat. Hist. Soc. 98: 87. 2001; Manilal & Sath. Kumar, Orch. Mem.169. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 446. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 727. 2006.

Type: Palakkad district: Silent Valley, Sispara, 1800 m, 26 Sep. 2000, *Stephen 007857* (KFRI).

Epiphytic pseudobulbous creeping herbs; pseudobulbs 1.2-2 x 0.5-0.7 cm, ovoid, angled. Leaves petiolate, solitary, lamina elliptic, 1.8-6 x 0.8-2 cm, emarginate, grooved along midrib, coriaceous. Inflorescence umbel or sub- umbel. Peduncle 10-12 cm long with 3 linear sterile bracts. Floral bracts 4-6 x 1-1.2 cm, ovate, acuminate. Flowers 4-7, golden yellow with purple tinge, 2.8-3.2 x 0.5-0.7 cm. Sepals dissimilar; dorsal sepals 0.7-0.9 cm long, ovate-lanceolate, papillate at the base, 5-nerved; lateral sepals 2.7-3 x 0.2-0.6 cm, free, linear-ovate, subulate, 5-nerved, induplicate, papillate. Petals elliptic, 0.4-0.6 x 0.15 cm, elliptic, slightly falcate, 5-nerved, cuspidate, entire, slightly papillate. Lip recurved, c. 0.45 x 0.12 cm, tongue-shaped, attached to the column foot. Column broadly ovate. Anther terminal. Pollinia 4 in pairs, oval-shaped. Operculum c. 0.1 x 0.07 cm, broadly ovate.

Flowering & Fruitng: August-September.

Habitat: Epiphytic on the moss-covered tree trunks in the evergreen shola forests.

Note: A local endemic species with very limted distribution. It deserves conservation efforts.

Specimen examined: Palakkad district: Silent Valley National Park, Sispara, 1800 m, 26 Sep. 2000, *Stephen 007857* (Holotype, KFRI).

2. **Bulbophyllum orezii** Sath. Kumar, in Sath. Kumar & Manilal, Orch. Mem. 170. 2004; *B. josephii* M. Kumar & S. Seq., J. Bombay Nat. Hist. Soc. 98: 89. 2001, non *B. josephii* (Kuntze) Summerh.,1945; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 446. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 727. 2006.

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Type: Palakkad district: Silent Valley, Punnamala, ± 850 m, *Stephen 007521* (KFRI).

Epiphytic pseudobulbous creeping herbs; pseudobulbs 1-1.3 x 0.6-1 cm, ovoid. Leaves solitary, lamina elliptic, 3.5-4 x 0.8-1 cm, emarginated, grooved along midrib, coriaceous. Inflorescence umbel or sub-umbel. Peduncle up to 5 cm long with 1 or 2 sterile bracts. Floral bracts minute, ovate, acuminate. Flowers yellow with violet specks, c. 10 x 3.5 cm. Pedicel up to c. 0.6 cm long. Sepals dissimilar; dorsal sepal ovate-lanceolate, c. 0.45 x 0.15 cm, acuminate, induplicate, scattered papillate at base, 5-nerved; lateral sepals oblong-lanceolate, 9.5-10 x 0.3 cm, papillate, connate at upper edges. Petals oblong-ovate, c. 0.3 x 0.16 cm, slightly falcate, apex apiculate, speckled with violet, 3-nerved. Lip tongue shaped, 0.25 cm long, recurved, attached to the column foot. Column orbicular-ovate, c. 0.15 x 0.15 cm. Anther terminal. Pollinia 4 in 2 groups. Operculum ovate-orbicular.

Flowering & fruiting: August-September.

Habitat: This species is narrowly distributed in its area of occurence. The type locality and adjacent areas need to be thoroughly explored to assess its distributional status for appropriate conservation measures.

Specimen examined: Palakkad district: Silent Valley National Park, Punnamala, ± 850 m, *Stephen 007521* (Holotype, KFRI).

3. **Bulbophyllum rosemarianum** Sath. Kumar, Suresh & Saleem, Rheedea 11: 97. 2001; Manilal & Sath. Kumar, Orch. Mem.170. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 446. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 728. 2006.

Type: Idukki district: Thalakode, 30 m, 2 Feb. 1998, *Saleem 28211* (TBGT). (Plate 64 a)

Epiphytic pseudobulbous herbs with creeping rhizomes; pseudobulbs 1.7-3.5 x 1.1-1.6 cm, quadrangular. Leaves solitary, lamina oblong, 5-18 x 1.6-3.2 cm, erect, oblong, thick and fleshy, deeply-channelled in the middle region, narrowed at base into a short petiole, obtuse at apex. Inflorescence arise from the base of pseudobulb, pale green, longer than leaf. Peduncle 5.5-9.2 cm long with 4 cup-like sterile bracts. Flowers pale yellow smelling like a ripenedd jack fruit or mango. Sepals dissimilar; dorsal sepal ovate-elliptic, 0.4-0.5 x 0.3-0.35 cm, truncate-angulate, 5-nerved, acute at apex; lateral sepals ovate-elliptic or boat-shaped, 0.8-0.9 x 0.4-0.45 cm, 5-nerved, margins folded inwards. Petals ovate-aristate, 0.2-0.25 x 0.15-0.2 cm, slightly oblique, gland-dotted, 1-nerved. Lip 0.3-0.35 x 0.15-0.2 cm, thick, yellow with brown markings, papillose throughout, 3-lobed, side lobes represented by 2 auricles. Column 0.2-0.3 cm long, thick. Operculum c. 0.1 x 0.1 cm, 2-celled, slightly rugose outside. Pollinia 4 in 2 groups, each one unequally devided. Fruits 0.2-0.25 x 0.7-012 cm, globose.

Flowering & Fruiting: January-March.

Habitat: This species can be seen in riparian vegetation of lowland forests; and were seen growing on the trunks of *Mangifera indica* (Idukki) and *Terminalia crenulata* (near Perumthenaruvi riverfalls, Pathanamthitta).

Note: The pleasant fruity smell is the characteristic feature of this narrow endemic species; owing to narrow distribution assumes conservation significance.

Specimens examined: Idukki district: Thalakode, 30 m, 2 Feb. 1998, *Saleem 28211* (Holotype, TBGT); Kannur district: Nellippara, 50 m, 11 Feb. 1997, *Sibi Mathew & Suresh Kumar 27297* (Paratype, CAL, TBGT); Pathanamthitta district: Perumthenaruvi, 450 m, 13 Mar. 2003, *Shaji & Shaju 7080* (TBGT).

4. **Bulbophyllum silentvalliensis** M. P. Sharma & S. K.Srivast., J. Jap. Bot. 68: 209. 1993; Sath. Kumar & Manilal, Cat. Ind. Orch. 66. 1994; Sath. Kumar *in* Manoharan *et al.*, Silent Valley Whis. Reas. 169. 1999; Manilal & Sath. Kumar, Orch. Mem. 171. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 111. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 728. 2006.

Type: Palakkad district: Silent Valley, *M. P. Sharma 16911* (CAL).

Epiphytic herbs with creeping rhizome, pseudobulbs at intervals. Leaves linear oblong, obtuse, notched at tip, sessile or subsessile. Scape exceeding the leaves, slender. Flowers 2-3, yellow. Bracts lanceolate, acuminate membranous. Dorsal sepal ovate entire, 5-nerved. Lateral sepal connate at margin along whole length except towards gibbous base, 5-nerved. Lateral petals broad, ovate, obtuse at apex, entire, 5-nerved. Lip attached to the column-foot; column-foot turning upward at one end. Column with short vertical acute glides.

Flowering & Fruiting: March-May.

Habitat: Epiphytic.

Note: A local endemic species distinct in having smaller leaves and lesser number of flowers in inflorescence.

So far not figured in any of the IUCN category. Being a local endemic species , it is necessary to locate this species from type locality and adjacent areas and conservation of its populations and habitats should be preserved.

Specimens examined: Palakkad district: Silent Valley National Park, *M. P. Sharma 16911* (Holotype, CAL).

CHEIROSTYLIS Blume

Bijdr. 413, t.16. 1825.

Cheirostylis seidenfadeniana Sath. Kumar & F. Rasm., Nord. J. Bot. 7(4): 409. 1987; Karth. *et al.*, Fl. Ind. Enu. Mono. 113. 1989; Manilal & Sath. Kumar, Field Key Orch. Kerala 7.1993; Sath. Kumar & Manilal, Cat. Ind. Orch. 67. 1994; N. Mohanan & Sivad., Fl. Agasthyamala 655. 2002; Manilal & Sath. Kumar, Orch. Mem. 172. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 448. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 729. 2006.

Type: Thiruvananthapuram district: Ponmudi, 950 m, 25 Oct. 1983. *Sathish Kumar C U 36960* (TBGT). (Plate 64 b)

Terrestrial herbs, 5-10 cm high. Stem creeping at base, then erect; creeping portion nodose; erect portion glandular hairy. Leaves ovate- lanceolate, 1.5-3 x 0.4-2.5 cm, acute apex. Petiole 1-1.5 cm long. Inflorescence terminal racemes; basal portion with 3-5 lanceolate bracts, 0.5-0.7 cm long. Floral bracts 0.2-0.5 cm long, subulate. Flowers densely clustered, secund. Sepals connate to form a tube, 0.25-0.3 cm long. Petals free, 0.2-0.3 cm long. Lip c. 0.4 cm long, straight; lateral lobes saccate with 3-4 basal papillae; mid-lobe 2-fid; margins entire, with 2 tufts of hairs at base. Pollinia 2. Capsule 0.5-0.6 cm in diam., subglobose.

Flowering & fruiting: November-January.

Habitat: Growing on moist rocks in deep shade in montane forests.

Note: A narrow endemic species with very limted distribution. It deserves conservation efforts.

Specimens examined: Thiruvananthapuram district: Agasthyamala, Bonaccord, Koviltherimala, ± 900 m, 23 Dec. 1987, *N. Mohanan 9220* (TBGT); Idukki district: Peruvanthanam, ± 500 m, 28 Nov. 1996, *N. Mohanan & Ravi 24772* (TBGT).

ERIA Lindley

Bot. Reg. 11: t. 904. 1825., *non.cons.*

Eria tiagii Manilal, Sath. Kumar & J. J. Wood, J. Econ. Taxon. Bot. 5(2): 483. 1984; Manilal, Fl. Silent Valley 280. 1988; Karth. *et al.*, Fl. Ind. Enum. Mono. 136. 1989; Manilal & Sath. Kumar, Field Key Orch. Kerala 25.1993; Sath. Kumar & Manilal, Cat. Ind. Orch. 73. 1994; Samaddar & Roy, Addit. Elem. Ind. Fl. 1: 1997; Sath. Kumar in Manoharan *et al.*, Silent Valley Whis. Reas. 202. 1999; Manilal & Sath. Kumar, Orch. Mem.188. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 455. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 738. 2006.

Type: Palakkad district, Silent Valley, Chembotti, 950 m, 20 Aug. 1982, *Sathish Kumar 10736* (CALI). (PLate 64 c)

Small, epiphytic pseudobulbous herbs; pseudobulbs compressed and usually connected end to end by slender, thread like rhizomes, often sheathed. Leaves 2-3, sessile, oblanceolate, 2-4 x 0.1-0.4 cm, apiculate. Inflorescence terminal on the leafy pseudobulbs, flexuosus; scape c. 3.5 cm long, 6-11-flowered, not second but zig-zag. Bracts small, ovate lanceolate. Flowers white. Dorsal sepal linear lanceolate, acuminate, 3-nerved; laterals connate below, attached to foot of column. Petals linear acuminate, 3-nerved. Lip clawed at base, shorter than sepals; disc with 2 slightly linear calli at base, margin of the basal region entire, distal end crenulate. Pollinia 8.

Flowering & Fruiting: August-September.

Habitat: In undisturbed evergreen forests.

Note: A local endemic species with very limted distribution. It deserves conservation efforts.

Specimens examined: Palakkad district: Chembotti in Silent Valley, 950 m, 20 Aug. 1982, *Sathish Kumar 10736* (Holotype, CALI); Kummathan thode, 900 m, 28 Sep. 1987, *Gangaprasad 15188* (TBGT).

HABENARIA Willdenow

Sp. Pl. 4 (1): 5, 44.1805.

Key to the species

1. Leaves many, cauline..... 1. *H. flabelliformis*
1. Leaves 2, radical..... 2. *H. periyarensis*

1. **Habenaria flabelliformis** Summerh. ex Fischer in Gamble, Fl. Pres. Madras 1887. 1936; Rathakr. & Chithra, Distr. End. Orch. Karnataka, Kerala & Tamil Nadu. J. Econ. Taxon. Bot. 5: 1001.1984; A. N. Henry *et al.*, J. Bombay Nat. Hist. Soc. 75: 684. 1978; Karth., *et al.* Fl. Ind. Enum. Mono. 143. 1989; Manilal & Sath. Kumar, Orch. Mem.188. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 459. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 742. 2006.

Type: 'Travancore', Anamudi, *E. Barnes 629* (K).

Terrestrial erect herbs. Leaves many, ovate or ovate-lanceolate, acute, amplexicaul. Sepals spreading, lanceolate, slightly falcate, obtuse or sub acute. Petals shorter, linear-ensiform, subfalcate, sub-acute, lip as long as sepals, coriaceous, sessile, divided nearly to the base into 3 subequal, acute lobes; midlobe linear-oblong, side lobes narrowly lanceolate. Spur longer than the sepals.

Flowering & Fruiting: Not specified.

Habitat: Grasslands.

Note: This speies was described based on Barnes's collection from Anamudi slopes of Idukki district. It has not been collected even the region has been well botanized. It is apparently extinct. A brief description of the species based on available literature is added.

2. **Habenaria periyarensis** Sasidh., Rajesh & Jomy, Rheedea 8: 167. 1998; Manilal & Sath. Kumar, Orch. Mem.197. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 460. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 744. 2006.

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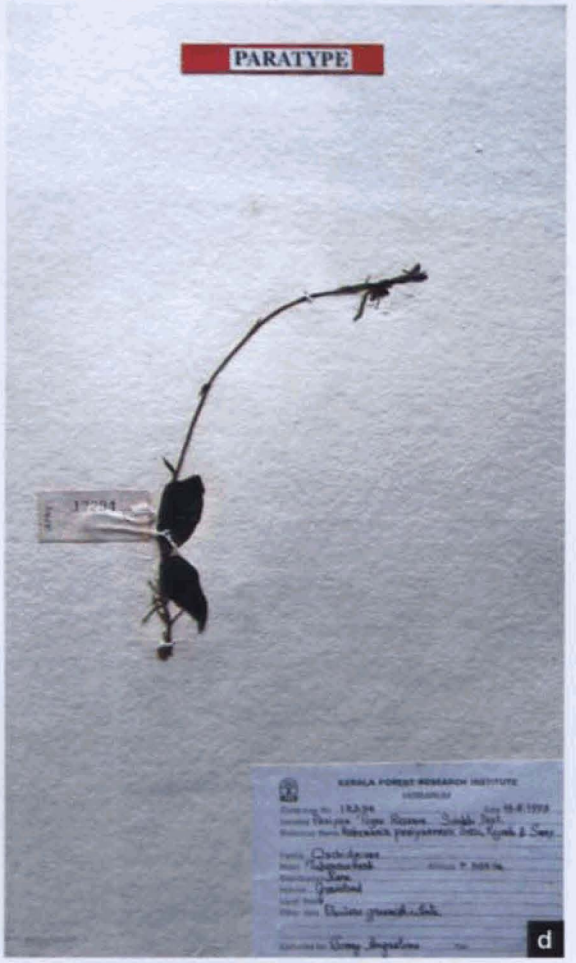

Plate 64. a. ***Bulbophyllum rosemarianum*** Sath.Kumar *et al.*: Preserved specimen at TBGT; b. ***Cheirostylis seidenfadeniana*** Sath. Kumar *et al.*: Herberium specimen at TBGT; c. ***Eria tiagii*** Manilal *et al.*: Type specimen at CALI; d. ***Habenaria periyarensis*** Sasidh. *et al.*: Type specimen at KFRI.

Type: Idukki district, Periyar Tiger Reserve, ± 1200 m, 5 Aug. 1996, *Jomy 17842* (KFRI). (Plate 64 d)

Terrestrial herbs, c. 25 cm tall. Leaves 2 or 3, radical, sessile, 4-5 x 1-2 cm, narrowly elliptic-lanceolate, acute, mucronate, cuneate at base, glabrous. Inflorescence a raceme. Peduncle 15-18 cm long, 3-5-flowered with 5 sterile bracts, 1-1.5 x 0.2-0.3 cm, ovate to linear acuminate. Floral bracts 0.7 x 0.2 cm, ovate acuminate, 3-veined. Dorsal sepal green, c. 0.7-1 x 0.6 cm, elliptic, acute, dorsally 3-ribed, 3-5-nerved. Lateral sepals white, reflexed, 0.6-1.2 x 0.6 cm, ovate, acute, oblique at base, 5-nerved. Petals green, 0.7-0.9 x 0.15-0.2 cm, linear-lanceolate, subacute, 2-veined. Lip greenish-white, 3-partite; lateral lobes filiform, 1-1.7 x 0.09 cm, acute and curving up; midlobe c. 1-2 x 0.1 cm, linear, obtuse. Spur white, 2-2.5 cm long, cylindrical, slightly inflated towards apex. Coulmn c. 0.5 x 0.4 cm. Anthers lateral. Pollinia pyriform. Staminodes 2, oblong. Ovary shortly pedicellate.

Flowering: July-August; fruits not seen.

Habitat: among short grasses in high altitude grasslands.

Note: A local endemic species known only from the type locality.

Specimens examined: Idukki district: Periyar Tiger Reserve, ± 1100 m, 19 Aug. 1993, *Jomy 17842* (Paratype, KFRI).

IPSEA Lindley

Gen. et Sp. Orch. 124, 1831.

Ipsea malabarica (Reichb.f.) Hook. f., Fl. Brit. India 5: 812. 1890; Rama Rao, Flr. Pl. Travancore 1914; Abraham & Vatsala, Intr. Orch. 268.1981; Manilal & Sath. Kumar, Bull. Pure & Appl. Sci. 2(C): 38. 1983; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 253. 1986; Sath. Kumar & Manilal, Kew Bull. 42: 937.1987; M. P. Nayar & Sastry, Red Data Book Ind. Pl. 1: 258. 1987; Manilal, Fl. Silent Valley 289. 1988; Karth. *et al.*, Fl. Ind. Enum. Mono. 198. 1989; Manilal & Sath. Kumar, Field Key Orch. Kerala 16.1993; Sath. Kumar *in* Manoharan *et al.*, Silent Valley Whis. Reas., 204. 1999; Manilal & Sath. Kumar, Orch. Mem.198. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 461. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 745. 2006. *Pachystoma malabaricum* Reichb. f. in Walp., Ann. Syst. 6: 462. 1864; *Spathaglottis malabarica* (Reichb. f.) U. C. Pardhan, Ind. Orch. 2: 702. 1979.

Type: Malabar Ghat, *Jerdon s.n.* (W). (Fig. 38; Plate 65 a & b)

Terrestrial tuberous herbs; tuber depressed. Leaves 1-2, linear- lanceolate, 20-40 x 0.4-2 cm, plicate. Inflorescence 18-34 cm long, arising from the lateral lobe of the tuber, sheathed at base, puberulous, pale violet. Floral bracts oblong-lanceolate, c. 2 x 2 cm long, margins involute, connate below forming a small tube enclosing pedicel with ovary, hairy outside.

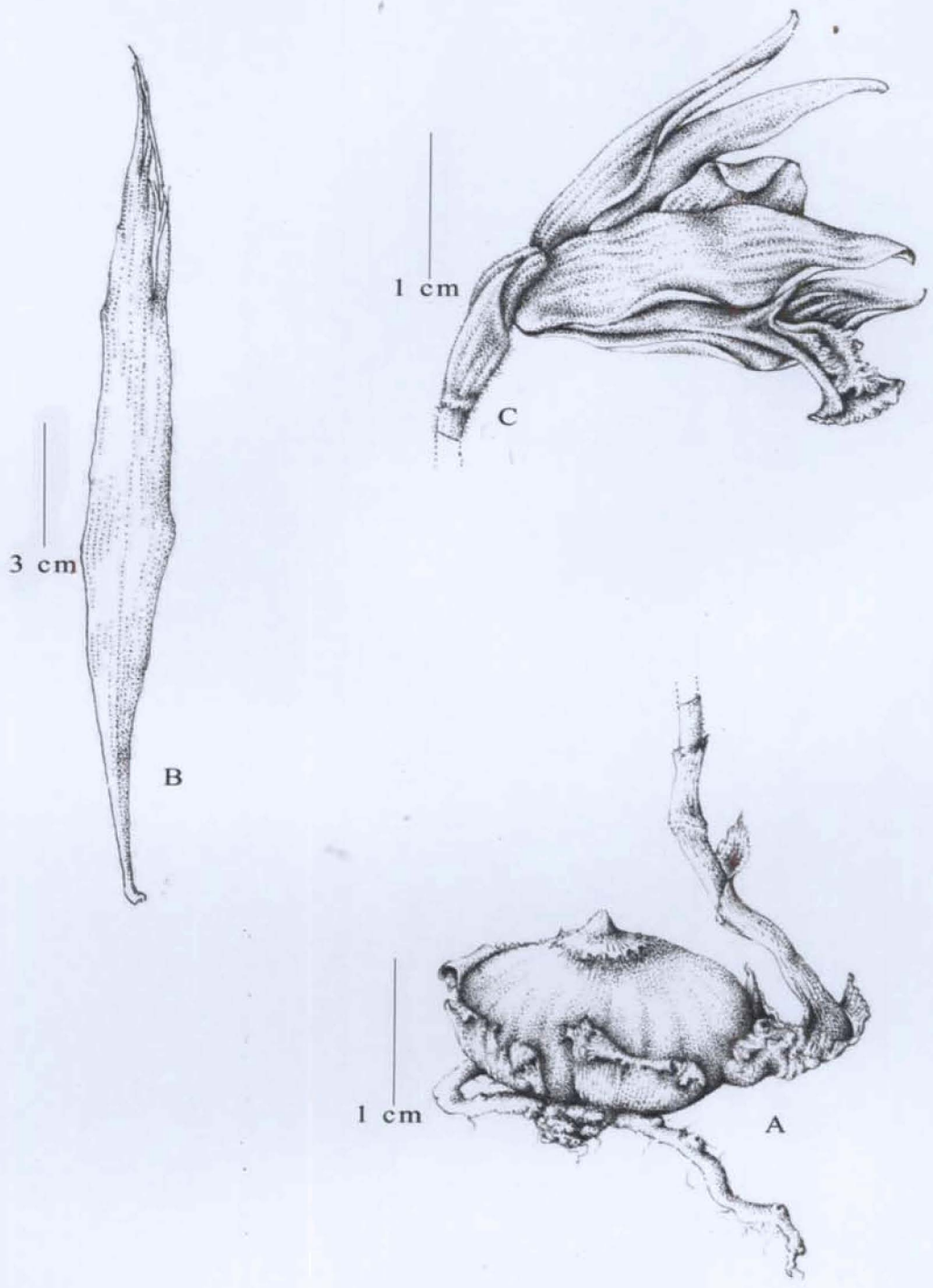

Fig. 38. ***Ipsea malabarica*** (Reichb. f.) Hook. f.: A. Tuber with base of inflorescence axis; B. Leaf; C. Flower.

NB5995 240 A

Flowers solitary or rarely 2, golden yellow. Dorsal sepals oblong, puberulous outside, 7-nerved; lateral sepals ovate-oblong, 7-nerved, adnate at the base to column foot. Petals oblong-lanceolate, subacute at apex, puberulous outside; midlobe obovate, emarginate, margin denticulate along. Disc with 5-6 serrate lamella. Pollinia 8, in 2 pairs of 4 each, waxy. Ovary puberulous.

Flowering & fruiting: October-December.

Habitat: Grasslands along the moist rocky slopes of the river banks. During the vegetative phase it is difficult to recognize the plants in the field due to grass-like appearance.

Note: The 'Malabar Daffodil', with large showy golden yellow flowers, remained unknown for about 130 years after the type collection. T. C. Jerdon collected this species in around 1850 from the 'Malabar Ghats' and the specimen is now in the Natural History Museum at Wien, Austria. N. C. Nair located this orchid species from Kunthipuzha river bank of Silent Valley in 1979. Later in 1982, Sathish Kumar Kumar collected it from Aruvanpara and reported its rediscovery with full taxonomic history and illustration in 1983. He also located this species from Poochippara and Sairandhri in Silent Valley. A. K. Pradeep has located a population of 40 plants at Chembra peak in Wayanad district in 1996. This distributional record is very interesting because in the type of *I. malabarica*, Jerdon had mentioned only 'Malabar Ghat' without any specific locality. As an ornithologist, Jerdon spent most of his time in Wayanad area, especially Mananthavady and Kuruva, and most probably Jerdon's collection might be from Wayanad. Nayar (1997) remarked it as 'Endangered'.

Specimens examined: Palakkad: Silent Valley, Poochipara, ± 1100 m, 9 Nov. 1983, *Sathish Kumar S V 11536* (CALI); *Ibid.*, 19 Nov. 1993, *Gangaprasad 18439* (TBGT); *Ibid.*, 26 Nov. 2003, *Shaju 4441* (TBGT);

KINGIDIUM P.F. Hunt

Kew Bull. 24: 97. 1970.

Kingidium niveum Sath. Kumar, in Sath. Kumar & Manilal, Cat. Ind. Orch. 53. 1994; Manilal & Sath. Kumar, Field Key Orch. Kerala 35. 1993; Sasidh. & Sivar., Flr. Pl. Thrissur For. 445.1996; Sath. Kumar *in* Manoharan *et al.*, Silent Valley Whis. Reas. 205. 1999; Manilal & Sath. Kumar, Orch. Mem. 199. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 461. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 746. 2006.

Type: Palakkad district: Silent Valley, Walghat, *Sathish Kumar 11264* (TBGT). (Plate 65 c)

Epiphytic herbs. Stem short. Leaves elliptic-oblong, 3-9 x 1.6-2.6 cm, fleshy, coriaceous, base narrowed into a short petiole, acute at apex. Inflorescence 1-3 cm long. Bracts cupular, entire, acute. Flower 1-4, white, c. 1 cm across. Dorsal sepal c. 0.6 x 0.1-0.3 cm, obovate, 5-

nerved, obtuse. Lateral sepals c. 0.5 x 0.4 cm, broadly ovate, 5-nerved, subacute. Petals obovate, c. 0.5 x 0.3 cm, slightly falcate, 5-nerved, obtuse. Lip 3-lobed. Lateral lobes c. 0.3 x 0.15 cm, erect, slightly toothed on margin, lamellate; lamella single, thick, yellow. Midlobe c. 0.37 x 0.7 cm, fleshy with linear callus, subentire or obscurely toothed. Disc with 2 pairs of unequal antennae. Column c. 0.2 cm long, slightly winged. Operculum 2-celled. Pollinia 4 in unequal pairs on strap-shaped stipe, attached to a triangular viscidium. Rostellum unequally 3-fid. Fruits c. 2 cm long, oblong.

Flowering & fruiting: March–January.

Habitat: Growing on tree trunks in evergreen forests.

Note: As a local endemic species, distribution status of this exclusive endemic species should be studied.

Specimen examined: Palakkad district:: Silent Valley, Walghat, *Sathish Kumar 11264* (Isotype, TBGT).

LIPARIS L. C. Richard

De Orch. Eur. 21, 30, 38. 1817, *nom. cons.*

Liparis walakkadensis M. Kumar & S. Seq., J. Orch. Soc. India 13 (1): 29. 1999; Manilal & Sath. Kumar, Orch. Mem. 201. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 462. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 747. 2006.

Type: Palakkad district, Silent Valley, Walakkad, 1100 m, 26 aug. 1995, *Stephen 007877* (KFRI).

Terrestrial herbs. Stem c. 4 cm long, swollen. Leaves 3, upper 2 subopposite, lower one smaller, subsessile, 1.2-3 x 0.6-1.4 cm, ovate, membranous, unequal at base and continued into sheaths, 1-1.5 cm long, acuminate, acute, 5-nerved, margin undulate. Flowers in lax recemes, greenish. Peduncle up to 15 cm long, angled, 5-ribbed, rachis up to 2 cm long. Sterile bracts many. Floral bracts ovate, acuminate. Sepals subsimilar; dorsal sepal oblong, c. 0.4 x 0.1 cm, acute, 3-nerved, entire; lateral sepals broadly elliptic, c. 0.3 x 0.15 cm, falcate, entire, attached on the back of lip, 3-nerved, subacute. Petals linear, thread-like, c. 0.5 x 0.04 cm, 1-nerved, truncate at apex. Lip clawed, transversely obcordate-orbicular, emarginated, c. 0.3 x 0.5 cm, minutely denticulate on the margins, 5-nerved. Disc with 2-transverse calli at base, calli flap like. Column slender, c. 0.03 x 0.03 cm, incurved, broadly winged near the top, 2-toothed. Anther terminal. Operculum reniform, 2-loculed. Pollinia 4 in 2 pairs, unequal. Ovary with c. 0.18 cm long pedicel.

Flowering & Fruiting: August -September.

Habitat: Evergreen and semi-evergreen forests.

Note: A local endemic species with very limted distribution. It deserves conservation efforts.

Specimen examined: Palakkad district: Silent Valley National Park, Walakkad, ± 1000

m, 26 Aug. 1995, *Stephen 007877* (Holotype, KFRI).

OBERONIA Lindley

Gen. Sp. Orch. Pl. 15. 1830, *nom. cons.*

Key to the species

1. Petals obtuse-truncate at apex. ..... 1. *O. agastyamalayana*
1. Petals acute at apex ..... 2. *O. wynadensis*

1. **Oberonia agastyamalayana** Sath. Kumar in Sath. Kumar & Manilal, Cat. Ind. Orch. 57. 1994; Field Key Orch. Kerala 20. 1993; Manilal & Sath. Kumar, Orch. Mem.199. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 464. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 746. 2006. *O. longifolia* M. Kumar & S. Seq., J. Orch. Soc. India 12(1-2): 29. 1998.

Type: Thiruvananthapuram district: Agasthyamala, *Sathish Kumar 1398* (TBGT).

(Fig. 39; Plate 65 d)

Tufted pendulous epiphytes. Leaves linear ensiform, 4-17 x 0.05-0.16 cm, acute. Scape adnate to the upper leaf, up to 15 cm long, flattened. Inflorescence 25-33 cm broad, tapering into a sterile tail. Flowers in distinct verticels, each with 4 flowers. Floral bracts ovate, acute. Sepals deflexed, c. 0.25 x 0.12-0.15 cm, ovate-oblong, 1-nerved, obtuse. Petals linear-oblong, c. 0.25 x 0.05 cm, obtuse-truncate at apex, 1-nerved. Lip quadrate, 3-lobed, 3-nerved; lateral lobes 0.2-0.25 x 0.35-0.4 cm, growing behind the column; midlobe bi-lobulate, 0.12-0.17 x 0.35-0.4 cm, orbicular with a sinus in between. Disc ovate, concave. Column c. 0.07 cm long, ovate-oblong. Ovary with pedicel 0.3-0.35 cm long. Pollinia ovoid.

Flowering & Fruiting: October-November.

Habitat: Evergreen forests.

Note: This endemic species is known only from the type locality.

Specimens examined: Thiruvananthapuram district: Agasthyamala, ± 1500 m, 18 Mar. 1993, *Gangaprasad 15136* (TBGT); *Ibid.*, 2 Mar. 2006, *Shaju 59491* (TBGT).

2. **Oberonia wynadensis** Sivad. & R. T. Balakr., Nord. J. Bot. 9(4): 394. 1989; Manilal & Sath. Kumar, Field Key Orch. Kerala 20.1993; Manilal & Sath. Kumar, Orch. Mem. 209. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 752. 2006. *O. pakshipadalensis* M. Kumar & S. Seq., J. Orch. Soc. India 12(1-2): 31. 1998.

Type: Wayanad district: Chembra peak, ± 1300 m, 23 Sep. 1984, *Balakrishnan CU40643* (K).

(Fig. 40)

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Tufted pendulous epiphytes. Leaves ditichous, 1-17 x 0.5-1.6 cm, auriculate at base, linear, ensiform, apex acute. Scape adnate to the upper leaf, compressed, 12-15 x 0.3-0.7 cm, with few sterile bracts at apex. Inflorescence 25-35 cm long, tapering to the tip in to a sterile tail. Flowers pedicellate in distinct whorls, each one c. 0.3 cm apart and 4 in a whorl. Floral bracts ovate-oblong, acute at apex. Sepals and petals deflexed. Dorsal sepal ovate- oblong, 0.23-0.25 x 0.14-0.16 cm, obtuse, 1-nerved, glabrous; lateral sepals broadly ovate, 0.2-0.23 x 0.15-0.17 cm, 1-nerved, glabrous. Petals linear- blong, c. 0.25 x 0.05 cm, 1-nerved, glabrous, acute at apex. Lip quadrate, 3-lobed, 3-nerved, 0.36-0.38 x 0.4-0.42 cm; lateral lobes entire margined; midlobe 2-lobulate, 0.12-0.17 x 0.35-0.4 cm, lobules orbicular with a quadrate sinus in between. Disc ovate, concave, glabrous. Column 0.07-0.1 x 0.05-0.07 cm, ovate, oblong. Ovary with pedicel 0.15-0.17 cm long. Pollinia 2, ovoid.

Flowering & Fruiting: September-October.

Habitat: This species is found growing as an epiphytic component of evergreen forests.

Note: This local endemic species is so far known only from the type locality. *O. pakshipadalensis* Muktesh & Stephen, later described from Wayanad is in no way different from O. Wyanadensis, hence it is reduced to a synonym.

The area of its occurrence needs an extensive exploration to assess its distributional status for further conservation efforts.

Specimens examined: Wayanad district: Chembra peak, near Meppadi, ± 1300 m, 23 Sep. 1984, *Balakrishnan CU 40643* (CALI); Pakshipadalam, ± 1500 m, 4 Nov. 2008, *Shaju 66745* (TBGT).

PTEROCERAS Hassk.

Fl. 25: 2, Beibl. 6. 1842

Pteroceras monsooniae Sasidh. & Sujanapal, Sida 20: 923. 2003; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 471. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 756. 2006.

Type: Palakkad district: Parambikulam wildlife Sanctuary, ± 1180 m, 28 May 2000, *Sujanapal 30596* (KFRI). (Plate 65 e)

Epiphytic herbs. Stem erect, to 2cm long, unbranched. Leaves 4, distichously alternate, 4-8 x 1-2 cm, articulate, linear to elliptic-lanceolate, slightly wider towards the apex, unequally bilobed, lobes rounded. Inflorescence recemose, from the axils of older leaf sheaths, 2-7, unbranched, 1-3 cm long. Peduncle terete, densely covered with soft brown prickles. Bracts broadly ovate, c. 0.6 cm long, apex spinulate, persistant. Flowers 2-4, sessile, spirally alternating. Sepals and petals free, spreading, sparsely prickly on abaxial surface, grayish-white; median sepal c. 1.8 x 1 cm, laterals adnate to the foot column, elliptic-ovate, acute apex; petals c. 1.4 x 0.8 cm, oblong-ovate, base rounded, glabrous. Labellum c. 0.6 cm long, side lobes

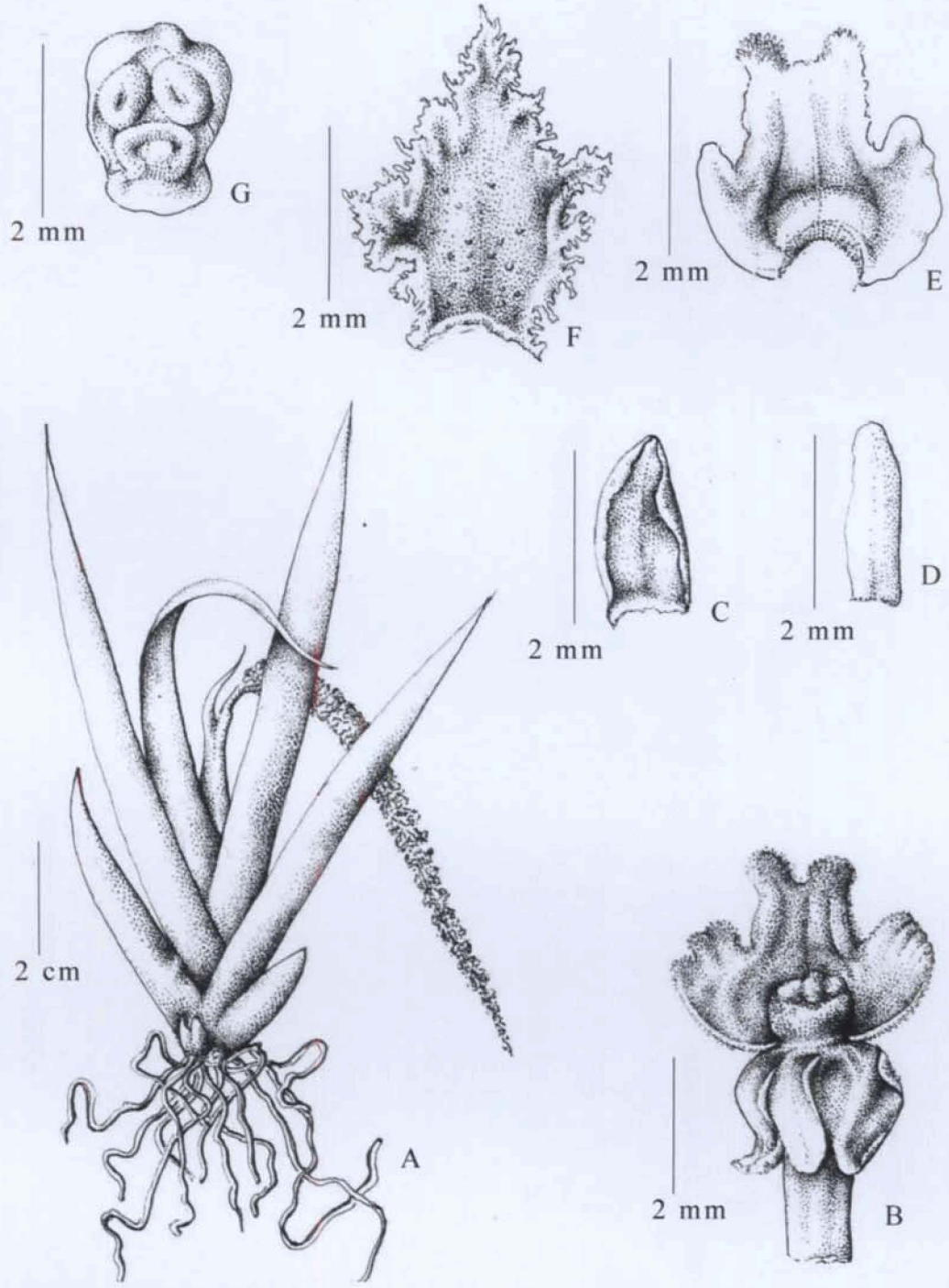

Fig. 39. ***Oberonia agastyamalayana*** Sath. Kumar: A. Habit; B. Flower; C. Dorsal sepal; D. Petal; E. Lip; F. Floral bract; G. Column.

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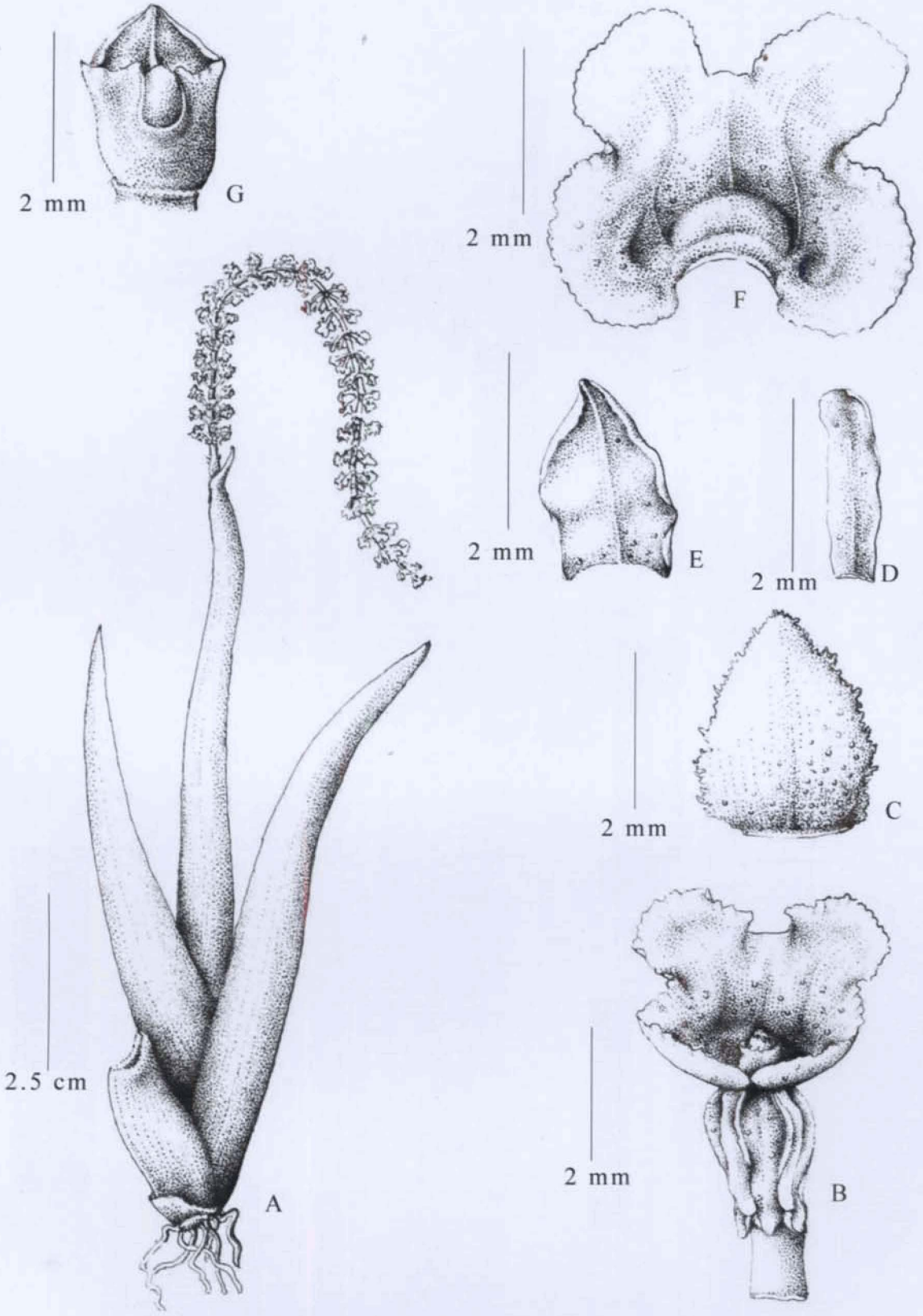
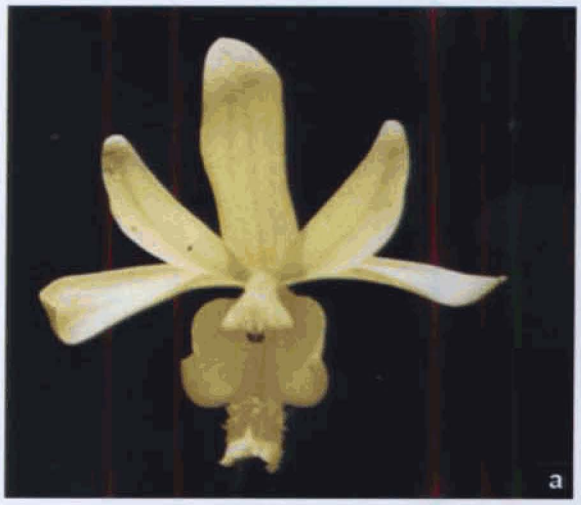
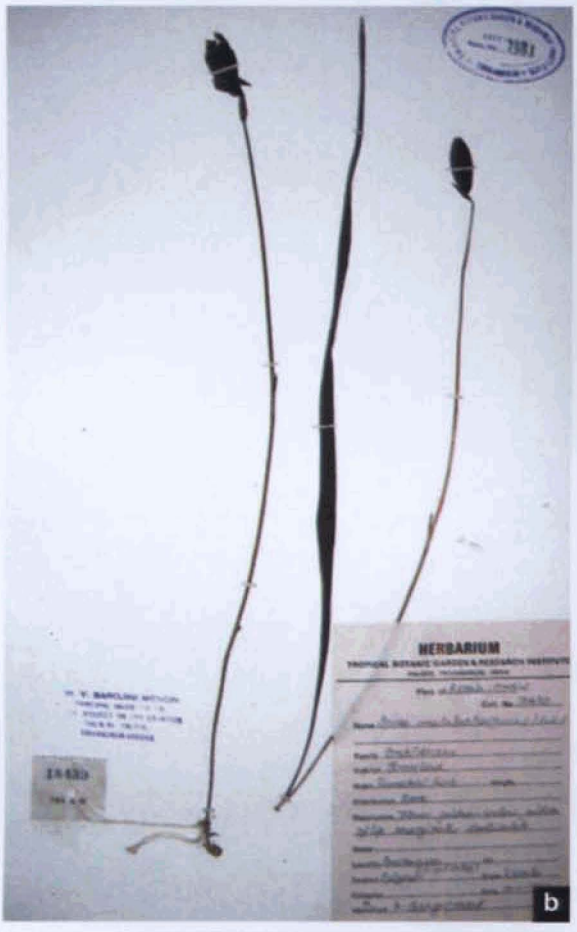


Fig. 40. ***Oberonia wynadensis*** Sivad. & Balakr.: A. Habit; B. Flower; C. Floral bract; D. Petal; E. Dorsal sepal; F. Lip; G. Column.





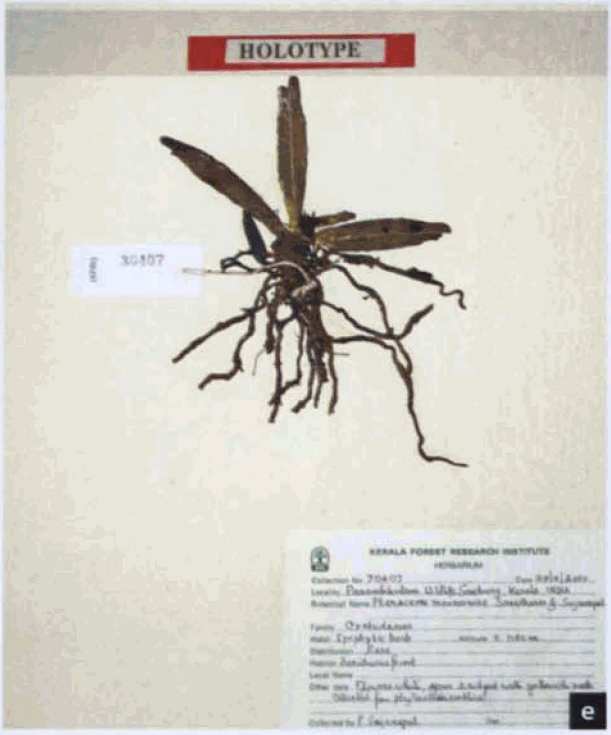


Plate 65. a & b. ***Ipsea malabarica*** Hook. f.: a. Single flower; b. Herberium specimen at TBGT; c. ***Kingidium niveum*** Sath. Kumar: Preserved specimen at TBGT; d. ***Oberonia agastyamalayana*** Sath. Kumar: Preserved specimen at TBGT. e. ***Pteroceras monsooniae*** Sasidh.: Type specimen at KFRI.

NB.5995

244. C

0.4 x 0.3 cm, apical portion widened, apex obliquely rounded, midlobe small with a porrect spur. Spur saccate, c. 0.3 cm across, 2-toothed at mouth, apex rounded with 2 dorsal ridges, lower ridge yellowish, c. 0.2 cm; rotellum c. 0.3 cm, deeply bifid. Anther triangular with caudiculate apex. Pollinia 2, obovoid, deeply cleft. Ovary terete, twisted. Capsule ellipsoid c. 2.8 x 1.6 cm, 6-ribbed, depressed at apex.

Flowering & Fruiting: May-June.

Habitat: Growing on trees at high altitude grasslands.

Note: As a local endemic species, distribution status of this exclusive endemic species should be studied.

Specimen examined: Palakkad district: Parambikulam wildlife Sanctuary, ± 1180 m, 28 May 2000, *Sujanapal 30596* (Paratype, KFRI).

SCHOENORCHIS Reinwardt

Bijdr. 6: t. 3. 1825.

Schoenorchis manilaliana M. Kumar & S. Seq., Kew Bull. 55: 241. 2000. Manilal & Sath. Kumar, Orch. Mem. 218. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 472. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 758. 2006.

Type: Palakkad district: Siruvani Reserve Forests, 7th Acre, Siruvani, ± 850 m, 13 Feb. 1998, *Stephen & Michael 008885* (KFRI).

Erect or pendulous herbs. Stem 1.5-6 cm long, curved upwards. Leaves linear-lanceolate, 1-3.5 x 0.2-0.4 cm, recurved, twisted, fleshy, semiterete, upper side concave, channelled, acute at apex. Inflorescence a leaf-opposed raceme, up to 6.5 cm long. Peduncle c. 2.5 cm long, semiterete with 3-4 sterile bracts. Floral bracts c. 0.13 x 0.06 cm, triangular-ovate, acuminate, 1-nerved, induplicate. Flowers white, c. 0.3 x 0.2 cm. Pedicel with ovary c. 2.5 cm long. Sepals and petals dissimilar; dorsal sepal elliptic-oblong, obtuse, c. 0.2 x 0.08 cm, 1-veined; lateral sepals obliquely-obovate, c. 0.18 x 0.08 cm, subacute, tip arching backwards, twisted, keeled on lower side towards the apex, 1-nerved; petals oblong-obovate, 0.15-0.18 x 0.03-0.05 cm, subacute, twisted, 1-nerved. Lip c. 0.2 cm long, pandurate, white, fleshy; lateral lobes 0.1 cm long, curved inwards; midlobe c. 0.1 x 0.07 cm, subglobose. Anther terminal, 2-loculed. Stigma at base. Operculum c. 0.03 x 0.02 cm with upwardly curved beak. Pollinia 4, unequal, collateral, attached to oblong-lanceolate, cymbiform stipe.

Flowering & Fruiting: November-May.

Habitat: Epiphytic on tree trunks in evergreen forests.

Note: A narrow endemic species known only from the type locality.

Specimen examined: Palakkad district: Siruvani Reserve Forests, 7th Acre, Siruvani, ± 850 m, 13 Feb. 1998, *Stephen & Michael 008885* (Holotype, KFRI).

TAENIOPHULLUM Blume

Bijdr. 354. 1825.

Taeniophyllum scaberulum Hook. f., Fl. Brit. India 6: 77.1890; Fischer in Gamble, Fl. Pres. Madras 1448. 1928; Bose & Bhattacharjee, Orch. India 497. 1980; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 253. 1987; Manilal & Sath. Kumar, Field Key Orch. Kerala 33. 1993; Rajesh, Jomy & Sasidh., Rheedea 7: 43. 1997; Manilal & Sath. Kumar, Orch. Mem. 224. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 472. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 761. 2006.

Type: 'Cottayam, Travancore' Rev. *E. Johnson* 1854 (K).

Small leafless epiphytes. Stem very short. Roots subterete, appressed to the bark of the host trees. Spikes 1.5-2 cm long, produced from the centre of the reduced stem, 2-4-flowered. Peduncle angular. Bracts 0.09-0.1 cm long, ovate-acute, persistent. Flowers subsessile, 0.35-0.4 x 0.2 cm, cream- white. Sepals and petals united into a 6-toothed tube; dorsal sepal 0.1 x 0.09 cm, ovate, subacute, basally 2-nerved; lateral sepals c. 0.1 x 0.08 cm, ovate, 1-nerved. Petals c. 0.09 x 0.08-0.09 cm, ovate, acute, 1-nerved. Lip c. 0.2 x 0.1 cm, ovate-acute, tip recurved into a barb-like mucro; base saccate, basally 4-nerved, united to form a single nerve at the apex. Column c. 0.05 x 0.05-0.06 cm, with 2 lateral oblong rounded outgrowths at base; rostellum acute. Anther terminal, unequally 4-locular. Pollinia 4 of 2 unequal superposed pair, pyrifrom, papillate. Capsule c. 1-2 x 0.2 cm, oblong, subfalcate, 9-ribbed, scaberulous.

Flowering & Fruiting: February-June.

Habitat: Epiphytic on branches of trees in evergreen forests at higher altitude. Hooker (1980) recorded it was growing on branches of teak (*Tectona grandis*).

Note: The palaeotropic genus *Taeniophyllum* has eight species in India. Among the Indian species, four are from the Himalayas, two from the Andamans and the rest from Peninsular India. Of the two Peninsular Indian species *Taeniophyllum alwisii* Lindl. was reported from the Western Ghats regions of Tamil Nadu and Kerala (Idukki and Wayanad). The other species *viz. T. scaberulum* was described by Hooker based on the specimen collected by Rev. E. Johnson from 'Cottayam, Travancore' in 1854. After the first collecton no later collections have been known and the species was catergorised as 'endengered' (Henry *et al.*, 1979; Kumar & Sasidharan, 1986; Ahmedullah & Nayar, 1987).The earlier efforts made to locate the species were not successful and it made the workers to consider it as extinct (Sath. Kumar, 1991; Sankar, 1995). No specimen of this species was deposited in any of the Indian Herbaria. In 1997, Rajesh collected this species from Idukki district. This collection after about 140 years of its first collection demonstrated that it is very rare but has not become extinct.

Specimen examined: Idukki district: Periyar Tiger Reserve, 900 m, 20 Sep. 1995, *Rajesh 16831*(KFRI).

XENIKOPHYTON Garay

Bot. Mus. Leafl. 23: 374. 1974

Xenikophyton seidenfadenianum M. Kumar, S. Seq. & J. J. Wood, Kew Bull. 57: 227. 2002; Manilal & Sath. Kumar, Orch. Mem. 230. 2004; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 472. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 764. 2006.

Type: Palakkad district: Siruvani Reserve Forests, Dam Site, ± 1000 m, *Stephen 0020621* (KFRI).

Epiphytic herbs. Stem up to 3 cm long, covered in old leaf sheaths. Leaves oblong, 7-9 x 1.2-1.5 cm, unequally bilobed, coriaceous, articulate at base. Inflorescence a simple receme, up to 6 cm long. Bracts broadly ovate, acuminate, gland-dotted. Flowers small, 0.4-0.42 x 0.3-0.31 cm, greenish-wight. Pedicel with ovary c. 0.2 cm long. Sepals streaked with brown, gland-dotted, 1-nerved; dorsal sepal oblong-ovate, 0.25-0.27 x 0.12-0.13 cm, truncate; lateral sepals ovate-oblong, 0.25-0.27 x 0.1-0.11 cm, slightly falcate, strongly keeled on reverse. Petals obovate, obtuse, 0.25-0.27 x 0.17-0.18 cm 1-nerved, gland-dotted. Lip sessile, spurred, 3-lobed; side lobes granulate; mid lobe scrotiform; spur large, 0.15 x 0.12 cm, rounded, 3-nerved. Column short, rounded. Stigma erect; rostellum simple, large, ovate, erect. Anther cap orbicular, with a reflexed tip above, grooved; viscidium oblong; stipes slender, ribbon-like. Pollinia 4.

Flowering & Fruiting: July-August.

Habitat: Epiphytic on tree trunks in subtropical savannah.

Note: As a local endemic species, distribution status of this exclusive endemic species should be studied.

Specimen examined: Palakkad district: Siruvani Reserve Forests, Dam Site, ± 1000 m, *Stephen 0020621* (Holotype, KFRI).

45. ZINGIBERACEAE

Table 65. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
52	1300	17	133	16 spp.

Genus/genera	Species/subsp./var.
9	45 spp., 2 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Amomum Roxb.	*A. cannicarpum* (Wight) Benth. ex Baker (Karnataka & Tamil Nadu)	

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Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	A. muricatum Bedd. (Karnataka & Tamil Nadu)	
Curcuma Roxb.	*C. decipiens* Dalz. (Maharashtra, Goa, Karnataka & Tamil Nadu)	*C. coriaceae* Mangaly & Sabu
	C. oligantha var. *lutea* (R. Ansari, V. J. Nair & N. C. Nair) Bhat (Karnataka)	*C. ecalcarata* Sivar. & Balach.
		C. haritha Mangaly & Sabu
		C. mutabilis Skornickova *et al.*
		C. raktkanta Mangaly & Sabu
		C. vamana Sabu & Mangaly
Zingiber Boehmer	*Z. neesanum* (Graham) Ramam. (Maharashtra, Goa, & Karnataka)	

Key to the genera

1. Inflorescence on a leafy shoot ..... **Alpinia**
1. Inflorescence on a leafless scape ..... **Curcuma**

Alpinia Roxburgh

Asiat. Res. 11: 350. 1810, *nom. cons.*

Alpinia smithiae Sabu & Mangaly, Edinburgh. J. Bot. 48: 69. 1991; Mangaly & Sabu, Rheedea 2: 50.1992; Sasidh. & Sivar., Flr. Pl. Thrissur For. 457.1996; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 461. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 841. 2006; Sabu, *Zingi. Costac.* S. India 70. 2006.

Type: Palakkad district, Attappady, ± 500 m, 6 Mar. 1989, *Sabu & Mangalay 17563* (MH). (Plate 66 a)

Leafy stem robust, 2-3 m tall. Leaves petiolate; petioles 3-4 cm long, rounded, hairy; lamina 50-60 x 6-12 cm, lanceolate to oblanceolate, acuminate, base oblique, densely pubescent below and glabrous above; ligule c. 1 cm long, entire, coriaceous, hairy outside. Inflorescence terminal, erect, c. 20 cm long. Bracts towards the apex, 3-4 x 1-1.2 cm, light green, hairy along the margin. Flowers pedicellate. Bracteoles white, 2-2.5 x 3.5 cm, deciduous. Calyx white, tubular, 1.8-2 cm long, shortly 3-lobed, deeply split on one side, minutely pubescent. Corolla white, tube c. 1 cm long, shorter than calyx, glabrous, lobes oblong, sparsely pubescent, margin ciliate. Labellum 3.5-4 x 3.5 cm, yellow, striped with purple-red, margin dark-yellow. Lateral staminodes subulate. Filament densely hairy; anther glandular hairy on back, crested, crest rounded, yellow. Epigynous glands 2. Ovary ovoid, densely pubescent, trilocular below; ovules many. Fruit globose, c. 2.5 x 2.5 cm, yellow-orange when mature. Seeds many, with

white lacerate aril.

Flowering & Fruiting: January-October.

Habitat: Growing in moist deciduous and evergreen forests in association with *A. malaccensis.*

Note: As a wild relative of crop species, propagation measures can be taken for its conservation.

Specimen examined: Palakkad district: Attappady, ± 500 m, 6 Mar. 1989, *Sabu and Mangalay 17563* (Isotype, CALI).

Curcuma Linnaeus

Sp. Pl. 2. 1853

Key to the species

1. Anther lobes not spurred ..... 2. *C. ecalcrata*
1. Anther lobes spurred.
   2. Inflorescence with or without inconspicuous comma.
      3. Rhizome stoloniferous; flowers shorter than bracts ..... 6. *C. vamana*
      3. Rhizome ovoid, cylindrical to conical; flowers longer than bracts ..... 4. *C. mutabilis*
   2. Inflorescence with well developed comma.
      4. Rhizome small; leaves coriaceous ..... 1. *C. coriacea*
      4. Rhizome large; leaves not coriaceous
         5. Pseudostem reddish purple; leaves spreading ... 5. *C. raktakanta*
         5. Pseudostem green with a few light pink dots; leaves erect ..... 3. *C. haritha*

1. **Curcuma coriacea** Mangaly & Sabu, Notes Roy. Bot. Gard. Edinburgh 45: 429. 1989; Rheedea 3(2): 143. 1993; Anil Kumar, Sivad. & Ravi, Fl. Pathanamthitta 680. 2005; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 461. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 843. 2006; Sabu, *Zingi. Costac.* S. India 145. 2006. ***Kattikuva.***

Type: Idukki district, Painavu, ±700 m, 25 May 1983, *Mangaly & Sabu 10337* (MH). (Plate 66 b)

Rhizome small, cylindrical to conical, 2-4 x 1-2 cm, non-aromatic, white inside; sessile tubers absent; root tubers cylindrical. Leafy shoot 30-45 cm tall; pseudostem 10-15 cm tall, green or with violet tinge. Leaves distichous; petiolate, 10-20 cm long; lamina 25-35 x 10-15 cm, elliptic, coriaceous, base and apex acute, densely pubescent on both surfaces; ligule not prominent. Inflorescence lateral; peduncle 5-10 cm long. Spike 5-10 cm long with a distinct

Plate 66. a. ***Alpinia smithiae*** Sabu & Mangaly: Habit - TBGRI Conservatory; b. ***Curcuma coriaceae*** Mangaly & Sabu: Type specimen at CALI; c. ***Curcuma ecalcarata*** Sivar. & Balach.: Type specimen at CALI; d. ***Curcumma haritha*** Mangaly & Sabu:Type specimen at CALI

coma. Coma bracts deep pink to violet. Fertile bracts 5-6 x 2.5-3 cm, ovate-acute, fused about half way from the base, light green with light pink in the middle extending towards the tip. Bracteoles 1.2-1.5 cm long. Flowers c. 6 cm long, slightly longer than the bracts, yellow, 3-5 in each bract. Calyx tubular, c. 1.3 cm long, tip 3-lobed, deeply split on one side, pubescent. Corolla tube funnel-shaped, lobes unequal; dorsal lobe broader, hooded, bright yellow; lateral lobes linear. Labellum c. 2 x 2 cm, tip deeply split, lobes rounded, deep yellow. Lateral staminodes ovate-oblong, bright yellow. Anther lobes with a small crest, spurred at base. Epigynous glands 2. Ovary trilocular with many ovules, pubescent. Fruit c. 1.2 x 0.7 cm, ovoid, trigonal, pubescent. Seeds many, with white lacerate aril.

Flowering & Fruiting: April-October.

Habitat: Open grasslands of higher altitudes and also the margins of secondary forests.

Note: As a wild relative of cultivated species, further explorations must be made to locate this species in its known distributional areas to confirm consrvation status.

Specimen examined: Idukki district: Painavu, ±750 m, 25 May 1983, *Mangaly & Sabu 10336* (Isotype, CALI).

2. **Curcuma ecalcarata** Sivar. & Balach., Notes Roy. Bot. Gard. Edinburgh 41: 321. 1989; Mangaly & Sabu, Rheedea 3(2): 151. 1993; Sasidh. & Sivar., Fl. Pl. Thrissur For. 459.1996; Anil Kumar, Sivad., & Ravi, Fl. Pathanamthitta 681. 2005; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 461. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 843. 2006; Sabu, *Zingi. Costac.* S. India 150. 2006. ***Van-kuzhi kuva.***

Type: Palakkad district: Kanjirapuzha, AVS herbal garden, *Sivarajan & Indu Balachandran AVS 1497* (CALI). (Plate 66 c)

Rhizome small, 3-5 x 2-2.5 cm, conical, yellow inside; sessile tubers absent; root tubers fusiform, white inside. Leafy shoot 30-45 cm tall. Leaves bifarious; petiolate, 20-25 cm long; lamina 20-30 x 10-15 cm, broadly ovate, acuminate, unequally cordate at abse, pubescent below, profusely lepidote on the lower surface. Inflorescence central; peduncle 12-15 cm long. Spike 10-15 cm long with a distinct coma. Coma bracts longer than the fertile ones, bright rose. Fertile bracts c. 3 x 2.5 cm, broadly rounded, tip recurved, green or rose. Bracteoles c. 0.7 cm long, triangular. Flowers 5-6 cm long, longer than the bracts, yellow or orange-yellow. Calyx 1-1.3 cm long, truncate, 3-lobed at apex, deeply split on one side, pubescent. Corolla tube 2.5-3 cm long, lobes unequal; dorsal lobe oblong, hooded; lateral lobes oblong-obtuse, light yellow-orange. Labellum 2-2.2 x 2-2.2 cm, 3-lobed, lateral lobes rounded; middle lobe triangular, yellow or orange-yellow. Lateral staminodes oblong-obtuse. Anther lobes ecalcarate, connective broad, hooded at apex, glandular hairs on the back. Epigynous glands 2. Ovary trilocular with many ovules, pubescent. Fruit c. 1.5 x 1 cm, obovoid, trigonal, pubescent. Seeds many, with white lacerate aril.

Flowering & Fruiting: July-November.

Habitat: Fairly common as undergrowth in moist deciduous and semi- evergreen forests, often in moist localities of coconut groves and rubber plantations in the plains.

Note: As a horticulturally promising wild relative, its distributonal status should be analysed for further conservation management.

Specimens examined: Palakkad district: Kanjirapuzha, AVS herbal garden, 14 Oct. 1982, *Sivarajan & Indu Balachandran AVS 1497* (Isotype, CALI); Kottayam district: Monipally, 100 m, 24 Apr. 2006, *P. A. Jose 57950* (TBGT); Pathanamthitta district: Mukkamkunnu, 9 Jul. 1996, *Mathew Dan 22664* (TBGT).

3. **Curcumma haritha** Mangaly & Sabu, Rheedea 3(2): 151. 1993; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 461. 2004; T. S. Nayar *et al.*, Flr. Pl. of Kerala - A Handb. 843; Sabu, *Zingib. Costac.* S. India 153. 2006. ***Karpurakuva.***

Type: Kozhikode district: Kolathara, 30 May 1988, *Sabu 39113* (CALI). (Plate 66 d)

Rhizome large, 4-5 x 3.5-4 cm, non-aromatic, yellowish-grey inside; sessile tubers many, finger-shaped, branched. Leafy shoot 70-100 cm tall; pseudostem c. 30 cm tall, green with a few light pink dots. Leaves distichous, petiolate; lamina 30-50 x 10-14 cm, ovate-elliptic, tip acuminate, base acute, densely puberulent on lower surface, semiplicate. Inflorescence lateral; peduncle 10-15 cm long. Spike 20-25 cm long with a distinct coma. Coma bracts 8-10, bright pink. Fertile bracts 10-15 cm, broadly ovate, tip rounded lower bracts green, upper green with pink tips. Bracteoles large, 3.5-4 x 2 cm long, white to light green with light pinkish shade at the tip. Flowers 4.5-5 cm long, slightly smaller than the bracts, 3-4 in each bract. Calyx c. 1 cm long, tip 3-lobed, deeply split on one side, minutely hairy. Corolla tube c. 3 cm long; dorsal lobe ovate-oblong, hooded, white; lateral lobes white. Labellum c. 2 x 2 cm, shortly 3-lobed, middle lobe light yellow with a dark yellow band. Lateral staminodes oblong, pale yellow. Stamens white, anther lobes spurred at base, crest absent. Epigynous glands 2. Ovary trilocular with many ovules, dense pubescent. Fruit not known.

Flowering & Fruiting: April-May

Habitat: Common in coconut groves of coastal plains, usually associated with *C. caesia.* It is also reported from the high altitude areas.

Note: As a wild relative of crop species, propagation measures can be taken for its conservation.

Specimens examined: Kozhikode district: Kolathara, 30 May 1988, *Sabu 39113A* (Holotype, CALI); Mahi, Union Teritory, 23 May 1996, *Mathew* Dan *22659* (TBGT); Pathanamthitta district: Konni, 7 Sep. 2000, *Mathew Dan 22663* (TBGT); Palakkad district: Attappady, 18 Jan. 2003, *Shaju, 4417* (TBGT).

4. **Curcuma mutabilis** Skornickova, Sabu & Prasanth, Gard. Bull. Singapore, 56: 43. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 843. 2006; Sabu, *Zingib. Costac.* S. India 153.

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2006. *C. nilamburensis* Velayudhan *et al.*, *Curcuma* Gen. Resour. 42. 1999. *nom. illegit.*; *C. neilgherrensis auct. non* Wight; Sivar. & Philip Mathew, Fl. Nilambur 708. 1996. 2006.

Type: Malappuram district: Nilambur, 29 May 2003, *Sckornickova & Prasanthkumar 84145* (CALI). (Plate 67 a)

Rhizomatous herb, 10-60 cm tall. Rhizome ovoid, without branches, cylindrical to conical. Leafy shoot 15-60 cm tall; pseudostem 5-30 cm tall, green or with violet tinge. Leaves distichous; petiolate, green or with red tinge; lamina 14-35 x 7-11 cm, ovate-elliptic; ligule 0.3-0.4 cm long, bilobed. Inflorescence ventral in the beginning and central in later; peduncle 4-20 cm long, glabrous, whitish, light green with red tinge. Coma inconspicuous, usually only upper most 2-3 bracts are sessile and linear than fertile ones. Fertile bracts ovate-elliptic, tip obtuse or slightly acuminate. Flowers 4-5, c. 5 cm long, excerted from bracts. Calyx 0.8-1.1 cm long, tip 3-lobed, white or tinged with pink or dark violet, sparsely hairy. Corolla tube c. 2.5-3 cm long, white, yellowish or yellow at base towards lobes, sometimes tinged with pink, red or violet. Labellum emarginate, split, 3-6 cm long, yellow or less frequently white. Lateral staminodes usually yellow or reddish at base, glandular hairs on mid portion. Anther spurred, white or creamy yellowish. Ovary trilocular with many ovules, white, hairy. Fruit dehiscent capsule, c. 1 x 1 cm, spherical. Seeds many, glabrous.

Flowering & Fruiting: May-September.

Habitat: As undergrowth in teak plantations, secondary forests and shrubby vegetation in dry lateritic soil.

Note: As a wild relative of cultivated species, it deserves conservation importance.

Specimen examined: Malappuram district: Nilambur, 29 May 2003, *Sckornickova & Prasanthkumar 84145* (Isotype, CALI).

5. **Curcuma raktakanta** Mangaly & Sabu, J. Econ. Taxon. Bot. 12: 475. 1988; Mangaly & Sabu, Rheedea 3(2): 151. 1993; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 843. 2006; Sabu, *Zingi. Costac.* S. India 153. 2006. ***Chenthandan kuva***.

Type: Ernakulam district: Neerikode, 3 July 1983, *Mangaly 10346A* (MH). (Plate 67: b-d)

Rhizome medium sized, conical, 3-4 x 2.5-4 cm, aromatic, greyish to yellowish inside, whitish towards the periphery; sessile tubers finger-shaped, branched; root tubers fusiform, yellowish inside. Leafy shoot 40-60 cm tall; pseudostem reddish purple. Leaves distichous; petiolate; lamina 35-45 x 10-12 cm, oblong-lanceolate, base and tip acuminate, glabrous above. Inflorescence lateral; peduncle 20-25 cm long, covered by reddish purple sheaths. Spike 10-15 cm long with a distinct coma. Coma bracts 6-8, linear, deep pink. Fertile bracts 8-10, broadly ovate, c. 5-5.5 x 5 cm, tip rounded, green with pink tip. Bracteoles: outer larger, c. 2.5 x 1.5 cm, white to light pink. Flowers slightly longer than the bracts, 3-4 in each bract. Calyx tubular, 1.5 cm long, 3-lobed, deeply split on one side, glabrous. Corolla tube funnel-shaped, lobes unequal; dorsal lobe hooded; lateral lobes with tip rounded, light pink. Labellum broad, 2 x 2.2

Plate 67. a. ***Curcuma mutabilis*** Skornickova *et al.*: Type specimen at CALI; b - d. ***Curcuma raktakanta*** Mangaly & Sabu: b. Habit; c. Basal portion with rhizome; d. Type specimen at CALI.

NB 5995 252 D

Plate 68. a - c. ***Curcuma vamana*** Sabu & Mangaly: a. Inflorescence; b. Rhizome; c. Type specimen at CALI.

NB 5995 252B

cm, margin wavy with median cleft, light yellow with a median dark yellow band, glabrous. Lateral staminodes included within the dorsal corolla lobe. Anther spurred at base, white, glandular hairs on the back, crest absent. Epigynous glands 2. Ovary trilocular with many ovules, densely pubescent. Fruit not known.

Flowering & Fruiting: April-May.

Habitat: Grows mostly in coconut and arecanut groves in alluvial soil.

Note: As a wild relative of cultivated species, it deserves conservation importance.

Specimens examined: Ernakulam district: Neerikode, 3 July 1983, *Mangaly 10346B* (Isotype, CALI); Ernakulam district, Vytila, 17 Apr. 2000, *Mathew Dan 36257* (TBGT); Kottayam district, Vaikkam, 28 Mar. 2006, *Shaju 3215* (TBGT).

6. **Curcuma vamana** Sabu & Mangaly, J. Econ. Taxon. Bot. 10: 307.1988; Mangaly & Sabu, Rheedea 3(2): 167. 1993; Sasidh. & Sivar., Flr. Pl. Thrissur For. 460.1996; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 461. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 843. 2006; Sabu, *Zingi. Costac.* S. India 181. 2006. *Curcuma peethapushpa* Sasidh. & Sivar., Notes Roy. Bot. Gard. Edinburgh. 45: 425. 1989, *nom. superfl.* ***Kunji-kuva***.

Type: Palakkad district: Monsoon forest, *Sabu & Mangaly 37342* (MH).

(Plate 68 a-c)

Rhizome small, conical, c. 3 x 0.5 cm, orange inside; sessile tubers absent; root tubers pherical or ellipsoid, fleshy, pearl-white inside. Leafy shoot c. 50 cm tall; pseudostem 8-10 cm tall, covered basally by leafless sheaths. Leaves distichous; petiolate, 20-30 cm long; lamina 20-25 x 6-8 cm, oblong, tip acuminate, base subequal, glabrous; ligule small. Inflorescence central; peduncle 10-18 cm long, light green, glabrous. Spike condensed, 2-4 cm long, distinct coma absent. Bracts 4-8, loosely arranged, c. 3 x 3 cm, ovate to obovate, tip acute, each substending 2-4 flowers, 1 or 2 sterile bracts towards the tip. Bracteoles c. 5 x 4 cm long, ovate-acute, glabrous. Flowers 1.8-2 cm long, shorter than the bracts, Calyx truncate, c. 0.4 cm long, deeply 3-lobed, white, glabrous. Corolla tube c. 0.8 cm long; lobes almost equal, glabrous, yellowish white. Labellum c. 8 x 7 cm, tip notched, lobe rounded, margin crisped, golden yellow, hairy at middle. Lateral staminodes golden yellow. Anther lobes with a small beak, glandular hairy. Epigynous glands absent. Ovary trilocular with many ovules. Fruit c. 0.1 x 0.8 cm, obovoid, with persistent calyx. Seeds many, with filiform aril.

Flowering & Fruiting: July-October

Habitat: Semi-deciduous forest and teak plantations.

Note: The area of its occurrence needs an extensive exploration to assess its distributional status for further conservation efforts.

Specimens examined: Palakkad district: Kanjirapuzha, AVS herbal garden, ± 400 m, 20 Jul. 1984, *Sabu 37343* (Isotype, CALI); *ibid*; Prambikulam, 13 Jul. 2000, *Mathew Dan 36262* (TBGT); Kollam district: Rockwood, 30 Aug. 1999, *Mathew Dan 36243* (TBGT); *Ibid*, 14 Sep.

2006, *Shaju 3268* (TBGT).

46. ARECACEAE

Table 66. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
202	2600	27	91	16 spp.

Genus/genera	Species/subsp./var.
8	26 spp., 2 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Arenga Labill.v	*A. wightii* Griffith (Maharashtra, Karnataka & Tamil Nadu)	
Calamus L.	*C. brandisii* Becc. Ex Becc. & Hook. f. (Karnataka & Tamil Nadu)	*C. dransfieldii* Renuka
	C. delessertianus Becc. (Maharashtra, Karnataka & Tamil Nadu)	*C. gamblei* var. *sphaerocarpa* Becc.
	C. hookerianus Becc. (Tamil Nadu)	*C. neelagiricus* Renuka
	C. huegelianus C. Martius (Karnataka & Tamil Nadu)	*C. shendurunii* Anto *et al.*
	C. metizanus Schltr. (Karnataka)	*C. renukae* Joemon Jacob *et al.*
	C. nagbettai Fernandez & Dey (Karnataka)	
	C. travancoricus Bedd. ex Becc. Hook. f. (Karnataka & Tamil Nadu)	
	C. vattayila Renuka (Karnataka & Tamil Nadu)	
Pinanga Blume	*P. dicksonii* (Roxb.) Blume (Karnataka & Tamil Nadu)	

CALAMUS Linnaeus

Sp. Pl. 325. 1753

Key to the species

1. Solitary moderate-sized rattan..... 3. *C. neelagiricus*

1. Clustering medium-sized rattans.
   2. Fruit ovoid.
      3. Spines yellow..... 2. *C. gamblei* var. *sphaerocarpa*
      3. Spines brown ..... 4. *C. renukae*
   2. Fruits obpyriform.
      4. Stem reaching 20 m.....5. *C. shendurunii*
      4. Stem reaching 8 m.....1. *C. dransfieldii*

1. **Calamus dransfieldii** Renuka, Kew Bull. 42: 433. 1987; M. Kumar *et al.*, J. Econ. Taxon. Bot. 15: 482. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 505. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 651. 2006.

Type: Palakkad district: Dhoni, ± 275 m, 16 Dec. 1983, *Renuka 2982* (KFRI). (Plate 69 a-d)

Solitary or clustering canes. Stem reaching up to 6-8 m high. Sheath green, sparsely spiny; spines 1 cm long, sturdy with a bulbous-base; knee of sheath conspicuous; flagellum 5-6 m long. Leaf ecirrate, to 2 m long; petiole to 25 cm; leaflets regular, 20-40 x 1-2 cm, linear-lanceolate, acuminate at tip, 3-ribbed, ciliate on ribs on both sides and at the acuminate tip; cilia 0.5-2 cm long. Inflorescence to 3.5 m long, flagellate. Fruits globose, obpyriform.

Flowering: November-December.

Habitat: Moist deciduous forests.

Uses: A good large diameter cane. Used in furniture industry and in basket making. Canes of this species are available only in very limited quantities (Renuka, 1992).

Note: Ecosystem conservation (*in-situ*) together with large scale cultivation (*ex-situ*), will guarantee the conservation of this exclusive endemic species.

Specimens examined: Palakkad district: Dhoni, ± 275 m, 16 Dec. 1983, *Renuka 2982* (Holotype, KFRI); Kollam district: Achankovil, ± 1000 m, 16 Mar. 1989, *Mukunthakumar & Vijayan 41* (TBGT); Thiruvananthapuram district: Theemparai, ± 1500 m, 18 Dec. 1986, *Mukunthakumar 25* (TBGT); *Ibid.*, Agasthyamala, Koviltherimala, ± 700 m, 22 Dec. 1987, *N. Mohanan 9191* (TBGT); Thiruvananthapuram district: Agasthaymala, Koviltherimala, ± 600 m, 21 Nov. 2008, *Shaju 65011* (TBGT).

2. **Calamus gamblei** var. **sphaerocarpa** Becc., Ann. Roy. Bot. Gard. (Culcutta) 11: 96, 316. 1908: Gamble, Fl. Pres. Madras 1568 (1094). 1931; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 505. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 651. 2006. ***Thannikodi*** (Plate 70 a-d)

Climbing canes. Stem to 10.5 m, without sheaths 1-3 cm in diameter, Leaf sheath green, young sheaths with brown tomentum. Leaflets distant, elongate-ensiform near the apex, margins remotely sinus ciliate, spines yellow. Rachis trigonous in the upper part, terete in the

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basal half, armed with small, solitary claws. Fruit ovoid with a slightly tapering base.

Flowering & Fruiting: May

Habitat: Climbing canes seen in evergreen forests.

Uses: A good quality cane used in furniture industry and basket making.

Note: A narrow endemic variety decribed based on Wight's collection from Anamudi slopes; type specimen is untraceable. So far not figured in any of the IUCN category; owing to narrow distribution assumes conservation significance.

Specimen examined: Pathanamthitta district: Pampa (Goodrical range), Kakki, ± 950 m, 24 May 1984, *Renuka 3173, 3174* (KFRI).

3. **Calamus neelagiricus** Renuka, Sasidh., & Anto, Rheedea 7: 69. 1997; Sasidh. *et al.* in Manoharan *et al.*, Silent Valley Whis. Reas. 169. 1999; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 505. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 652. 2006.

Type: Palakkad district: Silent Valley, Katirvamudi, ± 1100 m, 18 Mar.1997, *Anto & Renuka 007100* (KFRI). (Plate 71 a-c)

Solitary, moderate sized rattan. Stem reaching up to 25 m, with sheaths up to 5 cm in diam. Sheath green, spiny; spines c. 1 cm long, sturdy with a bulbous base; knee present; ochrea inconspicuous; flagellum 3-4 m long. Leaf ecirrate, to 2 m long; petiole to 25 cm long, petioles and rachis armed on the dorsal side with spines; spines c. 0.5 cm long, sturdy boulbous based, ventral side spiny at the point of attachment of leaflets with the rachis; leaflets acuminate, regular, c. 46 x 2 cm, midvein dorsally ciliate, lateral veins ventrally ciliate, apical leaflets free. Inflorescence flagellate, to 2.5 m long, up to 6 partial inflorescence, heavy with profuse fruiting, pendulous; partial inflorescence c. 30 cm long; primary sheaths closely sheathing, completely armed with sturdy spines; rachillae to 13 cm long, strongly recurved, coiled; secondary sheaths closely sheathing. Fruit oblate, c. 1 x 0.5 cm, pedicellate, scales straw yellow when dry, channelled in the middle, in 21 rows.

Flowering & Fruiting: April-May.

Habitat: Climbing rattans in evergreen forests.

Note: As a commercially important local endemic species, it warrants critical evaluation to obtain conservation status.

Specimen examined: Palakkad district: Silent Valley, Katirvamudi, ± 1100 m, 18th Mar.1997, *Anto & Renuka 007100* (Holotype, KFRI).

4. **Calamus renukae** Joemon Jacob, N. Mohanan & Kariyappa, Rheedea 18: 29. 2008.

Type: Palakkad district: Silent Valley, ± 1300 m, 17 May 2007, *Joemon Jacob 57491* (TBGT).

(Plate 72 a-c)

Clustering canes. Stem reaching up to 25 m in height, with sheaths up to 4-4.5 cm in

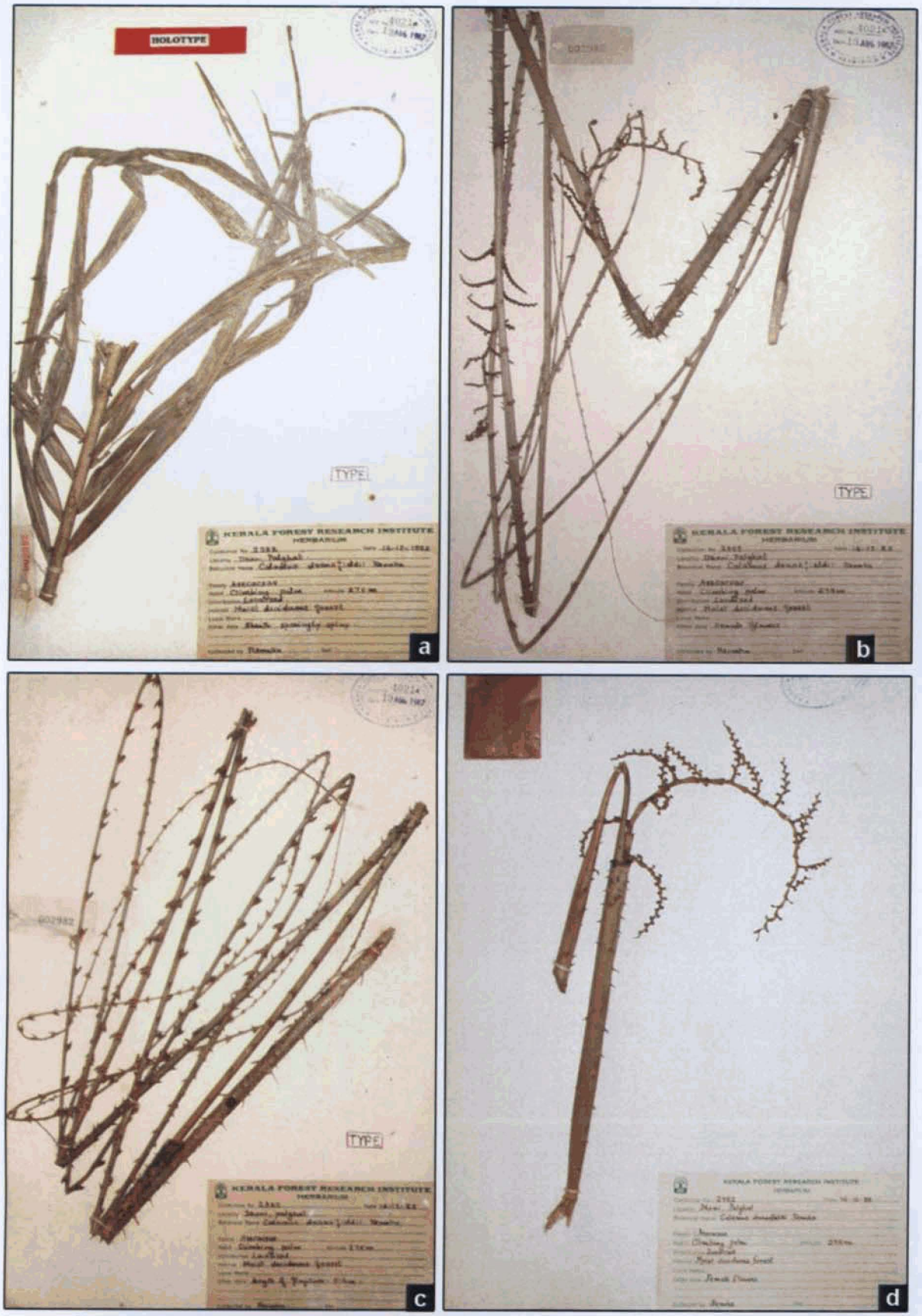

Plate 69. a - d. ***Calamus dransfieldii*** Renuka: Type specimens at KFRI.

NB 5995

256A

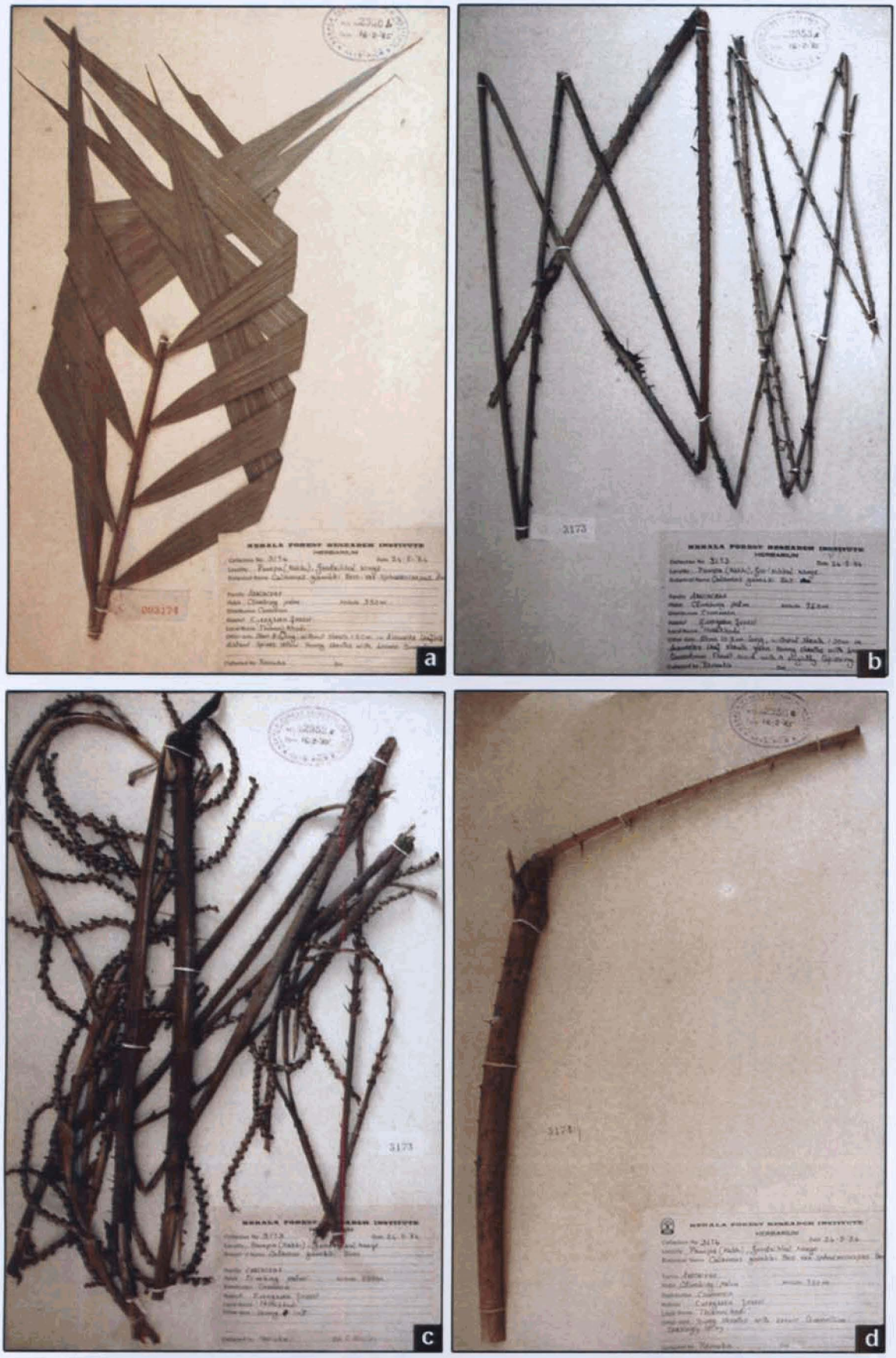

Plate 70. a - d. ***Calamus gamblei*** var. ***sphaerocarpa*** Becc.: Herberium specimens at KFRI.

NB 5995

256 B

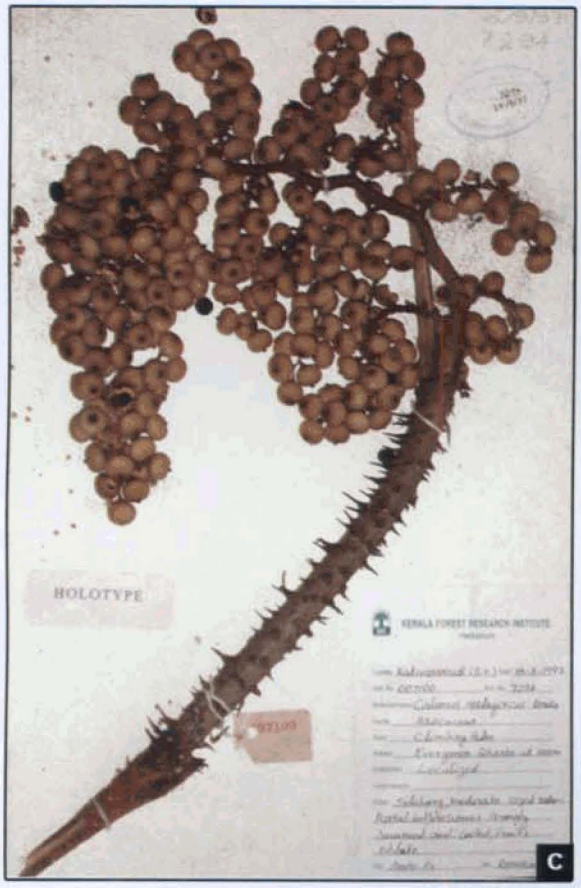

Plate 71. a - c. ***Calamus neelagiricus*** Renuka: Type specimens at KFRI.

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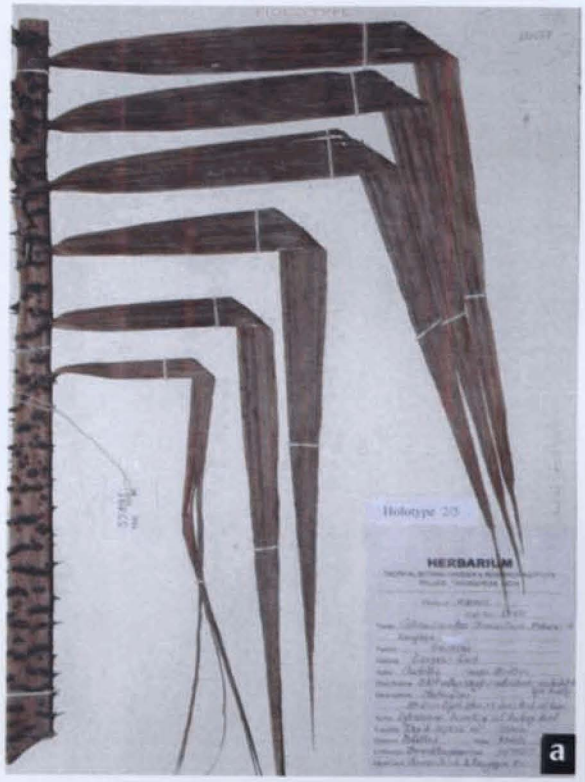
256 6



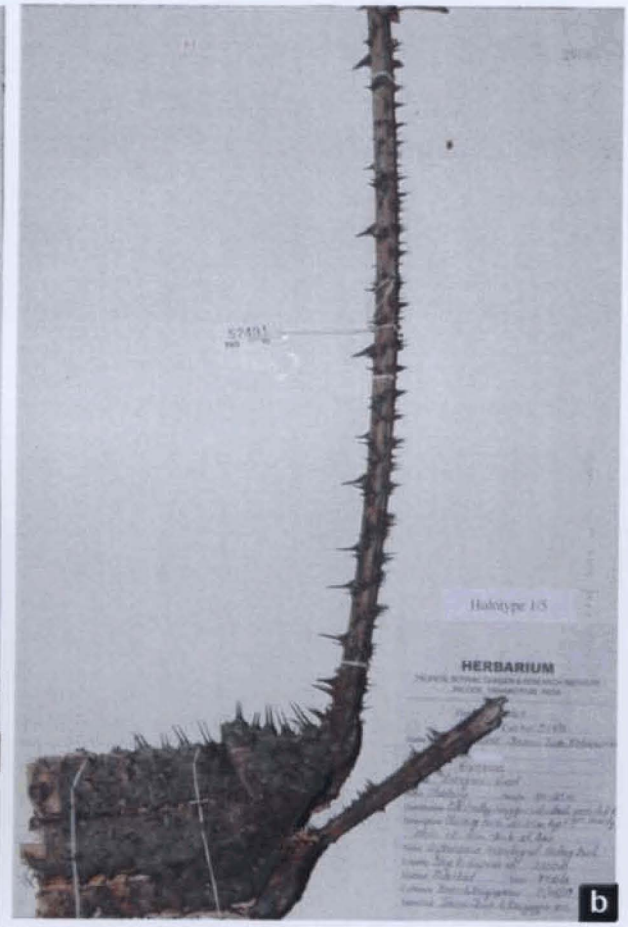


Plate. 72. a - c. ***Calamus renukae*** Joemon Jacob *et al.*: Type specimens at TBGT

NBS995

256 D

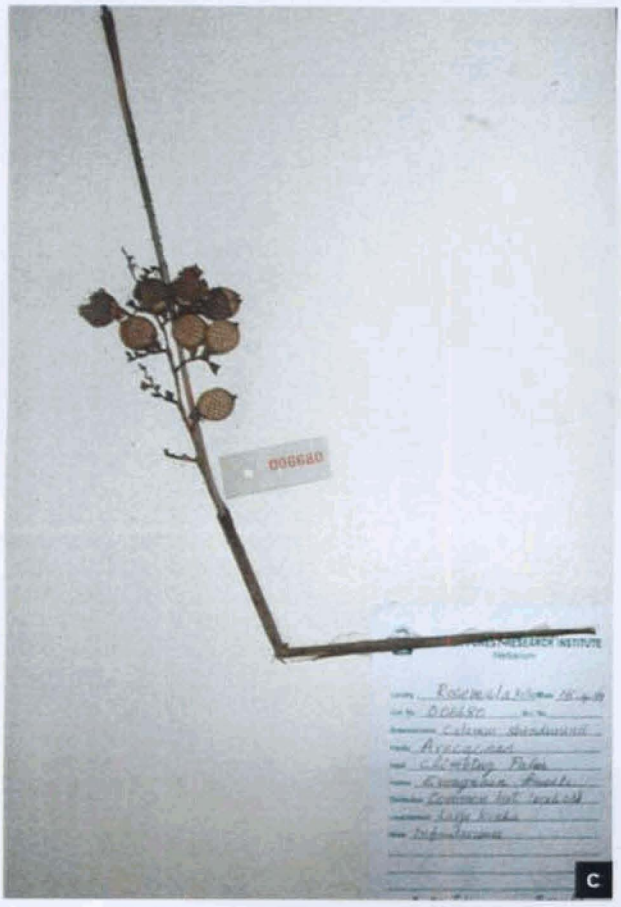


Plate 73. a - c. ***Calamus shendurunii*** Anto *et al.*: Type spcimes at KFRI.

NB 5995

diam. Sheath pale green or greenish brown tomentose towards apex, densely spiny; spines brown, up to 1.5 cm long, flat with a bulbous base; knee large and conspicuous, densely spiny; ochrea absent; flagellum up to 6 m long. Leaf ecirrate, to 1.8 m long; petiole to 35 cm; rachis biconvex; petioles and rachis spiny and brown tomentose on both sides; leaflets regular, c. 56 x 3.5 cm, narrowly lanceolate, acuminate, spinulose on margins, tips armed with short bristles. Inflorescence stout, to 2-3 m long, flagellate, with up to 4 partial inflorescence; 15-30 cm long, apparently panicled; primary sheaths widening towards tip, stout, with numerous seriate and solitary spines and tomentum. Fruit numerous, globose, 1.8-2 cm in diam., reddish brown, scales in 24 rows.

Flowering & Fruiting: March-May.

Habitat: Evergreen forests.

Note: As a commercially important local endemic species, it deserves conservation efforts.

Specimen examined: Palakkad district: Silent Valley National Park, ± 1300 m, 17 May 2007, *Joemon Jacob 57491* (Holotype, TBGT)

5. **Calamus shendurunii** Anto, Renuka & Sreek., Rheedea 11: 37. 2001; Sasidh., Biodiver. Doc. Kerala, Part 6, Fl. Pl. 505. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 653. 2006.

Type: Kollam district: Shenduruny Valley, Rosemala, ± 300 m, 15 Apr.1999, *Anto 006680* (KFRI). (Plate 73 a-c)

Clustering, moderate sized rattans. Stem reaching up to 20 m tall, with sheaths measures up to 2 cm in diam. Sheath dark green, shining, spiny; spines very few, 1-4, scattered with a bulbous base, tip black, c. 1 cm long; knee conspicuous, spines absent; flagellum up to 2 m long. Leaf ecirrate, to 1 m long; petiole to 25 cm long, armed on the dorsal side; rachis channelled on the dorsal side, ridges spiny, armed on the ventral side with recurved spines; spines 1 cm long, sturdy boulbous based; leaflets long acuminate, c. 35 x 3 cm, midvein ventrally setose, lateral veins dorsally setose towards the tip, apical leaflets basally united. Inflorescence flagellate, to 2 m long, partial inflorescence 3-4, up to 20 cm long, slender; primary sheaths closely sheathing, mouth of the sheath with bristles; secondary sheaths sparingly spiny; rachillae to 5 cm long. Fruit globose or obpyriform, c. 1 x 1.8 cm, with stalk like involucrophores; pedicel of the neuter flower persistent; scales in fruits 25 vertical rows, pale green, shallowly channelled along the middle.

Flowering & Fruiting: September.

Habitat: Evergreen forests.

Note: As a commercially important local endemic species, it warrants critical evaluation to obtain conservation status.

Specimens examined: Kollam district: Shenduruny Valley, Rosemala, ± 300 m, 15 Apr.1999, *Anto 006680* (Holotype, KFRI); *Ibid.*, 16 Dec. 2005, *Shaju 58505* (TBGT).

47. ARACEAE

Table 67. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
107	3700	25	138	35 spp.

Genus/genera	Species/subsp./var.
17	57 spp., 2 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Amorphophallus Blume ex Decne.	*A. commutatus* (Schott) Engl. var. *commutatus* (Maharashtra & Karnataka)	*A. bonaccordensis* Sivad. & N. Mohanan
	A. hohenackeri (Schott) Engl. & Gehrm. (Karnataka)	*A. commutaus* var. *wayanadensis* Sivad. & Jaleel
	A. smithsonianus Sivad.(Tamil Nadu)	*A. nicolsonianus* Sivad.
Anaphyllum Schott	*A. beddomei* Engl. (Tamil Nadu)	
	A. wightii Schott (Tamil Nadu)	
Arisaema C. Martius	*A. barnesi* C. E. C. Fischer (Karnataka & Tamil Nadu)	*A. agasthyanum* Sivad. & Sath. Kumar
	A. muricaudatum Sivad. (Maharashtra)	*A. attenuatum* Barnes & C. E. C. Fischer
	A. nilamburense Sivad. (Tamil Nadu)	*A. peltatum* C. E. C.Fischer
	A. translucens C. E. C. Fischer (Tamil Nadu)	*A. psittacus* Barnes
	A. tuberculatum C. E. C. Fischer (Tamil Nadu)	*A. sarracaenioides* Barnes & C. E. C. Fischer
	A. wightii Schott (Karnataka & Tamil Nadu)	
Cryptocoryne Fischer ex Wydler	*C. consobrina* Schott (Karnataka & Tamil Nadu)	
Lagenandra Dalz.	*L. meeboldii* (Engl.) C. E.C.Fischer (Karnataka & Tamil Nadu)	*L. keralensis* Sivad. & Jaleel
	L. toxicaria var. *barnesii* Fischer	*L. nairii* Ramam. & Rajan

Genus/genera	sp./subsp./var. (Karnataka & Tamil Nadu)	Exclusive endemics (Kerala)
Pothos L.	*P. armatus* Fischer (Tamil Nadu)	*P. keralensis* Pandurangan & V. J. Nair
	P. crassipedunculatus Sivad. & N. Mohanan (Tamil Nadu)	
	P. thomsonianus Schott (Karnataka & Tamil Nadu)	
Theriophonum Blume	*T. fischeri* Sivad.(Tamil Nadu)	
Typhonium Schott	*T. bulbiferum* Dalz. (Maharashtra & Tamil Nadu)	

Key to the genera

1. Terrestrial, riverine or marshy herbs ..... **Lagenandra**
1. Terrestrial, erect or climbing herbs.
   2. Climbing herbs ..... **Pothos**
   2. Erect herbs.
      3. Leaves tripartitely compound; leafless during flowering ..... **Amorphophallus**
      3. Leaves radiately lobed; leafy during flowering..... **Arisaema**

AMORPHOPHALLUS Blume ex Decaisne

Nouv. Ann. Mus. Hist. Nat. 3: 366. 1834 *nom. cons.*

Key to the species

1. Spadix with neuter flowers ..... 1. *A. bonaccordensis*
1. Spadix without neuter flowers.
   2. Tuber subglobose in reproductive and vegetative phase; spathe with constriction between tube and the limb .... 2. *A. commutatus* var. *wayanadensis*
   2. Tuber cylindrical in reproductive phase and obconic. in vegetative phase; spathe without constriction between the tube and the limb ..... 3. *A. nicolsonianus*

1. **Amorphophallus bonaccordensis** Sivad. & N. Mohanan, Blumea 39: 295. 1994; N. Mohanan & Sivad., Fl. Agasthyamala 750. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6,

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Flr. Pl. 508. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 639. 2006.

Type: Thiruvananthapuram district: Agasthyamala, Bonaccord, ± 700 m, 25 Apr. 1990, *N. Mohanan 8219* (TBGT). (Plate 74 a-c)

Corms subglobose, 4-8 cm diam. and 2.5 cm thick in vegetative phase, 4-7.5 cm diam. and 3-4 cm thick in reproductive phase. Cataphylls 3-4, 10.5-30 cm long and 1.3-20 cm broad, pale pink. Leaf trichotomously decompound; petiole 30-75 cm long, 0.8-1.6 diam., green with dark greenish brown mottles; leaflets sessile ovate-oblong, acuminate at apex, 6-13 long and 3-6 cm broad; peduncle cylindric, 30-75 cm long, 1-1.6 cm diam. Spathe ovate-oblong, 12-22 cm long, with a convolute base and expanded limb seperated by a constriction, tip acuminate. Spadix stipitate, 9-18 cm long, light greenish; basal 2-3.5 cm pistillate, middle 1-1.5 cm neuteriflorous, upper 3-3.5 cm staminate, terminal 4.5-10 cm produced into a sterile cylindric barren appendix. Staminate flowers closely arranged, each composed of 2-5 stamens. Pistillate flowers subspirally arranged; ovary sessile, subglobose, ovule 1; style short, cylindric; stigma 2-3-lobed. Neuter flowers in 1-3 rows, creamy white in colour, obovoid. Fruits not observed.

Flowering & Fruiting: March-April.

Habitat: Grasslands among deciduous forests.

Note: A local endemic species known only from its type locality. It is therefore necessary to identify more areas of its occurence towards planning further exploration activities.

Specimens examined: Thiruvananthapuram district: Agasthyamala, Bonaccord, ± 700 m, 25 Apr. 1990, *N. Mohanan 8219* (Isotype, TBGT); *Ibid.*, Kottur, 600 m, 10 Mar. 1994, *N. Mohanan 12428* (TBGT).

2. **Amorphophallus commutatus** var. **wayanadensis** Sivad. & Jaleel, Rheedea 12: 163. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 509. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 640. 2006.

Type: Wayanad district: Vaithiri, 13 Sep. 1975, *Sivadasan 7815* (CALI). (Plate 74 d & e)

Tubers subglobose, 10-16 cm diam., and 1.4-1.8 cm thick. Cataphylls usually 4, c. 4-35 cm long and 2-4.5 cm broad. Leaf trichotomously decompound; petiole cylindrical, smooth, 50-52 cm long and c. 1.5 cm diam., light green with whitish mottles and dark green dots; leaflets ovate-oblong, acuminate, base cuneate, decurrent on the rachis; smaller leaflets 4.5-8 cm long and 2.2-4 cm broad, bigger ones 12-18 cm long and 4-5.5 cm broad; peduncle 75-95 cm long and 1.4-1.8 diam. at base, light green with greenish black and purple green spots. Spathe ovate, oblong, c. 26-32 cm long 9-12 broad, with a convolute base and expanded limb, purplish at the top, greenish purple at the base with white mottles. Spadix sessile, 27-30 cm long; basal 2.3-2.5 cm pistillate, 3.7-4 cm staminate, and terminal c. 20.5-23 cm produced into a sterile appendix, reddish brown-coloured. Male flowers sessile, pale yellowish, loosely arranged. Female flowers green; ovary sub-globose, unilocular with single ovule; style very short or absent;

Plate 74. a - c. ***Amorphophallus bonaccordensis*** Sivad. & N. Mohanan: a. Habit with inflorescence; b. Inflorescence enlarged; c. Type specimen at TBGT; d & e. ***Amorphophallus commutatus*** var. ***wayanadensis*** Sivad. & Jaleel: Herbarium specimens at CALI: d. Vegetative phase - habit; e. Reproductive phase - habit.

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stigma discoid. Fruits broadly ovate, red-coloured berries, c. 1.2 cm long and c. 0.8 cm diam. Seed subspherical to ellipsoid.

Flowering & Fruiting: May-August.

Habitat: Evergreen and semi-evergreen forests.

Note: As local endemic variety, it deserves conservation importance.

Specimens examined: Wayanad district: Vaithiri, 13 Sep. 1975, *Sivadasan CU 7815* (infl.) (CALI); Kozhikode district: Wayanad Ghat, 29 May. 1997, *Abdul Jaleel & Bobby Thomas RIA 61*, (leaf) (CALI); *Ibid.*, 4th & 5th HP bent of Adivaram-Vaithiri road, 29 Aug. 1997, *RIA 62* (infl.) (CALI).

3. **Amorphophallus nicolsonianus** Sivad., Pl. Syst. Evol. 153: 165.1986; Manilal, Fl. Silent Valley 330. 1988; Sasidh. & Sivar., Flr. Pl. Thrissur For. 483.1996; Sivad. in Manoharan *et al.*, Silent Valley - Whis. Reas., 169. 1999; N. Mohanan & Sivad., Fl. Agasthyamala 752. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 509. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 640. 2006.

Type: Palakkad district: Silent Valley, Dam site, ± 1000 m, 3 Jan. 1983, *Sivadasan 21516-A* (K). (Fig. 41; Plate 75 a & b)

Corms obconical to napiform or subcylindric in vegetative phase, c. 6 cm long and 4 cm diam.; in reproductive phase13-18 cm long and 1.5-4.5 cm diam. Cataphylls usually 6-7, c. 1-24 cm long and c. 1.5 cm broad, lorate, tip rounded, minutely apiculate. Leaf trichotomously decompound; petiole cylindric, smooth, 30-56(60) cm long and 0.9-1.5(2) cm diam., green with light green mottles and small dark purplish spots; leaflets, except the terminal ones, with distinct petiolules or sometimes sessile; lamina ovate acuminate to oblong acuminate, base round, unequal; smaller leaflets c. 6-7.5 cm long and 3-3.5 cm broad, bigger ones 13-18.5 cm long and 4.5-5.5 cm broad; peduncle cylindric, 20-32 cm long and 0.4-0.6 cm diam. Spathe ovate-lanceolate, acuminate, 10-11.5 cm long and c. 3 cm broad, with a convolute base and expanded limb. Spadix sesile, 9-12 cm long, usually longer than the spathe; basal 1-1.75 cm pistillate, middle 2-2.7 cm staminate, and the rest 6-7 cm produced into a sterile appendix. Staminate flowers cream-coloured, densely arranged. Pistllate flowers green, loosely or densely subspiralled; ovary subglobose, unilocular with single ovule; style very short, thick; stigma capitate. Fruits ellipsoid, dark-red coloured berries, 1-1.3 cm long and 0.6-0.8 cm diam. Seeds ellipsoid.

Flowering & Fruiting: January-March.

Habitat: Evergreen and semi-evergreen forests.

Note: This narrow endemic species was reported from two districts other than the type locality. It was collected from Bonaccord area at Agasthyamala during the study. There was a good population in reproductive stage among the rocky boulders in evergreen forests. As a

wild relative of crop species, propagation measures can be taken for its conservation.

Specimens examined: Palakkad district: Silent Valley, Dam site, ± 1000 m, 1 June 1997, *Sivadasan CU 1918- 1a, 1b, 1c* (CALI); Thiruvananthapuram district: Agasthyamala, Bonaccord, ± 700 m, 16 Feb. 1991, *N. Mohanan 10333* (Infl.) (TBGT); *Ibid.*,19th Nov. 2008, *Shaju 65011* (Infl.) (TBGT); Kannur district: Meppadi, Kanthempara, 768 m, 27 Dec. 1997, *Jaleel RIA-242* (Leaf) (CALI).

ARISAEMA C. F. P. von Martius

Flora 14: 459. 1831.

Key to the species

1. Leaflets 7-8 ..... 1. *A. agasthyanum*
1. Leaflets 9 or more.
   2. Limb of spathe erect or suberect.
      3. Appendix c. 3.5 cm long, gradually tapering towards tip, apex acute ..... 2. *A. attenuatum*
      3. Appendix 2-3 cm long, cylindric, apex obtuse ..... 3. *A. peltatum*
   2. Limb of spathe tapering and recurved or cordate-based and pendant.
      4. Spathe with a tapering recurved limb ..... 4. *A. psittacus*
      4. Spathe with a cordate-based pendant limb ..... 5. *A. sarracenioides*

1. **Arisaema agasthyanum** Sivad. & Sath. Kumar, Aroideana 10(4): 18. 1987; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 510. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 641. 2006.

Type: Thiruvananthapuram district: Agasthyamala, 1800 m, 15 May 1985, *Sathish Kumar 1350* (K). (Plate 75 c & d)

Dioecious herbs; tubers 2-3 cm diam. Male plants smaller than female plants. Cataphylls 3, broad, tip acute. Leaf solitary; petiole 17-30(55) cm long, light green with minute purple spots; leaflets 7-8, 6-10 x 2-3.5 cm, radiate, shortly petioluled, oblong-obovate, acuminate, apiculate, base cuneate, margin erose. Inflorescence short-peduncled; peduncle 4-12 cm long and 0.35-0.5 cm diam., completely enclosed in petiolar sheath. Spathe 6-15 x 4-5 cm, convolute at base, striped with white and purple; limb expanded and curved. Spadix sessile, 4-6 cm long. Male spadix with basal staminate flowers for 1.4-1.7 cm long, 1-2 anthers forming an annular stalked structure. Female spadix with basal pistillate flowers for 1.2-1.5 cm long; ovary 1-celled, ovules 4-6; stigma capitate. Spadix-appendix blunt at tip with a lower stipe having

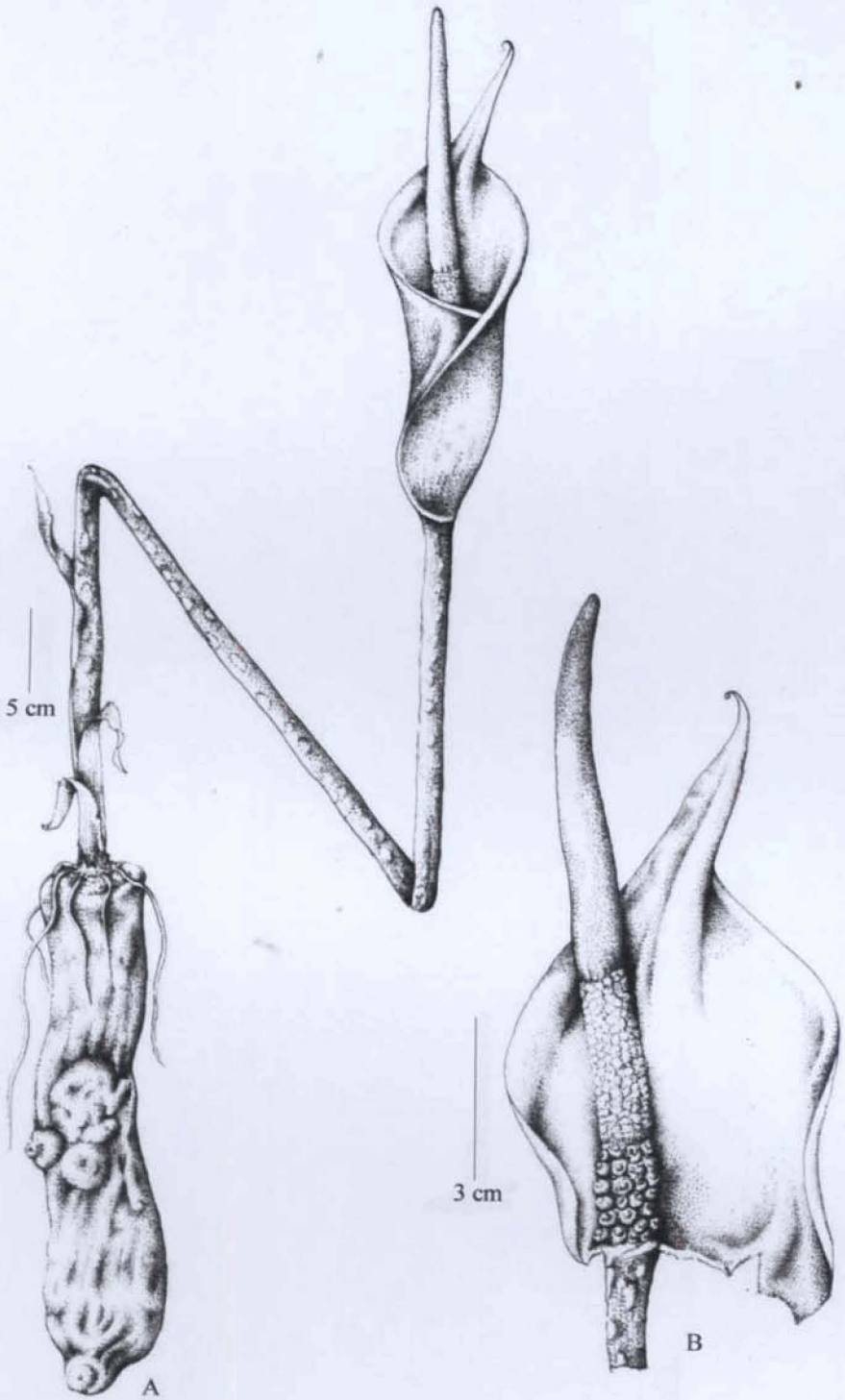

Fig. 41. ***Amorphophallus nicolsonianus*** Sivad.: A. Habit - reproductive phase; B. Inflorescence.

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Plate 75. a & b. ***Amorphophallus nicolsonianus*** Sivad.: a. Herbarium specimen at TBGT; b. Herbarium specimen at CALI; c & d. ***Arisaema agasthyanum*** Sivad. & Sath. Kumar: c. Herbarium specimen at TBGT; d. Few inflorescences; e & f. ***Arisaema attenuattum*** Barnes & C. E. C. Fischer: Herberium specimens at CALI.

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subulate sterile flowers; neuter flowers 1-2 in male spadix, many in female. Fruits not seen.

Flowering & Fruiting: April-June.

Habitat: In open rocky areas.

Note: A narrow endemic species so far known only from the type locality; owing to narrow distribution assumes conservation significance.

Specimens examined: Thiruvananthapuram district: Agasthyamala, 1800 m, 15 May 1985, *Sathish Kumar 1350* (male plant) (Isotype. TBGT); *Ibid.*, Pongalapara, ± 1200 m, 24 Jun. 1993, *N. Mohanan 11453* (TBGT).

2. **Arisaema attenuatum** E. Barnes & C. E. C. Fischer, Bull. Misc. Inform. Kew 1936: 275. 1936: Chatterjee, Bull. Bot. Soc. Bangal 8: 121.1959; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 205. 1987; Manilal, Fl. Silent Valley 331. 1988; Sivad. in Manoharan *et al.*, Silent Valley - Whis. Reas., 169. 1999; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 510. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 641. 2006.

Type: Idukki district: 'Munnar, Pallivasal, Travancore High Range', *E. Barnes 1193* (K).

(Plate 75 e & f)

Dioecious succulent glabrous herb. Tuber oblate, 2-3 cm diam. Cataphylls 3 or more, membraneous, beautifully mottled by longitudinal dark purple marking on a greenish and brown striated ground. Leaf solitary; petiole rather slender up to 80 cm long, often very conspicuously mottled; leaflets 6-12 in male plant and 9-13 in female plant, elliptic lanceolate to oblanceolate, finely acuminate, tapering at base, sessile, 12-22 cm long and 2-5.5 cm broad; peduncle slender, almost enclosed in petiolar sheath, tube of spathe cylindric, 7-9 cm long and 1-1.5 cm diam.; limb elongate-lanceolate, 4-6 cm long, long acuminate. Spadix 8-10 cm long, tapering more or less uniform, tip acute, end curved at right angles and shortly exerted. Male inflorescence 3-4 cm long, flowers crowded near the base, 1-7 sessile-anthered. Female inflorescence c. 2 cm long; ovaries crowded, subglobose, ovules 5-7; stigma almost sessile, white papillose; neuter flowers few to many scattered over a length of 2-3 cm above the pistillate portion; appendix slender, erect, subulate, 4-10 cm long. Fruit unknown.

Flowering & Fruiting: March-April.

Habitat: Shola forests.

Note: This species was first reported from 'Munnar, Pallivasal, Travancore High Range' by E. Barnes. After a lapse of fifty years Manilal collected this species from Silent Valley. Due to its very rare occurrence, Nayar (1997) remarked this species as belonging to 'Threatened' category.

Specimens examined: Thiruvananthapuram district: Ponmudi, 1000 m, 15 Sep. 1976, *M. Sivadasan CU 19143*, (cormus plant) (CALI); Palakkad district: Silent Valley, Thathengalam cardamom estate, 3600 ft., 1 Jun. 1977, *M. Sivadasan 19181a* (CALI); Idukki district:

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Eravikulam National Park, Naymakad, ± 1900 m, 20 July 1997, *Jaleel 113* (CALI).

3. **Arisaema peltatum** C. E. C. Fischer, Bull. Misc. Inform. Kew 1936: 277. 1936; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 207. 1987; Karth. *et al.*, Fl. Ind. Enum. Monocot. 1989; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 511. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 642. 2006.

Type: Idukki district: 'Munnar, Travancore High Range', *Barnes 1146 & 1147*(K).

(Plate 76 a & b)

Dioecious, glabrous herbs. Tuber subglobose, 1-2 cm diam. Cataphylls 3, membranous, subacute to obtuse, greenish mottled. Leaf solitary; petiole up to 60 cm long, sheathing, conspicuously mottled, longer than peduncle; leaflets radiate, 7-11, narrowly elliptic-lanceolate, acuminate or caudate acuminate, sessile, base cuneate, margin entire, 9-19 cm long, 2-3 cm broad. Spathe 10-14 cm long, lanceolate, acuminate, tube narrowly funnel-shaped, 3-5 cm long; limb ovate-lanceolate tapering into a slender tail. Spadix straight, exerted from the tube of the spathe, c. 5 cm long, floriferous portion c. 2 cm; appendix gradually tapering into an obtuse point. Male inflorescence 1.7-2 cm long, flowers scattered or often dense below consisting of 2-8 anthers on a short column; neuter flowers absent. Femle inflorescence narrowly conical, c. 2.5 cm long; ovaries crowded, subglobose; ovules 3-4; style columnar; stigma peltate, minutely papillose. Neuter flowers c. 25, extending over 1.5 cm, slender, subulate, acuminate, erect. Fruit not seen.

Flowering & Fruiting: April-May.

Habitat: Semi-evergreen forests.

Note: This species is so far known only by the type collections made by E. Barnes during 1935. It has not been recollected although its locality is well botanised. This would have been lost due to habitat destruction. Its threatened status has been reported earlier by Henry *et al.* (1978).

4. **Arisaema psittacus** E. Barnes in Hook., Ic. Pl. Ser. 5, 5: t. 3405. 1940; Chatterjee, Bull. Bot. Soc. Bengal 8: 131. 1959; K. Narayanan *et al.*, Rheedea 7: 101.1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 511. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 643. 2006.

Type: Mannavan Shola, *E. Barnes 1576, 1579* (K). (Plate 76 c & d)

Dioecious glabrous succulent herbs. Tubers oblate or subglobose, 2-6 cm in diam., 0.7-3 cm thick. Cataphylls 3, membranous, sheathing the leaf bases, apex subacute, greenish with greyish brown mottlings. Leaf solitary; petiole 50-120 cm long, 1-6 cm diam. at base, greenish with greyish-brown or purplish mottlings; leaflets radiate, 7-13, sessile, 15-35 cm long, 4-8 cm broad, elliptic lanceolate to obovate-lanceolate, apex caudate-acuminate, base cuneate, margin entire; peduncle slender, 30-60 cm long, 0.5-1.5 cm diam., light green or light green with grey

and purplish streaks. Spathe 16-36 cm long, broadly cylindrical, recurved, tube 6-13 cm long, limb more or less hemisperical, 6-14 cm long, apically tapering, 4-9 cm long. Spadix sessile erect, 7-15 cm long, larger in females. Male spadix with floriferous portion 2-3.5 cm; staminate flowers scattered, each 3-4-anthered, purple; neuter flowers absent or rarely a few present; appendix stout, greenish yellow, 3-5 cm, cylindrical, obtuse. Female spadix with floriferous portion 2-5 cm long; pistillate flowers numerous, compactly arranged; ovaries ovoid; ovules 3-6; style short, purplish; stigma white, peltate, papillose; neuter flowers several, scattered above the pistillate flowers; spadix–appendix same as in males but larger. Infructescence c. 13.5 cm long. Berries c. 150 per infructescence, orange-red when ripe.

Flowering & Fruiting: May-September.

Habitat: Shola forests.

Note: This is a little known endemic species which was first discribed by E. Barnes in 1940, based on his collections made in May 1937 from Chunduvarai and Mannavan Shola of the Munnar-Devikulam High Ranges. K. N. Nair *et al.* (1997) rediscovered this species from the type locality after sixty years. According to them, 'the highly restricted distribution, significantly low population size, and above all, the increasing threats to its natural habitat are factors that could adversely affect the survival of this stenotopic endemic species. The conservation status of this taxon has been designated as 'Indeterminate' in the IUCN Threatened Plant List of 1986. Ahmedullah & Nayar (1987) also remarked it as 'Threatened' belonging to category.

Specimens examined: Idukki district: Mannavan shola, ± 2110 m, 25 May 1997, *K. N. Nair, Jayakumar & Prathapachandran 31595* (male plant), *31549* (female spadix); *Ibid.*, 24 Sep. 1997, *Jayakumar* (infructescence) (TBGT); Mannavan Shola, 2100-2250 m, May 1937, *E. Barnes 1576, 1579* (K).

5. **Arisaema sarracaenioides** E. Barnes & C. E. C. Fischer in Hook., Ic. Pl. ser. 5, 4: t. 3307. 1936; Chatterjee, Bull. Bot. Soc. Bengal 8: 131. 1959; Sebastine, Bull. Bot. Surv. India 4: 219. 1962; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 207. 1987; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 511. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 643. 2006.

Type: 'Travancore, High Range: Naimakad Gap', *E. Barnes 1092* (K). (Plate 76 e & f)

Plants dioecious. Tuber globose, 1.5-2 cm in diam. Cataphylls 2-3, membranous, subacute. Leaf solitary, digitate compound; leaflets 5-9; petiolulate, broadly oblanceolate, caudate-acuminate, base cuneate, margin subentire; peduncle very short; petiole c. 50 cm long, terete. Spathe with cucculate limb, tube 10-15 cm long; limb c. 5 cm long, 4 cm broad, base cordate, recurved. Spadix 10-13 cm long, included, floriferous portion 2 cm. Appendix narrowly conical, curved, tapering from a swollen base into obtuse point. Male flowers sparsely arranged, each 4-6-anthered. Ovaries subglobose; style short; stigma papillose. A few

Plate 76. a & b. ***Arisaema peltatum*** C. E. C. Fischer: Type specimens at Kew; c & d. ***Arisaema psittacus*** Barnes: Type specimens at Kew; e & f. ***Arisaema sarracenioides*** Barnes & C. E. C. Fischer: e. Type specimen at Kew; f. Herbarium specimen at CALI.

NB 5915

subulate neuter flowers present in female spadix above the pistillate portion. Fruits spherical. Seeds 1-4.

Flowering & Fruiting: April-May.

Habitat: Evergreen forests.

Note: A narrow endemic species reported from Silent Valley (type locality) Wayanad and Thrissur districts with very limited number of individuals. Because of its rare occurrence Ahmedullah and Nayar (1987) categorized it under 'Rare & Threatened' of RET species.

Specimen examined: Idukki district: Eravikulam National Park, Naimakad, 20 Jul. 1997, *Jaleel 112* (CALI); Travancore, High Range: Naimakad Gap, c. 2000 m., *E. Barnes 1092* (Type: Kew).

LAGENANDRA Dalzell

in Hooker's J. Bot. Kew. Gard. Misc. 4: 289. 1852.

Key to the species

1. Spathe-limb with an erect slender caudate tip; pistillate flowers 6-8 in a single whorl ..... 1. *L. keralensis*
1. Spathe-limb with acaudate tip; pistillateflowers 12-15 in 2-3 whorls ..... 2. *L. nairii*

1. **Lagenandra keralensis** Sivad. & Jaleel, Bot. Bull. Acad. Sin. 42: 153. 2001; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 513. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 645. 2006.

Type: Ernakulam district: Kothamangalam, Bhoothathankettu, ± 750 m, 21 Jun, 1994, *Bobby Thomas RIA 91a, RIA 85* (K). (Plate 77 a & b)

Submerged rhizomatous creeping herbs. Stipular sheath1-2.6 cm long, broad at base, tapering towards the tip, base white, light purplish spotted on the upper half. Leaves 3-12 cm long, ovate, acute-acuminate at apex, base orbicular, usually light purplish, leaf surface bears unicellular hairs, margin closely undulate. Inflorescence 4.5-9 cm long. Peduncle 1-5 cm long, light purplish to pink in colour with small ridges extending up to half of limb. Limb curved towards one side, the upper portion of the limb caudate, light purple. Spadix c.1 cm long; with pistillate portion at base to c. 0.2 cm, followed by a sterile nacked interstice of c. 0.3-0.4 cm, a staminate portion of c. 0.2 mm long and a terminal sterile appendix of c. 0.1 mm long. Male flowers 80-100, spirally arranged. Pistillate portion comprises 6-8 female flowers in a single whorl; flowers sessile, short, flattened, conical, c. 0.2 mm long and c. 0.15 mm thick, white; ovary unilocular, ovules 4-8; stigma obcordate. Berries fleshy with irregular rough surface. Seeds 4-8, ellipsoid.

Plate 77. a & b. ***Lagenandra keralensis*** Sivad. & Jaleel: a. Type specimen at CALI; b. Habit; c & d. ***Lagenandra nairii*** Ramam. & Rajan: c. Type specimen at MH; d. Habitat with a dense population.

NB 5995

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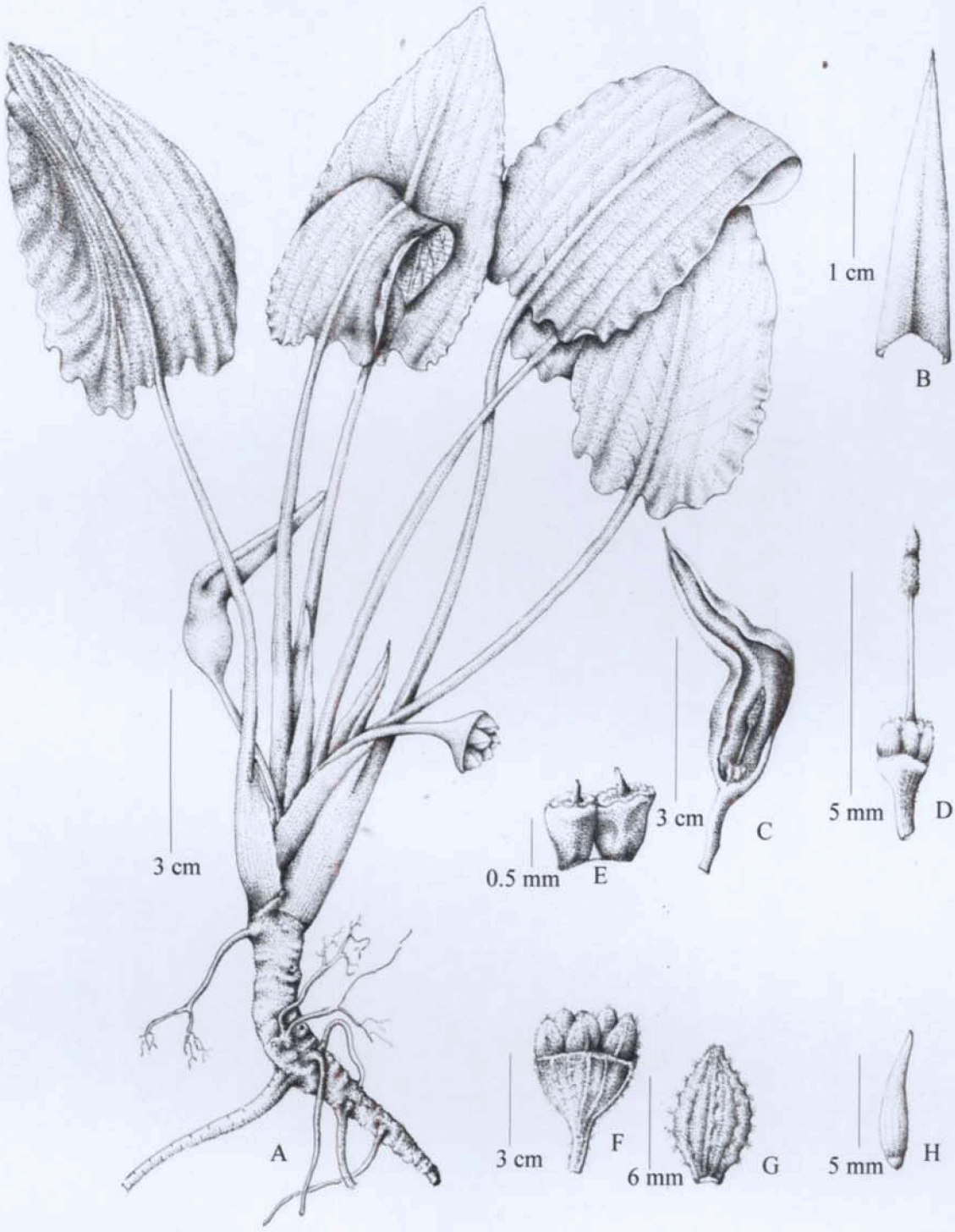

Fig. 42. ***Lagenandra nairii*** Ramam. & Rajan: A. Habit; B. Cataphyll; C. Inflorescence with a portion of the tube removed showing spadix; E. Single staminate flowers; F. Inflorescence; G. Single fruit; H.Seed.

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NB 5945

Flowering & Fruiting: March-June.

Habitat: Scattered distribution in shady stream-sides in undisturbed reverine forests.

Note: A local endemic species known only from the type locality. So further explorations must be made to locate this species in its known distributional areas to confirm its conservational status.

Specimens examined: Ernakulam district: Kothamangalam, Bhoothathankettu, ± 750 m, 21 Jun, 1994, *Bobby Thomas RIA 91a, RIA 85* (Para & Isotypes, CALI); *Ibid.*, 20 Apr. 2007, *Shaju 59411* (TBGT).

2. **Lagenandra nairii** Ramam. & Rajan, J. Bombay Nat. Hist. Soc. 80: 613. 1983; Sasidh. & Sivar., Flr. Pl. Thrissur For. 486.1996; Sasidh., Biod. Doc. Kerala, Part 6, Flr. Pl. 513. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 645. 2006.

Type: Thrissur district, near Athirapally water falls, ± 300 m, 17 Mar. 1982, *Ramamurthy 73052* (MH). (Fig. 42; Plate 77 c & d)

Submerged herbs. Rhizome creeping. Stipular sheath 5-10 cm long, elongate-triangular. Leaves 25-40 cm long, alternate, sheathed; leaf blades 10-20 x 5-10 cm, elliptic-oblong to ovate, entire or undulate, punctate above, dense tomentose below, acute or obtuse, base subcordate or rounded. Petiole 20-30 cm long, sheathed at base. Peduncles 2.5-5 cm long. Spathe to 4-5 cm long, tubular below, constricted in the middle. Limb ovate, acuminate, dark purple. Male flowers numerous, sub-terminal, c. 0.5 cm long, crowned with an ovate, fleshy sterile appendage; anthers sessile. Female flowers 0.1-0.2 cm long, seperated from male by a naked portion; ovary 1-loculed, many in whorls; stigma small, globose; ovules 4, basal, elliptic-oblong, striated. Syncarpium enclosed by the persistent cupular base of spathe. Berries ovoid, 4-angled, with spinous warts along the walls. Seeds obliquely ovate, elongate, striated.

Flowering & Fruiting: February - March.

Habitat: Forming thickets along the water-logged areas of the down stream of Athirapally water falls.

Note: As local endemic species with restricted distribution; it warrants critical evaluation to obtain conservation status.

Specimens examined: Thrissur district, Near Athirapally water falls, Chalakudi river, ± 300 m, 17 Mar. 1982, *Ramamurthy 73052* (Isotype, MH); *Ibid.*, 11 Feb. 1998, *Shaju 59496* (TBGT).

POTHOS Linnaeus

Sp. Pl. 968. 1753.

Pothos keralensis Pandurangan & V. J. Nair, Ind. J. For. 17 (1): 64. 1994; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 461. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 841. 2006.

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Type: Idukki district: Kulamavu, Meenmutty, ± 700 m, 24 Feb. 1983, *Pandurangan 78069* (MH). (Fig. 43; Plate 78 a-e)

Root climbers. Hanging branches with long slender whip-like flagella of about 5-6 m long with scale leaves and sometimes with roots at nodes. Leaves alternate, distichous. Petiole sheathing, distinctly acuminate, base partly convolute at nodal portions, 6-8.5 cm long. Blades asymmetric, elliptic oblong, coriaceous, glabrous, base obtuse, margin undulate, apex cuspidate, 11-8 x 4.5-7.5 cm; lateral nerves at right angles to midrib, and are connected by 2 intra-marginal collective veins. Spadix axillary, cylindric, curved, rusty pubescent, c. 6 cm long. Peduncles c. 3 cm long. Stipe c. 0.4 cm long. Perianth segments 6, imbricate, triangular, apex incurved, fleshy, rusty pubescent, pale yellow. Stamens 6, filaments flat, anthers subglobose. Ovary truncate, pubescent, 3-loculed, ovules 1 per locule; style o; stigma globose. Berry 4-6-angled.

Flowering & Fruiting: February-May.

Habitat: Epiphytic on trees in evergreen forests.

Note: Significantly small populations are seen in few localities of the district, where these populations are under severe threat due to habitat destruction; owing to this, efforts should be made for *in situ* and *ex situ* conservation of this narrow endemic species.

Specimens examined: Idukki district: Kulamavu, Meenmutty, ± 700 m, 24 Feb. 1983, *Pandurangan 78069* (Holotype, MH); *Ibid.*, Adimaly, Aram myle, ± 600 m, 24 Apr. 2007, *Shaju 59489* (TBGT).

48. ERIOCAULACEAE

Table 68. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
10	1150-1200	1	74	28spp.

Genus/genera	Species/subsp./var.
1	36 spp.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Eriocaulon L.	*E. dalzellii* Koern. (Maharashtra, Goa & Karnataka)	
	E. ensiforme Fischer (Tamil Nadu)	
	E. eurypeplon Koern. (Maharashtra, Goa & Karnataka)	
	E. lanceolatum Miq. Ex Koern.	*E. ansarii* Pradeep & Sunil

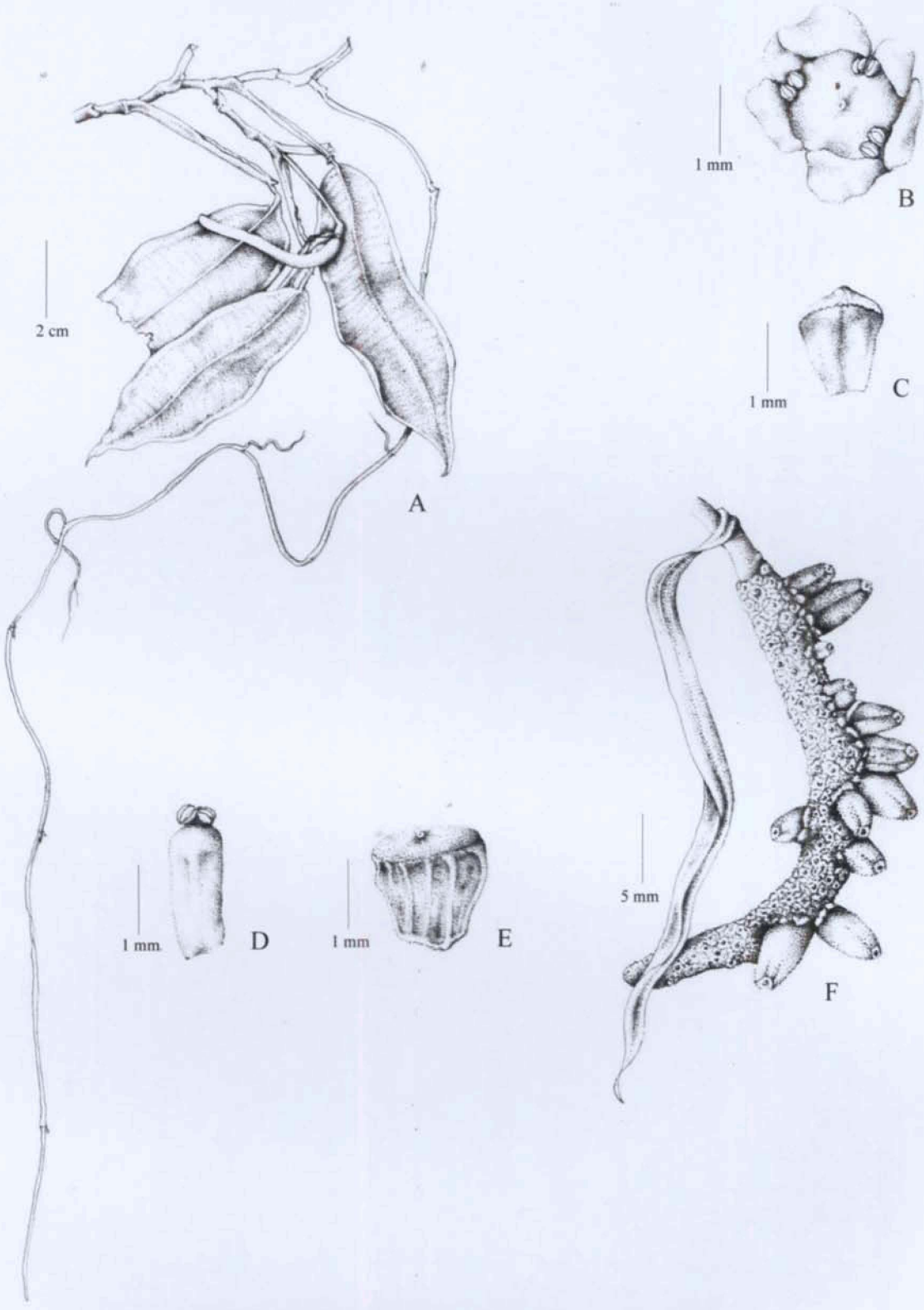

Fig. 43. ***Pothos kerelensis*** Pandurangan & V. J. Nair: A. Habit - a flowering branch with apical portion having a long flagellum; B. Single flower; C. Tepal; D. Stamen; E. Pistil; F. Inflorescence.

NB 5995

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Plate 78. a - e. ***Pothos keralensis*** Pandurangan & V. J. Nair: a. Habit - apical portion of a twig with a long flagellum; b. Flowering twig with inflorescence; c. Twig with infructescence; d. Infructescence; e. Type specimen at MH.

NBS995

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Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	(Maharashtra & Karnataka) *E. leucomelas* Steudel (Tamil Nadu) *E. nairii* Chandrb. & V. Chandras. (Tamil Nadu) *E. palghatense* R. Ansari & Balakr. (Maharashtra, Goa & Karnataka) *E. redactum* Ruhland (Maharashtra, Goa & Karnataka) *E. rhodae* Fyson (Karnataka & Tamil Nadu) *E. robustum* Steudel (Tamil Nadu) *E. talbotti* R. Ansari & Balakr. (Maharashtra, Karnataka & Tamil Nadu)	*E. devendranii* R. Vijaya Sankar *et al.* *E. sivarajanii* R. Ansarii & Balakr. *E. vasudevanii* R. Ansari & Balakr.

ERIOCAULON Linnaeus

Sp. Pl. 87. 1753.

Key to the species

1. Rootstock present.....1. *E. ansarii*
1. Rootstock absent.
   2. Peduncles up to 1 cm long.....2. *E. devendranii*
   2. Peduncles up to 7 cm long.
      3. Involucral bracts obovate-cuneate, cuspidate.....3. *E. sivarajanii*
      3. Involucral bracts oblong-obtuse, dentate or not along upper margin.....4. *E. vasudevanii*

1. **Eriocaulon ansarii** Pradeep & Sunil, Candollea 58. 321. 2003; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 518. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 704. 2006.

Type: Thrissur district: Kodungalloor, 45 m, 22 Aug. 1999, *Sunil 2190* (CALI).

Acaulescent herbs up to 5 cm tall. Rootstock thick, conical. Leaves rossulate, acicular, 0.3-0.1 cm long, glabrous. Peduncles 1-3, slender, up to 5 cm long, 3-ribbed, glabrous. Capitulum hemispheric, c. 0. 2 cm across, black; receptacle ovoid, pilose. Involucral bracts c. 0.1 x 0.05 cm, obovate-cuneate, obtuse, glabrous, black. Flowers sessile. Male flowers: sepals obovate-cuneate, connate into a spathe, c. 0.1 cm long, 3-lobed, glabrous; petals 3, subequal, glabrous, without any

black glands. Stamens 6; anthers globose, blackish. Female flowers: sepals 3, free, subequal, hyaline, not clawed, acute, c. 0.1 cm long, with or without a black gland in each, pilose with spreading hyaline hairs towards the middle inside. Ovary sessile, globose; style 3-fid. Seeds oblong-ellipsoid, c. 0.05 cm long, brownish, transversely striate, appendaged.

Flowering & Fruiting: August-September.

Habitat: Marshy fields.

Note: As a neoendemic species , further explorations are necessary to obtain a clear picture of conservation status.

Specimen examined: Thrissur district: Kodungalloor, 45 m, 22 Aug. 1999, *Sunil 2190* (Isotype, CALI).

2. **Eriocaulon devendranii** R. Vijaya Sankar, K. Ravikumar & N. M. Ganesh Babu, Rheedea 16: 59. 2006.

Type: Palakkad district: Chittur taluk, Anappady, 550 m, 26 Nov. 2003, *R. Vijaya Sankar 73127* (FRLH).

Acaulescent herbs up to 2 cm tall. Rootstock absent. Leaves 7-15, rosulte, linear-oblong, 0.5-1 cm x 0.1-0.2 cm, glabrous, sheathing at base, acute at apex. Peduncles 1-5, slender, up to 1 cm long, erect, glabrous, broadened at apex. Capitulum hemispherical, c. 0. 5 cm across, straw-coloured; receptacle convex, glabrous. Involucral bracts erect or spreading, 0.25-0.35 x 0.05-0.1 cm, ovate-oblong, multifid and acuminate at apex, 0.25-0.35 x 0.05-0.1 cm, chartaceous, glabrous. Flowers pedicellate. Male flowers: sepals connate into a spathe, c. 0.1 x 0.07 cm, cuneate at base, 3-lobed at apex; lobes obtuse and hoary, dark brown; petals 3, united into a tube, c. 0.07 x 0.02 cm, glabrous; lobes 3, minute, subacute with a black gland at apex. Stamens 6, ovoid, black. Female flowers: sepals 3, free, c. 0.07 cm long, dissimilar, the two lateral ones oblanceolate, obtuse and hairy at apex; petals 3, subequal, spathulate, c. 0.06 x 0.02 cm, obtuse with a black gland at apex, barbate, stipitate between sepals and petals. Ovary subsessile, ovoid; style 3-fid. Seeds oblong-ellipsoid, c. 0.04 x 0.02 cm, transversely striate, appendaged.

Flowering & Fruiting: October–November.

Habitat: Marshy fields of open forest areas, grasslands, along streams and roadsides.

Note: A local endemic species known only from the type locality.

Specimen examined: Palakkad district: Chittur taluk, Sungam range, Anappady, 550 m, 26 Nov. 2003, R. Vijaya Sankar, K. Ravikumar & N. M. *Ganesh Babu* 73127 (Holotype & Isotypes, FRLH).

3. **Eriocaulon sivarajanii** R. Ansari & N. P. Balakr., Eriocaul. India 60. 1994; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 521. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 707. 2006.

Type: Malappuram district: Calicut University Campus, 50 m, 10 Aug. 1975, *Radhakrishnan*

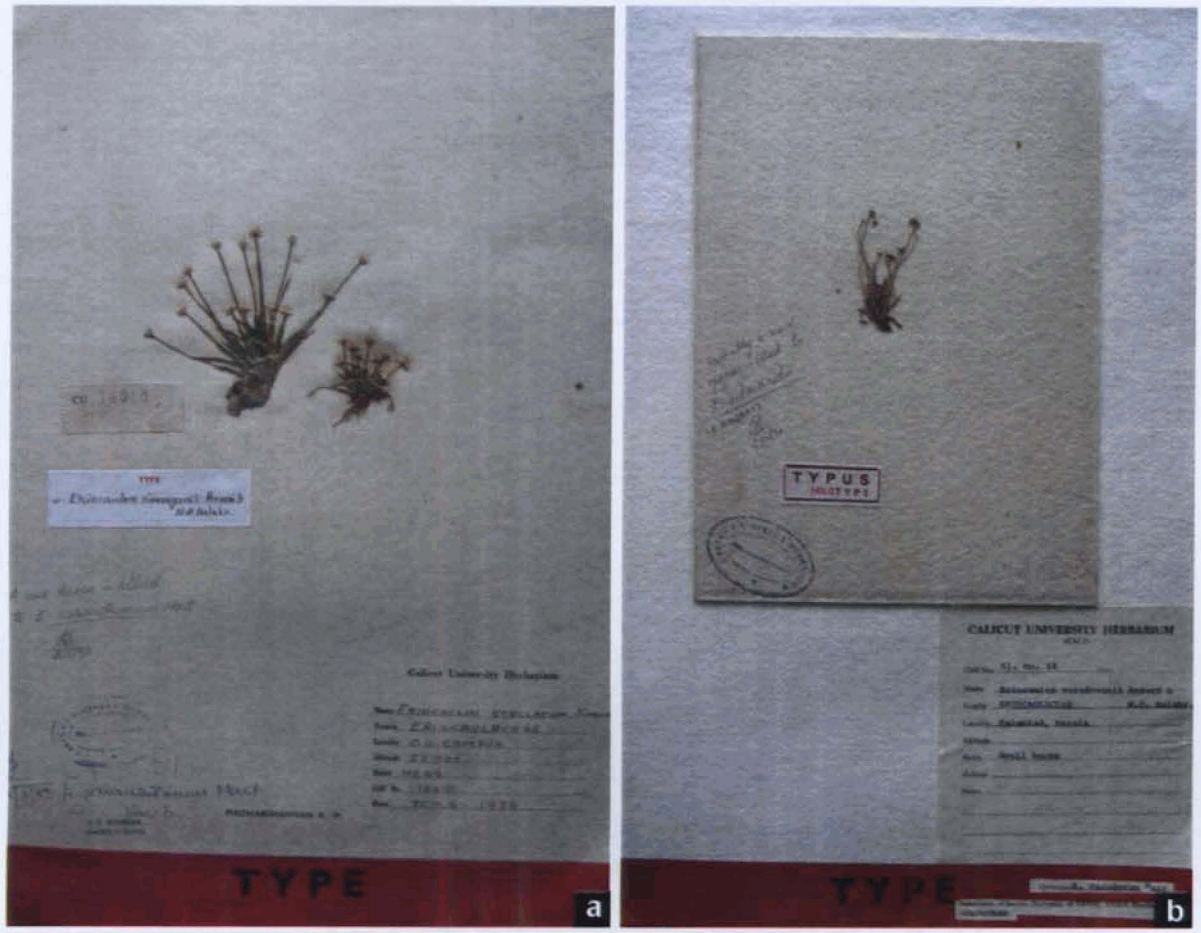

Plate 79. Type specimens.

a. ***Eriocaulon sivarajanii*** Ansari & Balakr. (CALI)
b. ***Eriocoulon vasudevanii*** Ansari & Balakr.(CALI)

16010 (CALI). (Plate 79 a)

Acaulescent herbs. Rootstock absent. Leaves rossulate, linear, acuminate up to 4 x 0.3 cm, glabrous. Peduncles few to many, up to 7 cm long, virgate, glabrous. Capitulum hemispherical or cuneate, c. 0.6 cm across, straw-coloured; receptacles convex, pilose. Involucral bracts erect or spreading, c. 0.3 x 0.2 cm, obovate-cuneate, cuspidate, dentate along upper margins, chartaceous, glabrous, straw-coloured. Flowers sessile or subsesile. Male flowers: sepals ovate, connate into a spathe of c. 0.15 x 0.1 cm, 3-lobed with obtuse lobes, hoary at apex, black; petals 3, subequal, ovate, acute, sparsely hoary, with black gland in each. Stamens 6; anthers oblong, blackish. Female flowers sessile: sepals 3, free, subequal, c. 0.1 cm long; the two lateral ones spathulate, obtuse, hoary at apex, black; the middle ones linear with a few hairs at apex; petals 3, subequal, oblanceolate, not clawed, acute, 0.1-0.15 cm, hyaline, sparsely barbate, with a black gland in each, not stipitate bwtween sepals and petals. Ovary sessile, ovoid; style 3-fid. Seeds oblong-ellipsoid, obtuse or acute, c. 0.06 cm long, pale pink, transversely striate, appendaged.

Flowering & Fruiting: August-September.

Habitat: In moist places in plains.

Note: A narrow endemic species known only from type locality; owing to narrow distribution assumes conservation significance.

Specimen examined: Malappuram district: Calicut University Campus, 50 m, 10 Aug. 1975, *Radhakrishnan 16010* (Holotype, CALI).

4. **Eriocoulon vasudevanii** R. Ansari & N. P. Balakr., Eriocaul. India 68. 1994; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 522. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 708. 2006.

Type: Palakkad district, Nelliampathy, Ayyappankavu, 12 Aug. 1979, *Vasudevan Nair 821* (CALI). (Plate 79 b)

Acaulescent herbs. Rootstock absent. Leaves rossulate, linear, acute, c. 2 x 0.1 cm, glabrous. Peduncles many, up to 6 cm long, virgate, glabrous. Capitulum hemispheric, c. 0. 4 cm across, black; receptacle convex, glabrous. Involucral bracts erect or spreading, c. 0.15 x 0.07 cm, oblong, obtuse, dentate or not along upper margins, chartaceous, straw-coloured, glabrous. Flowers pedicellate. Male flowers: sepals obovate, connate in to a spathe of 0.07 x 0.05 cm, deeply 2-lobed with acute lobes, glabrous; petals 3, minute, equal, ovate, glabrous with a black gland in each. Stamens 6; anthers glabrous, blackish. Female flowers: sepals 3, free, subequal; the two lateral ones linear, acuminate, not keeled, c. 0.07 cm long, glabrous, black; the middle one minute, acicular; petals 3, subequal, spathulate, not clawd, acute, c. 0.05-0.07 cm long, hyaline, sparsely barbate towards apex, with a black gland in each, stipitate between sepals and petals. Ovary stalked, ovoid or oblong; style 3-fid. Seeds oblong-ovoid, c. 0.03 cm long, pale yellow, transversely striate, appendaged.

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Flowering & Fruiting: August.

Habitat: On wet rocks

Note: As a neoendemic species, it warrants critical evaluation to obtain conservation status.

Specimen examined: Palakkad district: Nelliampathy, Ayyappankavu, 12 Aug. 1979, *Vasudevan Nair 821* (Partype, CALI).

49. CYPERACEAE

Table 69. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
70	4000	21	446	72spp.

Genus/genera	Species/subsp./var.
21	201 spp., 10 sub sp., 18 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Carex L.	*C. wightiana* Nees (Tamil Nadu)	*F. angamoozhiensis* Ravi & Anil Kumar
Fimbristylis Vahl	*F. aggregata* C. E. C.Fischer	*F. dauciformis* Govind.
	arnottiana Boeckeler (Tamil Nadu)	*F. humerosa* Govind
	F. pseudomicrocarya Govind. (Karnataka)	*F. hyalina* Govind. & Sasidh.
	F. tumida Govind. (Tamil Nadu)	*F. manilaliana* Govind.
	F. virella Govind. (Karnataka)	*F. perspicua* Govind.
		F. pseudonarayanii Ravi & Anil Kumar
		F. stigmatotecta Govind.
Furiena Rottb.		*F. ponmudiensis* Ravi & Anil Kumar
		F. simpsonii Ravi *et al.*
Pycreus P. Beauv.	*P. atroglumosus* (Govind.) P. Singh & V. Singh (Karnataka)	*P. palghattensis* Govind.
	P. malabaricus Clarke (Maharashtra, Goa, & Karnataka)	*P. similinervulosus* Govind.
	P. plurinodosus (Govind.) P. Singh & V. Singh (Karnataka)	
Scleria P. Bergius		*S. lithosperma* var. *muricata* Govind.

Key to the genera

1. Fertile florets unisexual ..... **Scleria**
1. Fertile florets bisexual.
   2. Stylar base dialated, not continuous with the nut..... **Fimbristylis**
   2. Stylar base not dialated, continuous with the nut.
      3. Hypogynous bristles or scales present..... **Fuirena**
      3. Hypogynous bristles or scales absent..... **Pycreus**

FIMBRISTYLIS M. Vahl

Enum. Pl. 2: 285. 1805-1806, *nom. cons.*

Key to the species

1. Robust perennial herbs; rhizomatus .....1. *F. angamoozhiensis*
1. Slender annual herbs; rhizome absent.
   2. Surface cells of nuts 10-20 rows.
      3. Culms tufted; leaves ligulate .....3. *F. hirsutifolia*
      3. Culm solitary; leaves eligulate.....9. *F. stigmatotecta*
   2. Surface cells of nuts 5-10 rows.
      4. Glumes distinctly mucronate.
         5. Inflorescence simple umbel of 3-5 spiklets;
            rachilla zig-zag .....8. *F. pseudonarayanii*
         5. inflorescence compound umbel of 6-12 spikelets;
            rachilla not zig-zag.....6. *F. manilaliana*
      4. Glumes not mucronate.
         6. Culms trigonous; nuts obovoid.
            7. Glumes triangular-ovate; bracts foliaceous .....5. *F. hyalina*
            7. Glumes orbicular to ovate; bracts filiform .....2. *F. dauciformis*
         6. Culms tetragonous; nuts not obovoid.
            8. Nuts smooth, perspicus.....7. *F. perspicua*
            8. Nuts distinctly tuberculate, not perspicus..... 4. *F. humerosa*

1. **Fimbristylis angamoozhiensis** Ravi & Anil Kumar, Rheedea 3: 108. 1993; Anil Kumar *et al.*, Fl. Pathanamthitta 744. 2005; N. Mohanan & Sivad., Fl. Agasthyamala 779. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 533. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 680. 2006.

Type: Pathanamthitta district: Angamoozhy, ± 400 m, 5 May 1991, *Anil Kumar, 1799* (MH). (Plate 80 a)

Robust perennials. Rhizome short, thick and woody. Culms triquetrous towards the base and flattened towards the apex, glabrous, up to 50 cm tall, Leaves many, basal and spiral; blade eligulate, flat tapering to an acute apex, recurved on margins, up to 70 cm long; sheath coriaceous, glabrous. Inflorescence compound umbel, up to 25 cm wide. Bracts leafy, several, unequal. Spikelets many, linear- lanceolate, upto 10-flowered, acute at both ends, c. 0.5 x 0.1 cm. Rachilla prominently winged. Glumes c.10, lower few empty, fertile ones triangular-ovate, boat-shaped, keeled, keel 3-nerved, sparsely scaberulous on the back towards the mucronate apex; mucro shortly spinulose, margins hyaline. Stamens 3, anthers linear. Style sparsely ciliolate towards the apex; stigma 3. Nuts oblanceoloid to ellipsoid, trigonous, cuneate at base, shortly stipitate, subacute at apex, trabeculate, c. 0.1 x 0.05 cm, surface cells transversely hexagonal in 3-6 vertical rows on each face.

Flowering & Fruiting: September-December.

Habitat: Exposed grassy hill slopes.

Note: Supposed to be a neoendemic species, further surveys are necessary to obtaoin a clear picture of distributional status.

Specimens examined: Pathanamthitta district: Angamoozhy, ± 400 m, 5 May 1991, *Anil kumar 1799* (Holotype, MH); Thiruvananthapuram district: Bonaccord, ± 600 m, 20 Oct. 1990, *N. Mohanan 8223* (TBGT).

2. **Fimbristylis dauciformis** Govind., Proc. Ind. Acad. Sci. (Pl. Sci.). 76 B: 181. 1962; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 214. 1987; Karth. & Sharma, J. Bombay Nat. Hist. Soc. 80: 77. 1983; Karth. *et al.*, Fl. Ind. Enu. Monogr. 77. 1989; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 461. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 841. 2006.

Type: Thrissur district: Peringalkuthu, *Govindarajalu 5987* (CAS). (Plate 80 b)

Annuals. Rhizome absent. Culms trigonus or subterete, up to 20 cm tall. Leaves folded, basal, acuminate or with a reduced blade, others foliaceous; sheath membranous; balde linear-flattened, ensiform, acute to aubacute at apex. Inflorescence compound or decompound. Bracts shorter than the inflorescence, filiform. Spikelets solitary or clustered, subglobose, 0.4-0.45 x 0.1-0.2 cm, brownish green; rachilla winged. Glumes orbicular to ovate, membranous, c. 0.2 x 0.08-0.1 cm, aristate, keel 3-nerved. Basal glumes 1-2, empty. Stamens 2; anther linear-lanceolate. Style flat, hairy throughout or papillose, dialated at base; stigma 2, papillose. Nuts obovoid, 0.08-0.09 x 0.05-0.07 cm, biconvex.

Flowering & Fruiting: October.

Habitat: Marshy areas.

Note: As a local endemic species, it deserves conservation efforts.

Specimen examined: Thrissur district: Near Peringalkuthu Inspection Bangalow; 17 Oct. 1962, *Govindarajalu 5987* (CAS).

3. **Fimbristylis hirsutifolia** Govind., Proc. Indian Acad. Sci. (Pl. Sci.) 100: 79. 1990; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 535. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 683. 2006.

Type: Malappuram district: Calicut University Campus, *Govindarajulu 15480* (CAL).

Annuals. Rhizome absent. Culms tufted, tetragonous, glabrous, leafy at base, 8-12 cm tall. Leaves hirsutely hairy abaxially and at margins, acute, flat, much shorter than culms, 6-9 nerved, 3-5 x 0.4-0.5 cm; ligulate; sheath membranous, hirsutely hairy. Inflorescence compound umbelliform, lax, 5-10 spikelets. Bracts much shorter than the inflorescence, filiform. Primary rays 4-8. Spikelets ovate-lanceolate, solitary, acute, angular, 0.45-0.5 x 0.15-0.2 cm. Rachilla shortly winged. Glumes elliptic-oblong, ovate, membranous, tannin striations resembling nerves, c. 0.2 x 0.08-0.1 cm, aristate, keel 3-nerved. Basal glumes 1-2, empty. Stamens 1; anther linear-lanceolate. Style flat, hairy throughout or papillose, dialated at base; stigma 2, papillose. Nuts obovate, pyriform, biconvex-planoconvex, minutely stipitate, umbonulate, 00.7-0.08 x 0.06-0.07 cm. surface cells hexagonal-quadrat in 15-20 regular rows on each face.

Flowering & Fruiting: December.

Habitat: Marshy areas.

Note: Being a neoendemic species, deserves conservation importance.

Specimen examined: Malappuram district: Calicut University Campus, *Govindarajulu 15480* (CAL).

4. **Fimbristylis humerosa** Govind., Rheedea 7: 117. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 535. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 683. 2006.

Type: Thrissur district: Peringalkuthu, *Govindarajulu 6012 A* (MH).

Annuals. Rhizome absent. Culms filifom tufted, tetragonous, smooth, glabrous, 10-20 cm tall. Leaves solitary to each culm, much reduced, 1-1.2 cm long, eligulate; sheath membranous, glabrous. Inflorescence simple, corymbiform, lax, 2-6 spikelets. Bracts 2-3, setaceous. Spikelets solitary, oblong-ovoid, ferruginous, up to 10-flowered. Rachilla winged. Glumes deltoid, ovoid, imbricate, ferruginous brown, glabrous, c. 0.15 x 0.14 cm, keel 3-nerved; basal glumes 2, awn-like, empty. Stamens 3, anther linear oblong. Style triquetrous, glabrous, pyramidal at base; stigma 3, glabrous. Nuts narrowly ovoid, trigonous, shortly stipitate, distinctly tuberculate, c. 0.1 x 0.05-0.06 cm, surface cells trasversely elongated hexagonal in 4-6 longitudinal rows on each face.

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Flowering & Fruiting: March.

Habitat: Marshy areas.

Note: As a local endemic species, it deserves conservation efforts.

Specimen examined: Thrissur district: Peringalkuthu Division, on the way to Orukomban, *Govindarajulu 6012 A* (Isotype, MH).

5. **Fimbristylis hyalina** Govind. & Sasidh., J. Econ. Taxon. Bot. 21(1-3): 373. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 536. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 683. 2006.

Type: Thrissur district: Athirapalli, *Sasidharan & Sivarajan 3984* (KFRI).

Annuals. Rhizome absent. Culms tufted, 15-20 cm tall, flatly trigonous, ribbed, leafy at base, glabrous. Leaves flat, shorter than culms, 10-15 x 0.12 cm, serrately scabrid towards apex, abruptly obtuse or subacute, keeled with thickened margin, glabrous, many-nerved, ligulate; sheath membranous, glabrous. Inflorescence compound with 10-20 congested spikelets, c. 4 x 5 cm. Bracts foliacious, shorter than inflorescence. Primary rays 3-4, filiform, 2-3 cm long. Spikelets fusiform, angular, solitary, 6-8-flowered, c. 3.5 x 1 cm. Rachilla with hyaline wing. Glumes triangular, ovate, imbricate, apiculate with broad hyaline margin and sides, glabrous, keeled, 3-nerved, 0.15-0.16 x 0.14-0.16 cm. Stamen 1. Style triquetrous, glabrous with pyramidal base; stigmas 3. Nuts obovoid, gradually attenuate towards base, symmetric or asymmetric, rounded or truncate at apex, distinctly stipate, globosely trigonous, tubercled, 0.8-0.9 x 0.6 cm, surface cells transversely hexagonal in 4-5 rows in each face.

Flowering & Fruiting: December.

Habitat: Along water course.

Note: As a local endemic species, it deserves conservation efforts.

Specimen examined: Thrissur district: Athirapalli, Charpa, ± 50 m, *Sasidharan & Sivarajan, 3984* (Paratype, KFRI).

6. **Fimbristylis manilaliana** Govind., Rheedea. 8(1): 87. 1998; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 536. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 684. 2006.

Type: Malappuram district: Thenhippalam, Calicut University Campus, *Govindarajulu 12699* (CALI).

Annuals. Rhizome absent. Culms tufted, triquetrous, 8-35 cm tall, leafy at base, glabrous. Leaves flat, red gland-dotted, keeled, ligulate, shorter than or as long as culms, 4-10 cm tall; sheath membranous, mouth ciliate. Inflorescence compound-decompound, corymbiform, cotracted with 6-12 lax spikelets, c. 1.5-2.5 x 2 cm. Bracts foliacious. Spikelets rhombic ovoid or conoid, sessile or subsessile, ferruginous, 8-10-flowered, solitary, 0.25-0.35 x 0.12-0.15 cm. Rachilla winged. Glumes broadly deltoid, ovate, imbricate, 0.17-0.18 x 0.15-0.2

cm, keel 3-nerved, mucronate. Stamens 3, linear oblong. Style triquetrous, glabrous; stigma 3, minutely hairy. Nuts broadly obovoid, minutely stipitate, globosely trigonous, prominently tuberculate, 0.05-0.07 x 0.05-0.06 cm, surface cells transversely hexagonal in 4-6 rows in each face.

Flowering & Fruiting: December.

Habitat: Wet or marshy ditches.

Note: As a local endemic species, it deserves conservation importance.

Specimen examined: Malappuram district: Thenhippalam, Calicut University Campus, *Govindarajulu 12699* (Isotype, CALI).

7. **Fimbristylis perspicua** Govind. & Sasidh., J. Econ. Taxon. Bot.21. 1: 373. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 537. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 684. 2006.

Type: Thrissur district, Peechi, *Sasidharan 0719* (MH).

Annuals. Rhizome absent. Culms 1-2, tetragonous, 12-15 cm tall, sulcate, rigid, leafy at base. Leaves many, broad flat, gradually acuminate, glabrous, distichous at base, keeled with many slender nerves, half the length of the culms, ligulate with thickened margin; sheath membranous, glabrous. Inflorescence usually compound consisting of 5-10 spiklets, corymbiform, 1-2 x 0.5-1cm. Rays 1-3, 3-4-gonous, glabrous. Bracts setaceous, shorter than inflorescence. Spikelets elliptic-ovoid, angular, 8-10-flowered, solitary, stalked, c. 0.25-0.27 x 0.1 cm. Rachilla winged. Glumes elliptic- ovate, rounded at apex, membranous, imbricate, 0.12-0.15 x 0.1 cm, keel 3-nerved. Stamens 3. Style trigonous, glabrous, dialated at base; stigma 3. Nuts globoid, stipitate or subtrigonous, rounded at apex, smooth, perspicus, 0.7-0.8 x 0.5-0.6 cm, surface cells transversely hexagonal in 6-8 rows in each face.

Flowering & Fruiting: March.

Habitat: Water logged areas.

Note: As a local endemic species, it deserves conservation importance.

Specimen examined: Thrissur district: Peechi, *Sasidharan 0719* (Holotype, MH).

8. **Fimbristylis pseudonarayanii** Ravi & Anil Kumar, Rheedea 3. 107. 1993; Prasad *et. al.*, J. Bombay Nat. Hist. Soc. 94: 22. 1997; N. Mohanan & Sivad., Fl. Agasthyamala 781. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6 Flr. Pl. 537. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 685. 2006.

Type: Kollam district: Thenmala, 200 m, 16 Oct. 1987, *Ravi 2254* (MH). (Plate 80 c)

Annuals. Rhizome absent. Culms tufted, smooth, quadrangular, upto 20 cm tall. Leaves many, basal; blade ensiform, acute to subacute at apex, 4-5 x 0.05-0.2 cm; sheath membranous, glabrous. Inflorescence a simple umbel of 3-5 spikelets. Bracts 2-5, acuminate to shortly foliaceous, shorter than the rays. Spikelets compressed, elliptic to lanceolate, up to 2 cm long.

Rachilla zig-zag, winged. Glumes distichous, up to 30, imbricating, broadly triangular, strongly keeled on the back, mucronate at apex, hyaline on margins, 0.2-0.3 cm long. Stamens 3, linear. Style glabrous, base conical; stigma 3. Nuts obovoid-trigonous, 0.08-0.1cm, with 5-7 hexagonal surface cells.

Flowering & Fruiting: November-January.

Habitat: Common in open moist rocky areas.

Note: Supposed to be a neoendemic species, further surveys are necessary to obtain a clear picture of distributional status.

Specimens examined: Kollam district: Thenmala, 200 m, 16 Oct. 1987, *Ravi 2254* (Isotype, SNCH); Kottayam district: Vandiperiyar to Pambanar, *Vivekanandan 20399* (Paratype, TBGT); Thiruvananthapuram district: Meenmutty, *N .Mohanan 10188, 7949, 12452*, (TBGT).

9. **Fimbristylis stigmatotecta** Govind., Rheedea 6: 59. 1996; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 538. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 686. 2006.

Type: Idukky district: Munnar, Devikulam, Lockhart Gap, *Govindarajalu 15126* (MH).

Annuals. Rhizome absent. Culms usually solitary or 3, flat, sulcate, 20-35 cm long. Leaves few to many or solitary, basal, linear, glabrous, 3-nerved, pungent, eligulate. Inflorescence simple, umbelliform with 3-5 spikelets, lax, 0.5-2 x 0.5-1.5 cm. Bracts short, lanceolate, glabrous. Rays 0. Spikelets elliptic-ovoid, acute, angular, ferruginous, 8-10-flowered, solitary, 0.8-0.9 x 0.2-0.3 cm. Rachilla winged. Basal glumes 1-2 empty. Glumes oblong-ovate, imbricate, rounded at apex, prominently mucronate, glabrous, c. 0.35-0.36 x 0.2 cm, keel flat, 7-nerved. Stamens 3. Style triquetrous, glabrous, pyramidal at base; stigma 3, fimbriate. Nuts globosely ovoid, narrowed towards at base, rounded at apex, obscurely trigonous, stipate, 0.1-0.12 x 0.7-0.1 cm, surface cells transversely hexagonal in 10-15 rows in each face.

Flowering & Fruiting: January-March.

Habitat: Grasslands.

Note: As a local endemic species, it deserves conservation importance.

Specimen examined: Idukky district: Munnar, Devikulam, Lockhart Gap, *Govindarajulu 15126* (Isotype, MH).

FUIRENA Rottboell

Descript. Icon. Nov. Pl. 70. 1773.

Key to the species

1. Hypogynous bristles 6..... 1. *F. ponmudiensis*

1. Hypogynous bristles 3..... 2. *F. simpsonii*

1. **Fuirena ponmudiensis** Ravi & Anil Kumar, Rheedea 4: 103. 1994; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 539. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 687. 2006.

Type: Thiruvananthapuram district: Ponmudi, *Anil Kumar 1068* (TBGT). (Plate 80 d)

Tufted perennials. Rhizome woody, erect. Culms trigonus, glabrous, up to 50 cm tall. Leaves cauline; sheath coriaceous, up to 4 cm long; ligule inverted, V-shaped, coriaceous, margin entire; blades stiff and coriaceous, acute to sharply acuminate, up to 12 x 0.7 cm long, canaliculated with parallel slender veins. Inflorescence a short terminal panicle with one or two partial ones in upper axils. Peduncles trigonous, up to 5 cm long. Bracts acicular, sparsely ciliate. Spikelets lanceolate, acute at apex, up to 1.5 x 0.25 cm, many-flowered. Glumes ovate-oblong, obtuse, concave, 3-nerved, puberulous outside, c. 0.35 cm long, awned from the back. Hypogynous bristles 6, 3 outer shorter, inner 3 longer, retrorsely scabrous. Stamens 3; anthers linear. Stigmas 3. Nut orbicular-ellipsoid, trigonous, sharply angled, tricostulate, c. 0.2 x 0.1 cm, prominently equally stalked and beaked, surface smooth.

Flowering & Fruiting: Throughout.

Habitat: Mountain swamps.

Note: Limited population of this narrow endemic species were observed in this area. Conservational measures should be taken for the survival of the species, as it is distributed in the threatended habitat.

Specimen examined: Thiruvananthapuram district: Ponmudi, Seethatheertham, ± 1000 m, 4 Dec. 1990, *Anil kumar 1068* (Isotype, TBGT).

2. **Fuirena simpsonii** Ravi, N. Mohanan & Shaju, Nordic. J. Bot. 22: 329. 2002; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 687. 2006.

Type: Kannur district, Pappinisseri, Sea level, 12 Dec. 1997, *Ravi 37077* (TBGT).

(Fig. 44; Plate 80 e)

Rhizomatous perennial. Rhizome creeping. Culms tufted, tetragonous to pentagonous, glabrous, up to 1.5 m tall. Leaves reduced to sheath at the base and upper ones bladed; sheath coriaceous, up to 7 cm long; ligule coriaceous and tubular around the culm; blades thick and rigid, linear to linear-lanceolate, up to 25 x 1 cm, 5-ribbed, glabrous except towards the sparsely puberulous base. Inflorescence a terminal, subcompound, corymbose panicle of glomerulous clusters of sessile spikelets with 2-3 partial panicles from the upper leaf axils; primary peduncle pentagonous to trigonous, up to 20 cm long; secondary peduncles up to 3 cm long; rays 1-1.5 cm long. Glomerules ovate to spherical, usually with many spikelets, c. 1.5 x 3 cm. Bracts leaf like. Spikelets ovate to elliptic-ovate, 1.5 x 0.35 cm, acute at apex, subsquarrose, pubescent. Rachilla cylindrical. Glumes membranous, ovate-oblong, c. 0.3 x 0.2 cm, concave, broadly

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rounded at the apex and broadly cuneate at the base, 3-nerved, shortly aristate. Perianth of 3 hypogynous scales alternate with bristles; scales ovate, clawed at base and aristate at the apex. Stamens 2-3. Stigma 3. Nutlet ellipsoid, 0.15-0.2 x 0.07- 0.1 cm, prominently beaked and stipitate, triquetrous, smooth.

Flowering & Fruiting: September-March.

Habitat: Estuarine margins.

Note: A species described from a very specific habitat during the study. As a mangrove associated sedge species, it needs further studies on the scientific aspects of habitat specificity and local endemism.

Specimen examined: Kannur district: Pappinisseri, Sea level, 12 Dec. 1997, *Ravi 37077* (Holotype, TBGT).

PYCREUS Palisot de Beauvois

Fl. Oware 2: 48. 1816.

Key to the species

1. Glumes mucronate.....2. *P. similinervulosus*
1. Glumes not mucronate.....1. *P. palghattensis*

1. **Pycreus palghattensis** Govind., Proc. Ind. Acad. Sci. (Pl. Sci.). 100. 427. 1990; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 544. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 693. 2006.

Type: Palakkad district: *VPK Nambiar, 12713* (CAL)

Annuals. Culms tufted, grassile, 1-ribbed, leafy at base, 6-12 cm tall. Leaves many, flat, 6-12 x 0.1-0.15 cm, distantly scabrid; sheath membranous with purplish red nerves. Bracts leaf-like, obliquely erect, up to 4. Spikes distinct, rectangular, c. 0.8 cm across. Rays 3-5, each bearing 5-10 spikelets, upto 2 cm long. Spikelets elliptic or elliptic-ovate, usually 10-flowered, 0.3-0.35 x 0.18-0.22 cm. Rachilla flexuose marked by persistent scales, narrowly winged. Glumes usually oblong or oblong-ovate, compact without lateral nerves, strongly keeled, mucronate, mucro erect, c. 0.1 x 0.1 cm. Stamens 2; anthers small, orbicular. Style slender, deeply bifurcated; stigma 2. Nuts elliptic, ovate or obovate, 0.04-0.05 cm long, asymmetric or symmetric, shortly stipitate, truncate or rounded at apex with granulate surface.

Flowering & Fruiting: September-March.

Habitat: Marshy areas.

Note: As a local endemic species, it deserves conservation importance.

Specimen examined: Palakkad district, *VPK Nambiar, 12713* (CAL)

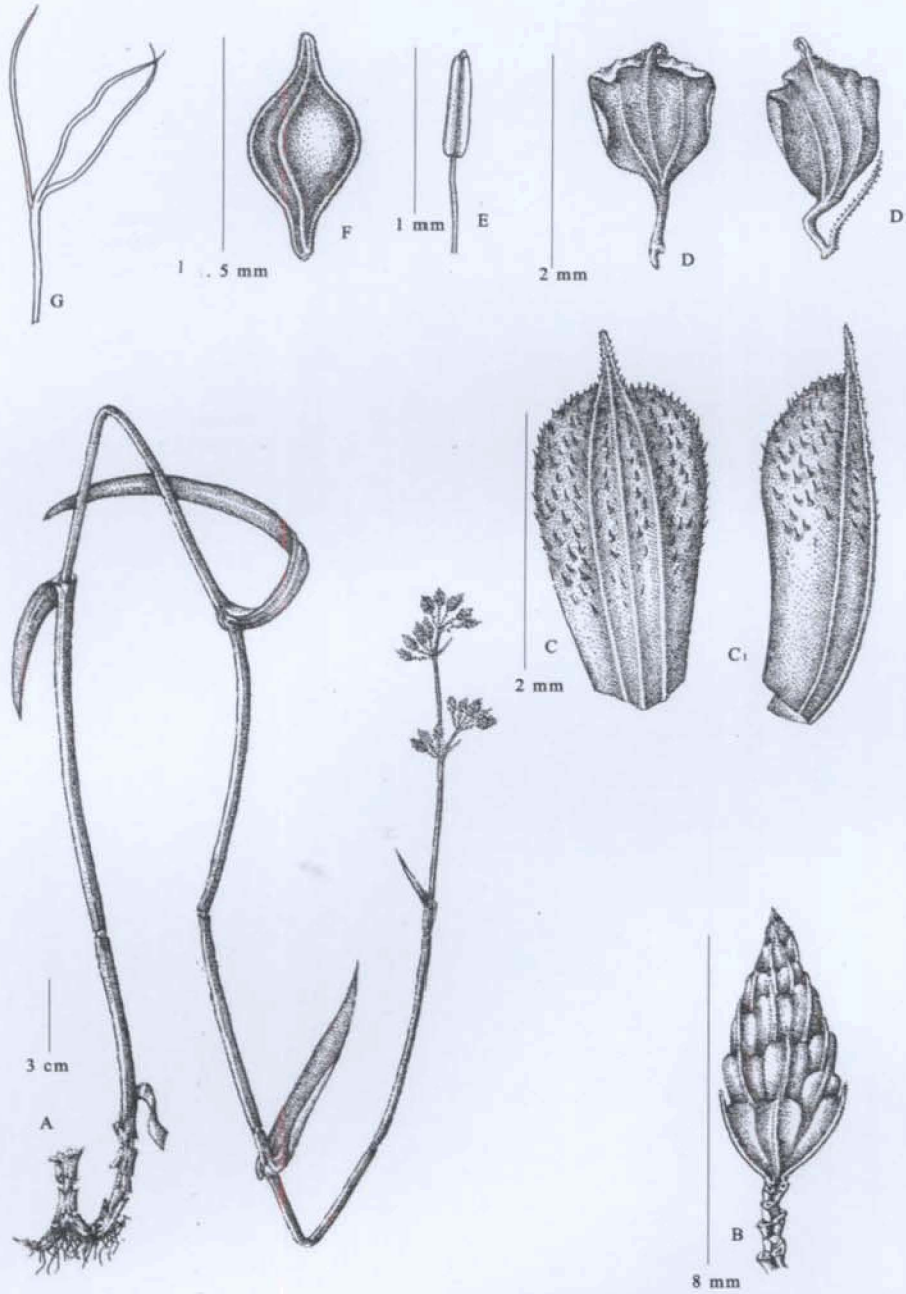

Fig.44. ***Fuirena simpsonii*** Ravi *et al.*: A. Habit; B. Spikelet; C. Glume - dorsal view; C1. Glume - side view; D. Hypogyonus scale; D1. Hypogynous scale with a hypogynous bristle; E. Stamen; F. Nut; G. Style and stigmas.

NB 5995

280 A

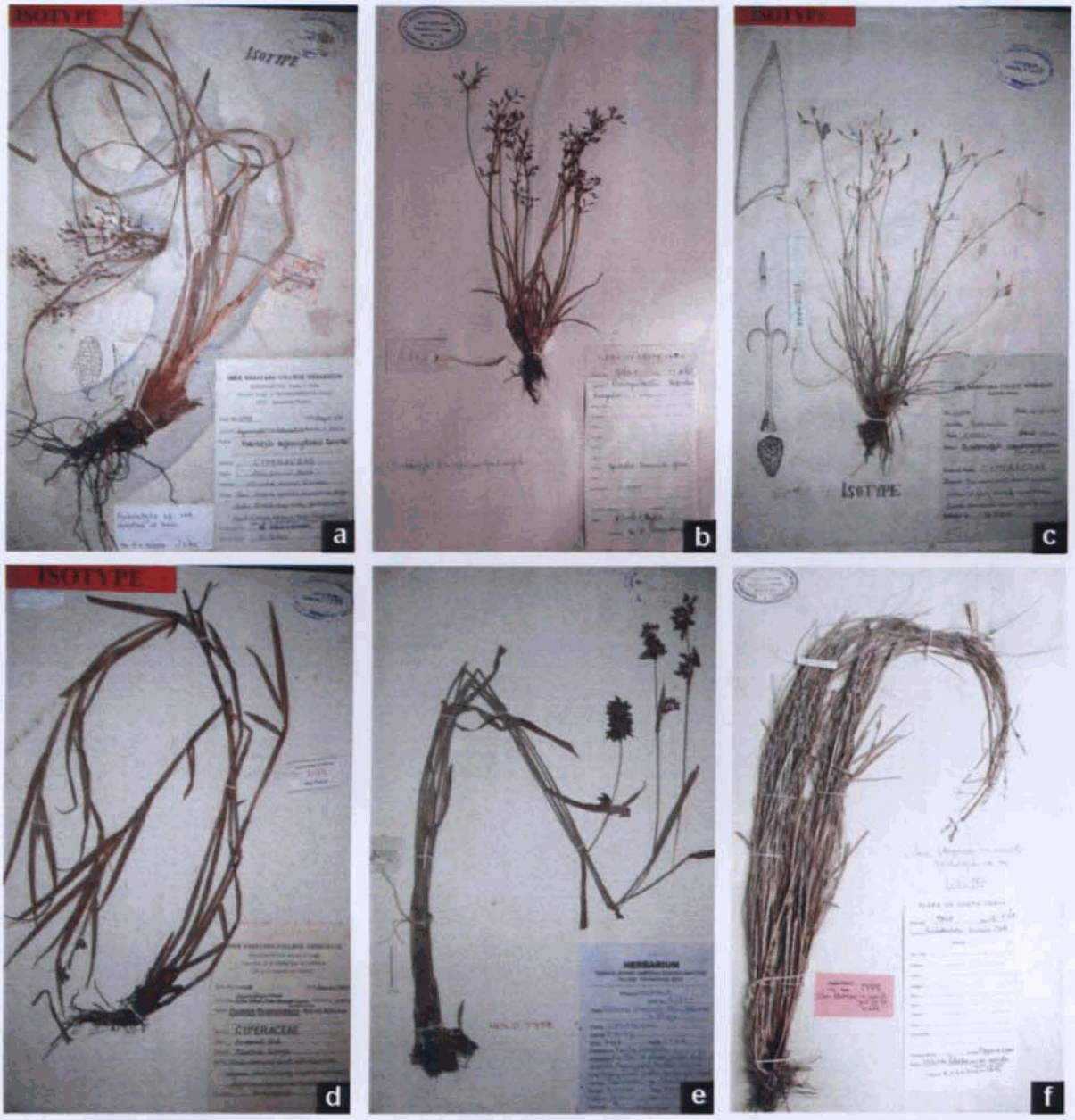

Plate 80. Type specimens.

a. ***Fimbristylis angamoozhiensis*** Ravi & Anil Kumar (TBGT);
b. ***Fimbristylis dauciformis*** Govind.(CAS);
c. ***Fimbristylis pseudonarayanaii*** Ravi & Anil Kumar(TBGT);
d. ***Fuirena ponmudiensis*** Ravi & Anil Kumar (TBGT);
e. ***Fuirena simpsonii*** Ravi, Mohanan & Shaju (TBGT);
f. ***Scleria lithosperma*** var. ***muricata*** Govind.(MH).

N135995

280 B

2. **Pycreus similinervulosus** Govind., Proc. Ind. Acad. Sci.(Pl. Sci.). 100: 430. 1990; Sasi. & Sivar., Flr. Pl. Thrissur For. 498.1996; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 545. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 694. 2006.

Type: Thrissur district: Orukomban, Poringalkuthu, *Govindarajulu 6012* (CAL).

Annuals. Culms gracile, triquetrous, to 25 cm tall. Leaves usually many, gradually acuminate, distinctly scabrid towards apex, flat, slender, usually longer than culms, 0.05-0.06 cm long; sheath membranous, purplish red. Inflorescence compound, disticly spicate, 15-20 spikelets. Primary rays 3-5, leaf-like, 8-20 cm long. Spikelets narrowly oblong ovate, 25-40-flowered, acute or subacute, compressed, 0.8-1.2 x 0.25-0.3 cm. Rachilla zig-zag, winged. Glumes narrowly oblong-ovate, obliquely spreding with 1-2 lateral nerves, strongly keeled, 3-nerved, mucronate, mucro recurved with bidentate apex, 0.15-0.18 x 0.08-0.09 cm. Stamens 2; anthers mall elliptic. Style short; stigma longer than style. Nuts ovate or turbinate, 0.05-0.06 x 0.05 cm, reddish brown or blakish with vertically arranged rows of granulate markings on the surface.

Flowering & Fruiting: July-October.

Habitat: Marshy places in grasslands.

Note: As a local endemic species, it deserves conservation importance.

Specimen examined: Thrissur district: Orukomban, Poringalkuthu, *Govindarajulu 6012* (CAL).

SCLERIA Bergius

Kongl. Ventensk. Acad. Handl. 26: 142. 1765.

Scleria lithosperma var. **muricata** Govind., Proc. Ind. Acad. Sci.(pl. Sci.). 71 B: 222.1970; Karth. & Sharma, J. Bombay. Nat. Hist. Soc. 80(1): 78. 1993; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 215. 1987: Karth. *et al.*, Fl. Ind. Enum. Monocot. 72. 1989; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 548. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 698. 2006.

Type: Kasaragod district: Pallathadka, 12 May 1969, *Krishnamoorthy 9512* (MH) (Plate 80 f)

Perennials. Culms slender and tufted, to 100 cm tall. Leaves all along the culm, triquetrous, canaliculate, glabrous, scabrous on margin; sheath 3-angled. Inflorescence terminal spicate panicle with 1-2 shorter lateral ones axillary to upper leaves. Spikelets bisexual, solitary or 2-3 together, c. 0.3 x 0.5 cm long. Glumes 3 to several, 0.3-0.4 cm long, second female and third onward male or upper ones empty. Nut broadly ellipsoid, obtusely trigonous, muricate.

Flowering & Fruiting: December.

Habitat: Marshy areas in grasslands.

Note: As a local endemic variety, it deserves conservation importance.

Specimen examined: Kasaragod district: Pallathadka, 12 May 1969, *Krishnamoorthy 9512* (Isotype, MH).

50. POACEAE

Table 70. Profile of Distribution and Endemism

World		India		
Genus/genera	Species	Genus/genera	Species	Endemic taxa of Western Ghats
600	9000-10000	241	1243	180 spp.

Genus/genera	Species/subsp./var.
119	401 spp., 2 ssp., 11 var.

Western Ghats endemic taxa in Kerala and adjacent states

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Agrostis L.	*A. peninsularis* Hook.f. (Tamil Nadu)	
Arthraxon P. Beauv.	*A. meeboldii* Stapf (Maharashtra & Karnataka)	
	A. villosus C.E.C. Fischer (Maharashtra,Karnataka & TamilNadu)	
Arundinaria Raddi	*A. wightiana* Nees (Tamil Nadu)	
Arundinella Raddi	*A. mesophylla* Nees ex Steudel (Tamil Nadu)	*A. cannanoric* V.J.Nair *et al.*
	A. vaginata Bor (Tamil Nadu)	*A. ravii* Shaju & N.Mohananan
Bhidea Stapf ex Bor	*B. burnsiana* Bor (Maharashtra, Karnataka & Tamil Nadu)	
	B. fischeri Sreek. & Shetty (Maharashtra)	
Bothriochloa Kuntze		*B. parameswaranii* Sreek. *et al.*
Chandrasekharania V. J. Nair *et al.*	*C. keralensis* V. J. Nair *et al.* (Karnataka)	
Chrysopogon Train.	*C. verticillatus* (Roxb.) Trin. ex Steudel (Karnataka, Tamil Nadu & Tamil Nadu)	*C. purushothamanii* Ravi *et al.* *C. tadulingamii* Sreek. *et al.*
Dendrocalamus Nees M.Kumar *et.al*	*D. stocksii* (Munro) (Maharashtra & Karnataka)	

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
Dicanthium Willemet	*D. oliganthum* (Hooker ex Steudel) Cope (Maharashtra, Karnataka & Tamil Nadu)	
Dimeria R. Br.	*D. bialata* C. E. C. Fischer (Karnataka)	*D. agasthyamalayana* Kiran Raj & Ravi
	D. hohenackeri Hochst.ex Miq. (Maharashtra & Karnataka)	*D. borii* Sreek. *et al.*
	D. lawsonii (Hook. f.) C. E. C Fischer (Karnataka & Tamil Nadu)	*D. chelarensis* Ravi
		D. copeana Sreek. *et al.*
	D. raizadae V. J. Nair *et al.* (Karnataka)	*D. copei* Ravi
		D. eradii Ravi
		D. idukkiensis Ravi & Anil Kumar
		D. jainii Sreek. *et al.*
		D. josephii Ravi & N. Mohanan
		D. kalavoorensis Ravi
		D. keralae N. C. Nair *et al.*
		D. kurumthotticalana Jacob
		D. namboodiriana Ravi & N. Mohanan
		D. sivarajanii N. Mohanan & Ravi
		D. sreenarayanii Ravi & Anil Kumar
Garnotia Brongn.	*G. arundinacea* Hook. f. (Karnataka & Tamil Nadu)	
	G. puchiparensis Bor (Tamil Nadu)	
Glyphochloa W. D. Clayton	*G. acuminata* (Hackel) W. D. Clayton (Maharashtra, Karnataka & Tamil Nadu)	
	G. divergens (Hackel) W. D. Clayton (Maharashtra, Karnataka & Tamil Nadu)	
Heteropogon Pers.	*H. fischerianus* Bor (Tamil Nadu)	
Isachne R. Br.		*I. fischeri* Bor
		I. henryi Srinivasan & Sreek.

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Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
		I. jayachandranii Gopalan & Chandras.
Ischaemum L.	*I. trvancorense* Stapf ex C. E. C. Fischer Maharashtra & Tamil Nadu)	*I. abrahamii* Ravi *et al.* *I. agasthyamalayanum* Sreek. *et al.* *I. calicutensis* Sreek. *et al.* *I. cannanorensis* Sreek. *et al.* *I. copeanum* Sreek. *et al.* *I. elimalayanum* Sreek. *et al.* *I. jayachandranii* Ansari *et al.* *I. kumarakodiensis* Ravi *et al.* *I. lanatum* Ravi *et al.* *I. malabaricum* Sreek. *et al.* *I. nairii* V. J. Nair *et al.* *I. pappinisseriensis* Ravi *et al.* *I. pushpangadanii* Ravi *et al.* *I. quilonensis* Ravi & Shaju *I. raui* Sreek. *et al.* *I. tadulingamii* N. C. Nair *et al.* *I. vembanadense* Patil & D'cruz *I. Wayanadense* Ravi *et al.*
Limnopoa C. E. Hubb.	*L. meeboldii* (C.E.C.Fischer) C. E.Hubb. (Karnataka)	
Ochlandra Thwaites	*O. beddomei* Gamble (Tamil Nadu)	*O. ebracteata* Raiz. &

Genus/genera	sp./subsp./var.	Exclusive endemics (Kerala)
	O. scriptoria (Dennst.) C. E. C. Fischer (Karnataka & Tamil Nadu)	Chatterjee
	O. setigera Gamble (Tamil Nadu)	*O. keralensis* M. Kumar *et al.*
	O. sivagiriana (Gamble) Camus (Tamil Nadu)	*O. soderstromiana* M. Kumar & S. Seq.
	O. trvancorica (Bedd.) Benth.ex Gamble var. *trvancorica* (Karnataka & Tamil Nadu)	*O. spirostylis* M. Kumar *et al*
	O. wightii (Munro) Fischer	*O. trvancorica* var. *hirsuta* Gamble
Oxytenanthera Munro	*O. bourdillonii* Gamble (Tamil Nadu)	
	O. ritcheyi (Munro) Blatter & Mc Cann (Maharashtra, Karnataka & Tamil Nadu)	
Silentvalleya V. J. Nair *et al.*		*S. nairii* V. J. Nair *et al.*
Teinostachyum Munro	*T. wightii* C. E. C. Fischer (Karnataka & Tamil Nadu)	
Themeda Forsskal	*T. sabarimalayana* Sreek. & V. J. Nair (Tamil Nadu)	
Tripogon Roemer & Schultes	*T. ananthaswamianus* Sreek.*et al.* (Tamil Nadu)	*T. sivarajanii* Sunil
	T. narayanii Sreek. *et al.* (Tamil Nadu)	*T. vellarianus* Pradeep
	T. wightii Hook. f.(Karnataka & Tamil Nadu)	
Zenkeria Trin	*Z. sebasteni* Henry & Chandrb. (Tamil Nadu)?	*Z. jainii* N. C. Nair *et al.*

Key to the genera

1.Woody shrubs or trees ..... **Ochlandra**

1. Herbs.

2. Spikelets with 1-several florets, breking up at maturity above the glumes; not articulated below the glumaes.

3. Slpikelts with 1 floret ..... **Zenkeria**

3. Spikelet with 2-several florets.

4. Paleas 2-keeled.

5. Inflorescence solitary ..... **Tripogon**

5. Inflorescence a panicle ..... **Silentvalleya**

4. Paleas not 2-keeled.

6. Second lemma awned or aristate; glumes unequal ..... **Arundinella**

6. Second lemma neither awned nor aristate; glumes almost equal ..... **Isachne**

2. Spikelets strictly with 2 florets, falling entire at maturity; articulated below the glumes.

7. Spikelets solitary, pedicelled..... **Dimeria**

7. Spikelets paired or rarely in threes, not pedicelled.

8. Inflorescence a solitary or digitate raceme ..... **Ischaemum**

8. Inflorescence a true or false panicle.

9. Joints and pedicels with a translucent median line .....**Bothriochloa**

9. Joints and pedicels solid, without a translucent median line ..... **Chrysopogon**

ARUNDINELLA Raddi

Agrost. Brasil. 36, t. f.3. 1823.

Key to the species

1. Culms 20-50 cm tall; palnicles lax; upper glume not aristate ..... 1. *A. cannanorica*

1. Culms 5-20 cm tall; panicles contracted; upper glume aristate ..... 2. *A. ravii*

1. **Arundinella cannanorica** V. J. Nair, Sreek. & N. C. Nair, J. Bombay Nat. Hist. Soc. 80: 369. 1984; Karth. *et. al.*, Fl, Ind. Enum. Monocot. 186. 1989; Sreek. & V. J. Nair, Fl. Kerala Grass. 333. 1991; Samaddar & Roy, Add. Ele. Ind. Fl. 130.1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 553. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 772. 2006.

Type: Kasaragod district: Paramba, ± 100 m, 16 Oct. 1981, *Sreekumar 71718* (MH). (Plate 81 a)

Annuals. Culm slender, erect, 20-50 cm tall; nodes glabrous. Leaves 2-5 x 0.2-0.25 cm, mostly basal, lanceolate, base rounded or cordate, glabrous; sheaths 1-8 cm long, glabrous or ciliate along one margin; ligule a row of hairs. Panicles 10-40 cm long, lax, villous; branches 1-1.2 cm long, ascending, alternate or rarely whorled, slender, filiform. Pedicels 2-1.5 cm long, slender. Spikelets 0.5-0.6 cm long, lanceolate, acuminate, turgid and glabrous. Lower glume ovate-lanceolate, 0.35-0.45 x 0.1-0.15 cm, 3-nerved, glabrous. Upper glume ovate-lanceolate, 0.5-0.55 x 0.12-0.15 cm, caudate or long acuminate, 5-nerved, galbrous. Lower lemma 0.25-0.3 x 0.1-0.15 cm, glabrous. Lower palea hyaline, elliptic-lanceolate, 2-keeled and auriculate at base, 2-nerved, glabrous. Upper lemma 0.15-0.2 x 0.05-0.07 cm, ovate, tip with a geniculate awn; awn 0.8-1 cm long with a coloumn of c. 0.4 cm long, dorsally covered with numerous wart-like outgrowths. Upper palea oblong, acute, 2-nerved. Lodicules 2, obovate, denticulate

at apex. Stamens 3. Ovary ovate.

Flowering & Fruiting: October-December.

Habitat: Dry rocky areas and open grasslands, along with other grasses such as *Dimeria* ssp., *Bhidea* ssp. and *Arundinella* spp.

Note: Supposed to be a neoendemic species, its distributional status should be analysed for further conservation management.

Specimen examined: Kasaragod district: Paramba, ± 100 m, 16 Oct. 1981, *Sreekumar 71718* (Paratype, MH).

2. **Arundinella ravii** Shaju & N. Mohanan, Rheedea 14: 47. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 773. 2006.

Type: Idukki district: Eravikulam National Park, ±1880 m, 8 Nov. 2000, *Shaju 43700* (TBGT).

(Fig. 45; Plate 81 b)

Small annuals. Culm slender, tufted, 15-20 cm tall; nodes strictly glabrous. Leaves 2-10 cm long, narrowly linear, acuminate, cuneate at base; ligules truncate or triangular, acute at apex. Inflorescence terminal, pyramidal to dichotomously branched panicles. Spikelets, small, 0.15-0.2 cm long, on filiform branches. Lower glume subcoriaceous, hyaline, ovate-lanceolate, 0.15-0.2 cm long, 1-nerved, keeled on the back along the nerve, acute at apex, scberulous on the margins. Upper glume ovate-lanceolate, 0.18-0.2 cm long, acute at apex, subcoriaceous to hyaline, 1-nerved, 1-keeled, scaberulous on the margin. Lower lemma thickly coriaceous, lanceolate, 3-nerved, 0.1-0.12 cm long, incurved on the sides, shortly notched and mucronate at apex, sparsely bearded at base and minutely scaberulous on the outside. Lower palea subcoriaceous, hyaline, linear-lanceolate, notched at apex. Upper lemma thickly coriaceous, linear-lanceolate, bearded at base, margin incurved, deeply bifid to below the middle with elongate and aristate lobes, c. 0.15 cm long, including c. 0.05 cm long scabrid arista; awned from the sinus, awn c. 0.25 cm long with a column up to 0.1 cm long. Upper palea subcoriaceous, hyaline, linear-lanceolate, 2-nerved, incurved, shortly-notched at apex. Stamens 3.

Flowering & Fruiting: August-November.

Habitat: Rocky grasslands at higher altitudes, associated with grasses like *Tripogon bromoides*, *Isachne setosa* and *Dicanthium oliganthum.*

Note: The recognition of this new Andropogonoid grass species from the grasslands of Eravikulam National Park, also substantiate the view that these magnificent grasslands of this area form one of the 'active speciation' centres of neoendemic grasses.

Supposed to be a neoendemic species, its distributional status should be analysed for further conservation management.

Specimen examined: Idukki district: Eravikulam National Park, ±1880 m, 8 Nov. 2000, *Shaju 43700* (Holotype, TBGT).

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BOTHRIOCHLOA Kuntze

Revis. Gen. Pl. 2: 762. 1891.

Bothriochloa parameswaranii Sreek., Malathi & V. J. Nair, J. Bombay Nat. Hist. Soc. 85: 163. 1988; Karth. *et al.*, Fl, Ind. Enum. Monocot. Addenda IV. 1989; Sreek. & V. J. Nair, Fl. Kerala Grass. 52. 1991; Samaddar & Roy, Add. Ele. Ind. Fl. 47.1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 555. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 775. 2006.

Type: Idukki district: Eravikulam National Park, ± 2100 m, 14 Feb. 1981, *Sreekumar 71858* (MH).

Perennials. Culms 10-20 cm tall, erect or geniculate; nodes glabrous. Leaves lanceolate, 2-10 x 0.2-0.3 cm, base rounded, glabrous or shortly villous; ligule ovate, membranous. Racemes 2-4-digitate or subdigitate, 2-4 cm long, puplish, linear, ciliate. Sessile spikelets oblong or elliptic, 0.3-0.4 cm long, callus bearded. Lower glume oblong, 0.3-0.35 x 0.1-0.15 cm, acute, chartaceous, keeled, 7-9-nerved, margin hyaline, ciliate. Upper glume ovate-lanceolate, 0.3-0.35 x 0.1-0.15 cm, chartaceous, 3-5-nerved, villous on the upper half. Lower floret empty. Lower lemma ovate-oblong, 0.25-0.3 x 0.1-0.15 cm, rounded at apex, hyaline. Lower palea absent. Upper lemma stipitate, 0.1-0.2 cm long; awned, awn 1-1.5 cm long. Upper palea absent. Stamens 3. Ovary oblong. Pedicelled spikelet oblong-lanceolate, 0.3-0.4 cm long. Pedicels 0.2-0.3 cm long, villous. Lower glume oblong-lanceolate, 0.3-0.4 cm long, chartaceous, 11-14-nerved, keeled. Upper glume and lower floret similar to sessile spikelet. Upper floret male or empty. Upper lemma oblong-acute, 0.2-0.3 cm long, not awned, hyaline, 3-nerved. Lodicules 2.

Flowering & Fruiting: February-March.

Habitat: Grasslands at higher altitudes.

Note: As local endemic species, it deserves conservation importance.

Specimen examined: Idukki district: Eravikulam National Park, ± 2100 m, 14 Feb. 1981, *Sreekumar 71858* (Isotype, MH).

CHRYSOPOGON Trinius

Fund. Agrost. 187. 1822. ('1820') *nom. cons.*

Key to the species

1. Culms up to 150 cm tall; inflorescence contracted ..... 1. *C. purushothmanii*
1. Culms up to 100 cm tall; inflorescence very effuse..... 2. *C. tadulingamii*

1. **Chrysopogon purushothamanii** Ravi, N. Mohanan & Kiran Raj, Rheedea 10: 94. 2000;

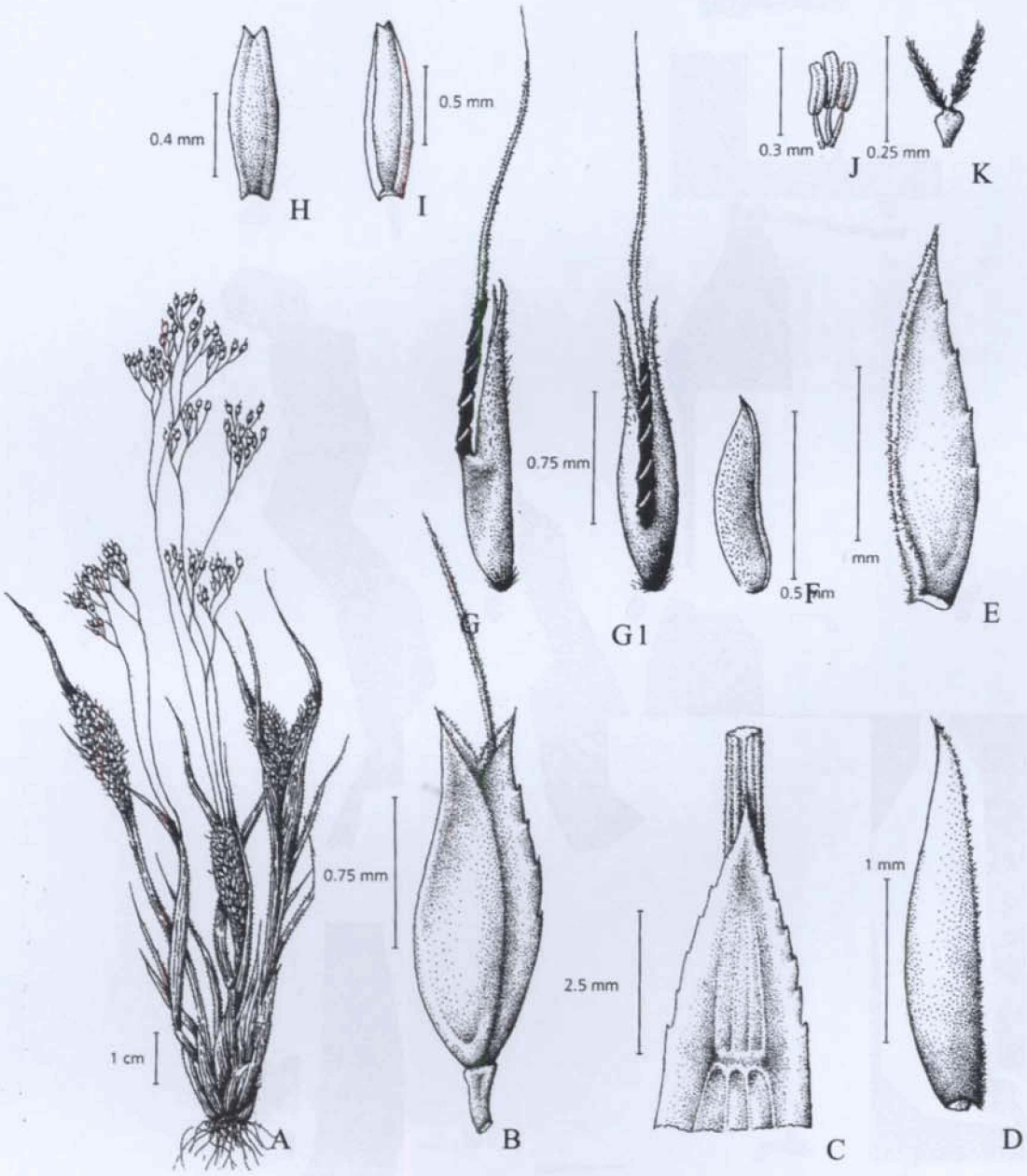

Fig. 45. ***Arundinella ravii*** Shaju & Mohanan: A. Habit; B. Ligule; C. Spikelet; D. Lower glume; E. Upper glume; F. Lower Lemma; G. Upper lemma - lateral view; G1. Upper lemma - dorsal view; H. Lower palea; I. Upper palea; J. Stamens; K. Pistil.

NJB 5995

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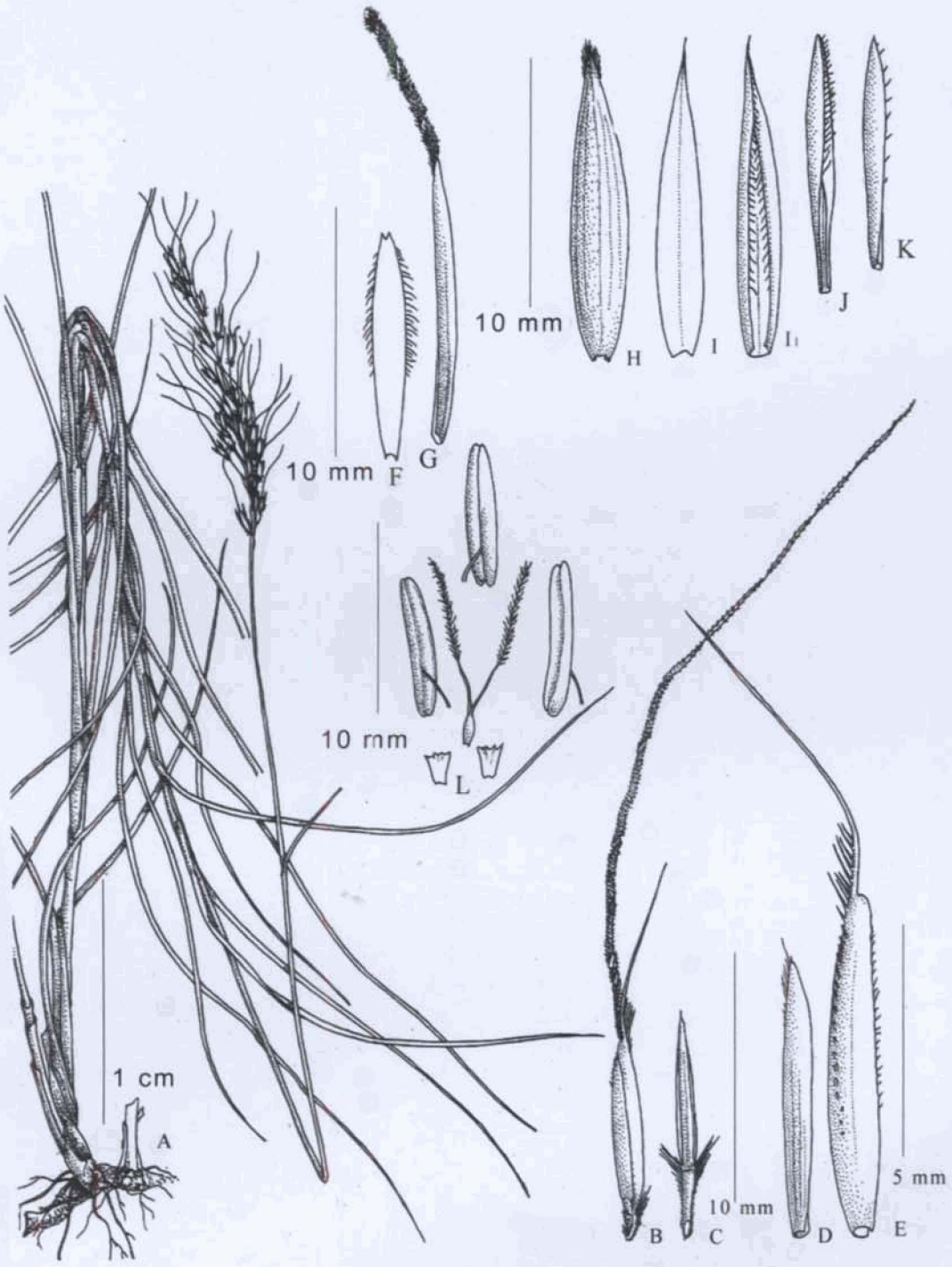

Fig. 46. ***Chrysopogon purushothamanii*** Ravi *et al.*: A. Habit; B. Sessile spikelet; C. Pedicelled spikelet; D-G. Glumes and lemmas: sessile spikelets: D. Lower glume; E. Upper glume; F. Lower lemma; G. Upper lemma; H-K. Glumes and lemmas: pedicelled spikelets: H. Lower glume; I. Upper glume; I1. Upper glume - front view; J. Lower lemma; K. Upper lemma; L. Lodicules, stamens & pistil.

NB 5995

288B

Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 559. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 781. 2006.

Type: Pathanamthitta district: Kokkathodu, Kattathipara, ±150 m, 26 November 2000, *Ravi 44810* (TBGT). (Fig. 46; Plate 81 c)

Perennials. Culms many, erect from branched creeping root-stock, up to 150 cm tall, slender; nodes glabrous. Leaves to 50 cm long, broad at base, tapering to a caudate-acuminate apex; sheath up to 8 cm long, rounded, keeled on the back, striate, glabrous; ligule membranous, fimbriate. Inflorescence contracted, ovate-lancelolate panicle, up to 12 cm long. Sessile spikelets 0.6-0.8 cm long. Callus densely bearded. Lower glume oblong-elliptic, 0.5-0.6 x 0.05 cm, coriaceous, acute at the apex, ciliate on the back towards the apex, 7-nerved. Upper glume oblong-lanceolate, 0.55-0.65 x 0.15 cm, boat-shaped, thickly coriaceous, margins hyaline, sparsely ciliate, awned from the notched apex; awn 0.4-0.8 cm long, sparsely pubescent to scaberulous. Lower lemma hyaline, oblanceolate, 0.45-0.5 x 0.1 cm, apically notched, long ciliate on the margins except towards the base and apex, epaleate and empty. Upper lemma hyaline, 0.55-0.6 cm long, shortly notched at the apex and awned from the sinus, 3-nerved, epaleate but bisexual; awn up to 3.5 cm long with a column up to 1.8 cm long, densely pubescent on the column and scaberulous upwards. Pedicelled spikelets elliptic, 0.5-0.6 x 0.12 cm. Pedicel 0.2-0.25 cm long, ciliate on the sides with brownish hairs. Lower glume chartaceous, elliptic, 0.5-0.6 x 0.12 cm, 9-nerved, shortly-keeled, sparsely ciliate on the margins towards the apex. Upper glume chartaceous, linear-lanceolate, up to 0.6 x 0.15 cm, 3-nerved, hyaline and sparsely ciliate on the margins. Lower lemma linear-oblanceolate, 0.5-0.55 cm long, subcoriaceous, acute-notched at apex, 3-nerved, incurved and long ciliate on the margins from the middle upwards, epaleate and empty. Upper lemma hyaline, elliptic-lanceolate, 3-nerved, epaleate but male. Lodicules 2, truncate-lobed at apex, Stamens 3. Ovary ovate.

Flowering & Fruiting: October-January.

Habitat: Collected from rocky hill top associated with other grasses like *Chrysopogon hackelii* and *Heteropogon contortus*.

Note: A narrow endemic species, so far known only from the type locality. Further explorations must be made to locate the species in its known distributional areas to confirm its conservation status.

Specimen examined: Pathanamthitta district: Kokkathodu, Kattathipara, ±150 m, 26 November 2000, *Ravi 44810* (Holotype, TBGT

2. **Chrysopogon tadulingamii** Sreek., V. J. Nair & N. C. Nair, J. Bombay Nat. Hist. Soc.80: 198. 1983; Karth. *et al.*, Fl, Ind. Enum. Monocot.198. 1989; Sreek. & V. J. Nair, Fl. Kerala Grass. 63. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 559. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 781. 2006.

Type: Kasaragod district: Periya, near cashew project area, ± 450 m, 18 Oct. 1981, *Sreekumar 71758* (MH). (Plate 81 d)

Perennial. Culms 30-100 cm tall, tufted, slender, erect; nodes glabrous. Leaves to 5-15 cm long, linear, base rounded, glabrous; sheath 2-6 cm long, rounded, striate, glabous; ligule thin, fimbriate, membranous. Inflorescence 5-15 cm long panicle with very few spikelets, capillary, slender, glabrous. Sessile spikelet 0.5-0.6 cm long, oblong or oblanceolate, laterally compressed, grooved. Callus densely bearded. Lower glume linear-lanceolate, 0.5-0.55 x 0.07-0.1 cm, brownish, setose towards apex. Upper glume 0.5-0.6 x 0.1-0.15 cm, obtuse and awned at apex; awn 0.1-0.15 cm long, scabrid. Lower lemma linear-oblong, 0.35-0.4 x 0.07-0.1 cm, acute, delicate, hyaline, margins long-ciliate, epaleate and empty. Upper lemma 0.4-0.5 x 0.05-0.1 cm long, shortly notched at the apex and awned from the sinus, 3-nerved, epaleate but bisexual; awn 5-6 cm long with a column of 2-3 cm long, villous with golden-yellow hairs on the column and scaberulous upwards. Pedicelled spikelets 0.8-1 cm long, purplish. Pedicels 0.5-0.6 cm long, angular, covered with golden yellow hairs. Lower glume lanceolate, 0.7-0.8 x 0.07-0.1 cm, acute, 3-nerved, margins infolded, hyaline, glabrous. Upper glume lanceolate, 0.8-1 x 0.1-0.15 cm, acuminate, 7-nerved, purple, margins infolded, hyaline, awned; awn 1-1.5 cm long, scabrid. Lower lemma oblong-lanceolate, 0.6-0.8 x 0.07-0.1 cm, 3-5-nerved, hyaline, villous, epaleate and empty. Upper lemma oblong, acute, 2-3-nerved, ciliate along the margins, epaleate but male. Lodicules 2, obovate, 2-lobed at apex. Stamens 2-3. Ovary ovate.

Flowering & Fruiting: October- December.

Habitat: Along dry-rocky hill slopes, associated with other grass species like *Themeda triandra*, *Arundinella mesophylla*, etc.

Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimen examined: Kasaragod district: Periya, near cashew project area, ± 450 m, 18 Oct. 1981, *Sreekumar 71758* (Isotype, MH).

DIMERIA R. Brown

Prodr. 204. 1810.

Key to the species

1. Racemes unequal in length; awn 2.5-3 cm long.
   upper floret with prominent palea ..... 11. *D. keralae*
1. Racemes almost equal in length; awn up to 1.5 cm long; upper floret without palea or palea not distinct.
   2. Racemes solitary.

3. Culms up to 50 cm long.
   4. Keel of the upper glume winged all along.....10. *D. kalavoorensis*
   4. Keel of the upper glume winged towards apex only.....12. *D. kurumthotticalana*
3. Culms up to 20 cm long.
   5. Rachis trigonous-flattened, broadly winged.....15. *D. sreenarayanii*
   5. Rachis flattened, not winged ..... 2. *D. borii*

2. Racemes 2-3.
   6. Upper glume winged.
      7. Winged 1/2 to1/3 towards apex; aristate.
         8. Keel winged1/3 towards apex; awn c. 0.6 cm long..... 6. *D. eradii*
         8. Keel winged 1/2 towards apex; awn c.1.2 cm long ..... 7. *D. idukkiensis*
      7. Winged all along; shortly aristate or not.
         9. Narrowly winged; margins long ciliate..... 3. *D. chelariensis*
         9. Broadly winged; margins short ciliate.
            10. Keel glabrous or sparsely to moderately ciliate; awn of the upper lemma up to 1 cm long.
               11. Rachis broadly winged, sparsely ciliate on the margins;keel of the upper glume sparselyciliate; awn with a column.....13. *D. namboodiriana*
               11. Rachis narrowly winged, scabrid on the margins; keel of the upper glume glabrous; awn without a column ....1. *D. agasthyamalayana*
            10. Keel densely ciliate; awn of the upper lemma 1-1.4 cm Long.
               12. Upper glume awned; rachis not winged ... 5. *D. copei*
               12. upper glume not awned; rachis winged:
                  13. Culms up to 20 cm tall; nodes glabrous; racemes usually 3..... 8. *D. jainii*
                  13. Culms up to 40 cm tall; nodes bearded; racemes 1-2 .....14. *D. sivarajanii*
   6. Upper glume not winged.
      14. Nodes bearded; rachis trigonous, zig-zag, obscurely winged ..... 4. *D. copeana*
      14. Nodes glabrous; rachis flattened, broadly winged ..... 9. *D. josephii*

1. **Dimeria agasthyamalayana** Ravi, N. Mohanan & Kiran Raj, Rheedea 11: 93. 2001; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 565. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A

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Handb. 789. 2006.

Type: Thiruvananthapuram district: Agasthyamala, Bonaccord, ±800 m, 1 Jan. 2000, *Kiran Raj 41939* (TBGT). (Plate 81 e)

Annual erect herbs. Culms tufted, slender, up to 40 cm tall; nodes glabrous. Leaves basal, linear-lanceolate, acuminate at apex, up to 18 x 0.5 cm; sheath keeled along the back, glabrous, up to 11 cm long; ligule membranous, obtuse-truncate and fimbriate at apex. Racemes 2-3. Rachis triquetrous-flattened, scabrid to scaberulous on the margins, 0.07 cm wide. Pedicels oblong, glabrous. Spikelets up to 0.4-0.5 cm long, oblong-lanceolate; callus bearded. Lower glume coriaceous, linear-oblong, 0.35-0.4 cm, acute at apex, keel narrowly winged towards the apex, scabrid on the margins, glabrous. Upper glume coriaceous, oblong-elliptic, 0.4-0.45 cm long, keel broadly winged, acute at apex, scabrid on margins, glabrous. Lower lemma hyaline, oblanceolate, 0.25-0.3 cm long, 1-nerved, sparsely ciliate on the margin, epaleate. Upper lemma hyaline, oblong-lanceolate, bifid at the apex into acute lobes, 0.3-0.35 cm long, awned from the sinus; awn up to 0.25-0.8 cm long, filiform and scaberulous, without a column. Palea lanceolate, sparsely papillate hairy. Lodicules 2. Stamens 2. Grains linear-oblong, 0.2-0.25 cm long, subcompressed.

Flowering & Fruiting: January-March.

Habitat: Growing in rocky crevices of hill slopes and higher slopes.

Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimen examined: Thiruvananthapuram district: Agasthyamala, Bonaccord, ±800 m, 1 Jan. 2000, *Kiran Raj 41939* (Holotype, TBGT).

2. **Dimeria borii** Sreek., V. J. Nair & N. C. Nair, J. Econ. Taxon. Bot. 3: 657.1982; Karth., *et. al.* Fl, Ind. Enum. Monocot.209. 1989; Sreek. & V. J. Nair, Fl. Kerala Grass. 185. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 565. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 790. 2006.

Type: Kozhikkode district: Kanjirakadavu, *Sreekumar 71855* (CAL). (Plate 81 f)

Tufted annual herbs. Culms 5-15 cm tall, erect; nodes glabrous. Leaves lanceolate, 2-5 x 0.2-0.4 cm, base rounded, villous with tubercle-based hairs; sheath keeled, glabrous, 1-4 cm long; ligule a short ovate membrane. Racemes single, 2-4 cm long. Rachis flattened, c. 0.1 cm wide, margins shortly ciliate. Spikelets 0.5-0.6 cm long, obovate with basal cuneate callus; Pedicels c. 0.05 cm long. Lower glume broadly lanceolate, 0.35-0.4 x 0.7-0.1 cm, shortly acuminate, coriaceous with shortly ciliate broad corky wings. Upper glume elliptic-lanceolate, 0.5-0.55 x 0.1-0.15 cm, acuminate, coriaceous, broadly winged, shortly ciliate along margins. Lower floret empty; lemma oblanceolate, 0.3-0.35 x 0.07-0.12 cm, acute, faintly 1-nerved, margins ciliate in the upper half. Upper floret bisexual; lemma 0.3-0.35 x 0.07-0.1 cm, 2-lobed ,

awned, lobes acuminate, delicate, 1-nerved, glabrous, awn 1.2-1.5 cm long, geniculate, coloumn c. 0.4 cm long, twisted, bristle scabrid. Stamens 2. Ovary elliptic.

Flowering & Fruiting: November-December.

Habitat: Growing in the crevices of rocks.

Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimen examined: Kozhikkode district: Kanjirakadavu, *Sreekumar 71855* (CAL).

3. **Dimeria chelariensis** Ravi, Rheedea 5: 37. 1995; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 565. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 790. 2006.

Type: Malappuram district: Chelari, ± 25 m, 28 Nov. 1992, *Ravi 3606* (TBGT). (Plate 82 a)

Perrenial herbs. Culms slender; nodes bearded. Leaves scattered, linear-lanceolate, up to 15 x 0.35 cm, acuminate, oblong-ciliate with bulbous- based hairs, mostly on the margin and midrib below; sheath to 4.5 cm long, sharply keeled on the back, lower sheath long ciliate; ligule membranous and fimbriate at apex. Racemes 2-4. Rachis 5-7 x 0.02-0.05 cm, zig-zag, trigonous, harply angled and scabrid at angles. Spikelets elliptic, 0.25-0.3 cm long. Pedicels c. 0.02 cm long, concave at apex; callus bearded. Lower glume linear-oblong, 0.2-0.25 x 0.02 cm, acuminate-aristate and incurved at apex, keeled on the back, keel scabrid, narrowly winged towards apex. Upper glume 0.25-0.27 x 0.06-0.07 cm, elliptic to oblanceolate, acute-aristate at apex, keeled on the back; keel scabrid and narrowly winged towards apex, with a few long cilia. Lower lemma 0.15-0.17 cm long, hyaline, oblanceolate-acute, 2-veined along the middle, ciliate on the margins towards apex. Upper lemma elliptic c. 0.2 cm long, hyaline, bifid at the apex, lobes acute, sparsely short ciliate on the margins, awned from the sinus; awn c. 0.8 cm long with c. 0.25 cm long column, scaberulous. Palea small, lanceolate, papillate; lodicules 2, wedge-shaped. Stamens 2. Ovary oblong. Grains c. 0.15 cm long, compressed, obliquely acute at apex.

Flowering & Fruiting: October-December.

Habitat: Collected from open lateritic fields, associated with *Dimeria ornithopoda* and *D. thwaitesii*.

Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimen examined: Malappuram district: Chelari, ± 25 m, 28 Nov. 1992, *Ravi 3606* (Holotype, TBGT).

4. **Dimeria copeana** Sreek., V. J. Nair & N. C. Nair, J. Bombay Nat. Hist. Soc.78: 577. 1981; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 221. 1986; Karth. *et. al.*, Fl, Ind. Enum. Monocot. 209. 1989; Sreek. & V. J. Nair, Fl. Kerala Grass. 188. 1991; Samaddar & Roy,

Plate 81. Type specimens.

a. ***Arundinella cannanorica*** V. J.Nair *et al* (MH);
b. ***Arundinella ravii*** Shaju & N. Mohanan (TBGT);
c. ***Chrysopogon purushothamanii*** Ravi *et al*. (TBGT);
d. ***Chrysopogon tadulingamii*** Sreek. *et al*. (MH);
e. ***Dimeria agasthyamalayana*** Ravi *et al*. (TBGT);
f. ***Dimeria borii*** Sreek. *et al*. (MH).

NB 5995

Add. Ele. Ind. Fl. 116.1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 565. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 790. 2006; Sunil & Sivad., Fl. Alappuzha 840. 2009.

Type: Alapuzha district: Thrikkunnapuzha, Sea level, 13 Mar. 1980, *Sreekumar 66736* (MH) (Plate 82 b)

Tufted, stoloniferous, perennial herbs. Culms 20-45 cm tall, capillary; nodes bearded. Leaves linear, 20-40 x 0.01-0.02 cm, acuminate, sparsely villous on the upper surface; sheath short, glabrous; ligule a small membrane. Racemes 2, 8-10 cm long, slender. Rachis trigonous, more or less zig-zag, obscurely winged, scabrid on the margins. Spikelets 0.35-0.45 cm long, 2-flowered, oblanceolate, compressed, adpressed to rachis, parsely hairy; callus bearded. Lower glume oblong, 0.3-0.4 cm long, acute, coriaceous, scabrid. Upper glume elliptic, 0.4-0.45 cm long, acute, straight on the back, slightly curved towards the apex, scabrid, hyaline, villous. Lower floret empty; lemma oblanceolate, c. 0.25 cm long, acute, 1-nerved, ciliate on the margins above, epaleate. Upper floret bisexual; lemma 0.3-0.35 cm long, oblong, acute, shortly bifid at the apex, awned from the sinus; awn 0.8-1 cm long, slender with a dark column, bristle pale, scabrid. Stamens 2. Ovary ovate. Grains oblong, c. 0.2 cm long, compressed.

Flowering & Fruiting: December-March.

Habitat: Collected from muddy substratum along the backwaters in the low lying area. Associate-species in the habitat include *Elaeocharis retroflexa*, *Fuirena umbellata*, *Ischaemum vembanadense*, etc.

Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimens examined: Alapuzha district: Thrikkunnapuzha, Sea level, 13 Mar. 1980, *Sreekumar 66736* (Isotype, MH); Pallana, K. V. Jetty, Sea level, 18 May 2006, *Shaju 59485* (TBGT).

5. **Dimeria copei** Ravi, Blumea 41: 251.1996; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 565. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 790. 2006; Sunil & Sivad., Fl. Alappuzha 840. 2009.

Type: Alapuzha district: Kalavoor, Sea level, 3 Dec. 1992, *Ravi 3655* (TBGT).(Plate 82 c & 88 a)

Annual erect robust herbs. Culms branched and tufted, up to 75 cm tall; nodes bearded. Leaves all along the culm, linear, up to 22 x 0.2 cm, narrowed to the base, acuminate at apex, sparsely beset with long bulbous- based hairs; sheath keeled, broadly hyaline on the margins, glabrous, up to 10 cm long; ligule membranous, fimbriate-truncate at apex. Racemes 1-3, up to 10 cm long. Rachis more or less, trigonous, flattened on the back, margins not winged, densely ciliate, 0.06-0.07 cm wide. Pedicels 0.04-0.05 cm ling, densely ciliate. Spikelets up to 0.75-0.8 cm long; callus bearded. Lower glume subcoriaceous, linear-oblong, 0.55-0.57 x 0.06-0.07 cm,

acuminate-aristate at apex, keeled on the back, keel narrowly winged, densely ciliate. Upper glume oblong-elliptic, 0.7-0.75 x 0.15 cm, acuminate-awned at apex, 0.1-0.12 cm long, scaberulous, keeled on the back, broadly winged all along the keel, densely long ciliate. Lower lemma hyaline, oblanceolate, c. 0.3 cm long, cuneate towards the base, acute at apex, 1-nerved, ciliate on the margin towards the apex, epaleate. Upper lemma oblanceolate, hyaline, 0.35-0.4 x 0.07 cm long, awned from the sinus of bifid apex; awn up to 0.12-14 cm long, coloumn 0.35-0.4 cm long, scberulous. Palea lanceolate. Lodicules 2, cuneate, Stamens 2. Grains oblong-elliptic, c. 0.2-0.25 cm long, flattened.

Flowering & Fruiting: December-February.

Habitat: Open waysides.

Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimen examined: Alapuzha district: Kalavoor, Sea level, 3 Dec. 1992, *Ravi 3655* (Holotype, TBGT).

6. **Dimeria eradii** Ravi, Rheedea 5: 39. 1995; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 566. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 790. 2006.

Type: Malappuram district: Thenhipalam, 29 Nov. 1992, *Ravi 3641* (TBGT). (Plate 82 d & 88 c)

Tufted annual. Culms slender, up to 40 cm tall, glabrous; nodes ciliate. Leaves basal, narrowly elliptic-lanceolate, up to 9 x 0.4 cm, acute to acuminate at apex, slightly cuneate or rounded at base, ciliate with bulbous based and simple hairs on the lower surface and sparely ciliate on the upper surface, scaberulous on the margins towards apex; sheath up to 7 cm long, keeled on the back, sparsely ciliate; ligule membranous, fimbriate at apex. Racemes 1-3. Rachis up to 10 x 0.06-0.1 cm, compressed-trigonous, broadly winged and ciliate on the margins. Spikelets 0.3-0.45 cm long. Pedicels short, c.0.03 cm long; callus bearded. Lower glume oblong-elliptic, 0.25-0.3 x 0.03-0.4 cm, acuminate-aristate at apex, keeled on the back, keel narrowly winged and ciliate except towards apex, hyaline towards margins, scaberulous, sparsely ciliate below the middle. Upper glume oblong-lanceolate, 0.27-0.45 cm long including c. 0.1 cm long arista, acuminate-aristate at apex, keeled on the back, keel winged 1/3 towards apex, scaberulous and ciliate except at apex, margins hyaline and ciliate in the middle. Lower lemma hyaline, oblanceolate, 0.2 x 0.07 cm, acute at apex, cuneate at base, 1-nerved, ciliate on the margins from below. Upper lemma elliptic, hyaline, c. 0.2-0.07 cm, bifid at the apex, lobes acute, awned from the sinus; awn 0.65-0.75 cm long with a column of c. 0.25 cm long. scaberulous. Palea small, papillate. Stamens 2. Lodicules 2. Grains oblong-elliptic, compressed, 0.1-0.15 cm long, obliquely acute at apex.

Flowering & Fruiting: November-February.

Habitat: Lateritic fields.

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Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimens examined: Malappuram district: Thenhipalam, 29 Nov. 1992, *Ravi 3641* (Holotype, TBGT); Kasaragod district: Seethamgoli, near Elkanna river, 3 Nov. 2006, *Shaju 59461*(TBGT).

7. **Dimeria Idukkiensis** Ravi & Anil Kumar, Rheedea 2: 104. 1992; Fl. Pathanamthitta 792 ; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 566. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 791. 2006.

Type: Idukky district: Kuttikkanam, Peerumed, ±1000 m, 19 Oct. 1991, *Anil Kumar 3190* (Isotype, TBGT). (Plate 82 e)

Tufted annuals. Culms slender, unbranched, up to 15 cm tall; nodes bearded. Leaves scattered, linear-lanceolate, acuminate, slightly rounded at base, tubercle-based hairs on the margins and veins, c. 5 x 0.5 cm; sheath keeled on the back towards the apex, up to 6.5 cm long; ligule transeversely oblong, membranous. Racemes mostly 2, up to 5 cm long. Rachis triquetrous, flattened, winged, keeled and zig-zag, shortly ciliate, c. 0.1 cm wide. Pedicels short. Spikelets elliptic-oblong, awned, 0.45-0.55 cm long; callus bearded. Lower glume linear-elliptic, c. 0.35 x 0.05 cm, acute, apex shortly curved, keel narrowly winged at the upper half, scaberulous, ciliate in the lower half. Upper glume elliptic-oblong, c. 0.55 x 0.75 cm, acute to shortly acuminate, keeled, broadly winged in the upper half of the keel, long ciliate on the back except the tip. Lower lemma oblanceolate, acute at apex, cuneate at base, hyaline, c. 0.25 cm long, ciliate on the margins in the upper half, empty and epaleate. Upper lemma elliptic-lanceolate, 2-cleft at the apex, awned and fertile; awn geniculate, c. 1.2 cm long, column c. 0.5 cm long. Palea absent. Lodicules 2. Stamens 2.

Flowering & Fruiting: October-December.

Habitat: Collected from high range areas.

Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimen examined: Idukky district: Kuttikkanam, Peerumed, ±1000 m, 19th Oct. 1991, *Anil Kumar 3190* (Isotype, TBGT).

8. **Dimeria jainii** Sreek., V. J. Nair & N. C. Nair, Curr. Sci. 52: 259.1983; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 221. 1986; Sreek. & V. J. Nair, Fl. Kerala Grass. 188. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 566. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 791. 2006.

Type: Kozhikode district: Pokkunnamala, *Sreekumar 71814* (MH). (Plate 82 f)

Annuals. Culms 10-20 cm tall, erect; nodes glabrous. Leaves linear-lanceolate, 0.2-0.8 x

Plate 82. Type specimens.

a. ***Dimeria chelariensis*** Ravi,(SNCH);
b. ***Dimeria copeana*** Sreekumar *et al.*(MH);
c. ***Dimeria copei*** Ravi (SNCH);
d. ***Dimeria eradii*** Ravi (SNCH);
e. ***Dimeria idukkiensis*** Ravi & Anil Kumar (SNCH);
f. ***Dimeria jainii*** Sreekumar, *et al.* (MH).

NIB 5995

0.02-0.03 cm, acuminate, rounded at base, covered with long or short tubercle-based hairs; sheath keeled, villous, 1-5 cm long; ligule a short, fimbriate membrane. Racemes usually 3, rarely 2, each 2-4 cm long. Rachis flattened, margins winged, densely ciliate, c. 0.05 cm wide. Spikelets 0.3-0.35 cm long; Pedicels c. 0.05 cm long; callus bearded. Lower glume linear to oblong-elliptic, c. 0.2 x 0.05-0.07 cm, densely ciliate along dorsal margins. Upper glume ovate, 0.3-0.35 x 0.15-0.2 cm, acuminate, broadly winged, long ciliate on keel. Lower floret empty; lemma elliptic, 0.15-0.2 x 0.03-0.05 cm, hyaline, faintly 1-nerved. Upper floret bisexual; lemma delicate, 0.17-0.2 x 0.06-0.07 cm, notched at apex, awned, 1-1.2 cm long, geniculate, column c. 0.3 cm long, twisted, bristle scabrid. Lodicules 2, oblanceolate, 2-lobed at apex. Stamens 2. Ovary elliptic.

Flowering & Fruiting: October-December.

Habitat: Collected from dry grasslands along with other grasses like *Aristida setacea*, *Ischaemum rangachrianum*, etc.

Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimen examined: Kozhikode district: Pokkunnamala, *Sreekumar 71814* (MH).

9. **Dimeria josephii** Ravi, N. Mohanan & Kiran Raj, Rheedea 11: 90. 2001; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 566. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 791. 2006.

Type: Palakkad district: ± 70 m, 24 Nov. 1998, Nenmara, *Ravi 30542* (TBGT). (Plate 83 a)

Annuals. Culms tufted, filiform, up to 30 cm tall; nodes glabrous. Leaves basal, linear-lanceolate, acuminate, rounded at base, bulbous-based hairs on the margins, c. 5 x 0.4 cm; sheath keeled, up to 8 cm long, bulbous based hairs mostly on the upper part; ligule a short membrane, obtuse-truncate and fimbriate at apex. Racemes single or mostly two, up to 5 cm long. Rachis flattened, broadly winged and ciliate on the margins, c. 0.1 cm wide. Pedicels short, densely ciliate on the outside. Spikelets 0.5-0.6 cm long; callus bearded. Lower glume linear-oblong, 0.3-0.4 cm long, acuminate-aristate at apex, keeled on the back and densely ciliate on the keel, sparsely hairy on the thinner sides. Upper glume linear-elliptic, 0.5-0.55 cm long, acuminate-aristate at apex, keel slightly winged ciliate on the keel, sparsely hairy on the sides. Lower lemma hyaline, linear, oblong-elliptic, 0.2-0.3 cm long, 1-nerved, sparsely ciliate on margins, empty and epaleate. Upper lemma elliptic, hyaline, bifid at the apex with acute lobes, 0.3-0.35 cm long, awned from the sinus; awn up to 1.3-1.6 cm long, column 0.4-0.6 cm long. Palea lanceolate, sparsely papillate on the out side with 1-2 long hairs. Lodicules 2. Stamens 2. Grains linear-oblong, c. 0.2 cm long.

Flowering & Fruiting: November-December.

Habitat: Growing in rocky crevices.

Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimen examined: Palakkad district: Nenmara, ± 70 m, 2 Nov. 1998, *Ravi 30542* (Holotype, TBGT).

10. **Dimeria kalavoorensis** Ravi, Blumea 41: 253.1996; Sasidh., Biodiver. Doc. Kerala. Part 6, Flr. Pl. 566. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 791. 2006; Sunil & Sivad., Fl. Alappuzha 840. 2009.

Type: Alapuzha district: AIR Campus, Kalavoor, Sea level, 3 Dec. 1992, *Ravi 3654* (TBGT) (Plate 83 b)

Annual erect herbs. Culms solitary, unbranched and filiform, up to 45 cm tall, glabrous; nodes bearded. Leaves all along the culm, linear, c. 5 x 0.2 cm, shortly narrowed to the base, acuminate at apex, beset with sparse bulbous-based hairs on the margins; sheath closely enclosing the culm, up to 7 cm long, keeled on the back, glabrous; ligule membranous, fimbriate-truncate at apex. Racemes solitary. Rachis straight, trigonous, flattened on the back, 0.5-4 x 0.5-0.6 cm, narrowly winged on the margins, margins ciliate. Pedicels 0.05-0.06 cm long, ciliate. Spikelets 0.6-0.65 cm long; callus bearded. Lower glume subcoriaceous, narrowly elliptic-oblong, 0.45-0.5 x 0.05 cm, acuminate-aristate at apex, keeled on the back, keel narrowly winged above the middle, silky-ciliate on the sides, densely ciliate on the keel. Upper glume subcoriaceous, elliptic-oblong, 0.5-0.55 x 0.1 cm, acuminate-awned at apex, awn up to 0.07 cm long, broadly winged all along the keel, silky ciliate. Lower lemma obalnceolate, c. 0.25 cm long, cuneate towards the base, acute at apex, hyaline, 1-nerved, ciliate on the margins above the middle and epaleate. Upper lemma oblanceolate, c. 0.3 x 0.05 cm, hyaline, awned from the sinus of bifid apex; awn 0.9-1.15 cm long with 0.3-0.35 cm long column. Palea elongate-triangular, hyaline, papillate towards the upper half. Lodicules 2, triangular-ovate, acute at apex. Stamens 2. Grains elliptic-oblong, 0.1-0.15 cm long, flattened.

Flowering & Fruiting: November-December.

Habitat Sandy water-logged areas, associated with species like *Panicum repens* and *Ischaemum rangacharianum*.

Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimen examined: Alapuzha district: AIR Campus, Kalavoor, Sea level, 3 Dec. 1992, *Ravi 3654* (Holotype, TBGT).

11. **Dimeria keralae** N. C. Nair, Sreek. & V. J. Nair, Bombay Nat. Hist. Soc.80: 626. 1984; Karth., *et al.* Fl, Ind. Enum. Monocot. 210. 1989; Sreek. & V. J. Nair, Fl. Kerala Grass. 194. 1991; Samaddar & Roy, Add. Ele. Ind. Fl. 118.1997; Sasidh., Biodiver. Doc. Kerala,

Part 6, Flr. Pl. 566. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 792. 2006.

Type: Kasaragod district: Periya, near cashew project area, ± 50 m, 18 Oct. 1981, *Sreeekumar 71727* (MH). (Plate 83 c)

Annuals. Culms 10-30 cm tall, erect, slender, purplish; nodes bearded. Leaves linear-lanceolate, 2-5 x 0.1-0.2 cm; sheath keeled, glabrous, up to 6 cm long; ligule a thin ovate membrane. Racemes 2, up to 2.5 cm long, usually unequal, inter-twined. Rachis flat on one side, angular on the outer side, c. 0.02 cm wide, glabrous. Spikelets 0.4-0.5 cm long, oblanceolate, cuneate at base, distant and pedicelled. Pedicels c. 1-0.15 cm long, joints oblique; callus acute at base, covered with golden yellow hairs. Lower glume oblong-linear, 0.35-0.4 x 0.07-0.7 cm, slightly emarginate, hyaline winged at apex, coriaceous, glabrous. Upper glume oblong-lanceolate, 0.4-0.5 x 0.07-0.1 cm, minutely winged at apex, hyaline wings with hairy margins, coriaceous, glabrous. Lower floret empty; lemma oblanceolate, 0.3-0.4 x 0.03-0.05 cm long, 1-nerved, delicate, hyaline and ciliate along the upper margins. Upper floret bisexual; lemma elliptic, 0.3-0.4 x 0.07-0.1 cm, notched at apex, with a very long stout awn, 2-3 cm long, geniculate, column 0.1-0.15 cm long, twisted, bristles scabrid. Palea minute, ovate-lanceolate. Lodicules 2, obovate, 3-lobed at apex. Stamens 2. Ovary elliptic. Grains 0.2-0.25 cm long, linear-oblong, compressed.

Flowering & Fruiting: October-December.

Habitat: Open dry grasslands.

Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimen examined: Kasaragod district: Periya, near cashew project area, ± 50 m, 18 Oct. 1981, *Sreeekumar 71727* (MH).

12. **Dimeria kurumthotticalana** Jacob, J. Bombay Nat. Hist. Soc.47: 47. 1947; Sebatine, Bull. Bot. Surv. India 4: 222.1962; Karth., Bull. Bot. Surv. India 13: 175. 1971; Karth. *et. al.*, Fl, Ind. Enum. Monocot.210. 1989; Sreek. & V. J. Nair, Fl. Kerala Grass. 96. 1991; Ravi & Anil Kumar, Rheedea 2: 106. 1992; Anil Kumar *et al.*, Fl. Pathanamthitta 792. 2005; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 566. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 792. 2006.

Type: 'Travancore', Peermede, *K. Cherian Jecob 20236 A* (MH). (Plate 83 d)

Tufted erect annual herbs. Culms unbranched or sparsely branched, up to 50 cm tall, glabrous; nodes bearded. Leaves basal or scattered, linear, acuminate, rounded at base, sparsely long ciliate on the lower surface, c. 15 x 0.5 cm; sheath keeled, hairy with tubercle-based hairs, up to 6 cm long; ligule membranous, rounded and fimbriate at apex. Racemes solitary, c. 5 cm long. Rachis flattened, subtrigonous and zig-zag, winged, ciliate on the margins, 0.1-0.15 cm wide. Pedicels short, ciliate on the outer margin. Spikelets oblanceolate, 0.4-0.6 cm long; callus

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bearded. Lower glume linear elliptic to oblong-elliptic, 0.4-0.5 x 0.05 cm, acuminate, keel ciliate except towards the spinulose apex. Upper glume oblong-elliptic, 0.45-0.55 x 0.1 cm, acuminate, keel winged towards the apex, long ciliate above the middle, spinulose towards the apex. Lower lemma linear-lanceolate, acute, hyaline, 0.2-0.3 cm long, ciliate on the margins from the middle upwards, 1-nerved, empty and epaleate. Upper lemma hyaline, bifid at the apex, 1-nerved, 0.25-0.35 cm long, awned from the sinus; awn 1-1.5 cm long, column. Palea hyaline, sparsely short-ciliate. Lodicules 2. Stamens 2. Stigmas 2. Grains obliquely linear-oblong, c. 0.2 cm long.

Flowering & Fruiting: October-December.

Habitat: Grassy hill slopes.

Note: As a neoendemic species, its distributional status should be analysed for further conservation management.

Specimens examined: 'Travancore': Peermede, 3200', Dec. 1941, *K. Cherian Jacob 20236 A* (MH); Kottayam district: Vallicode, ± 150 m, 4 Nov. 1989, *Anil kumar 2122* (SNCH).

13. **Dimeria namboodiriana** Ravi & N. Mohanan, Rheedea 7: 1. 1977; Sasidh., Biodiver. Doc. Kerala. Part 6, Flr. Pl. 567. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 792. 2006.

Type: Pathanamthitta district: Ponnambalamedu, ±1100 m, 5 Jan.1997, *Ravi 24050* (TBGT).

(Fig. 47; Plate 83 e & 88 b)

Marshy perennials with runners rooting and producing solitary to densely tufted culms at nodes. Culms simple or branched up to 50 cm tall; Leaves stiff and erect, elliptic-lanceolate, c. 20 x 0.7 cm, slightly narrowed to rounded base, acuminate at the apex, densely ciliate with bulbous-based hairs all over; sheath distichous towards the base, up to 10 cm long, strongly keeled and thick ciliate; ligule membranous, truncate, fimbriate. Racemes 2. Rachis fuscus, straight, flattened on the back, broadly winged, up to 8 x 0.15 cm, sparsely short ciliate on the margins. Pedicels flattened, 0.02-0.05 cm long, thickly ciliate on the outside. Spikelets oblong-elliptic, 0.55-0.75 cm long; callus bearded. Lower glume elliptic-oblong, 0.35-0.4 x 0.07-0.1 cm, acute-aristate at the apex, keel broadly winged all along, sparsely ciliate. Upper glume oblong-elliptic, 0.4-0.55 x 0.1-0.15 cm, keeled on the back and keel broadly winged all along, margin hyaline, sparsely ciliate in the middle. Lower lemma hyaline, oblanceolate, 0.25-0.35 x 0.1 cm, acute at the apex, cuneate towards the base, 2-nerved, sparsely ciliate on the margins. Upper lemma hyaline, oblanceolate, 0.34-0.4 x 0.07 cm, 1-nerved, bifid with acute lobes at the apex, sparsely ciliate towards the apex, awned from the sinus; awn up to 0.1 cm long with a column up to 0.35 cm long and scaberulous. Palea short, elliptic, acute at the apex and papillate on the surface with one or more long cilia. Lodicules 2, truncately lobed at apex. Stamens2. Grains oblong-elliptic, c. 0.2 x 0.05 cm, biconvexly flattened.

Flowering & Fruiting: December-January.

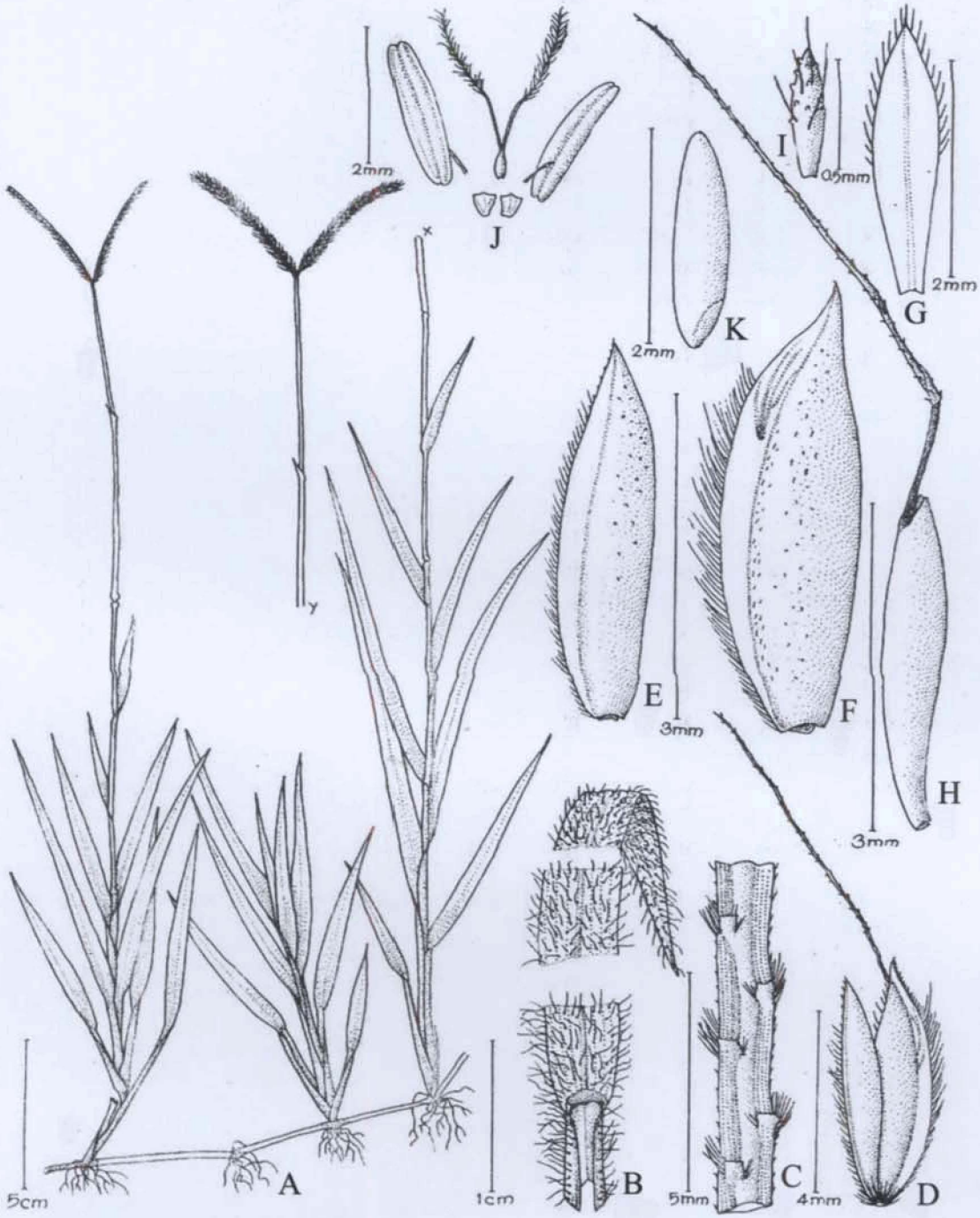

Fig. 47. ***Dimeria namboodiriana*** Ravi & N. Mohanan: A. Habit; B. Leaf; C. A portion of rachis; D. Spikelet; E. Lower glume; F. Upper glume; G. Lower lemma; H. Upper lemma; I. Upper palea; J. Lodicules, stamens & pistil; K. Grain

NB 5945

300 A

Habitat: Marshy area of high altitudes.

Note: As a narrow endemic species, it deserves conservation importance.

Specimens examined: Pathanamthitta district: Ponnambalamedu, ±1100 m, 5 Jan.1997, *Ravi 24050* (TBGT); *Ibid.*, Varayadukokka, ± 1000 m, 6 Jan. 2003, *Shaju 46498* (TBGT).

14. **Dimeria sivarajanii** N. Mohanan & Ravi, Rheedea 6: 47. 1966; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 567. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 793. 2006.

Type: Pathanamthitta district: Kochupampa hills, ±1100 m, 4 Jan. 1997, *Ravi 24041* (TBGT). (Fig. 48; Plate 83 f)

Annual erect herbs. Culms tufted and branched, up to 40 cm tall; nodes bearded. Leaves all along the culms, linear, elliptic-lanceolate, c. 15 x 0.5 cm, shortly narrowed and rounded at base, acuminate at apex, covered with bulbous-based hairs; sheath keeled on the back, up to 8 cm long; ligule membranous, truncate-fimbriate at apex. Racemes 1 or 2. Rachis flattened on the back, broadly winged, c. 7 x 0.1-0.15 cm, ciliate on the margins. Pedicels 0.05-0.07 cm long, densely ciliate. Spikelets elliptic-oblong, 0.55-0.75 cm long; callus bearded. Lower glume subcoriaceous, oblong-elliptic, acuminate-arstate at apex, 0.45-0.55 x 0.05-0.06 cm, keeled on the back and keel narrowly winged all along, densely ciliate on the back and sparsely short ciliate on the sides. Upper glume oblong-elliptic, 0.55-0.56 x 0.1-0.15 cm, acuminate-aristate at apex, broadly winged all along the keel, densely ciliate on the back, margins hyaline, sparsely short ciliate in the middle. Lower lemma hyaline, linear-lanceolate, 0.27-0.37 cm long, broadly cuneate in the lower half, acute at the apex, shortly ciliate on the margins, 2-nerved and epaleate. Upper lemma, hyaline, oblong-elliptic, 0.3-0.4 x 0.07 cm, bifid at the apex, lobes acute, shortly ciliate on the margins and awned from the sinus; awn geniculate, up to 1.4 cm long with a column 0.3-0.5 cm long. Palea linear-lanceolate, acuminate-aristate at the apex, sparsely papillate with few long cilia. Lodicules 2. Stamens 2. Grains oblong-elliptic, 0.2-0.25 x 0.05-0.07 cm, flattened.

Flowering & Fruiting: January-February.

Habitat: Marshy areas of higher altitudes.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Pathanamthitta district: Kochupampa hills, ±1100 m, 4 Jan. 1997, *Ravi 24041* (Holotype, TBGT).

15. **Dimeria sreenarayanii** Ravi & Anil Kumar, Rheedea 2: 101.1992; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 567. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 793. 2006.

Type: Kottayam district: Kuttikkanum, Peerumed, ±1000 m, 30 Dec. 1991, *Anil Kumar 3297* (TBGT). (Plate 84 a)

Tufted annual. Culms up to 20 cm tall, glabrous; nodes glabrous. Leaves scattered, linear-

lanceolate, acuminate, cuneately rounded at base, sparsely long ciliate on the upper surface, c. 7 x 0.4 cm; sheath keeled, glabrous, up to 7 cm long; ligule rounded and fimbriate at apex. Racemes single, up to 5 cm long. Rachis trigonous-flattened, broadly winged, shortly ciliate on the margins, 0.1-0.12 cm wide. Pedicels ciliate on the outer margins. Spikelets up to 0.7 cm long; callus bearded. Lower glume linear to oblong-elliptic, c. 0.5 x 0.08 cm, acuminate, shortly acute at apex, hyaline towards margins, keel narrowly winged at the upper half, ciliate all along, glabrous. Upper glume elliptic, c. 0.65 x 0.15 cm, shortly acuminate with a short arista, broadly winged on the keel, long ciliate on the back, sides hyaline, glabrous. Lower lemma hyaline, oblanceolate, c. 3 cm long, ciliate on the margin towards the apex, epaleate. Upper lemma elliptic, hyaline, bifid at the apex in to acute lobes, 0.35 cm long, awned from the sinus; awn up to 0.16 cm long, column 0.6 cm long. Palea elongate-triangular, long ciliate at the apex. Stamens 2. Lodicules 2. Grains obliquely elliptic, c. 0.2 cm long.

Flowering & Fruiting: November-January.

Habitat: Wet grassy slopes.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Kottayam district: Kuttikkanum, Peerumed, ±1000 m, 30 Dec. 1991, *Anil Kumar 3297* (Isotype, TBGT).

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Key to the species

1. Inflorescence a raceme..... 1. *I. fischeri*
1. Inflorescence a panicle.
   2. Glumes 5-7-nerved..... 3. *I. jayachndranii*
   2. Glumes 9-11-nerved..... 2. *I. henryi*

1. **Isachne fischeri** Bor, Kew Bull. 1949: 69 1949; Gamble, Fl. Pres. Madras 1706; Bor, Grass. Burma, Ceylon, India & Pakistan 222. 1962; Sebastine, Bull. Bot. Surv. India. 4: 322. 1962; Ved Prakash, Fasc. Fl. India. 14: 20. 1984; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 227. 1986; M. P. Nayar & Sastry, Red Data Book Ind. 1: 304. 1987; Sreek., & V. J. Nair, Fl. Kerala Grass. 412. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 575. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 803. 2006.

Type: Idukki district: Anamudi, 'Travancore, High Range', 8840 ft. Sep. 1933, *E. Barnes s.n.* (K). (Plate 84 b)

Annuals. Culms 3-5 cm tall, erect or ascending. Leaves lanceolate or elliptic, 0.5-0.8 x 0.1-0.35 cm, hirsute on both sides; sheaths sparsely hairy. Inflorescence racemose or paniculate, 1-

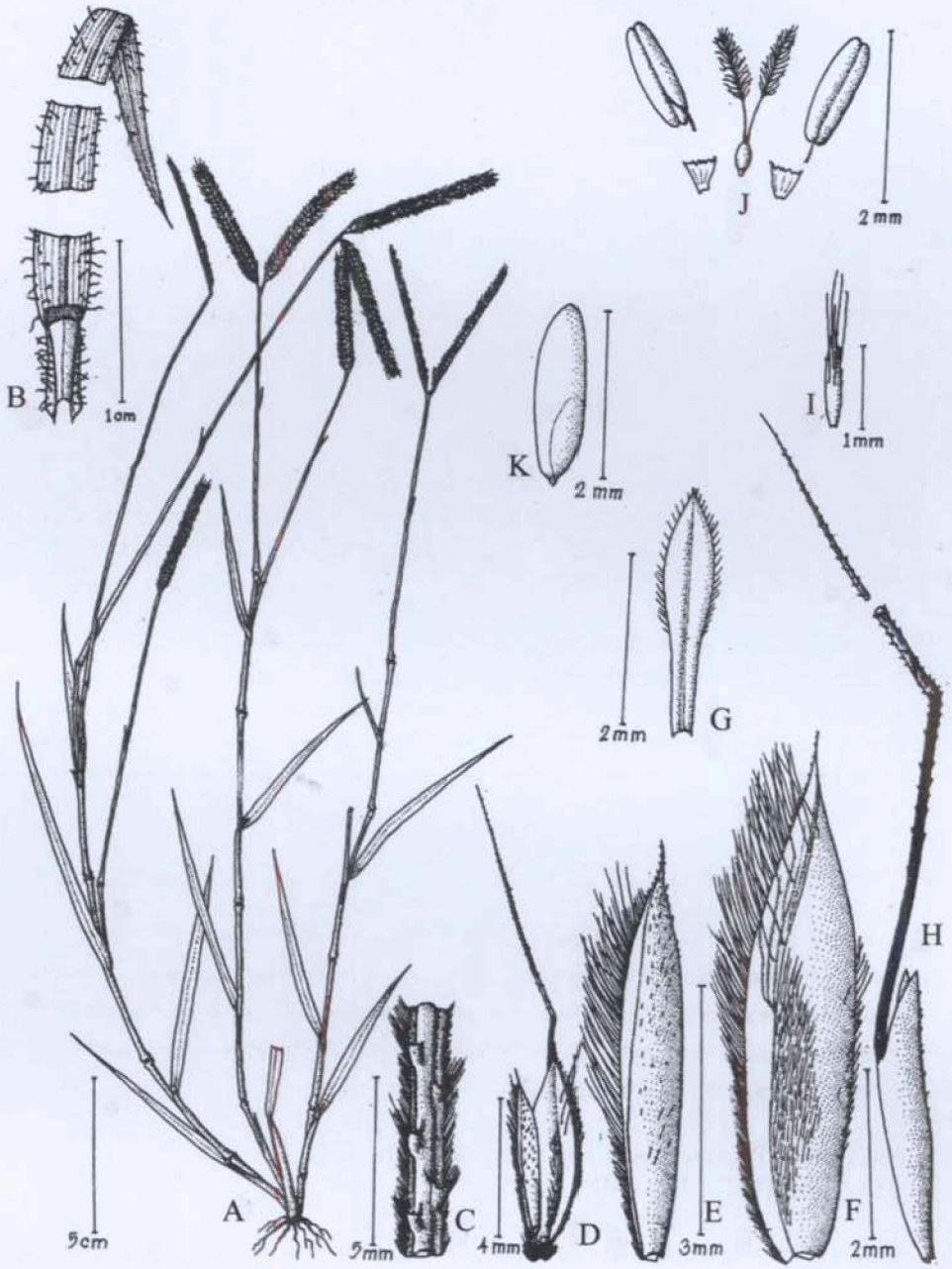

Fig. 48. ***Dimeria sivarajanii*** N. Mohanan & Ravi: A. Habit; B. Leaf; C. A portion of rachis; D. Spiklet; E. Lower glume; F. Upper glume; G. Lower lemma; H. Upper lemma; I. Upper palea; J. Lodicules, stamens & pistil; K. Grain.

NB 5995

3027

Plate 83. Type specimens.

a. ***Dimeria josephii*** Ravi *et al.* (TBGT);
b. ***Dimeria kalavoorensis*** Ravi (SNCH);
c. ***Dimeria keralae*** N.C.Nair *et al.* (MH);
d. ***Dimeria kurunthotticalana*** Jacob (MH);
e. ***Dimeria namboodiriana*** Ravi & N. Mohanan (TBGT).
f. ***Dimeria sivarajanii*** N. Mohanan & Ravi (TBGT)

302 B

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1.5 cm long, lax, few-flowered. Spikelets obovoid or elliptic or ovate-elliptic, 0.2-0.3 x 0.1-0.2 cm, tubercled-hairy. Lower glume ovate-lanceolate, chartaceous, 5-nerved. Upper glume ovate-lanceolate, 0.2-0.3 x 0.1-0.15 cm, chartaceous, 5-7-nerved. First lemma ovate-oblong, 0.2-0.25 x 0.1-0.15 cm, chartaceous, faintly 3-5-nerved. Palea oblong, delicate. Second lemma ovate-elliptic, 0.1-0.2 x 0.1 cm, coriaceous, hairy. Palea elliptic, coriaceous, softly hairy. Stamens 3. Grains ellipsoid, c. 0.1 cm long.

Flowering & Fruiting: September-November.

Habitat: Moist moss-covered rocks along grassy slopes.

Note: Bor (1962) decribed this species based on a collection by Barnes in September 1933 from Anamala summit, Eravikulam National Park, which is so far known to be a local endemic species. Because of its very narrow range of distribution Nayar (1997) remarked it as a 'Rare' category species.

Specimens examined: Idukki district: Summit of Anamudi, 'Travancore High Range' 8,840 ft., *E. Barnes s.n. Acc. No. K000245439* (K); *Ibid*, Eravikulam National Park, Anamudi, ± 2000 m, 19 Nov. 1965, *Shetty 26533* (MH).

2. **Isachne henryi** Srinivasan & Sreek., J. Bombay Nat. Hist. Soc. 84: 647. 1987; Karth., *et. al.* Fl, Ind. Enum. Monocot. Addenta IV. 1989; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 575. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 804. 2006.

Type: Wayanad district: Poothumoola, Hiladale R.F., ± 700 m, 13 Nov. 1981, *Sreenivasan 72358* (CAL).

Annuals. Culms 15-50 cm tall, caespitose. Leaves lanceolate or linear lanceolate, 2-8 x 0.2-0.5 cm, rounded or shallowly cordate at base, scabrid along the nerves; ligule a row of long hairs. Panicles c. 2-12 x 1-5 cm long, widely spreading, green to purplish. Spikelets ovate or orbicular, 0.15-0.2 cm long, pedicellate. Lower glume broadly ovate or orbicular, subequal, 0.17-0.2 x 0.15-0.2 cm, chartaceous, 9-11-nerved, setose hairy. Lower floret staminate; lemma broadly elliptic or ovate, 0.17-0.2 x 0.1-0.12 cm, obtuse, 5-7-nerved, glabrous; palea ovate, obtuse, margins 2-keeled; stamens 3. Upper floret bisexual; lemma orbicular, 0.12-0.15 x 0.12-0.15 cm, obtuse, 5-7-nerved, glabrous; palea orbicular, 2-keeled, hyaline. Stamens 3. Ovary oblong.

Flowering & Fruiting: October-December.

Habitat: Bunds of paddy feilds.

Note: It is a narrow endemic species, so far known only from the type locality. Further explorations must be made to locate the species in its known distributional areas to confirm its conservation status.

Specimen examined: Wayanad district: Poothumoola, Hiladale R.F., ± 700 m, 13 Nov. 1981, *Sreenivasan 72358* (Isotype, MH).

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3. **Isachne jayachandranii** Gopalan & V. Chandras., Kew Bull. 55: 1005. 2000; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 575. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 804. 2006.

Type: Thiruvananthapuram district: Agasthyamala, 1400 m, 6 Oct. 1973, *J. Joseph 44628* (MH). (Plate 84 c)

Annuala. Culms to 50 cm tall, erect, caespitose. Leaves broadly or narrowly ovate, 1-3 x 0.4-1 cm, sparsely hispid above, densely tuberculate-hispid beneath, acuminate at apex; sheaths 1-2.5 cm; ligule a fringe of hairs. Panicles 2-4 cm long. Rachis triquetrous, hirsute. Spikelets 0.25-0.34 x 0.2-0.25 cm, pedicellate. Lower glume narrowly ovate, 0.25-0.34 x 0.08-0.1 cm, acute, acuminate or caudate, 7-nerved, glabrous. Upper glume obovate, 0.25-0.3 x 0.08-1 cm, 7-nerved. Lower floret staminate; lemma ovate or elliptic, acute, 5-nerved; palea ovate, acute, 2-nerved. Stamens 3. Upper floret pistillate, pubescent; lemma broadly ovate or elliptic, incurved along margins, acute; palea ovate, pubescent incurved along margins. Ovary oblong. Grains ovoid, c. 0.1 cm long, brownish.

Flowering & Fruiting: October.

Habitat: Grassy slopes.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Thiruvananthapuram district: Agasthyamala, ± 1400 m, 6 Oct. 1973, *Joseph 44628* (Isotype, MH).

ISCHAEMUM Linnaeus

Sp. Pl. 1049. 1753.

Key to the the species

1. Spikelets awnless or awn rudimentary, concealed..... *7. I. jayachanranii*
1. Spikelets prominently awned, awns well exerted.
   2. Margins of the lower glume of the sessile spikelet expanded in the lower half ....2. *I. agasthyamalayanum.*
   2. Margins of the lower glume of the sessile spikelet narrowly and evenly inflexed from base to apex.
      3. Base of the lower leaves acute, narrow, rarely rounded or shallowly cordate.
         4. Pedicels of the pedicelled spikelets more than one-third length of the sessile spikelets.
            5. Lower glume of the sessile spikelets ovate-lanceolate, without nodules; pedicelled spikelets reduced.....16. *I. tadulingamii*
            5. Lower glume of the sessile spikelets ovate-oblong, with a few nodules and wrinkles; pedicelled spikelets developed.

6. Leaf blades up to 20 cm long; culms not robust.
7. Lower leaves rounded or shallowly cordate at base, not petioled..... .....4. *I. cannanorensis*
7. Lower leaves narrowed and tapering towards base with or without distinct petioles.
8. Aquatic habit ..... 8. *I. kumarakodiensis*
8. Non aquatic habit:
9. Culms robust.....1. *I. abrahamii*
9. Culms slender..... 6. *I. elimalayanum*
6. Leaf blades 10-60 cm long; culms robust up to 200 cm high ..... 11. *I. nairii*
4. Pedicels of the pedicelled spikelet less than one-third length of the sessile spikelets.
10. Lower glumes densely villous with white silky hairs; without nodules ..... 15. *I. raui*
10. Lower glumes glabrous; nodules distinct.
11. Lower glume of the sessile spikelet narrowly winged; nodules distinct, not interconnected ..... 14. *I. quilonensis*
11. Lower glume of the sessile spikelet not winged: nodules interconnected by ridges and furrows.
12. Racemes above 10 cm long..... 18. *I. wayanadense*
12. Racemes below 10 cm long..... 17. *I. vembanadense*
3. Base of the lower leaves usually sagittate or deeply cordate with distinct petioles or without petioles.
13. Lower leaves petiolate.
14. Pedicels of the pedicelled spikelets more than one third length of the sessile spikelets.....10. *I. malabaricum*
14. Pedicels of the pedicelled spikelets less than one third length of the sessile spikelets.
15. Joints of the rachis clavate-turbinate, densely white woolly all over the out side..... .....9. *I. lanatum*
15. Joints of the rachis clavate, glabrous .....13. *I. pushpangadanii*
13. Lower leaves sessile.
16. Pedicelled spikelets sterile.....12. *I. pappinisseriensis*
16. Pedicelled spikelets fertile.
17. Pedicels of the pedicelled spikelets more than one-third of the sessile spikelets..... 3. *I. calicutensis*
17. Pedicels of the pedicelled spikelets less than one-third of the sessile spikelets.....5. *I. copeanum*

1. **Ischaemum abrahamii** Ravi, N. Mohanan & Rajesh, Bot. Bull. Acad. Sin. 42: 225.2001; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 576. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 805. 2006.

Type: Malappuram district: Manathumangalam, ± 50 m, 15 Dec. 1996, *Ravi 33027* (TBGT).

(Fig. 49; Plate 84 d)

Perennials. Culms tufted, erect, robust, up to 1.5 m tall, rooting from the lower nodes; nodes ciliate. Leaves all along the culm, linear-elliptic, up to 40 x 1.5 cm, base cuneate in the lower ones and rounded in upper ones with a tuft of hairs at the base, acuminate at apex; sheath keeled, up to 15 cm long; ligules triangular-ovate, 2-keeled. Racemes 2, up to 10 cm long. Joints triquetrous, 0.25-0.35 cm long, densely-long pilose on the angles. Sessile spikelets 0.55-0.65 cm long, oblong-elliptic to oblong-lanceolate, awned; awn 0.5-0.6 cm long. Callus bearded. Lower glume oblong-elliptic, 0.47-0.57 x 0.17 cm, coriaceous, laterally keeled and narrowly winged on the upper half, nodulose and finely rugulose, densely long pilose except towards the subacute apex, 11-13-nerved. Upper glume coriaceous, boat-shaped, c. 0.4-0.5 x 0.1 cm, acute at apex, keel slightly winged, scaberulous outside, sparsely ciliate on the inrolled margins, 5-7-nerved. Lower lemma hyaline, linear, elliptic-lanceolate, c. 0.45-0.5 x 0.1 cm, acute at apex, 3-nerved, ciliate on the margins in the upper half. Lower palea hyaline, linear, elliptic-lanceolate, 0.42-0.47 x 0.1 cm, acute at the apex, 2-nerved. Upper lemma hyaline, elliptic, deeply cleft into 2-acuminate lobes, awned from the sinus, sparsely ciliate on the margins and scaberulous towards apex; awn geniculate, 0.16-0.19 cm long with a column 0.7-0.9 cm long. Upper palea oblong-lanceolate, hyaline, 2-nerved. Pedicelled spikelets 0.65-0.85 cm long. Pedicel 0.2- 0.35 cm long, clavate, triquetrous, densely pilose. Lower glume obliquely oblong lelliptic, 0.45-0.55 x 0.17 cm, coriaceous, leterally keeled and incurved on the margins, broadly winged on one side, 11-13-nerved. Upper glume, lower lemma, lower palea and upper palea similar to those of sessile spikelets, but slightly smaller. Upper lemma lanceolate, 0.4-0.45 x 0.07 cm, 3-nerved, aristate or shortly notched with an imperfect awn, up to 0.4 cm long. Lodicules 2. Stamens 3. Ovary oblong.

Flowering & Fruiting: October-January.

Habitat: Water channels in the hilly tracts.

Note: A neoendemic species collected during the study. It is necessary to identify more areas of its occurrence to confirm its conservation status.

Specimen examined: Malappuram district: Manathumangalam, ± 50 m, 15 Dec. 1996, *Ravi 33027* (Holotype, TBGT).

2. **Ischaemum agasthyamalayanum** Sreek., Janarth. & A. N. Henry, J. Bombay Nat. Hist. Soc. 84: 643. 1987; Sreek. & V. J. Nair, Fl. Kerala Grass. 126. 1991; M. Mohanan & A. N.

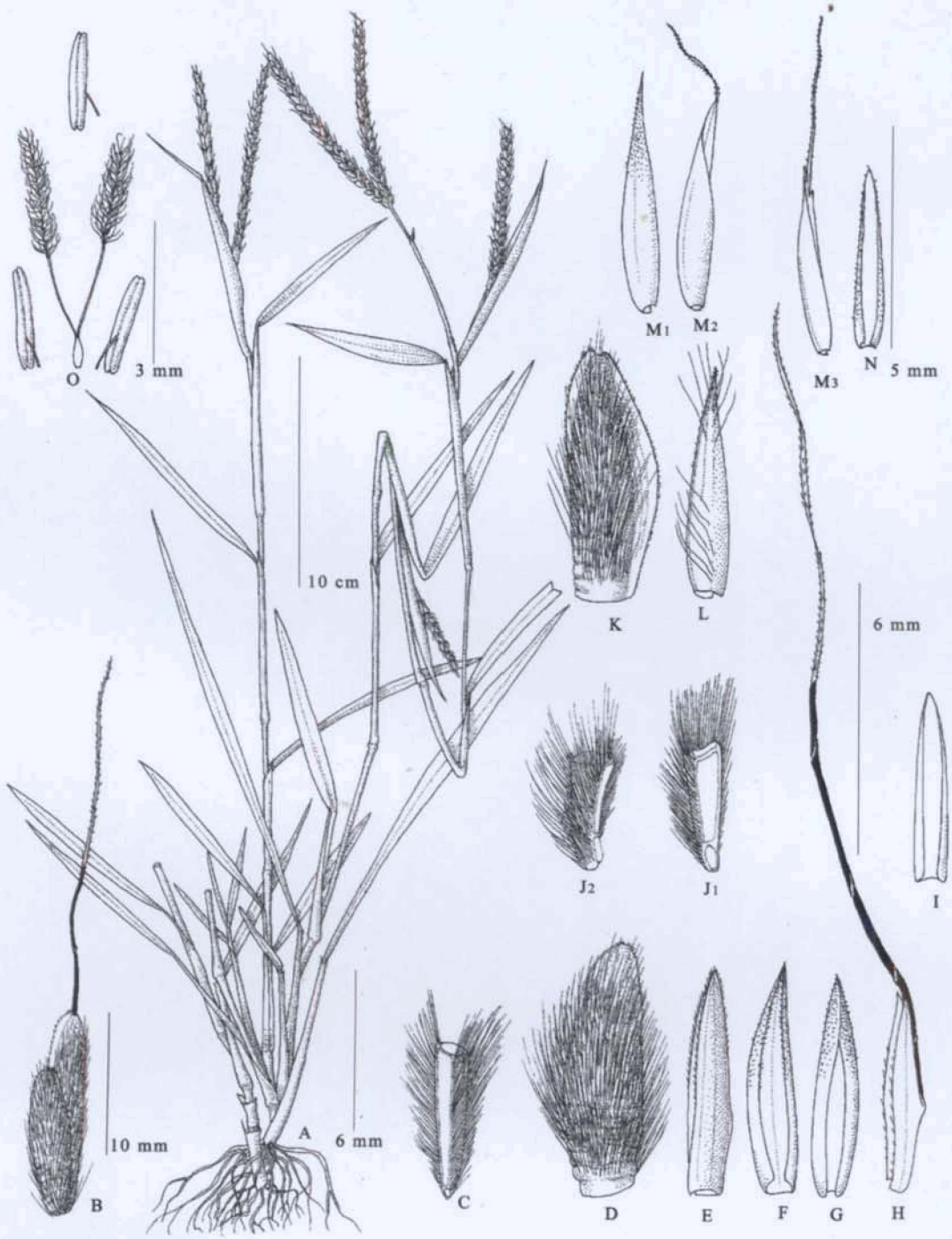

Fig. 49. ***Ishaemum abrahamii*** Ravi *et al*. A. Habit; B. Spiklet pair; C. Rachis joint; D-I. Sessile spikelet: D. Lower glume; E. Upper glume; F. Lower lemma; G. Lower palea; H. Upper lemma; I. Upper palea; J1 - N. Pedicelled spikelet: J1 & J2. Pedicel; K. lower glume; L. Upper glume; M1, M2 & M3.Upper lemma (from different spikelets); N. Upper palea; O. Lodicules stamens & pistil.

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Henry, Fl. Thiruvananthapuram 545. 1994; N. Mohanan & Sivad., Fl. Agasthyamala 828. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 576. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 805. 2006.

Type: Thiruvananthapuram district: Agasthyamala peak, 1800 m, 6 Oct. 1973, *J. Joseph 44634* (CAL). (Plate 84 e)

Perennials. Culms to 20-80 cm tall, trailing or geniculate; nodes bearded or glabrous. Leaves to 3-10 x 0.5-1 cm, elliptic-lanceolate to linear, acuminate at apex, round or shallowly cordate at base, covered with densely or sparse tubercle-based hairs; Sheath keeled; ligules ovate, acute, membranous. Racemes 2, rarely 3, 3-5 cm long, densely hairy. Callus 0.25-0.3 cm long, turbinate, hairy. Sessile spikelets 0.7-0.8 cm long, oblong-lanceolate, awned; awn 0.5-0.6 cm long. Callus bearded. Lower glume broadly ovate-lanceolate, 0.5-0.6 x 0.2-0.3 cm, 3-lobed at apex, chartaceous, 11-13-nerved, densely hairy, margin expanded in lower half. Upper glume ovate-lanceolate, 0.6-0.8 x 0.1-0.2 cm, acuminate, shortly bifid, aristate, keel winged and ciliate. Lower floret male. Upper floret bisexual. Lower lemma ovate-oblong, 0.45-0.5 x 0.2 cm, acute, margins hyaline, ciliate towards apex. Lower palea elliptic-lanceolate, 0.4-0.45 x 0.1 cm, 2-keeled, 2-nerved, margin infolded. Upper lemma notched, 0.4-0.5 x 0.15-0.2 cm, hyaline, 3-nerved, ciliate towards apex; awn 01-1.5 cm long; column 0.5-0.6 cm long. Upper palea oblong-lanceolate, hyaline, 2-nerved. Stamens 3. Ovary oblong. Pedicelled spikelets 0.6-0.7 cm long, awned, some times reduced, lanceolate to oblong-lanceolate. Pedicel 0.2- 0.25 cm long, densely villous. Lower glume oblong-lanceolate, 0.5-0.6 x 0.15-0.2 cm, acuminate, aristate, chartaceous, 9-11-nerved, keeled and densely villous on dorsal side. Upper glume and florets similar to those of the sessile spikelets.

Flowering & Fruiting: February-April.

Habitat: Along the grassy hill slopes and in higher altitude grasslands.

Note: It has not been figured in any conservation categories; owing to narrow distribution, assumes conservation significance.

Specimens examined: Thiruvananthapuram district: Western slopes of Agasthyamala peak, 1800 m, 6 Oct. 1973, *Joseph 44634* (Isotype, MH); *Ibid.*, Athirumala, ± 900 m, 14 Mar. 1994, *N. Mohanan 8923* (TBGT).

3. **Ischaemum calicutensis** Sreek., V. J. Nair & N. C. Nair, J. Econ. Taxon. Bot. 4: 1007. 1983; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 576. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 805. 2006.

Type: Kozhikode district: Pokkunnamala, near Nanmanda, ± 850 m, 29 Oct. 1981, *Sreekumar 71803* (MH). (Plate 84 f)

Perennials. Culms 30-80 cm long, creeping and stoloniferous; upper nodes sparsely villous. Leaves 2-10 x 0.8-0.12 cm, lanceolate, long acuminate, base deeply cordate or sagittate,

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glabrous; sheath keeled, striate, 6-8 cm long, glabrous; ligules ovate, acute, membranous. Racemes 2, 4-6 cm long, densely villous, enclosed in a spathe, 3-10 cm long. Callus 0.3-0.4 cm long, densely villous. Sessile spikelets 0.5-0.6 cm long, ovate-lanceolate, awned. Callus bearded. Lower glume ovate-lanceolate, 0.5-0.55 x 0.1-0.15 cm, coriaceous, 7-9-nerved, densely villous except in the upper part. Upper glume coriaceous, boat-shaped, 0.55-0.6 x 0.1-0.15 cm, keel slightly winged, faintly 5-nerved, covered with short adpressed hairs, margins hyaline, short ciliate. Lower lemma lanceolate, 0.45-0.5 x 0.07-0.1 cm, delicate, hyaline, faintly 5-7-nerved, margin infolded and ciliate. Lower palea hyaline, oblong-lanceolate, 0.4-0.45 x 0.07-0.1 cm, 2-keeled, 2-nerved, glabrous. Upper lemma delicate, hyaline, 0.3-0.35 x 0.1-0.15 cm, notched, lobes acute, faintly 3-nerved, awn 2-2.5 cm long, column 0.5-1 cm long, brownish, scabrid. Upper palea oblong, rounded or slightly emarginate at apex, delicate, hyaline, 2-keeled, 2-nerved, glabrous. Pedicelled spikelets 0.45-0.5 cm long, oblong, awned; pedicels more than one-third of the sessile spikelet, 0.1-0.15 cm long, densely villous. Lower glume oblong-lanceolate, 0.45-0.5 x 0.1-0.15 cm, coriaceous, faintly 5-7-nerved, densely villous. Upper glume, boat-shaped, 0.45-0.5 x 0.1-0.12 cm, coriaceous, faintly 5-nerved, densely villous. Lower lemma lanceolate, 3-5-nerved, margins folded, ciliate. Lower palea oblong-lanceolate, 2-keeled, 2-nerved, glabrous. Upper lemma lanceolate, 0.3-0.35 x 0.1-0.12 cm, notched, lobes acute, glabrous, awn 1.2-1.5 cm long, column c. 0.5 cm long, scabrid. Upper palea oblong, rounded at apex, 2-keeled, 2-nerved, glabrous. Lodicules 2. Stamens 3. Ovary oblong.

Flowering & Fruiting: October-December.

Habitat: Dry grasslands.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Kozhikode district: Pokkunnamala, near Nanmanda, ± 850 m, 29 Oct. 1981, *Sreekumar 71803* (Isotype, MH).

4. **Ischaemum cannanorensis** Sreek., Nair V. J. & N. C. Nair, J. Econ. Taxon. Bot. 4: 109. 1983; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 577. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 807. 2006.

Type: Kasaragod district: Paramba, Chattamchal, ± 100 m, 16 Oct. 1981, *Sreekumar 71702* (MH). (Plate 85 a)

Tufted perennials. Culms 15-60 cm tall, erect or geniculate; nodes bearded. Leaves lanceolate, long acuminate, 2-10 x 0.3-0.6 cm, base rounded or shallowly or even deeply cordate, villous or glabrous; sheaths 2-6 cm long, keeled, striate, glabrous; ligules an oblong acute membrane. Racemes 2, 2-5 cm long, enclosed in a spathe 3-6 cm long, glabrous. Callus 0.25-0.3 cm long, clavate, crustaceous, densely villous on dorsal side. Sessile spikelets 0.3-0.35 cm long, ovate-oblong or oblong-acute, densely hairy or glabrous, awned. Callus bearded.

Plate 84. Type specimens.

a. ***Dimeria sreenarayanii*** Ravi & Anil kumar (SNCH);
b. ***Isachne fischeri*** Bor (K)
c. ***Isachne jayachandranii*** Gopalan & Chandras. (MH);
d. ***Ischaemum abrahamii*** Ravi *et al.* (TBGT);
e. ***Ischaemum agasthyamalayanum*** Sreek. *et al.*(MH);
f. ***Ischaemum calicutensis*** Sreek. *et al.* (MH).

Lower glume ovate-oblong, 0.35-0.5 x 0.12-0.15 cm, coriaceous, smooth or wrinkled with a few shallow nodules and ridges, densely villous or glabrous, faintly 11-13-nerved. Upper glume coriaceous, 0.35-0.5 x 0.12-0.15 cm, acute at apex, margins hyaline, ciliate, 2-keeled, 2-nerved, glabrous. Lower lemma hyaline, 0.3-0.35 x 0.12-0.15 cm, notched, lobes acute, 3-5-nerved, glabrous, awn 1.5-2 cm long, geniculate, column 0.8-1 cm long, scabrid. Lower palea hyaline, 0.25-3 x 0.05-0.07 cm, oblong, rounded at apex, 2-keeled, 2-nerved, glabrous. Pedicelled spikelets 0.35-0.5 cm long, ovate-oblong, usually unawned, very rarely awned. Pedicel 0.2-0.25 cm long, linear-clavate, densely villous. Lower glume ovate-oblong, 0.4-0.5 x 0.15-0.17 cm, winged on one side, scabrid, coriaceous, 11-13- nerved, densely villous or glabrous. Upper glume 0.35-0.45 x 0.1-0.15 cm, lanceolate, keel angled, winged and scabrid towards apex. Lower lemma, and lower palea similar to those of sessile spikelet. Upper lemma ovate-lanceolate, 0.3-0.35 x 0.15-0.17 cm, 3-5-nerved, hyaline, glabrous. Upper palea oblong, hyaline. Lodicules 2, obovate, oblique, 2-horned at apex. Stamens 3. Ovary oblong.

Flowering & Fruiting: October-December.

Habitat: Dry lateritic hills.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Kasaragod district: Paramba, Chattamchal, ± 100 m, 16 Oct. 1981, *Sreekumar 71702* (Isotype, MH).

5. **Ischaemum copeanum** Sreek., V. J. Nair and N. C. Nair, J. Bombay Nat. Hist. Soc. 82: 390. 1985; Ravi & N. Mohanan, Rheedea 12: 138. 2002; Sasidh., Biodiver. Doc. Kerala, Part 6 Flr. Pl. 576. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 806. 2006.

Type: Kasaragod district: Cherkala, ± 200 m, 24 Nov. 1981, *Sreekumar 71838* (MH).

(Plate 85 b)

Creeping annuals. Culms 20-40 cm tall, creeping or geniculate, upper nodes villous. Leaves ovate-lanceolate, 2-5 x 0.4-1 cm, acuminate, rounded or shallowly cordate at base, sparsely covered with tubercle-based hairs; sheath 1-5 cm long; ligule ovate-acute membrane. Inflorescence with 1-2 peduncles from a spathe. Racemes 2, 2-3 cm long, slender, sparsely villous. Callus 0.3-0.35 cm long, linear-clavate, densely villous along the margins. Lowest group of sessile spikelets in three, two of them are awned. Unawned sessile spikelets 0.45-0.5 cm long, linear or oblong-lanceolate, silky villous on the lower half. Awned sessile spikelets 0.4-0.45 cm long, ovate, acute. Callus bearded. Lower glume ovate-oblong, 0.4-0.45 x 0.15-0.17 cm, chartaceous, faintly 11-13-nerved, silky villous in the lower half, margins incurved, slightly winged on one side. Upper glume boat-shaped, 0.4-0.45 x 0.1-0.15 cm, sharply keeled, 3-nerved, ciliolate on the upper half. Lower lemma hyaline, oblong-lanceolate, 0.35-0.4 x 0.1-0.15 cm, 3-5-nerved, ciliolate on the margins on the upper half. Lower palea hyaline, oblong-lanceolate, 0.3-0.35 x 0.07-0.1 cm, 2-keeled, 2-nerved. Upper lemma notched, lobes acute,

hyaline, 3-nerved, awn 1-1.5 cm long, geniculate, column 0.4-0.6 cm long, scabrid. Upper palea oblong, hyaline, 2-keeled, 2-nerved. Pedicelled spikelets 0.4-0.45 cm long, unawned; pedicels less than one-third of the sessile spikelet, 0.05-0.1 cm long, linear-clavate, densely villous. Lower glume oblong-lanceolate, 0.35-0.6 x 0.10.2 cm, densely villous on the lower half, 9-11-nerved. Upper glume coriaceous, oblong-lanceolate, boat-shaped, 0.3-0.6 cm long, keeled on the back, 3-5-nerved. Lower lemma, lower palea and upper plea similar to those of sessile spikelet. Upper lemma hyaline, lanceolate, 3-nerved, minutely scaberulous, shortly notched at the apex. Lodicules 2. Stamens 3. Ovary oblong. Grains ellipsoid.

Flowering & Fruiting: November-December.

Habitat: Wet rocky areas.

Note: As a narrow endemic species, it deserves conservation importance.

Specimens examined: Kasaragod district: Cherkala, ± 200 m, 24 Nov. 1981, *Sreekumar 71838* (Isotype, MH); Kannur district: Bakkalm, ± 30 m, 12 Dec. 1996, *Ravi 33716, 33717* (TBGT).

6. **Ischaemum elimalayanum** Sreek., V. J. Nair & N. C. Nair, J. Bombay Nat. Hist. Soc. 4: 1007. 1983; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 576. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 806. 2006.

Type: Kannur district: Elimala, ± 300 m, 20 Oct. 1981, *Sreekumar 71773* (CAL). (Plate 85 c)

Tufted perennials. Culms 30-120 cm tall, slender; nodes densely villous. Leaves linear-lanceolate, 5-20 x 0.4-1 cm, lower one narrowed towards base, upper ones shallowly cordate. Sheath keeled, 5-15 cm long, covered with dense tubercle-based hairs; ligules ovate. Racemes 2, 4-8 cm long, stout, sparsely villous. Callus linear-clavate, 0.25-0.3 cm long, crustaceous, long villous along margins. Sessile spikelets 0.5-0.55 cm long, awned. Callus bearded. Lower glume ovate or oblong, 0.45-0.5 x 0.17-0.2 cm, acute, crustaceous below with 4-5 shallow side nodules, deeply and irregularly wrinkled, faintly 9-11-nerved. Upper glume boat-shaped, 0.45-0.5 x 0.15-0.2 cm, keel rounded, humped in the middle, tip minutely winged and scabrid. Lower lemma hyaline, oblong-lanceolate, 0.4-0.45 x 0.1-0.15 cm, 3-nerved, margins incurved, ciliate on the upper half. Lower palea hyaline, elliptic-lanceolate, 0.4-0.45 x 0.1-0.15 cm, 2-keeled, 2-nerved, glabrous. Upper lemma hyaline, notched, lobes acute, 3-nerved, margins ciliolate on the upper half; awn 1.2-1.5 cm long, geniculate, column 0.5-0.7 cm long, scabrid. Upper palea oblong-acute, hyaline, 2-keeled, 2-nerved. Pedicelled spikelets oblong, 0.4-0.45 cm long, unawned. Pedicel 0.25-0.3 cm long, clavate, densely villous. Lower glume oblong, 0.4-0.45 x 0.15-0.17 cm, broadly winged on one side, wing auriformis, faintly 7-9-nerved, sparsely villous on the lower half. Upper glume lanceolate, 0.35-0.4 x 0.1-0.15 cm, keel rounded, minutely winged and scabrid towards apex, 3-5-nerved. Lower lemma oblong, hyaline, faintly 3-nerved, margins folded ciliate. Lower palea lanceolate, 2-keeled, 2-nerved. Upper lemma ovate-

lanceolate, 0.3-0.35 x 0.1-0.15 cm, 3-5-nerved, glabrous. Upper palea similar to those of sessile spikelet. Lodicules 2, obovate. Stamens 3. Ovary oblong.

Flowering & Fruiting: December-January.

Habitat: Growing along grassy hill slopes.

Note: As a narrow endemic species, it deserves conservation importance.

Specimens examined: Kannur district: Elimala, ± 300 m, 20 Oct. 1981, *Sreekumar 71773* (Isotype, MH); Thiruvananthapuram district: Agasthayamala, Attayar, ± 700 m, 22 Dec. 1989, *N. Mohanan 9177* (TBGT); Athirumala, ± 1000 m, 27 Aug. 1997, *Kiran Raj 34765* (TBGT); Kannur district: Ezhimala Naval Acadamy Campus, 8 Dec. 2006 *Shaju 48987* (TBGT)

7. **Ischaemum jayachandranii** R. Ansari, V. S. Ramach. & Sreek., Curr. Sci. 53. 151. 1984; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 577. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 807. 2006.

Type: Kasaragod district: Nileswram, ± 175 m, 29 Jan. 1979, *V. J. Nair 59981* (MH (Plate 85 d)

Stoloniferous perennials. Culms 30-50 cm tall, slender, erect or creeping; nodes glabrous. Leaves lanceolate or elliptic-lanceolate, 4-12 x 0.3-0.6 cm, lower ones narrowed and tapering towards base, upper ones rounded or shallowly cordate, glabrous, margins minutely serrulate; sheath 4-10 cm long, striate, glabrous; ligules an ovate acute mambrane. Racemes 2, 4-8 cm long, slender, glabrous. Callus 0.4-0.45 x 0.17-0.2 cm, turbinate, smooth, glabrous. Sessile spikelets 0.55-0.6 x 0.17-0.2 cm, oblong-lanceolate, unawned. Callus glabrous. Lower glume oblong-lanceolate, 0.5-0.55 x 0.17-0.2 cm, coriaceous, faintly 11-13-nerved, glabrous. Upper glume boat-shaped, 0.5-0.55 x 0.15-0.2 cm, sharply keeled, minutely winged at apex, faintly 3-5- nerved. Lower lemma hyaline, lanceolate, 0.5-0.6 x 0.1-0.15 cm, shortly acuminate, 3-5-nerved, margins incuved, glabrous. Lower palea hyaline, lanceolate, 0.45-0.5 x 0.1-0.15 cm, 2-keeled, 2-nerved. Upper lemma 0.45-0.5 x 0.15-0.2 cm, entire or rarely notched, ovate-lanceolate, 5-nerved, median nerve prominent and prolonged into a rudimentary awn when it is notched, lobes acuminate, longer than rudimentary awn, glabrous. Pedicelled spikelets 0.5-0.55 cm long, oblong-acute, unawned; Pedicel c. 0.1 cm long, clavate, glabrous. Lower glume 0.5-0.55 x 0.17-0.2 cm, ovate-acute, narrowly winged on one margin, wing scaberulous, coriaceous, smooth or glabrous, faintly 11-13-nerved. Upper glume 0.45-0.5 x 0.1-0.15 cm, lanceolate, keel rounded, coriaceous, glabrous; other florets similar to that of sessile spikelets.

Flowering & Fruiting: December-January.

Habitat: In water logged areas.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Kasaragod district: Nileswram, ± 175 m, 29 Jan. 1979, *V.J.Nair 59981* (Isotype, MH).

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8. **Ischaemum kumarakodiensis** Ravi, N. Mohanan & Kiran Raj, Rheedea 8: 149. 1998; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 577. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 807. 2006; Sunil, Fl. Alappuzha 860. 2009.

Type: Alapuzha district: Pallana, Kumarakodi, 29 Dec. 1996, *Ravi 33084* (TBGT).

(Fig. 50; Plate 85 e & 88 d)

Densely tufted perennials. Culms smooth, erect to decumbent, up to 75 cm tall, rooting from the lower nodes; nodes glabrous. Leaves all along the culm, linear-oblanceolate, up to 15 x 0.5 cm, gradually cuneate, non-petiolate, acuminate at apex, glabrous. Sheath keeled, up to 8 cm long, subcompressed, glabrous. Ligules 2-keeled, truncate at apex. Racemes 2, 4-7 cm long. Joints triquetrous, 0.3-0.4 cm long, ciliate on the outer angle. Sessile spikelets up to 0.5 cm long. Callus bearded. Lower glume oblong-elliptic, 0.45-0.5 x 0.15 cm, subcoriaceous, subacute to obtuse at apex, faintly 9-11-nerved, nodules faintly and irregularly wrinkled in the lower half and keeled on margins above and the keel sharply angled and narrowly winged on one sie towards apex and scaberulous on the margin of the wing. Upper glume coriaceous, oblong-elliptic, boat-shaped, 0.45-0.5 cm long, subacute at apex, 5-nerved, incurved on margins, sharply keeled on the back, shortly ciliate on the incurved margins. Lower lemma hyaline, elliptic-lanceolate, 0.45 x 0.1 cm, acute at apex, 3-nerved, incurved along the laterals, fertile and male. Lower palea hyaline, elliptic-lanceolate, 0.42-0.1 cm, acute at apex, 2-nerved. Upper lemma hyaline, elliptic, c. 0.35 cm long, cleft to the middle and awned from the sinus, acute at apex, 3-nerved; awn up to 1.4 cm long, geniculate with a column 0.4-0.65 cm long, scaberulous, fertile and bisexual. Upper palea linear-lanceolate, hyaline, 2-nerved, infolded along the nerves. Pedicelled spikelets obliquely ovoid, 0.4-0.5 x 0.2 cm. Pedicel 0.25-0.3 cm long, long ciliate on the outer angle. Lower glume thickly coriaceous, obliquely ovate, 0.4-0.5 x 0.2 cm, obtuse-notched at apex, broadly winged, 11-14-nerved. Upper glume, lower lemma, lower palea and upper palea similar to those of sessile spikelets. Upper lemma hyaline, elliptic-lanceolate, 0.3-0.35 x 0.07 cm, subacute at apex, 3-nerved, incurved along the margins, fertile and bisexual. Lodicules 2. Stamens 3. Ovary oblong.

Flowering & Fruiting: September-March.

Habitat: Thick tufts on the reverine banks.

Note: A neoendemic species described during the study, so further explorations must be made to locate the species in its known distributional areas to confirm its conservational status.

Specimen examined: Alappuzha district: Pallana, Kumarakodi, 29 Dec. 1996, *Ravi 33084* (Holotype, TBGT).

9. **Ischaemum lanatum** Ravi, N. Mohanan & Shaju, Rheedea 10: 91. 2000; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 577. 2004; T. S. Nayar *et al.* Flr. Pl. Kerala – A Handb. 807. 2006.

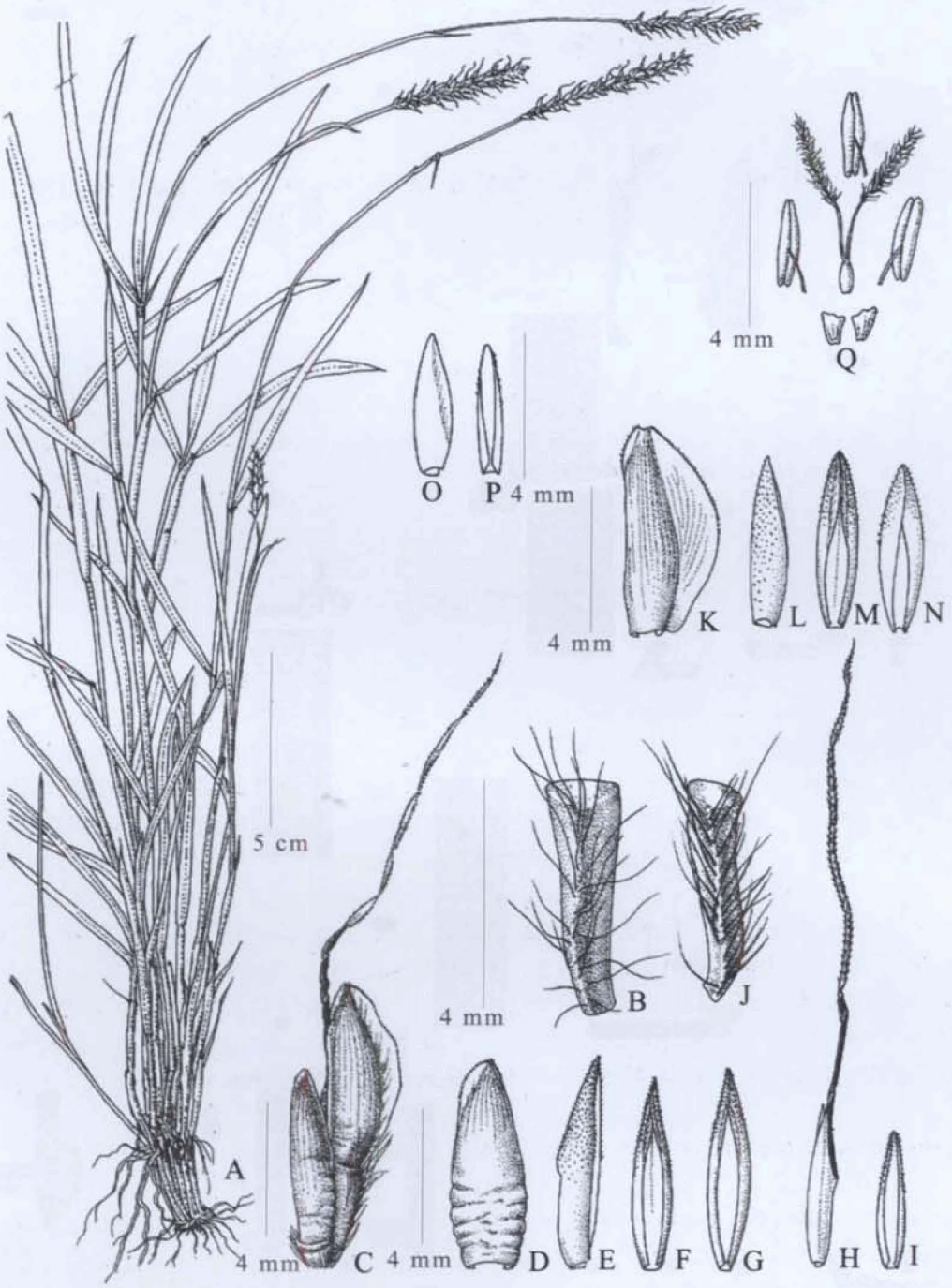

Fig. 50. ***Ischaemum kumarakodiensis*** Ravi *et al.*: A. Habit; B. Rachis joint; C. Spikelet pair; D-I Sessile spikelet: D. Lower glume; E. Upper glume; F. Lower lemma; G. Lower palea; H. Upper lemma; I. Upper palea; J - P. Pedicelled spikelet: J. Pedicel; K. Lower glume; L. Upper glume; M. Lower lemma; N. Lower palea; O. Upper lemma; P. Upper palea; Q. Lodicules, stamens & pistil.

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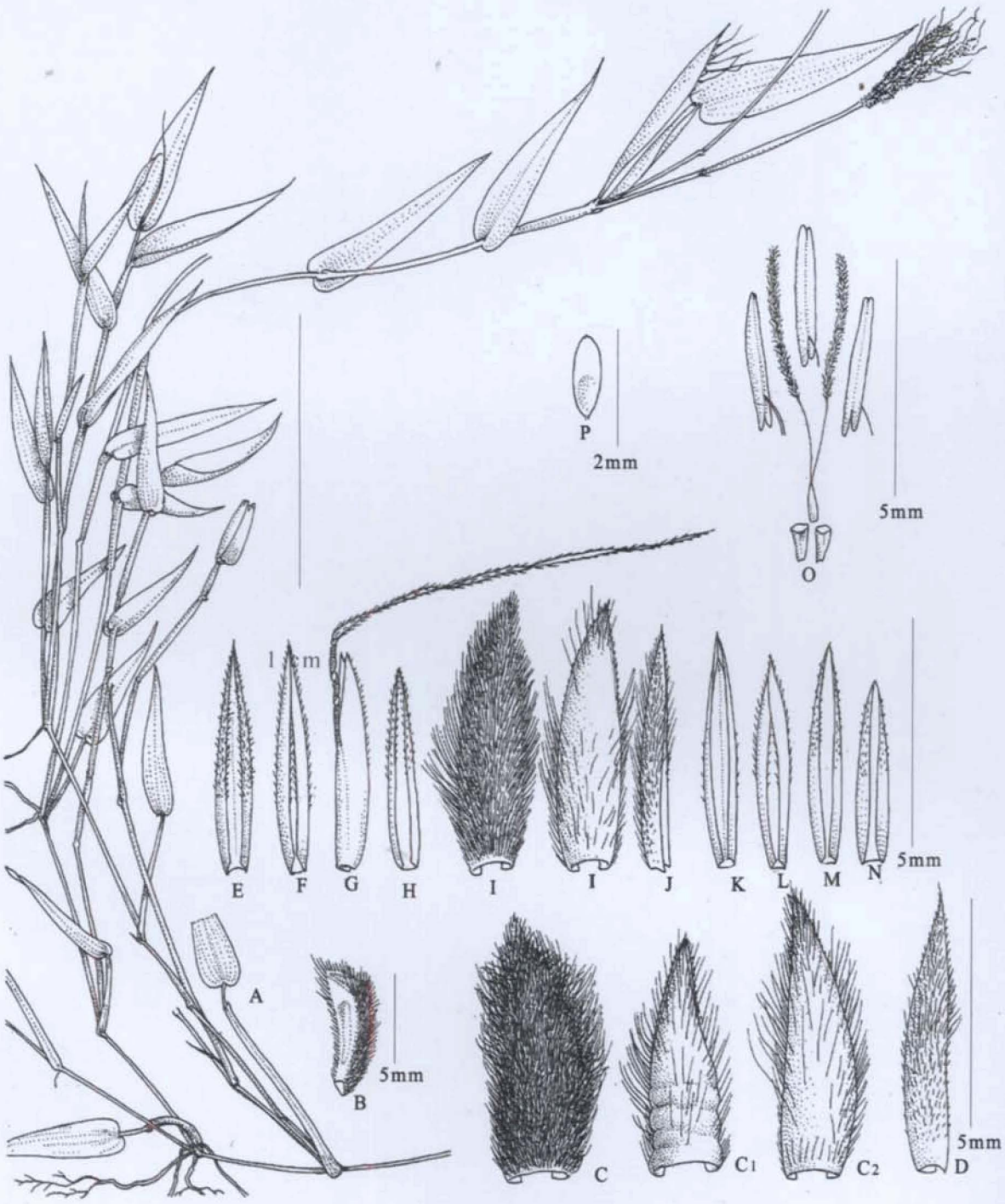

Fig. 51. ***Ischaemum lanatum*** Ravi *et al.*: A. Habit; B. Joints of rachis; C-H: From sessile spikelet: C. Lower glume; C1 & C2. Lower glume from different spikelets- after removal of most of the hairs; D. Upper glume; E. Lower lemma; F. Lower palea; G. Upper lemma; H. Upper palea; I - N. From pedicelled spikelet: I. Lower glume; I1. Lower glume after removal of most of the hairs; J. Upper glume; K. Lower lemma; L. Lower palea; M. Upper lemma; N. Upper palea; O. Lodicules, stamens & pislil; P. Grain

NB 5995

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Plate 85.Type specimens.

a. *Ischaemum cannanorensis* Sreek. *et al.* (MH);
b. *Ischaemum copeanum* Sreek. *et al.* (MH);
c. *Ischaemum elimalayanum* Sreek. *et al.* (TBGT);
d. *Ischaemum jayachandranii* Ansari *et al.* (MH);
e. *Ischaemum kumarakodiensis* Ravi *et al.* (TBGT);
f. *Ischaemum lanatum* Ravi *et al.* (TBGT).

NB 5995

312 C

Type: Kasaragod district: Hosdurg, Periya, ± 50 mm, 29 Nov. 1999, *Ravi 41535* (TBGT).

(Fig. 51; Plate 85 f)

Annulals. Culms slender, erect to decumbent, rooting at lower nodes, up to 100 cm long; nodes villous. Leaves all along the culm, oblong-lanceolate, up to 10 x 1 cm, rounded to cordate at the base in the lower ones, semisagittate in the upper ones, acuminate at apex. Sheath keeled, up to 9 cm long, keeled, hairy with bulbous-based hairs. Ligules triangular-ovate, truncate-notched at apex, 2-keeled, hairy outside. Racemes 2, up to 7 cm long, densely wooly. Joints triquetrous, clavate-turbinate, 0.4-0.65 x 0.2-0.25 cm, densely white-wooly all over the outside. Sessile spikelets elliptic-lanceolate to oblong-lanceolate, 0.6-0.75 cm long, awned. Callus bearded. Lower glume elliptic-lanceolate, 05-0.6 x 0.18-0.2 cm, crustaceous, laterally keeled on the upper with scaberulous keels, acute at apex, 2-3 nodulose and obscurely transversely rugose, 9-11-nerved, densely wooly. Upper glume oblong-lanceolate, coriaceous, boat-shaped, 0.5-0.6 x 0.1-0.15 cm, 5-7- nerved, keeled on back, acuminate-aristate at apex, densely hirsute-villous. Lower lemma hyaline, elliptic-lanceolate, 0.45-0.55 cm long, acuminate at apex. Lower palea hyaline, linear-elliptic to lanceolate, 0.42-0.55 cm long, acuminate at the apex, 2-nerved, keeled along the nerves, scaberulous-ciliate on the keels and margins. Upper lemma hyaline, elliptic to oblong, 0.37-0.5 cm long, deeply cleft, with acute to acuminate lobe, awned from the cleft, 3-nerved; awn 1.3-1.9 cm long with a column 0.5-0.8 cm long. Upper palea linear-lanceolate, hyaline, 2-nerved, keeled along the nerves. Pedicelled spikelets 0.5-0.8 cm long. Pedicel 0.15-0.25 cm long, and densely silky villous. Lower glume oblong-lanceolate, 0.45-0.65 x 0.15 cm, crustaceous and rounded on the sides, leterally keeled above with scaberulous keels, acute at apex, 7-11-nerved, densely silk-wooly. Upper glume, lower lemma, lower palea and upper palea similar to those of sessile spikelet. Upper lemma hyaline, linear-lanceolate, 0.4-0.45 cm long, acuminate at apex, 3-nerved, incurved on the sides and sparsely scaberulous. Lodicules 2, truncate at apex. Stamens 3. Ovary ovoid. Grains obovoid, c. 0.18 cm long.

Flowering & Fruiting: October-January.

Habitat: Shady location in rocky grassy hills.

Note: As a newly described narrow endemic species, its distributional status should be analysed for further conservation management.

Specimens examined: Kasaragod district: Hosdurg, Periya, ± 50 mm, 29 Nov. 1999, *Ravi 41535* (Holotype, TBGT); *Ibid.*, 29 Nov. 1999, *Ravi 41536* (Paratype, TGBGT).

10. **Ischaemum malabaricum** Sreek., V. J. Nair & N. C. Nair, Kew Bull. 39: 743. 1984; Sreek. & V. J. Nair, Fl. Kerala Grass. 145. 1991; Samaddar & Roy, Add. Ele. Ind. Fl. 229.1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 578. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 807. 2006.

Type: Kasaragod district: Pramba, 150 m, 16 Oct. 1981, *Sreekumar 71812* (MH).

(Plate 86 a)

Annuals. Culms creeping and geniculate; upper nodes villous, lower ones villous or glabrous. Leaves triangular, ovate-lanceolate, 1-10 x 0.5-0.15 cm, acute or long acuminate, base deeply cordate or sagittate, glabrous or sparsely villous; sheath 1-6 cm long, striate, glabrous; ligule an ovate membrane. Racemes 2, 2-6 cm long, slender, enclosed in a spathe. Callus 0.25-0.3 cm long, linear-clavate, rounded on dorsal side, margins long villous. Sessile spikelets 0.35-0.45 cm long, ovate-oblong, awned. Callus bearded. Lower glume ovate-oblong or elliptic, 0.3-0.5 x 0.1-0.15 cm, chartaceous, faintly 9-11-nerved, dorsally covered with long white hairs. Upper glume 0.3-0.35 x 0.12-0.15 cm, chartaceous, boat-shaped, dorsally rounded, 3-5 nerved, covered with short adpressed hairs, margins hyaline, ciliate. Lower lemma hyaline, linear-oblong or elliptic-lanceolate, 0.35-0.4 x 0.07-0.1 cm, acute, 2-keeled, 3-5-nerved, shortly hairy along the margins. Lower palea hyaline, linear, elliptic-oblong, 0.3-0.35 x 0.07-0.1 cm, 2-nerved, 2-keeled, glabrous. Upper lemma 0.25-0.3 x 0.07-0.1 cm, notched, lobes acute, hyaline, 3-nerved, ciliate, awn 1.2-1.5 cm long, column c. 0.5 cm long, scabrid. Upper palea oblong-oblanceolate, rounded at apex, hyaline, 2-keeled, 2-nerved, glabrous. Pedicelled spikelets 0.35-0. 4 cm long, eliptic-acute, unawned. Pedicel c. 0.2 cm long, linear, dialated at apex, dorsally rounded, ventrally flat, long villous along the margins. Lower glume oblong-lelliptic, 0.35-.04 x 0.07-0.1 cm, chartaceous, faintly 9-11-nerved, 2-keeled, scabrid along the keels. Upper glume elliptic-lanceolate, 0.35-0.4 x 0.1-0.15 cm, acute or shortly acuminate, 3-nerved, shortly keeled. Lower lemma elliptic-lanceolate, 0.35-.04 x 0.07-0.1 cm, 3-4 nerved, 2-keeled. Lower palea lanceolate, hyaline, 2-keeled, 2-nerved, glabrous. Upper lemma elliptic, acute, 0.25-0.3 x 0.07-0.1 cm, 3-nerved, shortly keeled. Upper palea linear-oblong, hyaline, 2-keeled, 2-nerved, glabrous. Lodicules 2. Stamens 3.

Flowering & Fruiting: October-December.

Habitat: Lateritic dry grasslands.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Kasaragod district: Paramba, on the way to Bandhadukka, 150 m, 16 Oct. 1981, *Sreekumar 71812* (Isotype, MH).

11. **Ischaemum nairii** V. J. Nair & Sreek., J. Econ. Taxon. Bot. 5: 1205. 1984; Karth. *et. al.*, Fl. Ind. Enum. Monocot. 232. 1989; Sreek. & V. J. Nair, Fl. Kerala Grass. 151. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 578. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 808. 2006.

Type: Kozhikode district: Kanjirakadavu, 900 m, 26 Nov. 1981, *Sreekumar 71843* (MH). (Plate 86 b)

Tufted perennials. Culms 100-200 cm tall, erect; nodes densely villous. Leaves 10-60 x 1-2 cm, linear-lanceolate, acuminate, base cuneate in the lower ones and shallowly cordate in upper ones, densely villous with tubercled hairs; Sheath 10-80 cm long, striate, villous in the

upper half; ligule ovate acute membrane. Racemes 2, 5-12 cm long, stout, glabrous or sparsely villous. Callus 0.25-0.3 cm long, crustaceous, linear-clavate, long villous along the margins and dorsal angles. Sessile spikelets 0.55-0.6 cm long, elliptic, awned. Callus densely bearded. Lower glume ovate-acute, 0.45-0.55 x 0.17-0.2 cmcrustaceous below with several side nodules joined by sharp ridges, 9-11-nerved. Upper glume boat shaped, 0.5-0.55 x 0.15-0.2 cm, dorsally keeled, tip minutely winged and scabrid, 7-9-nerved, margins hyaline and ciliate on the upper half. Lower lemma hyaline, oblong-lanceolate, 0.45-0.5 x 0.1-0.15 cm, 3-nerved, ciliate on the upper half. Lower palea hyaline, elliptic-lanceolate, 0.45-0.55 x 0.1 cm, 2-keeled, 2-nerved, margins incurved, ciliate on the upper half. Upper lemma 0.35-0.4 x 0.1-0.15 cm, notched, lobe sharply acute, hyaline, 3-nerved, margins ciliolate in the upper half; awn 1.4-1.6 cm long, geniculate, column 0.6-0.7 cm long, scabrid. Upper palea lanceolate, hyaline, 2-nerved, 2-keeled, glabrous. Pedicelled spikelets 0.5-0.55 cm long, ovate-acute, unawned. Pedicel 0.2-0.25 cm long, clavate, triquetrous, densely villous. Lower glume ovate, 0.45-0.5 x 0.2-0.25 cm, narrowly winged on one side, wing scabrid, side nodules indistinct, 7-9-nerved, glabrous. Upper glume 0.4-0.45 x 0.15-0.2 cm, ovate-lanceolate, keel rounded, 5-nerved, margins infolded, ciliate on the upper half. Lower lemma oblong-lanceolate, hyaline, 3-nerved, margins infolded, ciliate on the upper half. Lower palea similar to that of sessile spikelet. Upper lemma ovate-lanceolate, 0.35-0.4 x 0.17-0.2 cm, hyaline, 3-5-nerved, margins ciliate on the upper half. Upper palea similar to that of sessile spikelet. Lodicules 2. Stamens 3. Ovary oblong.

Flowering & Fruiting: November-December.

Habitat: Marshy places.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Kozhikode district: Kanjirakadavu, Near Kakkayam, 900 m, 26 Nov. 1981, *Sreekumar 71843* (Isotype, MH).

12. **Ischaemum pappinisseriensis** Ravi, N. Mohanan & Rajesh, Rheedea 8: 155. 1998; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 578. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 808. 2006.

Type: Kannur district: Pappinisseri, 12 Dec. 1996, *Ravi 33707* (TBGT). (Fig. 52; Plate 86 c)

Annuals. Culms tufted, erect to decumbent, up to 60 cm tall, rooting at lower nodes; nodes sparsely bearded. Leaves all along the culm, linear, oblong-lanceolate, up to 8 x 0.6 cm, lower ones cuneate and non-petiolate at base, upper ones cuneate rounded at base with a short-ciliate petiole, and acuminate at apex. Sheath keeled, up to 7 cm long, striate and glabrous. Ligules subcoriaceous, oblong-ovate, 2-keeled, truncate or shortly notched at apex. Racemes 2, up to 5 cm long. Joints triquetrous, turbinate, 0.3-0.1 cm long, densely-long ciliate on the outer angle. Sessile spikelets c. 0.5 x 0.2 cm. Callus bearded. Lower glume oblong-elliptic, 0.4-0.5 x 0.18-0.2 cm, crustaceous, laterally keeled with incurved margins and sharply angled and

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broadly on the upper half, deeply 3-5-nodulose on sides on the lower half, 13-15-nerved. Upper glume coriaceous, boat-shaped, c. 0.5 x 0.15 cm, 5-nerved, sharply angled keel incurved and shortly ciliate on margins, acute at apex. Lower lemma subcoriaceous, elliptic-lanceolate, 0.4-0.45 cm, acute at apex, 3-nerved, incurved on sides, sparsely ciliate on margins towards apex, paleate and male. Lower palea hyaline, elliptic-lanceolate, 0.35-0.4 x 0.1 cm, acute at the apex, 2-nerved. Upper lemma hyaline, oblong-lanceolate, 0.3-0.4 x 0.07 cm, deeply clefted in o 2 acuminate lobes, awned from the sinus, 3-nerved; awn up to 2.25 cm long with a column up to 0.75 cm long. Upper palea lanceolate, hyaline, 2-nerved, incurved on sides and obtuse at apex. lodicules 2, truncate at apex. Stamens 3. Ovary oblong. Pedicelled spikelets reduced and empty. Pedicel c. 0.3 cm long, linear-lanceolate, triquetrous, densely ciliate on outer angles. Lower glume oblong, 0.25-0.3 x 0.1 cm, broadly obtuse-retuse at apex, 9-11-nerved, flattened and keeled with the keels broadly all along on both sides and scabrid on margins. Upper glume highly reduced, hyaline, elliptic-lanceolate acute at apex, 2-nerved, ciliolate on margins towards apex. All other parts completely suppressed.

Flowering & Fruiting: October-March.

Habitat: Lowland lake side.

Note: As a newly described narrow endemic species, its distribution status should be analysed for further conservation management.

Specimen examined: Kannur district: Pappinisseri, 12 Dec. 1996, *Ravi 33707* (Holotype, TBGT).

13. **Ischaemum pushpangadanii** Ravi, N. Mohanan, Shaju & Kiran Raj, Rheedea 10: 49. 2000; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 578. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 808. 2006.

Type: Kozhikode district: Koilandy, Kakkayam hills, *Ravi 41460* (TBGT). (Fig. 53; Plate 86 d)

Annuals. Culms tufted, erect to diffuse, up to 100 cm tall, reddish when fresh; nodes villous towards apex of the culm and glabrous towards base. Leaves all along the culm, linear-lanceolate, up to 15 cm long, cordate-hastate, pseudo-petiolate towards the base and more or less rounded or cordate, sessile upwards and acuminate at apex. Sheath up to 5 cm long, keeled, striate, glabrous. Ligules notched to irregularly lobed at apex, keeled. Racemes 2, up to 5 cm long. Joints clavate, 0.35-0.4 cm long, glabrous. Sessile spikelets awned or unawned, linear-lanceolate, 0.6-0.7 cm. Callus glabrous. Lower glume linear-lanceolate, up to 0.6 x 0.1 cm, coriaceous, laterally keeled, sparsely scaberulous towards the acute apex, 2-4-nodulose on the lower half in the lower portion and densely long villous. Upper glume coriaceous, linear-lanceolate, up to 0.6 x 0.15 cm, keeled on the back, short ciliate on margins, faintly 2-nerved. Lower lemma hyaline, linear-lanceolate, 0.45-0.55 x 0.1 cm, acute at apex, incurved on margins, 3-nerved. Lower palea hyaline, linear-lanceolate, 0.45-0.55 x 0.1 cm, incurved on the

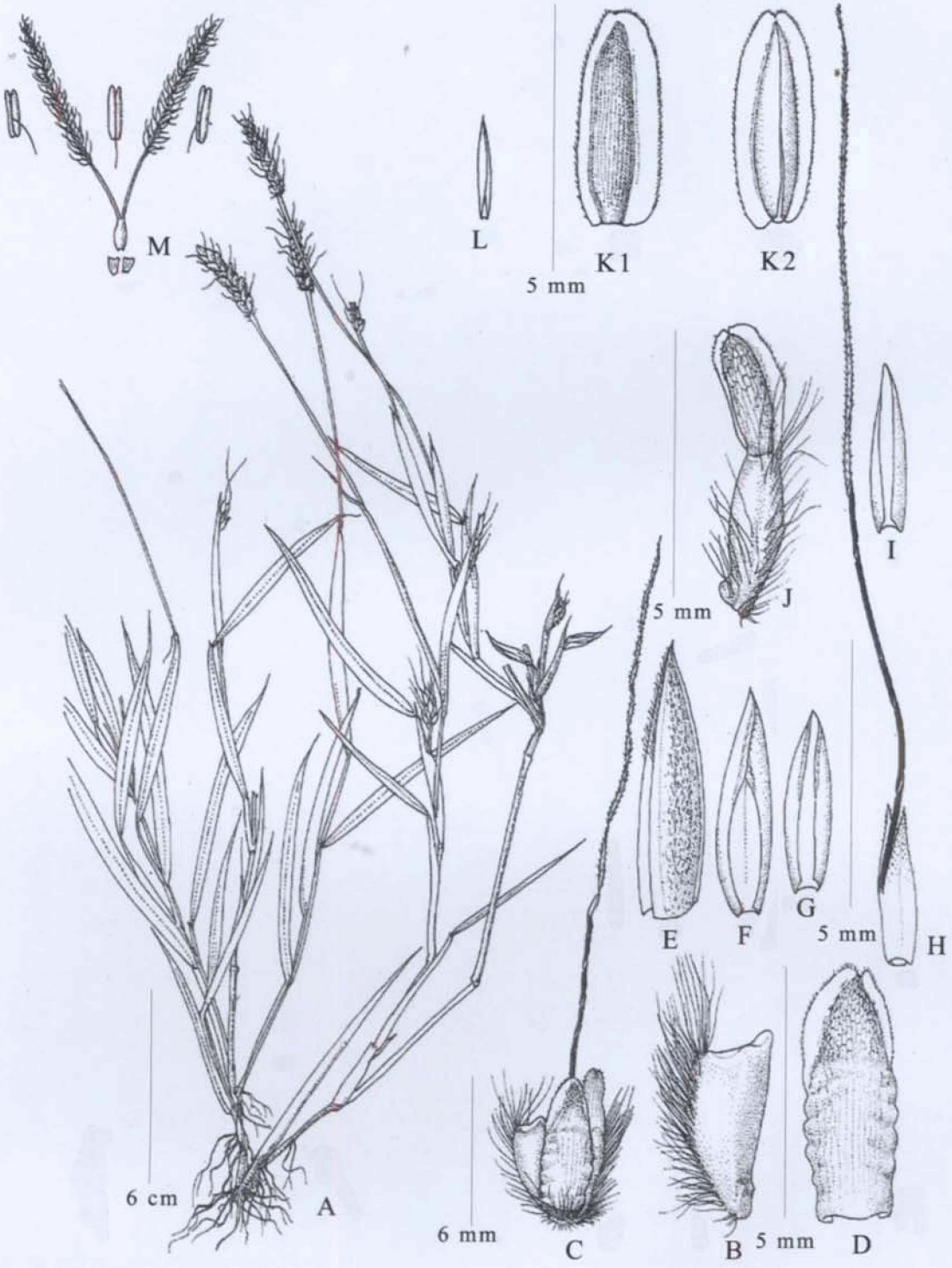

Fig. 52. ***Ischaemum pappinisseriensis*** Ravi *et al.*: A. Habit; B. Rachis joint; C. Spiklet pair; D - I. Sessile spiklets: D. Lower glume; E. Upper glume; F. Lower lemma; G. Lower palea; H. Upper lemma; I Upper palea; J - L. Pedicelled spiklet: J. Spiklet. K1 & K2. Lower glume; L. Upper glume; M. Lodicules, stamens & Pistil.

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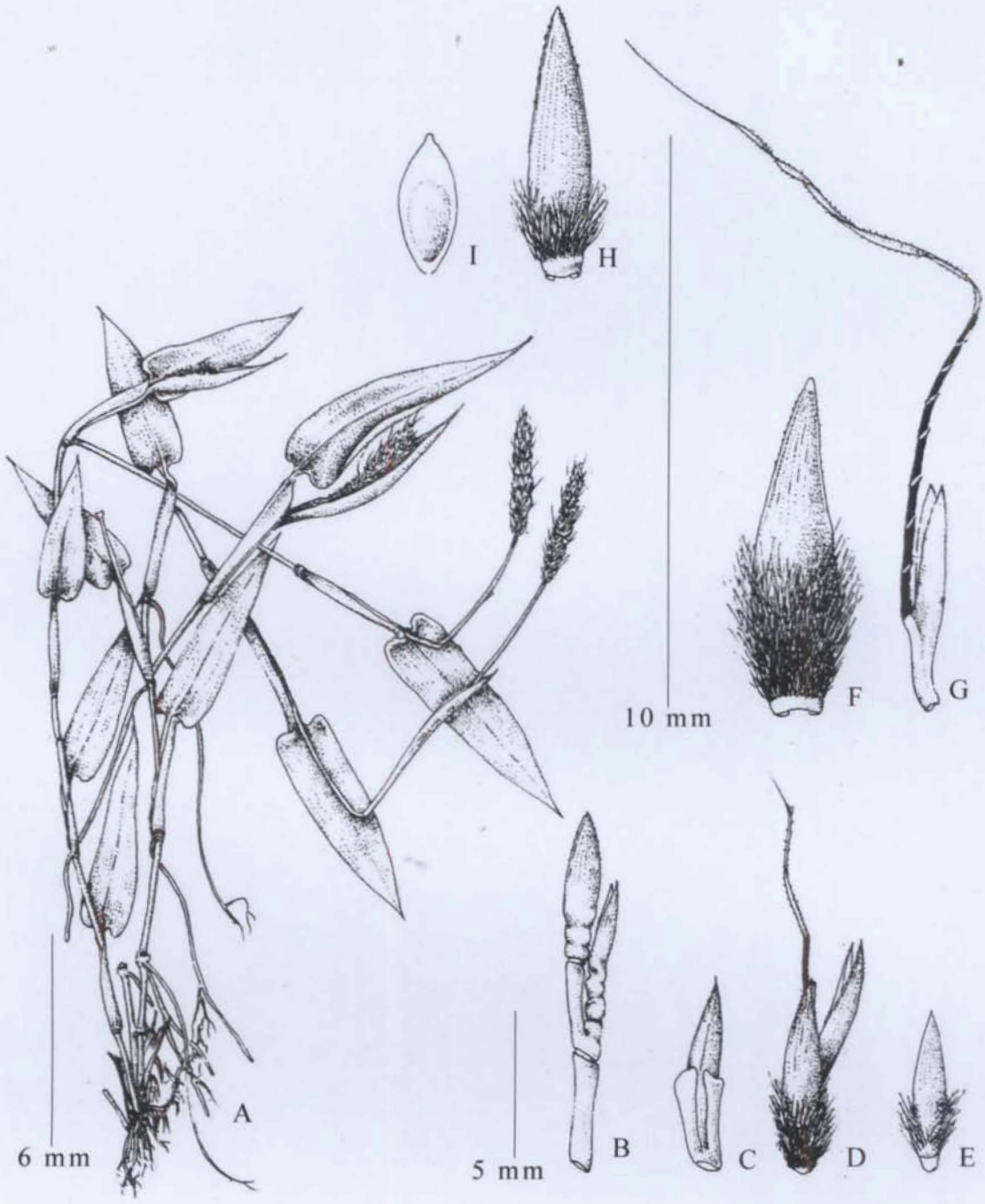

Fig. 53. ***Ischaemum pushpangadanii*** Ravi *et al.*, A. Habit; B. Lower most spikelet pair; C. A sessile spikelet with a pedicel and a rachis joint; D. A spikelet pair from the middle of a receme; E. A pedicelled spikelet from the middle of a receme; F & G. From sessile awned spikelet: F. Lower glume; G. Upper lemma; H. Upper pedicelled hairy spikelet; I. Grain.

NB 5945

316 B

sides, acute at the apex, 2-nerved. Upper lemma hyaline, 0.35-0.4 x 0.07 cm, oblong, shortly bifid at apex with acute lobes, strongly mid-veined and unawned in the unawned sessile spikelets and linear-oblong-elliptic, deeply cleft with linear-acute lobes, 3-veined and awned from the sinus in the awned sessile spikelets; awn, when present, 1.3-1.5 cm long with a column 0.6-0.7 cm long. Upper palea hyaline, linear-lanceolate. Pedicelled spikelets linear-elliptic. Pedicel crustaceous, clavate, up to 0.8 cm long, turbinate, glabrous. Lower glume thickly coriaceous, linear-elliptic to lanceolate, 0.45-0.55 x 0.1-0.15 cn, larger ones towards the base and smaller ones towards the apex of the raceme, incurved on the margins, laterally sharply keeled and scaberulous on the margins towards the acute apex, 2-3-nodulose and glabrous in the basal spikelets. Upper glume, lower lemma, lower palea and upper palea similar to those of sessile spikelet, but smaller. Upper lemma hyaline, elliptic-lanceolate, 0.3-0.45 cm long, acute at apex, incurved, 3-nerved. Lodicules 2. Stamens 3. Ovary oblong. Grains oblong, compressed, 0.2-0.25 cm long, apiculate at apex.

Flowering & Fruiting: September-December.

Habitat: Wet rocky cliffs.

Note: A neoendemic species described during the study. It is necessary to identify more areas of its occurrence towards planning further conservation management.

Specimens examined: Kozhikode district: Koilandy, Kakkayam hills, ± 420 m, 26 Oct. 1999, *Ravi 41460* (Holotype, TBGT); *Ibid.*, 27 Nov.1998, *Ravi 39623* (Paratype, TBGT).

14. **Ischaemum quilonensis** Ravi & Shaju, Rheedea 8: 152. 1998; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 578. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 808. 2006.

Type: Kollam district: Perumkulam Ela, Perumkulam Ela, 27 Oct.1996, *Ravi 24098* (TBGT) (Fig. 54; Plate 86 e & 88 e)

Perennials. Culms tufted, creeping and rooting from the lower nodes, up to 80 cm tall; nodes glabrous. Leaves all along the culm, linear-lanceolate, up to 20 x 1.2 cm, acute at apex, lower ones cuneate to cuneately round at base; sheath up to 12 cm long, glabrous; ligules triangular-ovate, unequally notched at apex, 2-keeled. Racemes 2, very rarely 3, up to 10 cm long. Joints broadly clavate, 0.45-0.55 x 0.2-0.25 cm, mostly glabrous, shortly ciliate on the outer angles. Sessile spikelets 0.5-0.7 x 0.2-0.25 cm, ovate-oblong. Callus glabrous. Lower glume oblong-lanceolate, 0.5-0.7 x 0.2-0.25 cm, coriaceous, laterally keeled and incurved on margins, truncate-retuse at apex, prominently 3-5 nodules on sides, narrowly winged on one side and very slenderly winged on the other above, 11-13-nerved. Upper glume coriaceous, boat-shaped, 0.4-0.5 cm long, keel scaberulous and slightly winged towards the acute apex, 3-5-nerved. Lower lemma hyaline, lance-elliptic, 0.5-0.55 x o.12-0.15 cm, acute at apex, 3-5 nerved. Lower palea hyaline, lanceo-elliptic, 0.45-0.5 x 0.0.12-0.15 cm, shortly notched at apex, 2-nerved and keeled along the nerves. Upper lemma hyaline, elliptic, deeply cleft at apex with

acute lobes, awned from the sinus, 3-5-nerved; awn up to 1 cm long with a column up to 5 cm long. Upper palea lanceolate, hyaline, slightly notched at apex, 2-nerved. Pedicelled spikelets obliquely oblong-elliptic, 0.45-0.6 cm long. Pedicel triquetrous, 0.15-0.2 cm long. Lower glume obliquely oblong lelliptic, as long as spikelet, sharply keeled on sides and incurved on margins, subacute at apex, 11-13-nerved. Upper glume, lower lemma, lower palea and upper palea similar to those of sessile spikelet. Upper lemma hyaline, oblong-elliptic, 0.4-0.5 x 0.1 cm, boat-shaped, faintly 3-5-nerved. Lodicules 2, horned at apex. Stamens 3. Ovary oblong. Grains oblong-elliptic.

Flowering & Fruiting: August-March.

Habitat: Marshylands, roadside pools and bunds of paddy fields.

Note: As a newly described narrow endemic species, its distribution status should be analysed for further conservation management.

Specimens examined: Kollam district: Perumkulam Ela, 27 Oct.1996, *Ravi 24098* (Holotype, TBGT); *Ibid.*, Kulathupuzha, Chozhiyakodu, 8 Nov. 2006, *Shaju 59481* (TBGT).

15. **Ischaemum raui** Sreek., V. J. Nair & N. C. Nair, Fl. Kerala Grass. 157. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 578. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 809. 2006.

Type: Kannur district: Mughu road, ± 150 m, 17 Oct. 1981, *Sreekumar 71747* (CAL).

Creeping annuals. Culms 10-30 cm tall, erect or geniculate; nodes villous. Leaves ovate-lanceolate or triangular, 1-3 x 0.4-0.8 cm, sharply acute, rounded or shallowly cordate at base, glabrous; sheath 1-4 cm long, striate, glabrous; ligule ovate, membranous. Racemes 1-2, 1-3 cm long, stout, densely villous, peduncles long exerted. Callus 0.25-0.3 cm long, slightly turbinate, densely villous. Sessile spikelets 0.35-0.4 cm long, ovate, acute awned, dendsely villous. Callus bearded. Lower glume ovate, 0.35-0.4 x 0.15-0.2 cm, coriaceous, 9-11-nerved, densely silky villous. Upper glume coriaceous, boat-shaped, 0.35-0.4 x 0.1-0.15 cm, keel rounded, slightly winged, softly hairy. Lower lemma hyaline, ovate-lanceolate, 0.35-0.4 x 0.1-0.15 cm, 3-5-nerved, ciliate on the margins in the upper half. Lower palea hyaline, lanceolate, 0.35-0.4 x 0.1-0.12 cm, 2-keeled, 2-nerved, glabrous. Upper lemma hyaline, elliptic, 0.35-0.4 x 0.1-0.12 cm, notched, lobes acute, 3-nerved, margins ciliolate on the upper half; awn 1-2 cm long, geniculate, column 0.6-0.7 cm long, scabrid. Upper palea oblanceolate, hyaline, 2-keeled, 2-nerved, glabrous with few wart-like dots towards the apex. Pedicelled spikelets 0.35-0.4 cm long, lanceolate, unawned, densely villous. Pedicel 0.05-0.1 cm long. Glumes and florets more or less similar to that of sessile spikelets.

Flowering & Fruiting: January-March.

Habitat: Dry grasslands.

Note: As a narrow endemic species, it deserves conservation importance.

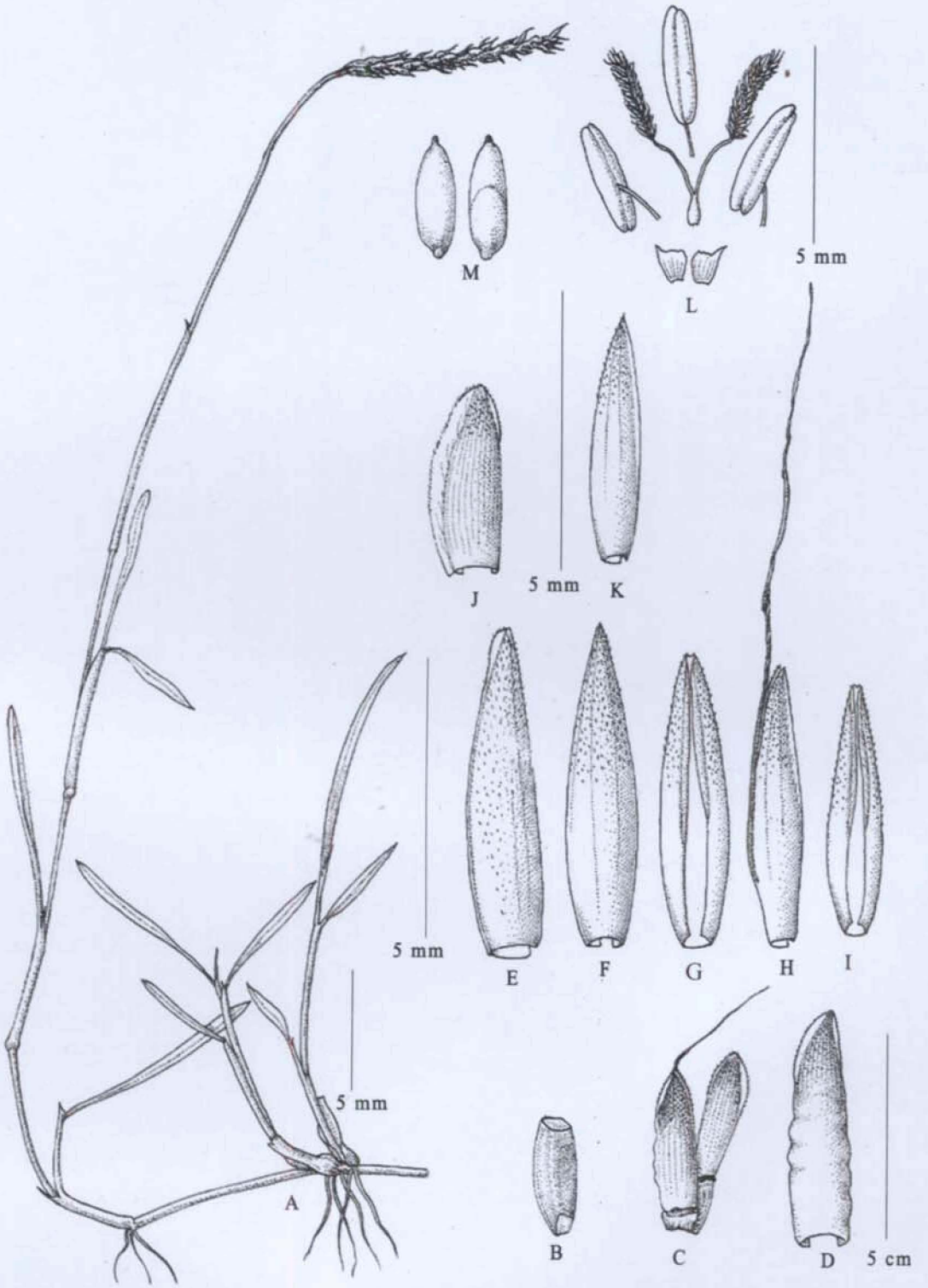

Fig. 54. ***Ischaemum quiloensis*** Ravi & Shaju A. Habit; B. Rachis joint ; C. Spikelet pair; D. Lower glume; E. Upper glume; F. Lower lemma; G. Lower palea; H. Upper lemma; I. Upper palea; J-K. Pedicelled spikelet: J. Lower glume; K. Upper lemma; L. Lodicules, stamens & pistil; M. Grain

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Plate 86. Type specimens

a. ***Ischaemum malabaricum*** Sreek. *et al*. (MH);
b. ***Ischaemum nairii*** V. J. Nair & Sreek. (MH);
c. ***Ischaemum pappinisseriensis*** Ravi *et al*. (TBGT);
d. ***Ischaemum pushpangadanii*** Ravi *et al*. (TBGT);
e. ***Ischaemum quilonensis*** Ravi & Shaju (TBGT);
f. ***Ischaemum tadulingamii*** N. C. Nair & Sreek. (MH).

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318.B

Specimen examined: Kannur district: Mughu road, ± 150 m, 17 Oct. 1981, *Sreekumar 71747* (Isotype, MH).

16. **Ischaemum tadulingamii** N. C. Nair & Sreek., Blumea 30: 385. 1985; Karth. *et. al.*, Fl, Ind. Enum. Monocot. 231. 1989; Samaddar & Roy, Add. Ele. Ind. Fl. 231.1997; Sreek. & V. J. Nair, Fl. Kerala Grass. 161. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 579. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 809. 2006.

Type: Idukki district: Eravikulam National Park, 2200 m, 28 Aug. 1980, *Sreekumar 71863* (MH). (Plate 86 f)

Tufted annuals or perennials. Culms 10-30 cm tall, erect; nodes glabrous. Leaves linear-lanceolate, 2-10 x 0.4-0.6 cm, shortly acuminate, narrowed and tapering at the base, sparsely villous with tubercle-based hairs; sheath 2-8 cm long, striate, villous; ligules ovate, acute, membranous. Racemes 2 or 3, 2-6 cm long, stout, spahte 2-10 cm long, glabrous. Joints linear, turbinate, 0.35-0.4 cm long, coriaceous, long villous along the margin and dorsal angles. Sessile spikelets ovate-lanceolate, 0.6-0.7 cm long. Callus densely bearded. Lower glume ovate-lanceolate, 0.6-0.65 x 0.17-0.2 cm, acuminate, without nodules, chartaceous, 11-13-nerved. Upper glume chartaceous, boat-shaped, 0.55-0.6 x 0.12-0.15 cm, acuminate, keels rounded, 3-5-nerved, covered with short adpressed hairs, margins incurved, ciliate. Lower lemma lanceolate, 0.45-0.5 x 0.1-0.15 cm, hyaline, 3-nerved, margins infolded and ciliate in the upper half, glabrous. Lower palea elliptic-lanceolate, 0.4-0.45 x 0.1-0.15 cm, hyaline, 2-keeled, margins infolded and ciliate in the upper half. Upper lemma lanceolate, 0.4-0.45 x 0.1-0.15 cm, hyaline, 3-nerved, margins infolded and ciliate on the upper half, apex notched, lobes acute; awn 1-1.2 cm long, geniculate, column 0.5-0.6 cm long, scabrid. Upper palea oblong, hyaline, 2-keeled, apex rounded. Pedicelled spikelets ovate-lanceolate, 0.4-0.6 cm long, unawned, usually reduced, sterile. Pedicel linear, turbinate, 0.3-0.4 cm long, villous along the margins and dorsal angle. Lower glume ovate-lanceolate, 0.45-0.6 x 0.1-0.15 cm, winged on one margin, wing scabrid, faintly 9-11-nerved. Upper glume ovate-lanceolate, 0.3-0.5 cm long, keel rounded, glabrous, apex acute. Florets empty.

Flowering & Fruiting: March-April.

Habitat: Rocky areas in graslands.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Idukki district: Eravikulam National Park, 2200 m, 28 Aug. 1980, *Sreekumar 71863* (Isotype, MH).

17. **Ischaemum vembanadense** Patil & D'cruz, J. Bombay Nat. Hist. Soc.70: 324. 1973; Karth. & Sharma, J. Bombay Nat. Hist. Soc. 80: 78. 1983; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 228. 1986; Karth. *et. al.*, Fl, Ind. Enum. Monocot. 233. 1989; Sreek. &

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V. J. Nair, Fl. Kerala Grass. 168. 1991; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 579. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 810. 2006; Sunil, Fl. Alappuzha 864. 2009.

Type: Alappuzha district: 10 Jan. 1970, *Patil I-919,* (Herbarium, Botany Section, College of Agriculture, Poona).

Perennials. Culms 20-150 cm tall, creeping and rooting at the lower nodes, geniculate or rarely erect; nodes galbrous. Leaves lanceolate 5-12 x 0.5-0.1 cm, acuminate, shallowly cordate at base; sheath slightly keeled, ciliate along the margins; ligule ovate, membranous. Racemes 2, 5-8 cm long. Joints clavate-turbinate, 04-05 cm long. Sessile spikelets 05-06 cm long, oblong-lanceolate, awned or very rarely awnless. Callus glabrous. Lower glume oblong-lanceolate, c. 0.5-0.6 x 0.2 cm, crustaceous with 4-6-nodules, interconnected with ridges and furrows, faintly 13-15-nerved. Upper glume boat shaped, ovate-lanceolate, 0.5-0.6 x 0.15 cm, dorsally keeled, chartaceous, 5-nerved. Lower lemma ovate-lanceolate, 0.5-0.6 x 0.15-0.2 cm, 3-nerved. Lower palea oblong-lanceolate, 0.5-0.6 x 0.1 cm, chartaceous, 2-keeled, 2-nerved. Upper lemma deeply notched, 0.45-0.5 x 0.1-0.15 cm, awned or rarely awnles, lobes acute, hyaline, 3-nerved, awn 1-1.5 cm long, column, 0.5-0.6 cm long. Upper palea oblong-lanceolate, hyaline, 2-nerved. Pedicelled spikelets 0.5-0.6 cm long, oblong, awnless. Pedicel 0.1-0.2 cm long, glabrous. Lower glume oblong, 0.5-0.6 x 0.1.5-0.2 cm, acute, chartaceous, 13-15-nerved, narrowly winged on one margin. Upper glume, lower lemma, lower palea and upper palea similar to those of sessile spikelet. Upper lemma awnless.

Flowering & Fruiting: October – January.

Habitat: Along the banks of rivers and backwaters, sometimes trailing and floating over the weeds growing in canals and backwarters.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Alappuzha district: Thottapalli, K. V. Jetty, near Pallana, 22 Nov 2006, *Shaju 59487* (TBGT).

18. **Ischaemum wayanadense** Ravi, N. Mohanan & Shaju, Bot. Bull. Acad. Sin. 42: 223. 2001; Sasidh., Biodiver. Doc. Kerala. Part 6, Flr. Pl. 579. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 810. 2006.

Type: Wayanad district: Kelloor, Thekkupara, ± 800 m, 14 Dec. 1996, *Ravi 33779* (TBGT). (Fig. 55; Plate 87 a)

Perennials. Culms tufted, reddish-brown, creeping, spreading, and rooting at the lower nodes, up to 1.5 m long; nodes ciliate. Leaves all along the culm, lanceolate to linear-lanceolate, up to 15 x 1.2 cm, base cuneate in the lower ones and rounded in the upper ones and acuminate at apex; sheath up to 10 cm long, closely striate and glabrous; ligules subcoriaceous, triangular, 2-keeled. Racemes 2, up to 7 cm long. Joints triquetrous, 0.3-0.4 cm long, oblong-clavate,

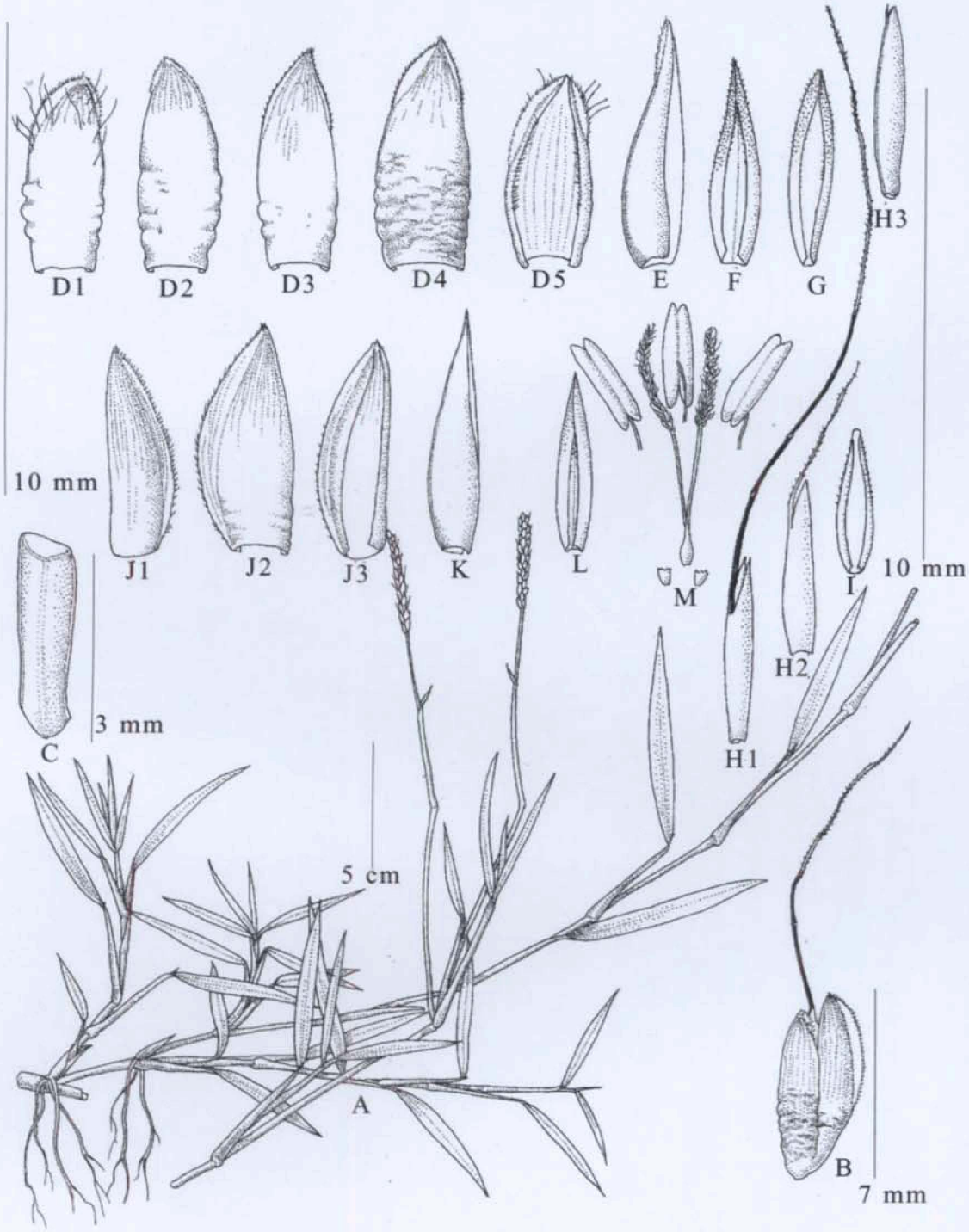

Fig. 55. ***Ishaemum wayanadense*** Ravi *et al.*: A. Habit; B. Spikelet pair; C. Rachis joint; D1-I, Sessile spiklet: D1, D2, D3 & D4. Lower glumes (from different spikelets); D5. Adaxial side of a lower glume; E. Upper glume; F. Lower lemma; G. Lower palea; H1, H2 & H3. Upper lemma (from different spikelets); I. Upper palea; J1 - L. Pedicelled spikelet: J1 & J2. Lower glumes (from different spikelets); J3. Adaxial side of a lower glume; K. Upper glume; L. Upper lemma; M. Lodicules, stamens & pistil.

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glabrous or shortly ciliate. Sessile spikelets 0.5-0.6 cm long, oblong-ovate. Lower glume oblong-lancelate, 0.4-0.5 x 0.15-0.18 cm, coriaceous, laterally keeled and narrowly winged on one side, nodulose below with or without obscure or slightly prominent interconnecting ridges and furrows, 11-13-nerved. Upper glume coriaceous, boat-shaped, 0.4-0.5 cm long, acute at apex, shortly incurved on the margins, keel slightly winged towards the apex, scaberulous outside, sparsely ciliate on the incurved margins, 5-nerved. Lower lemma sub-hyaline, elliptic-lanceolate, 0.35-0.45 cm long, subacute at apex, 2-nerved. Lower palea hyaline, elliptic-lanceolate, 0.35-0.45 cm long, subacute at the apex, 2-nerved. Upper lemma hyaline, 0.4-0.45 cm long, mostly cleft to the middle and awned, subacute at the apex; awn geniculate, up to 1.5 cm long with a column of 0.8 cm long. Upper palea hyaline, elliptic-lanceolate, subacute at apex, 2-nerved. Pedicelled spikelets 0.45-0.50 cm long, oblong, acute, unawned. Pedicel 0.1- 0.2 cm long, glabrous. Lower glume obliquely oblong-elliptic, coriaceous, 0.45-0.5 x 0.17-0.2 cm, leterally keeled with the keel sharply angled on one side and broadly winged on the other and the wing rounded in the middle and scabrid on the margin towards the apex with a subtruncate, shortly notched, hyaline tip. Upper glume, lower lemma, lower palea and upper palea similar to those of sessile spikelet, but slightly smaller. Upper lemma 0.35-0.45 cm long, similar to that of the unawned sessile spikelet. Lodicules 2. Stamens 3. Ovary oblong.

Flowering & Fruiting: January

Habitat: Wet places, by the sides of roads and bunds of water channels in cultivated fields.

Note: As a newly described narrow endemic species, its distribution status should be analysed for further conservation management.

Specimens examined: Wayanad district: Kelloor, Thekkupara, ± 800 m, 14 Dec. 1996, *Ravi 33779* (Holotype, TBGT); *Ibid.*, Thettuvadi, Kalpetta-Mananthavadi route, ± 750 m, 13 Jan. 1999, *Ravi 32550* (Paratype, TBGT).

OCHLANDRA Thwaites

Enum. Pl. Zeylaniae 376. 1864.

Key to the species

1. Filaments fused (monadelphous).
   2. Small straggling bamboos..... 2. *O. keralensis*
   2. Shrubby arborescent bamboos.
      3. Lodicules 3 or 4; stigma 7 or more up to 10 ..... 1. *O. ebrateata*
      3. lodicules 3; stigma not more than 5.....5. *O. travancorica* var. *hirsuta*

1. Filaments free.
   4. Caryopsis-beak with bulbous base..... 3. *O. soderstromiana*

4. Caryopsis-beak without bulbous base..... 4. *O. spirostylis*

1. **Ochlandra ebracteata** Raiz. & Chatterjee, Ind. For. 89: 362. 1963; Tewari, Monogr. Bamboo 110. 1992; M. Kumar, Rheedea, 5: 68. 1995; Seethalakshmi & M. Kumar, Bamboos India 180. 1998; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 581. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 813. 2006. ***Valleta.*** (Plate 87 b)

An erect, shrubby or arborescent, clump-forming plant, each clump with 60-70 culms. Culms up to 4-6 m tall; nodes shining green; sheath ovate-obtuse, 13-15 cm long, covered with appressed, subulate, chocolate brown or black hairs; ligule 0.5-0.9 cm long. Leaves oblong-lanceolate, acuminate at apex, shortly cuneate at base, glabrous on sides, margin and apices scabrid. Inflorescence a flagellate spike of verticellate clusters of sessile spikelets with a few comparatively large fertile spikelets mixed with smaller sterile ones; fertile spikelets 3-3.5 cm long, cylindro-conical, smooth, shining and glabrous. Sterile glumes 4, 1.3-1.8 cm long. Lemma 2.5-3 cm long. Palea membranous, 3 cm long. Lodicules 4, membranous. Stamens numerous, filaments fused. Ovary very small, densely compressed, spherical. Caryopsis up to 6 cm long, chocolate brown in colour, oblong with a long awn like beak.

Flowering & Fruiting: Flowering was first noted during March-April, 1961 and 1963. It flowers gregariously and the clump dies after flowering. Flowering started in January and first set of mature seeds were available by April. The local people reported that they observed flowering once in six years (Seethalakshmi, 1998)

Habitat: Growing in reverine evergreen forests.

Note: Occurrence of the species in Thiruvananthapuram district, precisely in Paruthipally Forest Range of Kottur Reserve was recorded by Raizada and Chatterji (1961). This species is used in paper industry and for making baskets and mats; leaves are used as fodder. Powder prepared from the dried seeds is used as cattle feed (Seethalekshmi, 1998).

So far the species has not been figured in any of the IUCN category. However, in consideration of its narrow distribution, assumes conservation significance.

Specimens examined: Thiruvananthapuram district: Kottur, 4 Mar. 1993, *Gopakumar 49701, 49703, 49705* (TBGT); Kollam district: Achankovil, Arampa, ± 750 m, 15 Apr. 2009, *Shaju 68272* (TBGT).

2. **Ochlandra keralensis** M. Kumar, Ramesh & S. Seq., J. Econ. Taxon. Bot. 25: 49. 2001; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 581. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 814. 2006.

Type: Pathanamthitta district: Pachakkanam, Pachakkanam, ± 1000 m, 9 Dec. 1998, *Ramesh & Stephen 20730* (KFRI).

Small straggling bamboo. Culms erect, up to 3 m tall; nodes prominent and swollen;

sheath persistent, ovate, 15-18 cm long, thin, striate, hairy when young, wrinkled. Leaves alternate, linear lanceolate, 22-30 x 2.5-3.8 cm, acuminate at apex, base truncate, margin serrulate towards apex; inner and outer ligule present. Inflorescence developing by a way of pseudo-spikelets forming aggregation at the terminal or leafy axis. Spikelets 2-2.4 x 0.4-0.6 cm, ovate-lanceolate, glabrous, dark purple-green in colour. Bracts 2, ovate. Sterile glumes 3, 1.4-1.6 x 0.5-0.7 cm, many-veined, glabrous, margin ciliate towards apex, tip mucronate. Lemma membranous towards base, apex acuminmate, 2-2.5 x 0.8-1 cm, glabrous. Palea membranous, linear-ovate, 1.4-1.5 x 0.6-0.7 cm, acute, upper margin overlapping. Lodicules 3, membranous, unequal, ovate, acute with a prominent notch at apex, lobes unequal. Lodicules 4, membranous. Stamens up to 56; anther lobes bequal; filaments free. Ovary rounded, glabrous; style cylindrical. Caryopsis large, light green with a purplish tinge, 8.5-9.5 x 1.6-2 cm, beak 5 cm long.

Flowering & Fruiting: A gregarious flowering; the flowering and fruiting continues up to almost a year and a half.

Habitat: Growing in water logged open areas in the evergreen forests.

Note: It is a narrow endemic species, so far known only from the type locality. Further explorations must be made to locate the species in its known distributional areas to confirm its conservation status.

Specimen examined: Pathanamthitta district: Pachakkanam, ± 1000 m, 9 Dec. 1998, *Ramesh & Stephen 20730* (Holotype, KFRI).

3. **Ochlandra soderstromiana** M. Kumar, Ramesh & S. Seq., Rheedea 9: 31. 1999; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 814. 2006.

Type: Idukki district: Kallar, Kallar Valley Estate, 1000 m, 15 Jun. 1998, *Stephen 008883* (KFRI).

Small straggling bamboos. Culms erect, up to 5 m tall; nodes smooth, prominent; sheath persistent, ovate, 15-19 cm long, thin, striate, smooth; ligule short, 0. 3 cm long. Leaves linear lanceolate, 13-28 x 2.3-3.7 cm, acuminate at apex, base truncate, margin serrulate towards apex; inner and outer ligule present. Inflorescence of axillary or terminal spicate panicles. Spikelets few, 2-4.8 x 0.5-0.9 cm, ovate-lanceolate, glabrous. Bracts 2, ovate, acuminate. Sterile glumes 3-4, 0.9-2.8 x 0.6-1.5 cm, ovate, mucronate, glabrous, margin overlapping. Lemma membranous towards base, 2-3 x 0.6-1.7 cm, ovate, acuminate, margin overlapping. Palea membranous, linear-ovate, 2-2.8 x 0.5-0.6 cm, acute, upper margin overlapping. Lodicules 3, membranous, unequal, ovate, acute, bifurcated, fimbriate at apex. Stamens up to 68, subequal, filaments free. Ovary rounded, glabrous; style cylindrical. Caryopsis up to10 cm long, elliptic-oblong, beak 5 cm long, bulbous at base, awn like.

Flowering & Fruiting: April-August.

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Habitat: Evergreen forests.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Idukki district: Kallar, Kallar Valley Estate, 1000 m, 15 Jun. 1998, *Stephen 008883* (Holotype, KFRI).

4. **Ochlandra spirostylis** M. Kumar, Seethalakshmi & S. Seq., Rheedea, 9: 31. 1999; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 582. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 814. 2006.

Type: Idukki district: Adimali, Chattuparakudy, 900 m, 16 Jun. 1998, *Stephen 008884* (KFRI).

Shrubs. Culms erect, up to 6 m tall; nodes raised, a greyish band with brown appressed hairs below on each node; sheath thin, papery, 13-15 cm long. Leaves to 25-32 x 4.5-5.8 cm, acuminate at apex, base truncate, margin serrulate towards the base; inner ligule brownish, cartilaginous; outer ligule prominent, flap-like; leaf-sheath, glabrous, striate. Inflorescence of axillary or terminal subverticillate spicate panicles. Spikelets few, 1.5-5 x 0.3-1 cm, ovate-lanceolate, glabrous. Bracts 3, ovate, mucronate. Sterile glumes 3, 1.5-3 x 1.2-2.2 cm, ovate, long mucronate, glabrous, margin ciliate towards apex. Lemma 3-3.5 x 2-4 cm, ovate, acuminate, margin ciliate towards to apex. Palea membranous, notched at apex, fimbriate along notches, ciliate along overlapping margins. Lodicules 3, membranous, bifurcated, fimbriate or ciliate. Stamens pink coloured with 1-2 spicules at apex of the connective. Ovary rounded and ridged. Caryopsis ellipsoid, 10-10.5 cm long with a 5.5 cm long awn-like beak.

Flowering & Fruiting: April-August.

Habitat: Evergreen forests.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Idukki district: Adimali, Chattuparakudy, 900 m, 16 Jun. 1998, *Stephen 008884* (Holotype, KFRI).

5. **Ochlandra travancorica** var. **hirsuta** Gamble, Ann. Roy. Bot. Gard. Calcutta 7: 126. 1896; Camus, Les Bambusees 183. 1913; Varmah & Bahadur, Ind. For. Rec. (n.s.) Bot. 6(1): 4. 1980; Tewari, Monogr. Bamboo 117. 1992; Chand Basha & M. Kumar, Rheedea 4: 28. 1994; M. Kumar, Rheedea 5: 63. 1995; Seethalakshmi & M. Kumar, Bamboos India 196. 1998; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 815. 2006.

Type: 'Travancore hills', *Beddome 87* (K).

Shrubs. Culms tufted, 2-6 m tall; nodes swollen; sheath to 4 cm long, truncate with fringed tip, surface covered with appressed, black or golden, bulbous based hairs. Leaves to 9-32 x 5-6 cm long, lanceolate with a setaceous, often twisted tip, rounded at base, pellucid glandular; leaf sheath falcately articulate at base and with a smooth, callose tip, appressed, bulbous- based hairy; ligule short, truncate. Inflorescence of axillary or terminal spicate

panicles. Spikelets in verticels, some smaller and sterile, others larger and fertile, densely cloathed with velvetty hairs. Basal empty glumes 3, broadly ovate-aristate. Lemma c. 4.5 cm long, oblong with a ciliate tip. Palea keeled. Lodicules 3, dissimilar membranous, linear, acute or forked at tip. Stamens many, monadelphous, with a short tube. Ovary ovoid. Caryopsis large, c. 7.3 x 3.5 cm, ovoid-oblong, abruptly beaked at apex.

Flowering & Fruiting: Throughout the year.

Habitat: As an undrgrowth in the evergreen and reverine forests.

Note: Used mainly for pulp and rayon manufacture (M. Kumar, 1995). Culms are used for mat and basket making, umbrella handles, fishing rods, handicraft and for making walls of huts. Leaves are used for thatching.

So far not figured in any of the conservation category; conservation measures should be made for *in-situ* conservation in ecologically suitable areas in its distributional range.

Specimens examined: Kollam district: Achankoil, *Vijayakumaran & Jayalakshmi 7214* (KFRI); Pandimotta, Kulathupuzha, *Seethalakshmi & Jayalakshmi 7215* (KFRI).

SILENTVALLEYA V. J. Nair, P.V. Sreek., Vajravelu & Bhargavan

Bombay Nat. Hist. Soc. 79(3): 654. 1983.

Silentvalleya nairii V. J. Nair, Sreek., Vajr. & Bhargavan, J. Bombay Nat. Hist. Soc. 79: 654. 1983; Sreek. & V. J. Nair, Fl. Kerala Grass. 397. 1991; Samaddar & Roy, Add. Ele. Ind. Fl. 130.1997; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 230. 1987; Biju in Manoharan *et al.*, Silent Valley- Whis. Reas. 165. 1999; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 592. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala – A Handb. 828. 2006.

Type: Palakkad district: Silent Valley dam site, ± 850 m, 5 Oct. 1979, *Nair 64268* (MH). (Plate 87 c & 88 f)

Perennias. Culms tufted, to 40-100 cm tall, erect; nodes glabrous. Leaves 40-60 cm long, linear with filiform tips; ligules a narrow truncate membrane. Inflorescence a panicle, 15-30 cm long, with 6-10 racemes scattered along a central axis, each 8-20 cm long. Spikelets oblong-lanceolate, c.0.8 x 0.2 cm, 6-10-flowered with a terminal reduced floret. Callus densely bearded. Lower glumes c. 0.2 x 0.1 cm, ovate, acute, faintly 1-nerved and glabrous. Upper glumes, c. 0.4 x 0.12 cm, lanceolate, acuminate, 3-nerved, Lemma c. 0.4 x 0.17 cm, ovate-lanceolate, 3-nerved, tip ending in an awn, 0.3-0.5 cm long, scabrid. Palea elliptic, 2-keeled, keels minutely winged, shortly ciliate. Lodicule 2, obovate, 2-horned at apex. Stamens 3. Ovary oblanceoloid. Caryopsis oblong- lanceoloid, c. 0.2 cm long, stalked.

Flowering & Fruiting: October-March.

Habitat: Crevices of rocks and other similar rocky areas.

Note: An exclusive endemic monotypic genus of the state having restricted distribution

in its type locality. During the study this species is collected from nearby area of the down stream of Kunthipuzha near Pathrakadavu. This genus belongs to Eragrosteae of the family Poceae, one of the actively evolving grass tribes in Kerala having high species diversity and endemism. As a narrow endemic taxon this genus reflects the phytogeographic as well as phylogenetic significance of the tribe.

So far not figured in any of the IUCN category; owing to narrow distribution, assumes conservation significance.

Specimens examined: Palakkad district: Silent Valley dam site, ± 850 m, 5 Oct. 1979, *Nair 64268* (Isotype, MH); *ibid.*, Pathrakadavu, ±800 m, 24 Nov. 2003, *Shaju 44434* (TBGT).

TRIPOGON J. J. Roemer & J. A. Schultes

Syst. Veg. 2: 34. 600. 1817.

Key to the species

1. Leaves glabrous ..... 2. *T. vellarianus*
1. Leaves villous ..... 1. *T. sivarajanii*

1. **Tripogon sivarajanii** Sunil, Sida 18: 809. 1999; Sasidh., Biodiver. Doc. Kerala, Part 6,Flr. Pl. 595. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 832. 2006.

Type: Idukki district: Valakettimala, Moolamattam, ± 1020 m, 2 Sep. 1997, *Sunil 2117* (CALI). (Plate 87 d)

Tufted perennial herbs. Culm 40-70 cm tall, erect; nodes glabrous. Leaves 15-60 x 2-3 cm, linear, acuminate, villous on the upper surface with short dense hairs intermingled with long scattered shaggy hairs, glabrous below; sheath smooth; ligules glabrous, membranous. Racemes 20-40 cm long with 25-60 spikelets; rachis smooth, glabrous. Spikelets 5-8-flowered, 0.7-0.8 cm long, Callus bearded. Lower glumes, c. 0.2 cm long, lanceolate, shallowly notched on one side. Upper glumes, 0.3-0.4 cm long, lanceolate, acute or acuminate at apex. Lemma 0.3-0.35 cm long, 3-nerved, 1-awned, glabrous, 2-lobed at apex, lobes acuminate, awned in the sinus, awn 0.3-0.35 cm long, more or less equal to lemma, scabrid. Palea 02-0.3 cm long, elliptic, 2-lobed at apex, 2-keeled, keels minutely winged, margin ciliate. Lodicule 2, Stamens 3. Ovary globose. Grains not known.

Flowering & Fruiting: September - December.

Habitat: Grassy hill slopes.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Idukki district: Valakettimala, Moolamattam, ± 1020 m, 2 Sep. 1997, *Sunil 2117* (Isotype, CALI).

2. **Tripogon vellarianus** Pradeep, Sida 18: 811. 1999; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 595. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 833. 2006.

Type: Kozhikode district: Vellarimala, ± 1300 m, 17 Oct. 1997, *Pradeep 56110* (MH). (Plate 87 e)

Tufted perennial herbs. Culm 30-90 cm tall, erect; nodes glabrous. Leaves 3-6 x 0.8-1.5 cm, linear; sheath closely clasping, rigid, glabrous; ligules indistinct. Racemes 30-40 cm long, rachis stout, glabrous. Spikelets 1-1.7 cm long, distant, dorsoventrally flattened, 8-10-flowered. Callus bearded. Lower glumes 0.4-0.3 x 0.12 cm, lanceolate, acuminate at apex, purplish tinged dorsally, glabrous. Upper glumes 0.3-05 x 0.15 cm, elliptic-lanceolate, acute at apex, prominently 3-nerved, glabrous. Lemma c. 0.5 x 0.3 cm, ovate-lanceolate, 3-nerved, median awn c. 0.3 cm long, lateral awns absent or up to 0.5 cm long, often closely appressed to the median awn, glabrous. Palea c. 0.4 x 0.32 cm, hyaline, narrowly elliptic, keeled; keels minutely winged, puberulous. Lodicule 2, quadrate, apex closely 3-toothed. Stamens 3. Ovary ovate. Grains not known.

Flowering & Fruiting: October-January.

Habitat: Wet rocky grasslands adjoining evergreen forests.

Note: As a narrow endemic species, it deserves conservation importance.

Specimens examined: Kozhikode district: Vellarimala, ± 1300 m, 17 Oct. 1997, *Pradeep 56110* (Holotype, MH; Isotype, CALI).

ZENKERIA Trinius

Linnaea 11: 150. 1837.

Zenkeria jainii N. C. Nair, Sreek. & V. J. Nair J. Bombay Nat. Hist. Soc. 78: 352. 1981; Ahmedullah & M. P. Nayar, End. Pl. Ind. Reg. 234. 1987; Karth. *et al.*, Fl, Ind. Enum. Monocot. 274. 1989; Sreek. & V. J. Nair, Fl. Kerala Grass. 365. 1991; Samaddar & Roy, Add. Elem. Ind. Fl. 468. 1997; Sasidh., Biodiver. Doc. Kerala, Part 6, Flr. Pl. 596. 2004; T. S. Nayar *et al.*, Flr. Pl. Kerala - A Handb. 834. 2006.

Type: Idukki district: Eravikulam National Park, ± 2000 m, 20 Aug. 1980, *Sreekumar 68419* (MH). (Plate 87 f)

Perennials. Culms to 45-60 cm tall, erect. Leaves to 15-50 x 0.8-1.6 cm, chartaceous, elliptic to linear lanceolate, tapering at both ends, sparsely villous on upperside; sheaths 8-16 cm long, chartaceous; ligule a tuft of short hairs. Panicles pyramidal, c. 20 cm long, densely flowered with capillary, villous spreading branches. Spikelets 0.5-0.55 cm long, oblong-lanceolate, each 2-flowered, bisexual. Pedicels 0.2-1.5 cm long, villous; rachilla short, bearded, disarticulating above the glumes. Glumes subequal, c. 0.3 x 0.1 cm, ovate-lanceloate to lanceolate, acute to shortly acuminate, glabrous, 1-nerved, keeled. Lemmas c. 0.5 x 0.1 cm,

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lanceolate, acuminate, 5-nerved, coriaceous, long ciliate below the middle. Palea ovate-lanceolate, c. 0.4 x 0.1 cm, notched at the apex, 2-keeled, 2-nerved, hyaline, long ciliate along the keels. Lodicules 2, ovate, retuse at apex. Stamens 3. Ovary ovate. Grains not seen.

Flowering & Fruiting: August-December.

Habitat: Grows in clumps in the crevices of moist rocks.

Note: As a narrow endemic species, it deserves conservation importance.

Specimen examined: Idukki district: Eravikulam National Park, ± 2000 m, 20 Aug. 1980, *Sreekumar 68419* (Isotype, MH).

Plate 87. a. ***Ischaemum wayanadense*** Ravi *et al.*:Type specimen at TBGT; b. ***Ochlandra ebracteata*** Raiz. & Chatterjee: Herbarium specimen at TBGT; c. ***Silentvalleya nairii*** V. J. Nair *et al.*: Herbarium specimen at ERRC; d. ***Tripogon sivarajanii*** Sunil: Type specimen at CALI; e. ***Tripogon vellarianus*** Pradeep: Type specimen at CALI; f. ***Zenkeria jainii*** N. C. Nair: Type specimen at MH.

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TAXONOMIC AND ETHNOBOTANIC STUDIES OF ENDEMIC ANGIOSPERMS OF KERALA

THESIS SUBMITTED TO THE
UNIVERSITY OF CALICUT

IN PART-FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN BOTANY

BY
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KERALA, INDIA

SEPTEMBER 2010

6. ANALYSIS

6.1. Endemic regions

Endemism is one of the important and easily identifiable components of biodiversity. The distribution and concentration of endemic plants in a particular region is an index to the overall biogeography of the area. An attempt has been made to analyse the distribution patterns of the exclusive endemic angiosperms of Kerala with a view to identify centers of endemic concentration within the State. On the basis the distribution of exclusive endemic plants, the following regions or ecosystems can be considered as micro-hotspots of endemism with in the State.

6.1.1. Micro-hotspots

The concept of protecting largest number of species in the smallest areas led Myers (1988) to focus on the species-rich tropical forests manifesting their high degrees of endemism. According to Myers 'Hotspots' are characterised by exceptional concentration of species with high levels of endemism in the tropical forest ecosystems which face high degrees of threat from various factors. The Western Ghats formed by low hills and mountains which lie along the eastern border of the State (Fig. 56), plays a significant role in contributing to relative aggregation of endemics in the flora of Kerala. Further the two passes, the Palghat gap and the Aryankavu (Shenkotta) pass segments the Westen Ghats in Kerala, and offer an island-effect to the natural mountain system. This natural segment bounded by the two above passes form a hotspot of biodiversity in which the following microcenters of endemism are significant.

6.1.1.1. Agasthyamala

Considering the uniqueness and high degree of diversity of flora, Henry *et al.* (1984) recommended Agasthyamala and its neighbouring areas as a potential zone for treating it as a Biosphere Reserve. Later, IUCN (Davis *et al.*, 1995) has identified Agasthyamala and its environs as one among the three centers of diversity within India, the others being Anamalai High Ranges and Nilgiri-Silent Valley-Wayanad hills.The great diversity in ecological factors and high range of altitudinal variation have been attributed as responsible factors for the very

rich and diverse vegetation of the area. Out of the 1117 species (Mohanan & Sivadasan, 2002), 317 species are endemic. Of these, 32 species, 1 subspecies and 4 varieties were found to be locally endemic to the Agasthyamala range. Many of these local endemics have their distribution restricted to the 'type locality' alone. Species like *Memecylon agastyamalaianum*, *Memecylon sivadasanii*, *Acrotrema agastyamalayanum*, *Amorphophallus bonaccordensis*, *Symplocos macrophylla* subsp. *namboodirianus*, *Strobilanthes barbatus* var. *bonaccordensis*, *Strobilanthes pushpangadanii* show extremely small range of distribution (<5 km^2) in this region and are regarded as point endemics. Woody lifeform is considered as one of the characteristic features of palaeoendemism (Bramwell, 1972). Such species like *Humboldtia unijuga* var. *trijuga*, *Ixora agasthyamalayana*, *Litsea beei*, *Memecylon agastyamalaianum*, *Memecylon sivadasanii*, *Pavetta bourdillonii*, and *Symplocos macrophylla* subsp. *namboodirianus* with characteristic woody habit substantiate the relic nature of the flora.

From the above analysis, it could be concluded that most of the exclusive endemic species of Agasthyamala are confined to very narrow geographical area at different altitudinal zones within the high ranges, probably due to their antiquity or habitat specificity. Further, these floristic areas of relict nature represent an active epibiotic zone for speciation as evidenced by the occurrence of a few newly evolved species such as *Amorphophallus bonaccordensis*, *Arisaema agasthyanum*, *Ixora agasthyamalayana*, *Ischaemum agasthyamalayanum*, *Memecylon sivadasanii*, *Memeycylon agastyamalaianum*, *Litsea beei*, *Strobilanthes pushpangadanii*, etc. The high endemism and rarity manifested by the flora of Agasthyamala give insights into the evolutionary significance of species.

6.1.1.2. Anamudi high ranges

The area comprises the segment of Western Ghats south of Palghat gap and north of Pampa and Sabarigiri catchment area including Meghamalai. The highest peak is Anamudi (alt. 2695 m). With the unique physiographic configuration coupled with high altitude, heavy rainfall and tropical humid climate, the area is bestowed with a large number of endemic species including biotopic and stenotopic (i.e., confined to a single biotope) endemics. Present study enumerates 845 species of Peninsular Indian endemics, particularly Western Ghats endemics distributed in the area. This region alone contributes 65 exclusive endemics from certain niche-specific areas. This hotspot area includes 9 protected areas of the State. They are vestiges or remnents of former vegetation and provide both a strong selective force for the evolution of neoendemics and a refuge from competition for palaeoendemics. This region is also one of the centers of endemic species of the genus *Impatiens*. Out of 30 species, 11 species are strictly endemic to this region. *Impatiens concinna*, *I. macrocarpa*, *I. munnarensis*, and *I. pandata* are some of the stenotopic endemic species known only from their type collection.

The genus *Arisaema* also shows specific habitat requirements and hence restricted in distribution. The physiography of the region with high altitudinal ranges and valleys and folds of mountains, heavy rainfall on the windward side, low precipitation on the rain shadow pockets, and diurnal temperature variations have created varying ecological micro-niches. This resulted in the formation of ecospecies, cryptic species and endemic species.

6.1.1.3. Silent Valley and Wayanad

The region comprises areas north of Palghat gap extending from Silent Valley mountains to the crest of Nilgiri ranges and Wayanad. The diversity of flora of Silent Valley-Wayanad ranges with its altitudinal variations from 300 to 2554 m and rainfall ranging from 3000 to 5000 mm is unique encompassing evergreen, semi-evergreen, moist-deciduous to shola forests and grasslands. This area includes three protected areas, viz. Silent Valley National Park, Wayanad Wildlfe Sanctuary and Aralam Wildlife Sanctuary. There are 40 endemic species exclusively found in this region. They include the wild relatives of crop plants like Pepper, Cinnamon, Turmeric etc. A strictly endemic monotypic genus *Silentvalleya* of Poaceae is reported from this hotspot area. *Cassine kedarnathii*, *Eugenia argentea* and *Syzygium palghatense* are palaeoendemic tree species having local distribution in this area.

6.1.2. Endemic belts of Kerala

In the light of the present findings, a set of endemic belts have been identified within and outside the boundaries of the above micro-centres of endemism. These belts have been identified on the basis of distribution pattern exhibited by a few important palaeo- and neo-endemic taxa. The following forms a brief description of endemic belts identified within the political boundary of the State (Fig. 57).

6.1.2.1. Agasthyamala-Chemunji

This belt is considered as one of the active speciation zones of southern Western Ghats, especially of Kerala, due to more climatic shifts, gradual transformation in the rainfall and altitudinal variations. The centres of high species diversity and endemism within Agasthyamala-Chemunji belt are Chemunji, Bonaccord, Agasthyarkoodam and Braemore forests. There are about 30 Kerala endemic flowering plants and many of them are narrow in distribution. The important palaeo and neoendemic species reported from this belt are *Humboldtia unijuga* var. *trijuga*, *Ixora agasthymalayana*, *Litsea beei*, *Memecylon agastyamalaianum*, *Memecylon sivadasanii*, *Pavetta bourdillonii*, *Symplocos macrophylla* subsp. *namboodirianus*, *Acrotrema agastyamalayanum*, *Amorphophallus bonaccordensis*, *Arisaema agasthyanum*, *Dimeria agasthyamalayana*, *Strobilanthes barbatus* var. *bonaccordensis*, *Strobilanthes pushpangadanii*, *Exacum courtallensis* var. *bonaccordensis* and *Ischaemum*

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agasthyamalayanum. Most of them are narrow or point or local endemic in category as per distribution characteristics.

6.1.2.2. Ponmudi hills

It lies on north of Agasthyamla hills and west of Tamil Nadu boundary. Ponmudi area is one of the important endemic belts in southern Kerala, which does not include any protected areas of the State. It is the type locality of some possibly extinct and recently rediscovered species of IUCN Red List category. Species like *Ophiorrhiza caudata, Ophiorrhiza barnesii* and *Pavetta oblanceolata* could not be located after their type collection from the type locality - Mercheston Estate - within Ponmudi hills. *Syzygium bourdillonii,* another endangered category species, was also reported from the Mercheston Estate. The prominent endemic tree species, *Dialium travancoricum,* cosidered as 'critically endangered' and represented by only one species of the genus in India was described by Bourdillon based on the specimens collected in 1898 from Ponmudi. After a century, this species was rediscovered from the same locality (Sasidharan, 1998). *Fuirena ponmudiensis, Biophytum reinwardtii* var. *keralensis* and *Thottea ponmudiana, Phyllocephalum rangacharii* var. *agastyamalyanum,* are some of the local endemic species of the area.

6.1.2.3. Thenmala-Kulathupuzha

This endemic belt included in Agasthyamala hotspot area and situated in Kollam district comprises Aryankavu, Achenkovil, Kallar Valley and Shenduruny WLS (which is an important protected area holding many endemic elements of Southern Western Ghats). Altitude of the area varies from 50 to 700 m. A total of 27 Kerala endemic species have been reported from this belt. The prominent endemic tree species reported are *Aglaia malabarica, Litsea travancorica, Inga cynometroides, Polyalthia shendurunii, Sageraea grandiflora* and *Stereospermum colais* var. *shendurunii.* These important endemic trees exclusively occurring in this region reveals the relic nature of the endemic belt.

6.1.2.4. Ranni-Konni

This endemic belt comprises Sabarimala hills, Moozhiyar and Pampa Valley. The majority of the endemic species are with very critical number of populations having very narrow distribution. About 22 endemic species are reported from this belt. This endemic belt is an isolated fragment of the Western Ghats showing a high degree of endemism. All the tree species are palaeoendemics. *Diospyros sulcata,* a palaeoendemic species reported from this endemic belt is supposed to be extinct because it could not be relocated after its type collection despite repeated explorations. Of the palaeoendemic species, some are recent findings as exemplified by *Dysoxylum swaminathanianum,* an active epibiotic species, *Kunstleria keralensis* - the only representative species of the genus in whole of the country, and

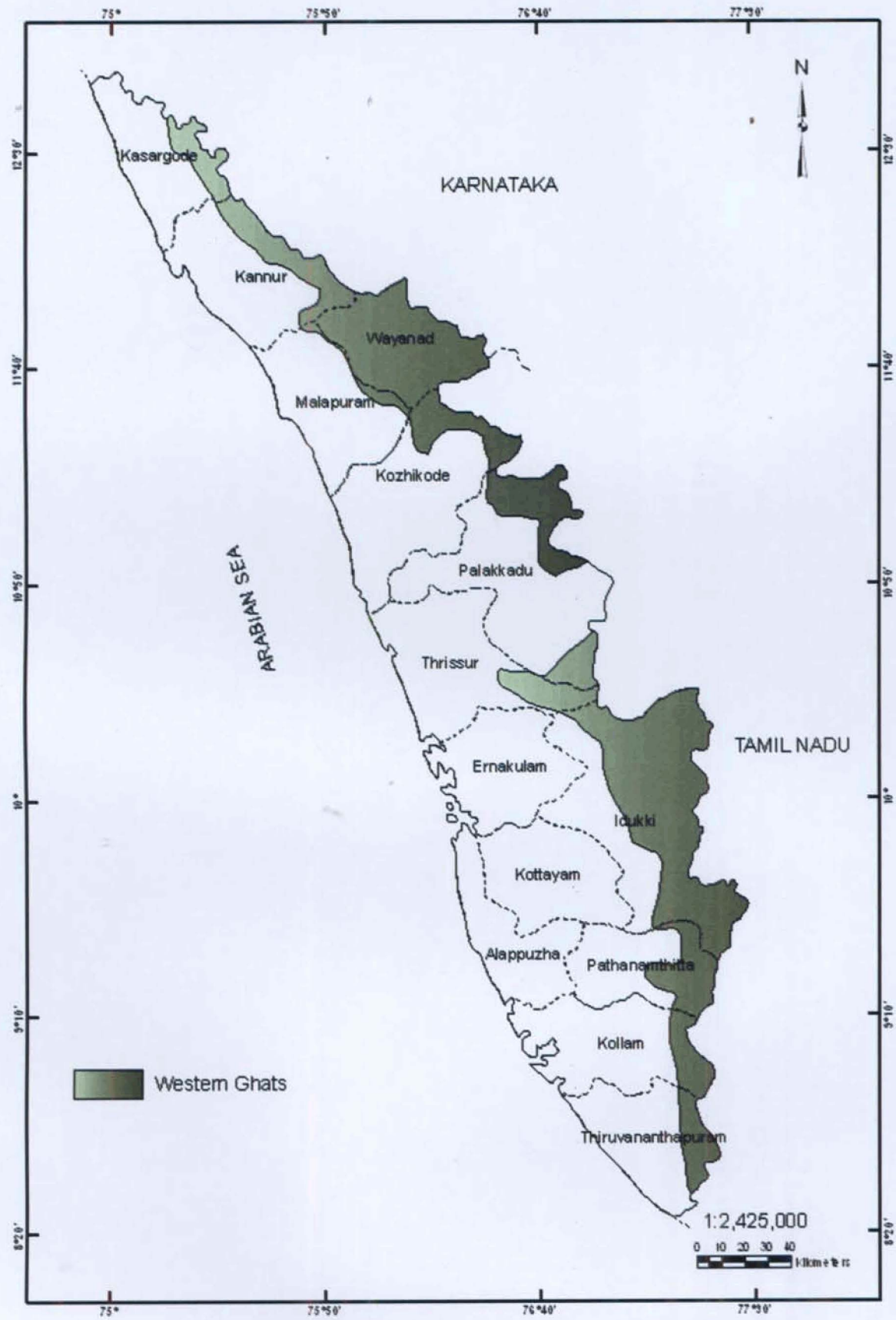

Fig. 56. WESTERN GHATS REGION OF KERALA

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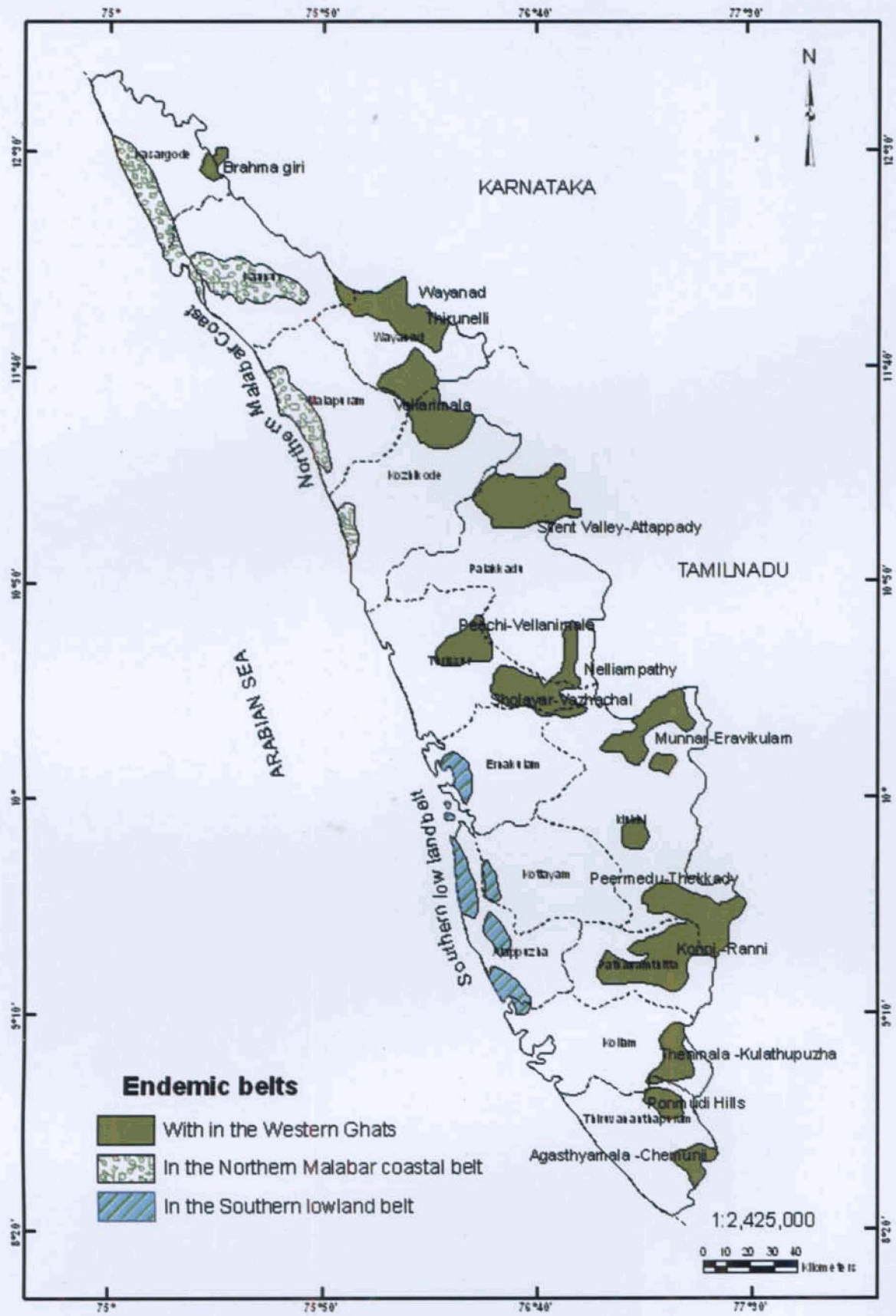

Fig. 57. ENDEMIC BELTS OF KERALA

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phytogeographically interesting species *Julostylis polyandra*. Until the discovery of this species, the genus *Julostylis* was trearted as monotypic, and as endemic to Sri Lanka. The discovery of the species from this endemic belt of Southen Western Ghats formed a record of the extended distribution of the genus, and further substantiated the view of Gondwanaland origin of Peninisular Indian flora. *Dimeria sivarajanii, Dimeria namboodiriana, Dimeria Idukkiensis, Dimeria kurumthotticalana, Fimbristylis angamoozhiensis* and *Fimbristylis pseudonarayanii, Justicia pathanamthittiensis* are neoendemic species reported from the high altitude grasslands showing the successful speciation of grasses and sedges in this endemic belt.

6.1.2.5. Perumedu-Thekkadi

This endemic belt lies in the southern end of Idukki district and encompasses Periyar Wildlife Sanctuary, which is considered as one of the prime habitats of endemic species. *Mucuna pruriens* var. *thekkadiensis, Syzygium periyarensis, Taeniophyllum scaberulum* are some point endemic species reported from Periyar Wildlife Sanctuary. *Biophytum congestiflorum, Curcuma vamana, Ixora johnsonii, Kunstleria keralensis, Zehneria maysorensis* var. *oblonga, Dysoxylum beddomei* are some strict endemics which show extended distribution in this belt. *Vernonia multibracteata,* an endangered species is known only from its type collection from this belt.

6.1.2.6. Munnar-Eravikulam

It is well known that Munnar region of High ranges of Kerala is geographically unique for altitudinal and climatic factors, which might have led to the high endemic concentration in the region. Within this region, the Munnar-Devikolam belt is richer in Kerala specific endemics, especially because of the occurrence of a large number of species of *Impatiens* (Balsaminaceae) and *Arisaema* (Araceae). The Eravikulam National Park or the 'Hamilton Plateau' is one of the most magnificent grasslands of South India, which is situated along the western slopes of Anamudi, wherefrom, five species of exclusive endemic grassess, namely *Arundinella ravii, Bothriochloa parameswaranii, Isachne fischeri, Ischaemum tadulingamii* and *Zenkeria jainii* were discribed. The following species are known only from single collection and no recent report of their occurrence in any of the neighbouring regions is avilable, whose conservation status is 'Possibly Extinct' as per IUCN records: *Anaphalis barnesii, Arisaema peltatum, Didymocarpus macrostachya, Impatiens concinna, Impatiens macrocarpa, Impatiens munnarensis, Impatiens pallidiflora, Impatiens verecunda, Ophiorrhiza munnarensis, Sonerila nemakadensis.* Therefore, this floristically unique belt with significant number of exclusive endemics assumes conservation significance.

6.1.2.7. Sholayar-Athirappally

This belt lying in the Thrissur district comprises Athirappalli-Vazhachal-Sholayar

forest continuum forms one of the unique ecosystems with high endemic concentration. Important endemic taxa exclusively occurring in this belt are *Fimbristylis dauciformis, Fimbristylis humerosa, Fimbristylis hyalina, Pycreus similinervulosus, Lagenandra nairii* and *Impatiens sholayarensis*. All these species with single loclity distribution form local or point endemics. A possibly extinct species *Smithia vencobarowii* is also relocated from this belt.

6.1.2.8. Peechi-Vellanimala

This endemic belt lies in the midland regions of Thrissur district and includes Vellanimala, Vazhani and Peechi region. It is part of the Anamudi high range 'hotspot'. Fourteen Kerala endemic species are reported from this belt. *Aglaia malabarica, Ardisia stonei, Dysoxylum beddomei, Palaquium ravii* are some narrow endemic species reported from this belt. *Tarenna trichurensis* and *Fimbristylis perspicua* are two point endemic species reported so far only from this region.

6.1.2.9. Silent Valley-Attappady

This is an important endemic belt of the central Kerala located in the northern Palakkad which comprises evergreen forests of Mukkali, Silent Valley National Park, Walpara, Sispara, Poochipara and some parts of Palakkad hills. The belt with altitudinal variation from 900-1200 m, is considered as the main zone of active speciation in Western Ghats within the State. There are 32 endemic species reported from here and most of them are narrow in distribution. *Piper silentvalleyensis, Piper nigrum* var. *hirtellosum, Cassine kedarnathii, Jasminum rottlerianum* var. *glabrior, Willisia arekaliana,* ***Cinnamomum palghatensis*** are some point endemic species and varieties, and *Silentvalleya nairii* - a point endemic monotypic genus represented from this belt. A critically endangered species *Ipsea malabarica* has been relocated from this hot endemic belt.

6.1.2.10. Wayanad-Thirunelli

This endemic belt covers the Kerala part of the Nilgiri Biosphere Reserve, which comprises semi-evergreen forests of Thamarassery pass, Chembra, Kambamala and Pakshipathalam. Altitude varies from 800-1800 m. Present analysis revealed that 21 exclusive endemic species of the State are recorded from this region. *Eugenia argentea* and *Mesa velutina* form critically endangered and recently relocated exclusive endemic species of this belt. *Thottea sivarajanii, Oberonia wynadensis, Bulbophyllum keralensis, Sonerila wynaadensis, Tephrosia wynaadensis, Amorphophallus commutatus* var. *wayanadensis* and *Ischaemum wayanadense* are some narrow endemic species reported from this belt. Extended distribution of the critically endangered narrow endemic species *Ipsea malabarica* shows its survival through the course of geological and climatic changes until finding its refugium in this isolated geographic region.

6.1.3. Coastal endemic belts of Kerala

This endemic belt comprises two main centers. They are Northern Malabar Coast and Southern Lowland endemic belt which together holds about 50 endemic species of Kerala. Biogeographically, all existing protected areas of the State are located in the Western Ghats province, but this endemic belt is in the coastal province. The threatened natural systems like mangroves, wetlands, lowland grasslands and sacred groves are largely found in this belt. The grasses show high endemism with about 28 endemic species. *Dimeria* and *Ischaemum* are the two dominant genera manifesting high percentage of endemism with 15 and 18 species respectively.

It is interesting to note that the coastal belt alone contains nearly over 23% of the total Kerala endemics. While considering the two criteria for recognising hotspots - degree of endemism and species diversity - there is sufficient justification for treating the coastal belt as a distinctive hotspot of the State. The earlier workers have failed to recognize the coastal area as a potential area of endemism probably because they have confined themselves to the forest belt of the State for the study of endemism.

6.1.3.1. Northern Malabar coastal belt

It comprises the coastal region of Malabar, viz. Ezhimala-Valapattanam, Kanjirakadavu, Valiyaparathode, Cherkala and lowland regions of Kannur, Kozhikkod and Malappuram Districts. Average altitude of the region is 50 m and it does not include any protected area. Thierteen exclusive endemic species of the State are reported from this belt. The prominent among them include *Ischaemum cannanorensis, Ischaemum malabaricum, Ischaemum elimalayanum, Lepidagathis keralensis, Spermacoce malabarica, Sonerila cannanorensis, Justicia ekakusuma,* etc. The important aquatic endemic angiosperms of the belt are *Rotala cookii, Nymphoides sivarajanii* and *Nymphoides krishnakesara.*

6.1.3.2. Southern Lowland belt

It comprises the area around all of Ernakulam and Thrikkunnapuzha and Kuttanadu areas of Alappuzha. 20 endemic species are confined to this endemic belt. The prominent species among them are *Dimeria copeana, Dimeria copeii, Dimeria kalavoorensis, Ischaemum vembanadense, Ischaemum kumarakodiensis, Nymphoides macrospermum, Rotala vasudevanii* and *Burmannia stricta.*

6.1.3.4. Ecologically sensitive areas with special reference to endemism

Mangroves: The mangroves, the important vegetation type along the coastal belt, constitute the esturine flora. The main mangrove vegetations of Kerala are seen in Pappinisseri, Kunjimangalam and Edakkavu of Kannur, Nadakkavu of Malappuram,

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Kumarakom of Kottayam, Ayiramthengu and Asramam of Kollam, and Veli of Thiruvananthapuram. The mangrove eco-sites are encountered as isolated patches and the total area is less than 50 sq. km in the state. Their importance as breeding grounds of fishes and other aquatic animals and in the stabilization of shoreline environment by acting as a buffer against the encroachment by sea is well known. The mangrove ecosystem contains considerable number of endemic species like, *Lindernia tenuifolia* var. *pygmaea*, *Fuirena simpsonii* and *Ischaemum pappinisseriensis*. The mangroves of Kerala have been subjected to great biotic pressures and are replaced by extensive developmental projects.

Sacred groves: Sacred groves or 'Serpent forests' (Kavu) are found throughout the lowlands and midland zones of Kerala extending up to the foothills of highlands. While most of these isolated formations are confined to lower elevations, a few groves are found in the high ranges of Pathanamthitta, Kottayam, Idukki, and Wayanad districts. Alappuzha, Thrissur, Kozhikode, Kannur and Kasaragode districts have recorded highest number of sacred groves in the State. They are similar to the lowland evergreen forests in their structural and functional attributes, exhibiting local variations in species content and richness.

These sacred groves are islands of vegetation, with the man made ecosystems all around serving as barriers. Several rare and endemic elements of the Western Ghats are fairly well preserved in these formations. *Cinnamomum nicolsonianum*, *Kunstleria keralensis*, *Ixora johnsonii*, *Thottea Idukkiana* and *Grewia palodensis* are some of the exclusive endemic species found in these isolated ecosystems. As such the sacred groves are unique in their species diversity and they serve as *in-situ* genetic resource conservatories.

Wetlands (Aquatic and marshy/Backwater estuaries): These threatened natural ecosystems contain considerable number of endemic elements which need protection from the anthropogenic activities. Most of the endemic species confined to this region have become very scarce and rare due to the destruction of habitats. Vembanadu-Kole, Ashtamudi, Sasthamkotta are some of the major wetland systems of the State. *Lagenandra nairii* (Athirapally falls), *Rotala cookii*, *Rotala malabarica*, *Rotala vasudevanii* (fresh water ponds in Alwaye), *Nymphoides krishnakesara*, *Nymphoides sivarajanii*, *Nymphoides macrospermum* (coastal plain of Malabar), *Ischaemum vembanadense*, *Ischaemum quilonensis*, *Ischaemum kumarakodiensis* (backwaters of southern coastal regions), *Utricularia subramanii* are the prominent endemic species found in this threatened sensitive habitat. Altogether, there are about 30 endemic species found in this region and are neoendemic in origin in the sense that, neondemics generally have herbaceous and shrubby forms and they occur in areas where there is high environmental stress.

6.2. Endemism in Kerala

Though, as earlier stated, phytogeographically the State shares its endemism with the Western Ghats, a number of new species of angiosperms have been recorded exclusively from Kerala, and most of them are not reported from anywhere else (exclusive endemics of the State) in the Western Ghats system. This may be due to the fact that the species are niche-specific. Of the 851 Western Ghats endemic taxa occurring in the State, 267 taxa (240 species, 1 subspecies and 26 varieties) spread over 128 genera and 50 families are found only within the State (Appendix II). This constitutes 5.5% of the total flowering plants and 17% of total endemics of the State, which are exclusively restricted to the present political boundary of the State.

6.2.1. District-wise distribution of exclusive endemic taxa of the state

An analysis of the patterns of occurrence of exclusive endemic taxa of the State showed that they are more concentrated in the Districts having forested highlands (Appendix II & Fig. 58). Idukki district has the higest number of endemic plants (63 sp., 3 var.) followed by Thiruvananthapuram (44 sp., 1 subsp., 5 var.), Palakkad (46 sp., 3 var.), Kollam (31 sp., 2 var.), Thrissur (33 sp.), Pathanamthitta (26 sp., 1 var.), Kannur (21 sp.,4 var.), Kozhikode (20 sp., 2 var.), Wayanad (19 sp., 1 var.), Malappuram (14 sp., 1 var.), Kasaragod (19 sp., 2 var.), Alappuzha (10 sp.), Ernakulam (7 sp.), and Kottayam (5 sp.).

If we consider the geographical distributional range of endemic taxa, 142 species are found restricted to a single locality (65%), 70 species are found in less than 5 localities (31%) and only 7 species are found in more than 5 localities, but that too in below 10 locations. Altitudinally, there are 66 species found above 1500 m, and 67 species between 800-1500 m. Majority of the endemic taxa are from the evergreen forests (39%) followed by aquatic and wetland type vegetation with 19% and grasslands and rocky/ hilly areas with 13% each.

6.2.2. Dominant families showing high percentage of endemism

Of the 50 families represented, 5 families, viz. Poaceae (49 sp., 1 var.), Orchidaceae (18 sp.), Rubiaceae (16 sp., 1 var.), Balsaminaceae (15 sp.), Cyperaceae (13 sp., 1 var.) have the highest number of endemic species in the State (Fig. 59). Dominant genera having largest representation of endemics are *Ischaemum* (18 sp.), *Impatiens* (15 sp.), *Dimeria* (15 sp.), *Fimbristylis* (9 sp.) and *Curcuma* (6 sp.).

Two dominant families, namely Poaceae and Balsaminaceae, possess maximum number of exclusive endemic species in the State. A brief analysis of the factors responsible for

effecting high degree of endemism in these families is given below.

Poaceae

It is estimated that about 401 species, 2 subspecies., 11 varieties. belonging to 119 genera occur in Kerala which make Poaceae the largest angiosperm family in the State. This represents 32% of total grass species of India and 90% of Peninsular Indian grass flora. The major genera exhibiting maximum species diversity and endemism in Kerala, Peninsular India, and the world are shown in Table 71 below.

71. Species diversity and endemism of major grass genera

Sl. No.	Genus	No. of species in Kerala	No. of species in Peninsular India	No. of species in India	World
1	*Arthraxon* P. Beauv.	4 (2)	12 (8)	13	20
2	*Arundinella Raddi*	13 (4)	18 (14)	25	47
3	*Bhidea* Stapf	2 (2)	2 (2)	2	2
4	*Bothriochloa O. Kuntze*	5 (1)	14 (9)	14	35
5	*Chandrasekharania* Nair *et al.*	1 (1)	1 (1)	1	1
6	*Chrysopogon* Trin.	10 (3)	15 (10)	20	29
7	*Danthonidium* C. E. Hubbard	1	1	1	1
8	*Dicanthium* Willemet	4 (1)	11 (7)	11	20
9	*Dimeria* R. Br.	31 (19)	43 (32)	46	79
10	*Glyphochloa* Clayton	3 (2)	9 (9)	9	9
11	*Heteropogon* Pers.	2 (1)	6 (3)	6	6
12	*Indopoa* Bor	1	1	1	1
13	*Isachne* R. Br.	12 (3)	24 (16)	33	50
14	*Ischaemum* L.	35 (19)	45 (35)	51	75
15	*Limnopoa* C. E. Hubbard	1 (1)	1 (1)	1	1
16	*Ochlandra* L.	10 (10)	11 (10)	11	12
17	*Oryza* L.	3	7 (4)	16	18
18	*Silentvalleya* Nair *et al.*	1 (1)	1(1)	1	1
19	*Tripogon* Roem. & Schult.	8 (5)	13 (9)	16	23

(Number of exclusive Kerala endemics in brackets)

The present study has recorded the occurrence of about 96 species and 2 varieties of endemic grasses forming 31% of Indian endemics in Kerala, of which 49 species and 1 variety are exclusively endemic to the present political boundary of the State. It is found that about 80% of the Peninsular Indian endemics are represented in this region. *Ischaemum* with 35

Fig. 58. District-wise distribution of exclusive endemic taxa in Kerala

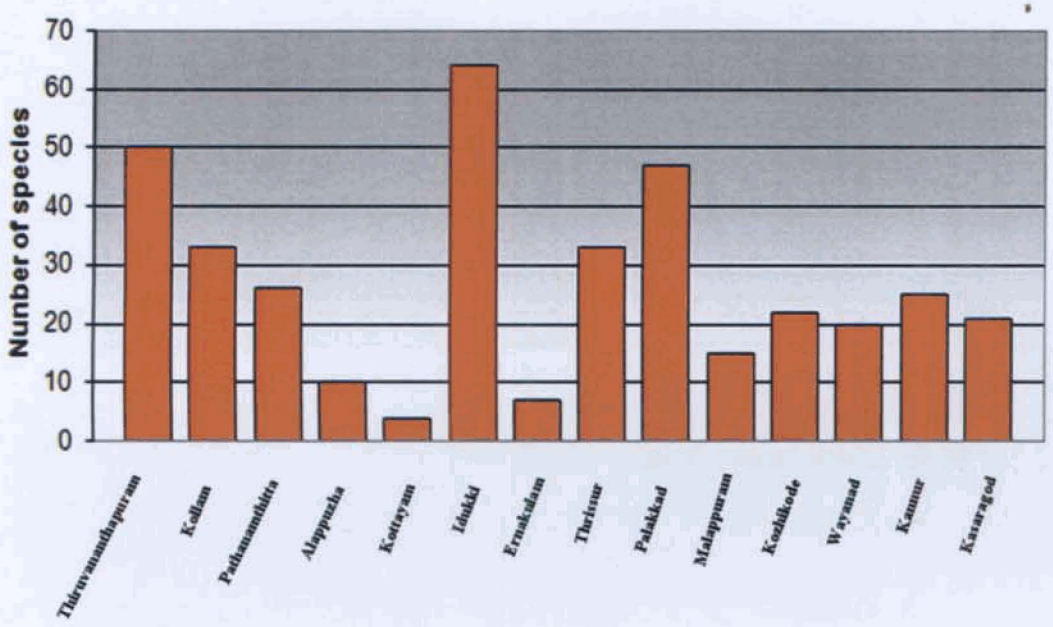
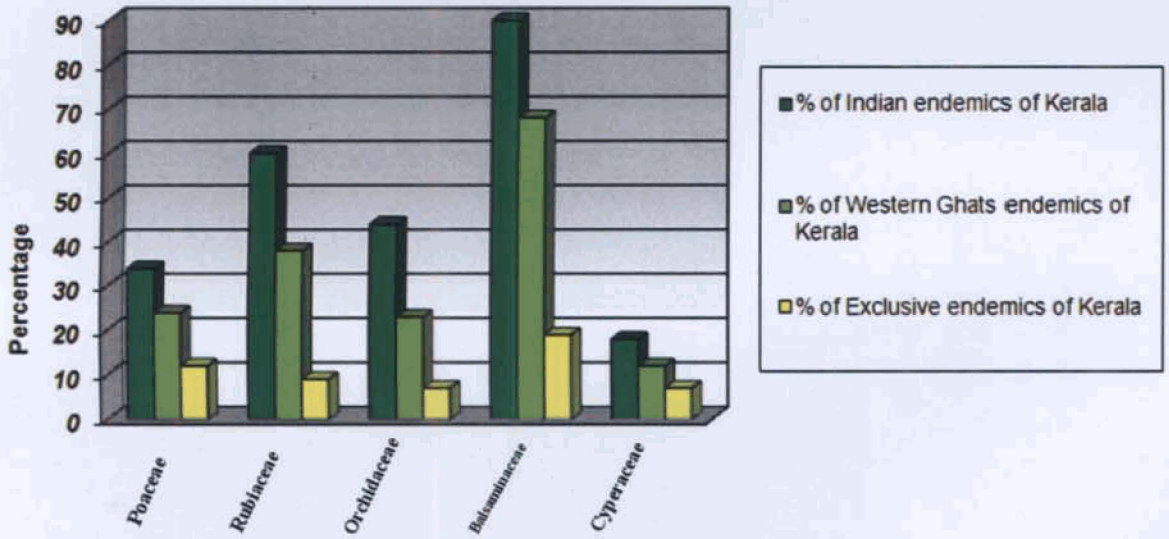


Fig. 59. Dominant families showing high percentage of endemism



species and *Dimeria* with 31 species are the dominant genera in the family which manifest high degree of endemism. There are a total of 18 and 15 species of *Ischaemum* and *Dimeria* respectively representing exclusive endemics in the state (Figs. 60 & 61). The endemic monotypic genus solely occurring in the state is *Silentvalleya*, which shows restricted distribution in its type locality.

A review on grass diversity of the State has also revealed that the tribe Andropogoneae have shown maximum diversity and endemism when compared to the species diversity of other grass tribes represented. About 70% of the endemic grass taxa could be collected during the present study. It is found that nearly 60% of the endemic species are scarce in distribution and most of them are known only from the type collection.

Based on recent phylogenetic studies, Andropogoneae is considered monophyletic in origin and described as forming a 'natural' group because of the many similar morphological features exhibited by the constituent taxa. The present study also revealed that the Andrpogonoids constitute the largest group with about 120 species under 32 genera, forming 27% of the total grass species and showing high degree of endemism in the state. Mehrotra and Jain (1980) have estimated that about 46% of the total Andropogonoids present in India are endemics, and nearly 31% of them are strictly confined to Peninsular India. *Ischaemum, Dimeria, Chrysopogon* are some of the dominant genera of this group, of which *Ischaemum* and *Dimeria* have the highest number of endemic grass species.

The various analyses indicate that the Andrpogonoids form a successful group in the Peninsular India and Western Ghats in general, and Kerala in particular. The rich species diversity and high degree of endemism indicate that the group is actively evolving in the Kerala region of Western Ghats.

Grass dominated ecosystems with special reference to endemics

Grass dominated ecosystems form an important constituent of Kerala vegetation which comprise over 250 sq. km of the State's geographical area. It harbours immensely rich plant diversity with high degree of endemism. On the basis of the degree of endemism and species diversity - the two criteria for recognising hotspots of the State-there is sufficient justification for treating the grass dominated ecosystems as a distinctive hotspot of the State. According to Sreekumar and Nair (1991) grasslands of Kerala have been broadly classified into two major types.

1. Low level grasslands occurring below 1000 m altitude, which contribute much to the

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endemism in the State. Within this there are of two types namely, dry grasslands and wet grasslands.

a. Dry grasslands: Usually seen along the laterite-rocky hill areas in Northern Kerala. The highly endemic grass genera *Dimeria, Ischaemum* and *Arundinella* show maximum representation in this ecosystem.

b. Wet grasslands: Usually occurring along coastal regions (Northern Malabar Coast) and lowland regions (Southern lowland belt) of Kerala. Endemic species of *Isachne, Ischaemum,* and *Dimeria* are the common constituents of this type of vegetation.

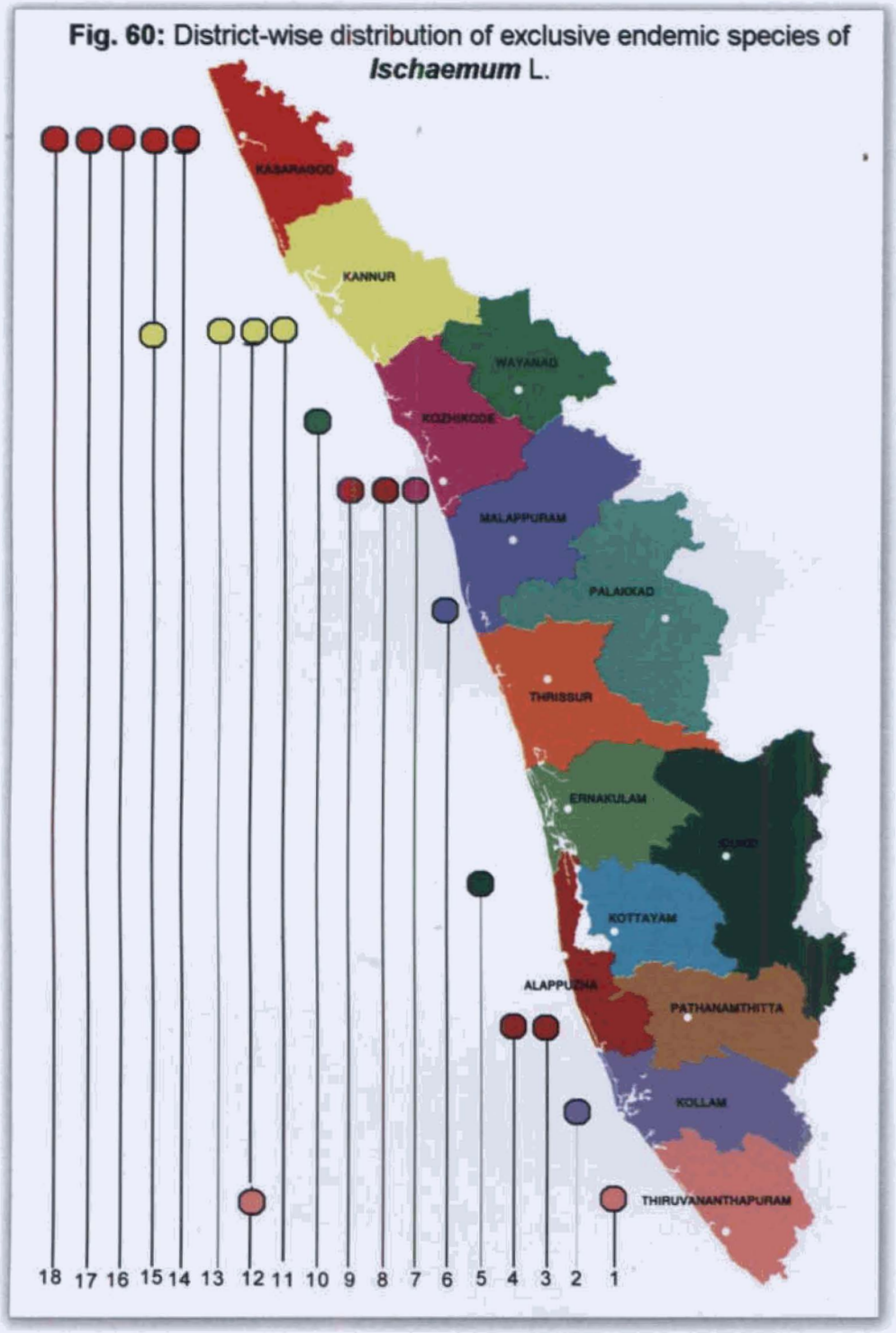
2. High altitude grasslands occurring above 1000 m altitude and distributed along the highland region of the State are with endemic species of *Arundinella, Isachne, Bothriochloa, Silentvalleya, Chrysopogon, Tripogon* and *Zenkeria.* Many grasslands of this region are interspersed with patches of evergreen forests that form the shola grasslands constituting endemic biotomes.

Riparian belt of evergreen and semi-evergreen forests harbours endemic *Ochlandra* species.

Table 72. Exclusive endemic grass taxa and their habitat specificity

Sl. No	Species	Habitat
1	*Dimeria copeana*	Wetlands
2	*Dimeria copei*	
3	*Dimeria kalavoorensis*	
4	*Isachne henryi*	
5	*Ischaemum jaychandranii*	
6	*Ischaemum kumarakodiensis*	
7	*Ischaemum nairii*	
8	*Ischaemum pappinisseriensis*	
9	*Ischaemum quilonensis*	
10	*Ischaemum vembanadense*	
11	*Ischaemum wayanadense*	
12	*Dimeria borii*	Wet rocky hill slopes
13	*Dimeria josephii*	
14	*Dimeria sreenaryanii*	
15	*Isachne fischeri*	
16	*Ischaemum copeanum*	
17	*Ischaemum lanatum*	
18	*Ischaemum pushpangadanii*	

Fig. 60: District-wise distribution of exclusive endemic species of ***Ischaemum*** L.



1. *I. agasthyamalaynum* Sreek. *et al.*
2. *I. quilonensis* Ravi *et al.*
3. *I. kumarakodiensis* Ravi *et al.*
4. *I. vembanadense* Patil & D'Cruz.
5. *I. tadulingamii* Nair *et al.*
6. *I. abrahamii* Ravi *et al.*
7. *I. calicutensis* Sreek. *et al.*
8. *I. nairii* Nair *et al.*
9. *I. pushpangadanii* Ravi *et al.*
10. *I. wayanadense* Ravi *et al.*
11. *I. elimalayanum* Sreek *et al.*
12. *I. raui* Sreek. *et al.*
13. *I. pappinisseriensis* Ravi *et al.*
14. *I. cannanorensis* Sreek. *et al.*
15. *I. copeanum* Sreek. *et al.*
16. *I. jayachandranii* Ansari *et al.*
17. *I. lanatum* Ravi *et al.*
18. *I. malabaricum* Sreek. *et al.*

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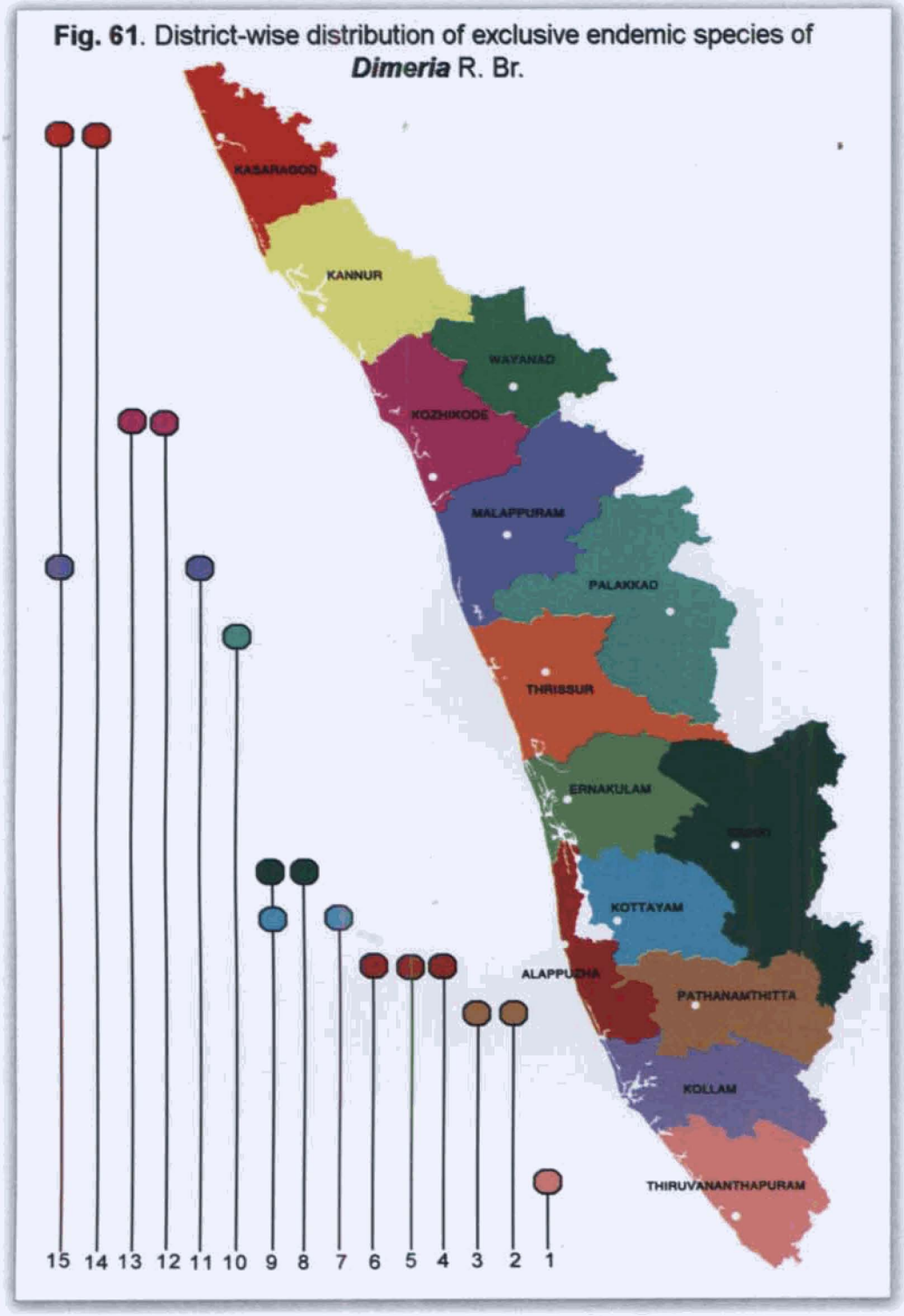
Fig. 61. District-wise distribution of exclusive endemic species of ***Dimeria*** R. Br.



1. *D. agasthyamalayana* Ravi *et al.*
2. *D. namboodiriana* Ravi *et al.*
3. *D. sivarajanii* Mohanan *et al.*
4. *D. copeana* Sreek. *et al.*
5. *D. copei* Ravi
6. *D. kalavoorensis* Ravi
7. *D. sreenarayanii* Ravi *et al.*
8. *D. idukkiensis* Ravi & Anil Kumar.
9. *D. kurunthotticalana* Jacob
10. *D. josephii* Ravi *et al.*
11. *D. chelariensis* Ravi
12. *D. borii* Sreek. *et al.*
13. *D. jainii* Sreek. *et al.*
14. *D. keralae* Nair *et al.*
15. *D. eradii* Ravi

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Plate 88. Species in their specific habitats:
a. ***Dimeria copei*** Ravi; b. ***Dimeria namboodiriana*** Ravi *et al.*; c. ***Dimeria eradii*** Ravi; d. ***Ischaemum kumarakodiensis*** Ravi *et al.*; e. ***Ischaemum quilonensis*** Ravi & Shaju; f. ***Silentvalleya nairii*** V. J. Nair *et al.*; g. ***Ischaemum elimalayanum*** Sreek. *et al.*

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Sl. No	Species	Habitat
19	*Ischaemum tadulingamii*	
20	*Silentvalleya nairii*	
21	*Tripogon sivarajanii*	
22	*Tripogon vellarianus*	
23	*Dimeria agasthyamalayana*	Grassy hill slopes
24	*Dimeria Idukkiensis*	
25	*Dimeria kurunthotticalana*	
26	*Isachne jayachandranii*	
27	*Ischaemum abrahamii*	
28	*Ischaemum agasthyamalayanum*	
29	*Ischaemum elimalayanum*	
30	*Arundinella cannanorica*	Dry grasslands
31	*Dimeria jainii*	
32	*Dimeria keralae*	
33	*Ischaemum calicutensis*	
34	*Ischaemum raui*	
35	*Dimeria chelariensis*	Lateritic grasslands
36	*Dimeria eradii*	
37	*Ischaemum cannanorensis*	
38	*Ischaemum malabaricum*	
39	*Chrysopogon purushothamanii*	Dry rocky hill slopes
40	*Chrysopogon tadulingamii*	
41	*Ochlandra ebracteata*	Evergreen forests
42	*Ochlandra keralensis*	
43	*Ochlandra soderstromiana*	
44	*Ochlandra spirostylis*	
45	*Ochlandra travancorica* var. *hirsuta*	
46	*Arundinella ravii*	High altitude grasslands
47	*Bothriochloa parameswaranii*	
48	*Dimeria sivarajanii*	
49	*Dimeria namboodirianus*	

Grassland ecosystems and other grass dominated habitats of the State deserve special attention in conservation efforts. The present study clearly showed that endemic taxa of the State are mostly located in its different grass dominated habitats (Plate 88). V. J. Nair *et al.* (1982) have discovered two new grass genera, viz. *Silentvalleya* and *Chandrasekharania*

(recently reported also from Tamil Nadu region), from such grass dominated habitats. While *Silentvalleya* reported from wet rocky hill slopes of the dam site of abandoned Silent Valley hydro electric project (c.850 m), *Chandrasekharania* was discovered from Kannoth region of Kannur district (c. 185 m). The lateritic dry grasslands occurring in the northern districts of Kasaragod, Kannur, Kozhikode and isolated hills of lower Wayanad possess highest number of endemic grass species. Therefore, these habitats are considered as the centre of origin of Andropogonoid grass genera like *Dimeria*, *Ischaemum* and the two strictly endemic genera of Peninsular India, viz. *Glyphochloa* and *Bhidea*, with their distribution extending up to the neighbouring states of Tamil Nadu and Karnataka. Low level wet grasslands, the threatened natural ecosystems, also contain considerable number of endemic elements. Vembanadu-Kole, Ashtamudi and Sasthamkotta are some of the major wetland systems of the state which form another centre of speciation for the neoendemic grass species of the genera *Isachne*, *Ischaemum* and *Dimeria*. The southern districts of the state including the above Ramsar Sites, also show high degree of endemism. Further, the grassy slopes of different forest types are inhabited by a number of exclusive endemic grass species of different genera like *Chrysopogon*, *Ischaemum*, *Dimeria*, etc. Occurrence of strict endemic species of primitive genera like *Ochlandra* in reverine evergreen forests also exemplifies the habitat diversity of these endemic grasses.

Balsaminaceae

The genus *Impatiens* is a characteristic constituent of wet tropics occurring prolifically in montane forests from which present day distribution of many species appear to have been radiated. *Impatiens* is notably represented on the mountains of tropical Africa, South East Asia including China, Malaya Peninsula, India and Sri Lanka. The greatest concentration of its species is in India, including the Himalayas extending eastwards reaching Myanmar. It is particularly interesting to note that no species are shared in common between northern and southern India, as the mountain masses of the the Himalayas and Deccan peninsula are effectively isolated from each other by the wide dry plains of central and northern India. Thus the two major centres of development with discontinuous distribution in the Himalayas and Southern Western Ghats show a relatively high degree of endemism. The *Impatiens* group, in all probability, is considered to be an ancient one having arisen from a common genetic stock and developed separately and independently on parallel lines in different centres, viz. the Himalayas, Myanmar, South India and Sri Lanka. Bhaskar's (1975) work on *Impatiens* has shown that the genus exhibit about 95% endemism in southern India and Sri Lanka. The South Indian *Impatiens* species are closely allied to their Sri Lankan counterparts, reflecting a common ancestry. Though most of the species of *Impatiens* are palaeoendemic, a few could have been evolved recently through speciation. All these endemics are well established in their

particular habitats, showing their adaptability and preferences for selective and specialized ecological conditions.

It is found that about 90% of Peninsular Indian endemic species of the genus *Impatiens* are represented in Kerala, *i.e.* a total of 71 species and 1 variety of *Impatiens* constitute one of the dominant families having high degree of endemism in the state. It can be seen that almost two thirds of these endemic species are confined to high altitude mountain regions or biotopes. Most species occur in montane forests above 800 m altitude, isolated from one another forming 'island' like mountain blocks. This results in a high degree of "local endemism or point endemism" among the species. Some species have become narrow endemic owing to their habitat specificity. Most of these endemic species are considered palaeoendemic due to the reasons mentioned above. The present study showed that there are 15 species strictly confined to the State (Fig. 62). Of these, *I. tilo*, *I. cochinica*, *I. concinna*, *I. munnarensis*, *I. pandata*, *I. macrocarpa*, *I. pallidiflora* and *I. verecunda* are known only from the type collections. Though the type localities of these species were explored, none of them could be relocated during the present study, probably due to habitat destruction in the recent past.

The distribution of *Impatiens* is strictly controlled by the availability of suitable habitat conditions; indeed there are relatively few habitats suitable for majority of the species found in Kerala. Of the above mentioned 15 exclusive endemic species,13 species are strictly confined to the high altitude mountain ranges of Idukki, Palakkad and Thrissur districts and specific localities of two species, viz. *I. concinna* & *I. tilo* are not mentioned in their protologues. These species exclusively prefer high altitude moisture zones, especially reverine and stream margins, mossy banks and moist forest areas in particular (Fig. 63). Even within these confines, rather minor habitat changes, reflected by a change in density of canopy of trees, or perhaps an increase in altitude, may favour or destroy a particular species. Each species, though occurring in the same general vicinity, often occupy a visibly different ecological niche.

The narrowness of distribution of most of the species of *Impatiens*, according to Fyson (1932), is attributed to the loss of interaction between the areas of their origin that existed in the past and controlled by specific climatic and other factors. This left many of the species isolated on the higher hills, while the hot plains in between posed barriers for crossing of such delicate plants. He seemed to favour the view that new taxa might arise by mutation in isolated areas when there is no chance for general mixing with the main stock to prevent divergence. Accordingly the narrow endemism exhibited by the species of *Impatiens* in the Western Ghats indicate that they are neoendemics (Engler, 1882) and further the Western Ghats region is the main area of speciation as far as the genus is concerned. According to Bhaskar (1981) Western

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Ghats region is the second richest area in the Indian subcontinent, and perhaps in the world with respect to the distribution of species of *Impatiens*.

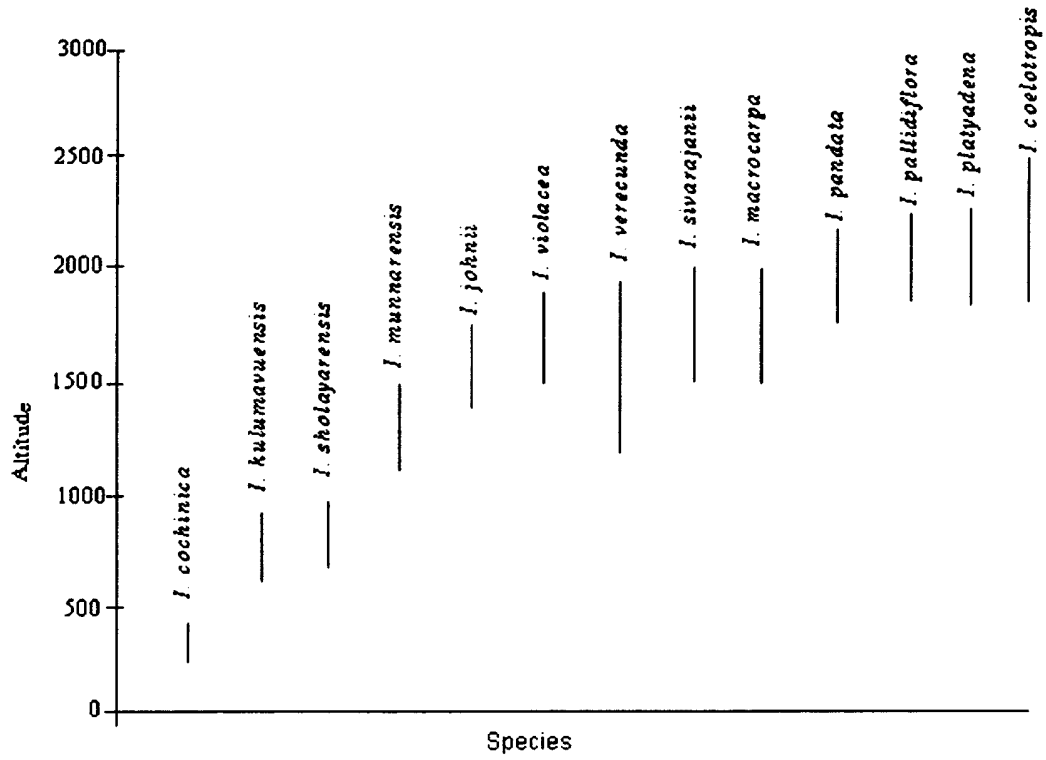


Fig. 63. Altitudinal distribution of exclusive endemic species of *Impatiens* L. in Kerala

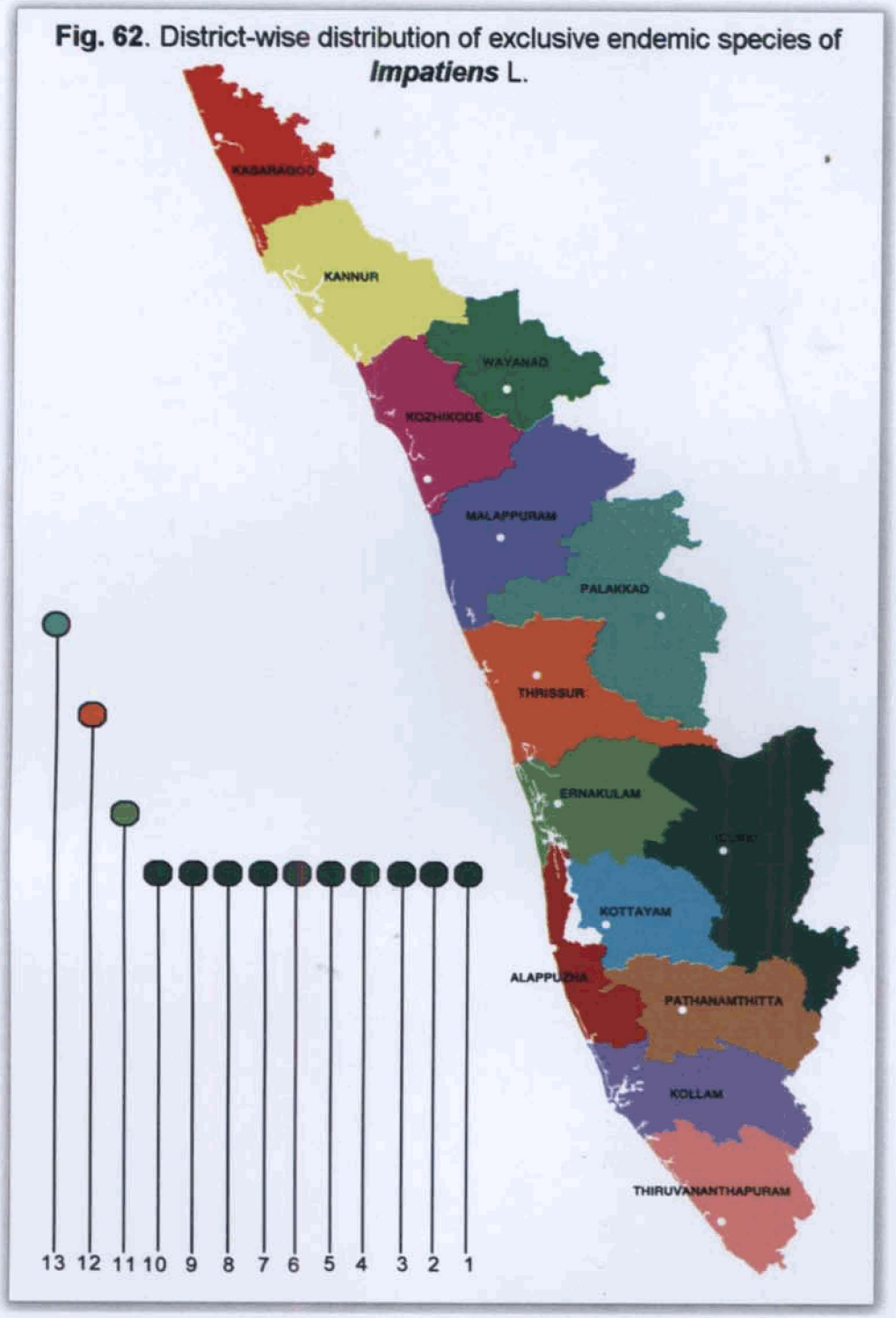
6.2.3. Physiognomic distribution of exclusive endemic plants of the state

Of the 267 endemic flowering plants represented in Kerala, 32 trees (12%), 64 shrubs (24%) and 171 herbs (64%), (Fig. 64) as per physiognomic distribution; 149 taxa are dicots and 109 taxa are monocots.

6.2.4. Rare and threatened exclusive endemic plants

The analysis showed that 54 species have been categorised as rare and threatened in the IUCN Red List categories (Ahmedullah & Nayar, 1987; Nayar, 1997; IUCN, 2000). The percentage of rare and threatened plants is 21, which is fairly a high percentage (Fig. 65). Most of these species are known only from single collection and no recent reports of their occurrence in any of the neighbouring regions are available. Exclusive endemics of the family Balsaminaceae having more species come under 'Possibly extinct', 'Critically endangered', 'Endangered' and 'Vulnerable' categories. All these species are biotopic endemics distributed at an altitudinal range between 1000-2500 m. Causes for its decline and possible extinction may be due to massive deforestation and other ecological and anthropogenic factors. Some

Fig. 62. District-wise distribution of exclusive endemic species of ***Impatiens*** L.



1. *I. coelotropis* C. E. C. Fischer
2. *I. johnii* Barnes
3. *I. kulamavuensis* Pandur. & Nair
4. *I. macrocarpa* Hook. f.
5. *I. munnarensis* Barnes
6. *I. pallidiflora* Hook. f.
7. *I. pandata* Barnes
8. *I. patyadena* C. E. C. Fischer
9. *I. verecunda* Hook. f.
10. *I. violacea* M. Kumar *et al.*
11. *I. cochinica* Hook. f.
12. *I. sholayarensis* M. Kumar *et al.*
13. *I. sivarajanii* M. Kumar *et al.*

(*I. concinna* Hook f. & I. tilo (DC) Suresh: Locality unknown)

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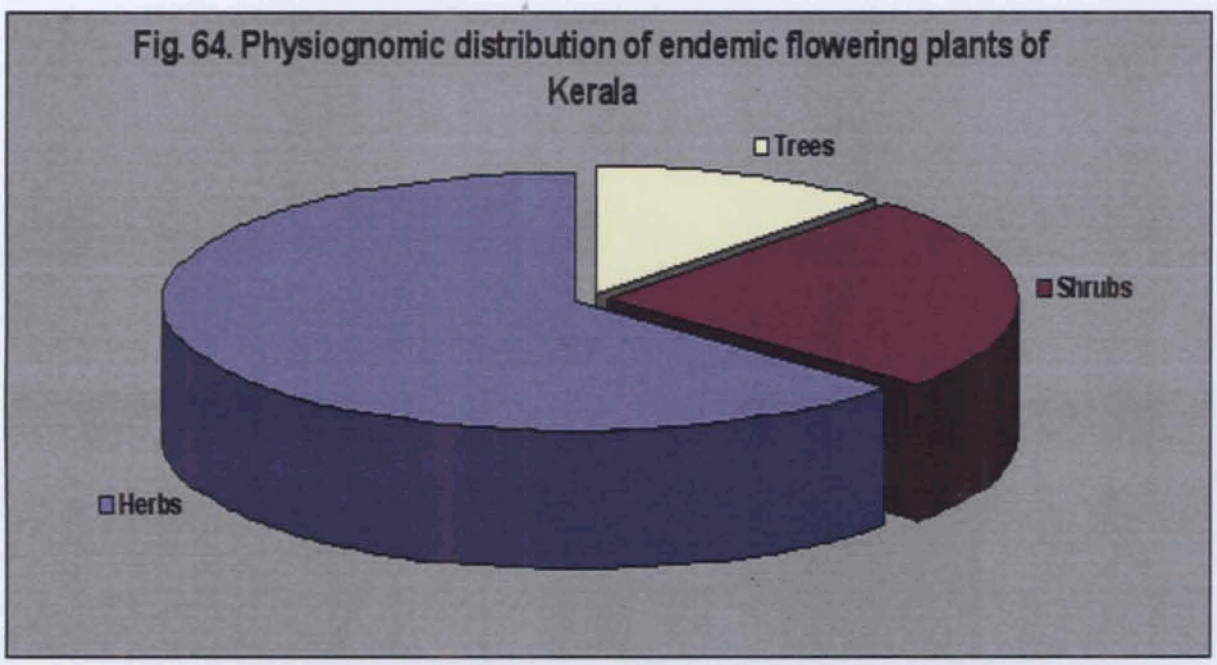
Fig. 64. Physiognomic distribution of endemic flowering plants of Kerala
Trees
Shrubs
Herbs

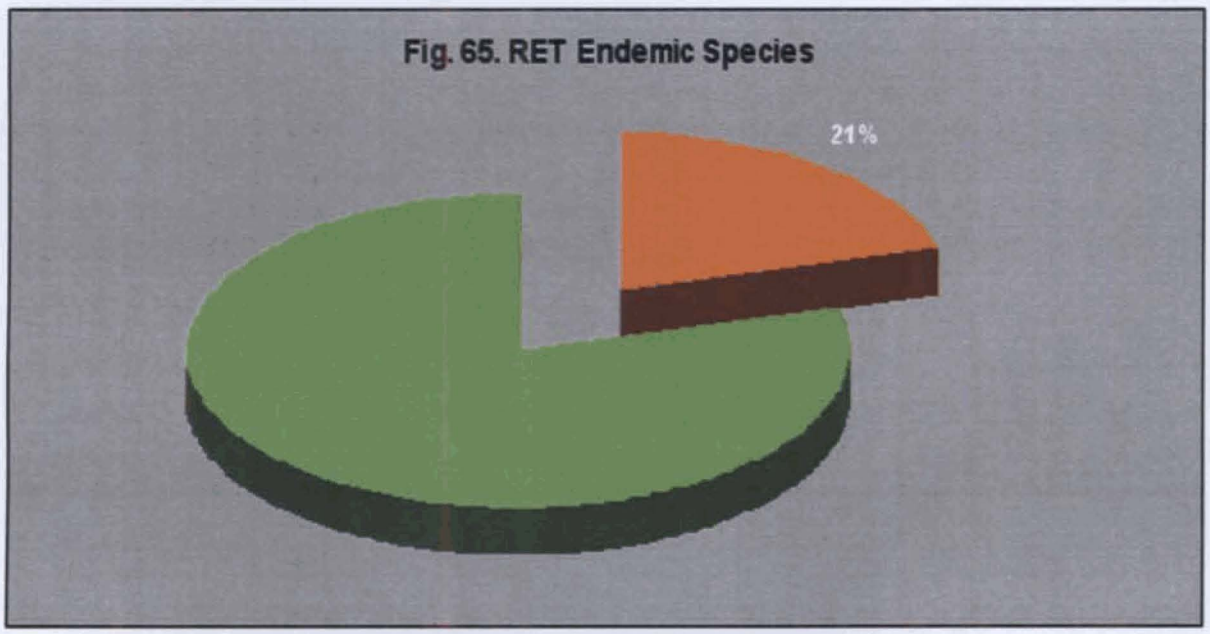
Fig. 65. RET Endemic Species
21%

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palaeoendemic tree species of the families Ebenaceae (*Diospyros sulcata*), Anacardiaceae (*Buchanania barberi*) and Fabaceae (*Dialium trvancoricum*) are also on the verge of extinction or are possibly extinct. The following forms a comprehensive list (Table 73) of the exclusive endemic species coming under this category (Nayar *et al.* 1987, 1990 & 1997; IUCN, 2000).

Table 73. List of Rare and threatened exclusive endemic plants

No.	Name of species	Family	Status
1	*Phaeanthus malabaricus* Bedd.	Annonaceae	Lower risk:near threatened (IUCN, 2000)
2	*Polyalthia shendurunii* Basha & N. Sasidharan	Annonaceae	Endangered (IUCN. 2000)
3	*Sageraea grandiflora* Dunn	Annonaceae	Endangered (IUCN. 2000)
4	*Impatiens cochinica* Hook. f.	Balsaminaceae	Critically endangered (Nayar, 1997)
5	*Impatiens coelotropis* C. E.C.Fisch.	Balsaminaceae	Vulnerable (Nayar, 1997)
6	*Impatiens concinna* Hook. f.	Balsaminaceae	Endangered (Nayar, 1997)
7	*Impatiens johnii* Barnes	Balsaminaceae	Endangered (Nayar, 1997)
8	*Impatiens macrocarpa* Hook. f.	Balsaminaceae	Ctitically endangered (Nayar, 1997)
9	*Impatiens munnarensis* Barnes	Balsaminaceae	Critically endangered.
10	*Impatiens pallidiflora* Hook. f.	Balsaminaceae	Endangered (Nayar, 1997)
11	*Impatiens pandata* Barnes	Balsaminaceae	Endangered (Nayar, 1997)
12	*Impatiens platyadena* C.E.C. Fisch.	Balsaminaceae	Critically endangered (Nayar, 1997)
13	*Impatiens verecunda* Hook. f.	Balsaminaceae	Critically endangered
14	*Aglaia malabarica* N. Sasidharan	Meliaceae	Critically endangered (IUCN, 2000)
15	*Dysoxylum beddomei* Hiern	Meliaceae	Endangered (IUCN, 2000)
16	*Buchanania barberi* Gamble	Anacardiaceae	Critically endangered (IUCN, 2000)
17	*Dalbergia beddomei* Thoth.	Fabaceae	Endangered (Nayar, 1997)
18	*Smithia venkobarowii* Gamble	Fabaceae	Possibly extinct (Nayar, 1997)
19	*Tephrosia wynaadensis* Drumm.	Fabaceae	Rare (Nayar, 1997)
20	*Dialium travancoricum* Bourd.	Fabaceae	Critically endangered (IUCN, 2000)
21	*Humboldtia unijuga* var. *trijuga*	Fabaceae	Critically endangered

No.	Name of species	Family	Status
	Joseph & Chandras.		(IUCN, 2000)
22	*Inga cynometroides* (Bedd.) Bedd. ex Baker	Fabaceae	Possibly extinct (Nayar, 1997)
23	*Eugenia argentea* Bedd.	Myrtaceae	Possibly extinct (Nayar, 1997)
24	*Syzygium bourdillonii* (Gamble) Rathkr. & Nair	Myrtaceae	Endangered (IUCN, 2000)
25	*Syzygium palghatense* Gamble	Myrtaceae	Critically endangered (IUCN, 2000)
26	*Sonerila elegans* var. *beddomei* G. S. Giri & Nayar	Melastomataceae	Rare (Nayar, 1997)
27	*Sonerila nemakadensis* C. E. C. Fisch.	Melastomataceae	Rare & Threatened (Ahmedullah & Nayar, 1987)
28	*Luffa umbellata* (Klein) Roem.	Cucurbitaceae	Rare & Threatened (Ahmedullah & Nayar, 1987)
29	*Ixora johnsonii* Hook. f.	Rubiaceae	Critically endangered (IUCN, 2000)
30	*Ophiorrhiza barnesii* C. E. C. Fisch.	Rubiaceae	Critically endangered
31	*Ophiorrhiza caudata* C. E. C. Fisch.	Rubiaceae	Possibly extinct (Nayar,1997)
32	*Ophiorrhiza munnarensis* C. E. C. Fisch.	Rubiaceae	Critically endangered
33	*Pavetta nemoralis* Bremek.	Rubiaceae	Possibly extinct (Nayar, 1997)
34	*Pavetta oblanceolata* Bremek.	Rubiaceae	Critically endangered (Nayar,1997)
35	*Pavetta travancorica* Bremek.	Rubiaceae	Critically endangered (Nayar,1997)
36	*Anaphalis barnesii* DC.	Rubiaceae	Endangered (Nayar, 1997)
37	*Vernonia anaimudica* Shetty & Vivek.	Rubiaceae	Vulnerable Nayar, 1997)
38	*Vernonia beddomei* Hook. f.	Rubiaceae	Rare & Threatened (Ahmedullah & Nayar, 1987)
39	*Mesa velutina* Mez	Myrsinaceae	Endangered (IUCN, 2000)

No.	Name of species	Family	Status
40	*Diospyros sulcata* Bourd.	Ebenaceae	Possibly extinct (Nayar, 1997)
41	*Ceropegia beddomei* Hook. f.	Asclepiadaceae	Endangered (Nayar, 1997)
42	*Didymocarpus macrostachya* Barnes	Gesneriaceae	Critically endangered
43	*Strobilanthes dupenii* Bedd. ex Clarke	Acanthaceae	Rare (Nayar, 1997)
44	*Litsea travancorica* Gamble	Lauraceae	Endangered (IUCN, 2000)
45	*Aporusa bourdillonii* Stapf	Euphorbiaceae	Endangered (IUCN, 2000)
46	*Acampe congesta* (Lindl.) Lindl.	Orchidaceae	Possibly extinct (Nyar, 1997)
47	*Ipsea malabarica* (Reichb.f.) Hook.f.	Orchidaceae	Endangered (Nayar, 1997)
48	*Haplothismia exannulata* Airy Shaw	Burmanniaceae	Possibly extinct (Nayar, 1997)
49	*Arisaema attenuatum* Barnes & C. E. C. Fisch.	Araceae	Threatened (Nayar, 1997)
50	*Arisaema psittacus* Barnes	Araceae	Threatened (Nayar, 1997)
51	*Arisaema sarracaenioides* Barnes & C. E. C. Fisch.	Araceae	Rare & Threatened (Ahmedullah & Nayar, 1987)
52	*Dimeria kurumthotticalana* Jacob	Poaceae	Endangered (Nayar, 1997)
53	*Isachne fischeri* Bor	Poaceae	Rare (Nayar, 1997)
54	*Ischaemum agasthyamalayanum* Sreekumar *et al.*	Poaceae	Rare (Nayar, 1997)

As per IUCN (2008) categorization, only tree species figure in the Red listed Plants of India. According to this, 15 exclusive endemic tree species of the State apear under various threat categories which are listed below (Table 74).

Table 74. Exclusive endemic species coming under IUCN Red List Plants of India (2008)

Sl. No.	Name of species	*EX*	*EW*	*CR*	*EN*	*VU*	*LR*			*DD*	*NE*
							cd	*nt*	*lc*		
1	*Buchanania barberi* Gamble (Anacardiaceae)			*							
2	*Phaeanthus malabaricus* Bedd. (Annonaceae)							*			
3	*Polyalthia shendurunii* Basha &				*						

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Sl. No.	Name of species	*EX*	*EW*	*CR*	*EN*	*VU*	*LR*			*DD*	*NE*
							cd	*nt*	*lc*		
	N. Sasidharan (Annonaceae)										
4	*Sageraea grandiflora* Dunn (Annonaceae)			*							
5	*Aporusa bourdillonii* Stapf (Euphorbiaceae)			*							
6	*Litsea travancorica* Gamble (Lauraceae)			*							
7	*Cynometra beddomei* Prain (Fabaceae)	*									
8	*Dialium travancoricum* Bourd. (Fabaceae)		*								
9	*Julostylis polyandra* Ravi & Anil (Malvaceae)			*							
10	*Aglaia malabarica* Sasidh. (Meliaceae)		*								
11	*Dysoxylum beddomei* Hiern (Meliaceae)			*							
12	*Mesa velutina* Mez (Myrsinaceae)			*							
13	*Syzygium bourdillonii* (Gamble) Rathakr. & Nair (Myrtaceae)			*							
14	*Ixora johnsonii* Hook.f. (Rubiaceae)		*								
15	*Palaquium ravii* N. Sasidharan & Vivek. (Sapotaceae)			*							

EX: Extinct; *EW*: Extinct in the Wild; *CR*: Critically Endangered; *EN*: Endangered; *VU* : Vulnerable; *LR* : Lower Risk: *cd* : Conservation Dependent; *nt*: Near Threatened; *lc*: Least Concern; *DD*: Data Deficient; *NE*: Not Evaluated

6.2.5. Exclusive endemic genetic resources of the State

About 37 species which are exclusively endemic genetic resources have been identified during the study. Among these, 25 species are wild relatives of cultivated crops. They are edible fruits (7 species), vegetables (5 species), spices (3 species), tubers (3 species) and rhizomes (7 species) (Table 75). There are about 15 timber yielding endemic species (trees, bamboos and

canes) also identified from the State (Table 76). Most of these endemic genetic resourses are very narrow in distribution and it is also necessary to conserve habitats of each of these wild endemic species.

Table 75. Endemic Wild Crop Relatives
(Fruits, vegetables, spices, tubers & rhizomes)

No	Name of species	Family
	Edible fruits	
1	*Buchanania barberi*	Anacardiaceae
2	*Eugenia argentea*	Myrtaceae
3	*Syzygium bourdillonii*	Myrtaceae
4	*Syzygium palghatense*	Myrtaceae
5	*Syzygium periyarensis*	Myrtaceae
6	*Antidesma keralense*	Euphorbiaceae
7	*Aporusa bourdillonii*	Euphorbiaceae
	Vegetables	
8	*Cucumella silentvalleyii*	Cucurbitaceae
9	*Cucurbita maxima* var. *badagarensis*	Cucurbitaceae
10	*Luffa umbellata*	Cucurbitaceae
11	*Zehneria maysorensis* var. *oblonga*	Cucurbitaceae
12	*Begonia malabarica*	Bigoniaceae
	Spices	
13	*Cinnmomum nicolsonianum*	Lauraceae
14	*Piper silentvalleyensis*	Piperaceae
15	*Piper nigrum* var. *hirtellosum*	Piperaceae
	Tubers	
16	*Amorphophallus bonaccordensis*	Araceae
17	*Amorphophallus nocolsonianus*	Araceae
18	*Amorphophallus commutatus* var. *wayanadensis*	Araceae
	Rhizomes	
19	*Alpinia smithiae*	Zingiberaceae
20	*Curcuma coriacea*	Zingiberaceae
21	*Curcuma ecalcarata*	Zingiberaceae
22	*Curcuma haritha*	Zingiberaceae
23	*Curcuma mutabilis*	Zingiberaceae
24	*Curcuma raktakanta*	Zingiberaceae
25	*Curcuma vamana*	Zingiberaceae

Table 76. Timber Yielding
(Trees, bamboos and canes)

No	Name of species	Family
	Timber	
1	*Polyalthia shendurunii*	Annonaceae
2	*Dysoxylum beddomei*	Meliaceae
3	*Dialium travancoricum*	Fabaceae
4	*Cassine kedarnathii*	Celastraceae
5	*Aglaia malabarica*	Meliaceae
6	*Sageraea grandiflora*	Annonaceae
	Bamboos	
7	*Ochlandra ebracteata*	Poaceae
8	*O. soderstromiana*	Poaceae
9	*O. spirotylis*	Poaceae
10	*O. travancorica* var. *hirsuta*	Poaceae
	Canes	
11	*Calamus dransfieldii*	Arecaceae
12	*C. shendurunii*	Arecaceae
13	*C. neelagiricus*	Arecaceae
14	*C.gambelii* var.*sphaerocarpa*	Arecaceae
15	*Calamus renukae*	Areceae?

6.2.6. Analysis on ethnobotanical information of the endemic species

India harbours 17023 species of flowering plants (Karthikeyan, 1999). It is estimated that about 9,500 species of flowering plants in India are ethnobotanically important (Ministry of Environment and Forests, 1994) . This constitute 55% of Indian flora. Though Kerala has about 4681 species of flowering plants (Nayar et al., 2006), no comprehensive data occur on the number of plant species used by different tribals of Kerala. The tribals inhabiting different districts in the State make use of a wide range of plant species available to them, but the use of endemic plants by the tribes in their daily life is confined to a small number of species. The present study reports 21 such species. An analysis of these ethnobotanical species based on their uses revealed that 9 species are used as medicine, 6 as wild edibles, 5 species and 1 variety for thatching, tying, basket-making and mat-making and 2 as insect repellents (Fig. 66).

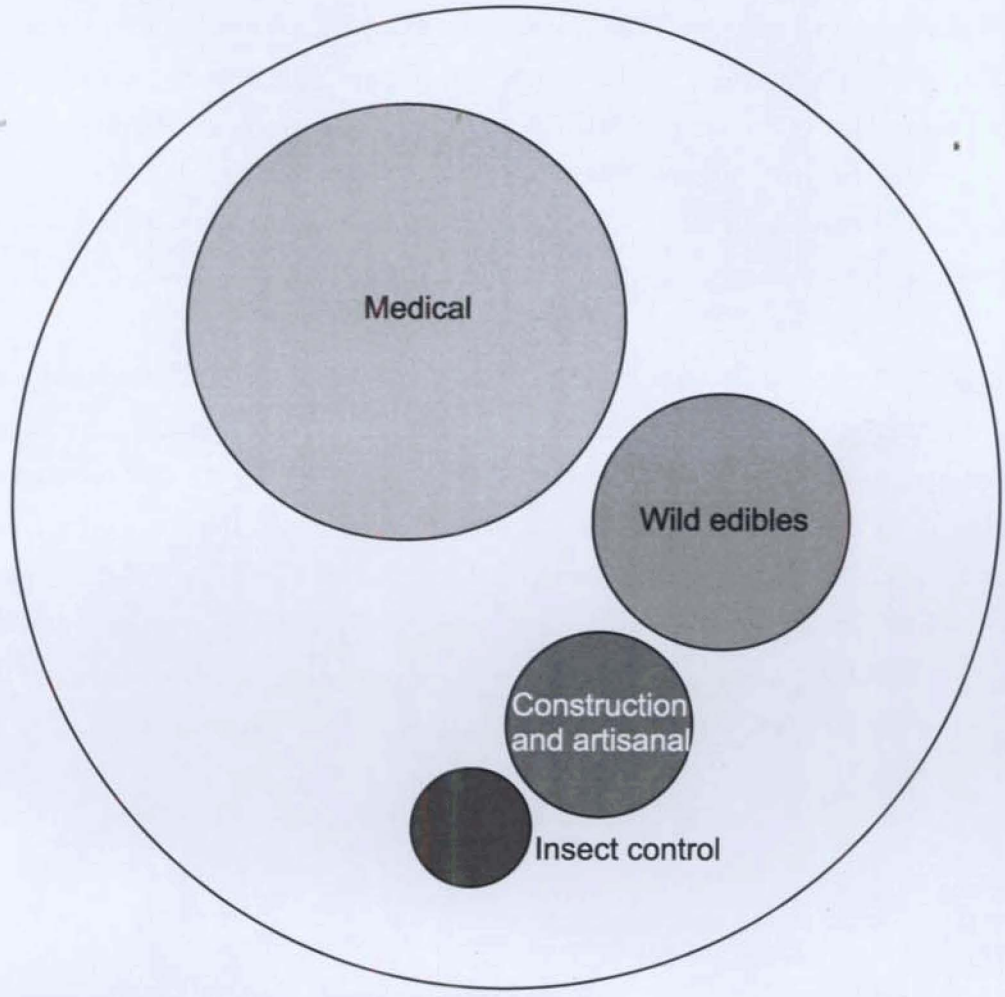

Fig. 66. Utilization profile of ethnobotanically significant exclusive endemic plant species in Kerala

6.3. Conclusion

Endemics are more prone to extinction because of their restricted geographical range size, high habitat specificity, low population abundance, and due to both deterministic (habitat transformation) and stochastic (small population effects) factors. There is therefore a need for adopting appropriate conservation strategies, particularly for conserving local endemics. Conservation oriented management strategies to protect and regenerate the endemic angiosperms of Kerala, needs data on their present availability in the State. It is also essential to understand their distribution patterns within the State, with thrust on habitat preferences, population structure and also ecological constraints rendering them to be endemics. Along with the exploration trips, the real threat factors, including the historical processes that have led to the endangerment of each species were also traced during the present study. The severe decline in the population of most of the species, especially of the tree species was the result of the destruction of their natural habitat for establishing cash crops and forestry

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TAXONOMIC AND ETHNOBOTANIC STUDIES OF ENDEMIC ANGIOSPERMS OF KERALA

THESIS SUBMITTED TO THE
UNIVERSITY OF CALICUT

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FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN BOTANY

BY
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KERALA, INDIA

SEPTEMBER 2010

7. SUMMARY

A comprehensive study on the distribution pattern of endemic angiosperm taxa within the political boundary of Kerala (political region endemism) has been attempted in the present research programme with emphasis on identifying centres of endemic concentration in the State, evaluation of their status, measures for conservation, and ethnobotanic aspects.

The study area, Kerala, forms one of the smallest states in India, which covers only 1.8% of the total geographical area of the country and holds about 25% of the total plant species of the Indian subcontinent. Located in the equatorial tropics, the State is blessed with luxuriant vegetation and enormous plant diversity and is positioned in the hottest hotspot of endemism, the Southern Western Ghats, showing wide diversity of ecosystem, species and genetic resources. The bio-climatic fluctuations and tropical features of the southern Western Ghats are attributed to the high percentage of endemism and species diversity in the State.

As the first effort of the study, a comprehensive checklist of the endemic species of Kerala was prepared with reference to the Floras/floristic checklists, revisions and monographs pertaining to the State of Kerala. From this, the endemic species reported to be having exclusive distribution in the state were enumerated with details on their type locality, distribution pattern and habitat specificity. Herbarium studies were made subsequently for the confirmation of type localities and other characteristics, from the relevant herbaria in India, where the specimens of endemic species represented from the State are deposited. This was followed by a series of field explorations with special emphasis to the type locality and other areas of distribution of each species. The data generated through field study were analyzed with reference to the information gathered from published Floras that covered the geographical area of Kerala, reversionary/monographic works that dealt with flowering plants occurring in the State, and other relevant information from journals that provide details of plants from Kerala.

The study, comprising comprehensive literature survey and herbarium visits coupled with field exploration and integrated analysis yielded significant findings on the content and distribution of endemics within the geographical area of Kerala State. The present floristic

analysis revealed that, 267 taxa (240 species, 1 subspecies and 26 varieties) are exclusive endemics of Kerala, manifesting an exceptional concentration of endemic species in the state that are limited to relatively smaller areas.

Sysytematic treatments of 267 exclusive endemic taxa were carried out and presented according to Bentham & Hooker's system of classification. Keys have been provided for families, genera, species and infraspecific taxa, and are strictly dichotomous and intended. Each species was provided with detailed nomenclatural citations. It was followed by a diagnostic and precise species description. Simultaneously, data on phenology and habitat, special notes on taxonomic characters, status category, endemic characteristics, threat factors, phytogeography and conservational aspects were also included. Illustrations of about 35 selected plants and photographs of vegetation types, interesting plants and herbarium specimens are also included.

The present work also dealt with the ethnobotanical aspects of endemic angiosperms of Kerala, which was carried out along with the taxonomic study. It showed that 21 endemic plants are intimately associated with different tribal communities of Kerala. An analysis of usage proved that 9 species are utilized by the tribals as medicine, 6 as wild edibles, 6 in thatching and artisanal creations, and 2 as insect repellents. The results have been substantiated with relevant photographs.

Identification of 11 endemic belts in the state, in addition to the three hotspot areas, could be considered microendemic centers within the political boundary. Among these, 10 belts are concentrated in the forest regions of the Western Ghats. Nevertheless, identification of a coastal endemic belt in the lowland region of the State deserves special mention. It comprises two regions viz. Northern Malabar Coastal belt and Southern lowland belt. The coastal belt has been considered as one of the centers of active speciation in the State, because of the occurence of considerable number of neoendemic grasses and other wetland species.

The 267 exclusive endemic taxa limited within the present political boundary of Kerala are distributed in 50 families. The families with largest representation of endemic species are Poaceae (50 species), Orchidaceae (18 species) and Rubiaceae (17 species). There are two monotypic genera, *Silentvalleya* and *Haplothismia* endemic to the State. The genus with highest representatoion of exclusive endemic species is *Ischaemum* (18 species), followed by *Impatiens* and *Dimeria* (15 species each), and *Fimbristylis* (9 species).

A total of 37 species which are exclusive endemic genetic resources have been identified

during the study. Among these 25 species are wild relatives of cultivated crops. They include edible fruits (7 species), vegetables (5 species), spices (3 species), tubers (3 species) and rhizomes (7 species). Also there are 12 timber yielding endemic species (trees, bamboos and canes) identified from the State.

The district-wise analysis of the patterns of occurrence of exclusive endemic taxa showed that they are more concentrated in the districts having forested highlands. Idukki district has the highest number of endemic taxa (64) followed by Thiruvananthapuram (50), Palakkad (47), Kollam (33), Thrissur (33) and Pathanamthitta (26). As per physiognomic distribution, out of the 262 endemic flowering plants represented in Kerala, 32 are trees, 64 shrubs, and 171 herbs; 149 taxa (sp.) are dicots and 109 taxa monocots. Further analysis showed that 54 species have been categorised as rare, threatened and other IUCN Red List categories (Ahmedullah & Nayar, 1987; Nayar, 1997; IUCN, 2000 & 2008).

The main threats to the endemic plants of the State are loss of habitat due to forestry operations, encroachment, development of commercial plantations, grazing, industrialization and urbanization and other development projects. The study also realised that most of these endemics have critically low population, warranting implementation of appropriate conservation measures so as to maintain the endemic diversity which is our national heritage and to save these valuble plant group for the generations to come.

During the present study 7 new species, which are exclusively endemic to the State were published based on the materials collected. They are ***Arundinella ravii*** Shaju et Mohanan (2004), ***Fuirena simpsonii*** Ravi *et al.*, (2002), ***Ischaemum wayanadense*** Ravi *et al.*, (2001), ***Ischaemum quilonensis*** Ravi et Shaju (1998), ***Ischaemum pushpangadanii*** Ravi *et al.*, (2000), ***Ischaemum lanatum*** Ravi *et al.*, (2000), and ***Memecylon sivadasanii*** Mohanan *et al.*, (2001). A supposed to be extint species which is exclusively endemic to the state - ***Buchanania barberi*** Gamble - has been rediscovered during present study (Santhosh Kumar *et al.*, 2002), after a lapse of 97 years. Other endemic species rediscovered during the study are ***Nothopegia aureo-fulva*** Bedd. ex Hook. f., after a centuary old collection by Mohanan, Jayakumar, Shaju and Kiran Raj (2000), ***Poeciloneuron pauciflorum*** Bedd., after 70 years by Mohanan, Shaju Kiranraj and Ravi (1999), ***Cinnamomum heyneanum*** Nees, after a lapse of 185 years by Santhosh Kumar, Geetha Kumary, Pandurangan and Shaju (2003), ***Garcinia imberti*** Bourd., after a century by Mohanan, Shaju, Rajkumar and Pandurangan (1997), and ***Pavetta wightii*** Hook.f., after a centuary by Mohanan and Shaju (2004). Few new records for India have also been reported during the present study. They are: ***Cinnamomum dubium*** Nees by Geetha kumary, Santhosh Kumar, Pandurangan and Shaju (2007), ***Garnotia micrantha*** Thwaites var.

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micrantha by Ravi, Mohanan, Kiran Raj and Shaju (2000); and ***Memecylon royneii*** by Rajendraprasad, Prathapan, Pandurangan and Shaju (2000). Further, a new genus record for Kerala namely ***Lepironia*** by Shaji, Shaju, Nair and Sivadasan (2009) has also been established.

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SEPTEMBER 2010

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TAXONOMIC AND ETHNOBOTANIC STUDIES OF ENDEMIC ANGIOSPERMS OF KERALA

THESIS SUBMITTED TO THE
UNIVERSITY OF CALICUT

IN PART-FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
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IN BOTANY

BY
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Appendix I

Exclusive endemics of Kerala State

1. DILLENIACEAE

1. *Acrotrema agastyamalayanum* Santhosh Kumar, Mathew Dan & G. M. Nair

2. ANNONACEAE

2. *Orophea malabarica* Sasidh. & Sivar.
3. *Orophea sivarajanii* Sasidh.,
4. *Phaeanthus malabaricus* Bedd.,
5. *Polyalthia shendurunii* Basha & Sasidh.
6. *Sageraea grandiflora* Dunn

3. FLACOURTIACEAE

7. *Hydnocarpus pendulus* Manilal, Sabu & Sivar.

4. MALVACEAE

8. *Hibiscus sreenarayanianus* Anilkumar & Ravi
9. *Julostylis ampumalensis* Pradeep & Sivar.
10. *Julostylis polyandra* Ravi & Anilkumar
11. *Sida fryxellii* Sivar. & Pradeep
12. *Sida ravii* Sivad. & Anilkumar

5. TILIACEAE

13. Grewia palodensis Santhosh Kumar, Shanavas, Binu & Almeida

6. OXALIDACEAE

14. *Biophytum congestiflorum* Govind.
15. *Biophytum longipedunculatum* Govind.
16. *Biophytum reinwardtii* var. *keralanum* S. Kumar, Yeragi, Babu & Shanavas*
17. *Biophytum veldkampii* Shanavas, Santhosh Kumar, Binu & Pushpangadan

7. BALSAMINACEAE

18. *Impatiens cochinica* Hook.f.
19. *Impatiens coelotropis* Fischer
20. *Impatiens concinna* Hook.f
21. *Impatiens johnii* Barnes
22. *Impatiens kulamavuensis* Pandurangan & Nair
23. *Impatiens macrocarpa* Hook.f.
24. *Impatiens munnarensis* Barnes
25. *Impatiens pallidiflora* Hook.f.
26. *Impatiens pandata* Barnes
27. *Impatiens platyadena* Fischer
28. *Impatiens sholayarensis* Muktesh & Stephen
29. *Impatiens sivarajanii* Muktesh & Stephen
30. *Impatiens tilo* (DC) Suresh

31. *Impatiens verecunda* Hook.f.
32. *Impatiens violacea* Muktesh & Sequiera

8. MELIACEAE
33. *Aglaia malabarica* Sasidh.
34. *Dysoxylum beddomei* Hiern
35. *Disoxylum swaminathanianum* Anilkumar & Sivad.

9. CELASTRACEAE
36. *Cassine kedarnathii* Sasidh. & Swarup.

10. RHAMNACEAE
37. *Colubrina travancorica* Bedd.

11. ANACARDIACEAE
38. *Buchanania barberi* Gamble

12. CONNARACEAE
39. *Connarus parameswaranii* Ramamurthy & Rajan

13. FABACEAE (LEGUMINOSAE)

13a. FABOIDEAE (PAPILIONOIDEAE)
40. *Dalbergia beddomei* Thoth.
41. *Geissaspis tenella* var. *malabarica* Sivar. & Babu*
42. *Kunsteleria keralensis* Mohanan & Nair
43. *Macuna pruriens* var. *thekkadiensis* Thoth. & Ravikumar*
44. *Smithia venkobarowii* Gamble
45. *Tephrosia travancorica* Thoth. & Das
46. *Tephrosia wynaadensis* Drumm

13b. CAESALPINIOIDEAE
47. *Cynometra beddomei* Prain
48. *Dialium travancoricum* Bourd.
49. *Humboldtia sanjappae* Sasidh. & Sujanapal
50. *Humboldtia unijuga* var. *trijuga* Joseph & Chandras.*

13c. MIMOSOIDEAE
51. *Inga cynometroides* (Bedd.) Bedd. ex Baker

14. MYRTACEAE
52. *Eugenia argentea* Bedd.
53. *Syzygium bourdillonii* (Gamble) Rathakr. & Nair
54. *Syzygium palghatense* Gamble
55. *Syzygium periyarensis* Jomy & Sasidh.

15. MELASTOMATACEAE
56. *Medinilla anamalaiana* Sasidh. & Sujanapal
57. *Osbeckia abrahamii* Giri & Nayar

58. *Sonerila barnesii* Fischer
59. *Sonerila cannanorensis* G. S. Giri & M. P. Nayar
60. *Sonerila elegans* var. *beddomei* Giri & Nayar*
61. *Sonerila nemakadensis* Fischer
62. *Sonerila waynaadensis* Nayar
63. *Memecylon agastyamalaianum* Santhosh Kumar, Raju & Shanavas
64. *Memecylon sivadasanii* Mohanan, Ravi, Kiran Raj & Shaju
65. *Memecylon wightianum* Triana

16. LYTHRACEAE

66. *Rotala cookii* Joseph & Sivar.
67. *Rotala malabarica* Pradeep, Joseph & Sivar
68. *Rotala vasudevanii*, Joseph & Sivar.

17. CUCURBITACEAE

69. *Cucumella silentvalleyii* Manilal, Sabu & Philip.
70. *Zehneria mysorensis* var. *oblonga* Prasad and Mini*
71. *Cucurbita maxima* var. *badagarensis* Mudaliar *
72. *Luffa umbellata* (Klein) Roem.

18. BEGONIACEAE

73. *Begonia malabarica* Lam.

19. ARALIACEAE

74. *Schefflera chandrasekharanii* Ramamurthy & Rajan

20. RUBIACEAE

75. *Ixora agasthyamalayana* Sivadasan & Mohanan
76. *Ixora johnsoni* Hook. f.
77. *Ixora sivarajiana* Pradeep
78. *Ophiorrhiza barnesii* Fischer
79. *Ophiorrhiza brunonis* var. *johnsonii* Hook. f.*
80. *Ophiorrhiza caudata* Fischer
81. *Ophiorrhiza munnarensis* Fischer
82. *Ophiorrhiza nairii* Ramamurthy & Rajan
83. *Ophiorrhiza shendurunii* Shanavas Khan, Santhosh Kumar &Pushpangadan
84. *Pavetta bourdillonii* Sivadasan & Mohanan
85. *Pavetta nemoralis* Bremek.
86. *Pavetta oblanceolata* Bremek.
87. *Pavetta travancorica* Bremek.
88. *Psilanthus malabaricus* Sivarajan, Biju & P. Mathew
89. *Psychotria keralensis* Deb & Gangop.
90. *Spermacocce malabarica* (Sivar. & Manilal) Sivar., R.V. Nair & AhmedKunju
91. *Tarenna trichurensis* Sasidh. & Sivar.

21. ASTERACEAE

92. *Anaphalis barnesii* C. Fischer
93. *Blumea membrnacea* var. *gracilis* Hook. f.*
94. *Phyllocephalum rangacharii* var. *agastyamalayanum* Geetha Kumary *et al.*

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95. *Vernonia anaimudica* Shetty & Vivek.
96. *Vernonia beddomeii* Hook. f.
97. *Vernonia multibracteata* Gamble

22. MYRSINACEAE

98. *Antistrophe glabra* Pandurangan & V. J. Nair
99. *Ardisia stoneii* Sasidh. &Sivar.
100. *Mesa velutina* Mez

23. SAPOTACEAE

101. *Palquium ravii* Sasidh. & Vink

24. EBENACEAE

102. *Diospyros sulcata* Bourd.

25. SYMPLOCACEAE

103. *Symplocos macrophylla* ssp. *namboodirianus* Sivad., & Mohanan**

26. OLEACEAE

104. *Jasminum agastyamalayanum* Sabeena, Asmitha, Mulani, S. Kumar & Sibin
105. *Jasminum rottlerianum* var. *glabrior* C. B. Clarke*

27. ASCLEPIADACEAE

106. *Ceropegia beddomei* Hook. f.
107. *Heterostemma vasudevanii* Swarup. Mangaly

28. GENTIANACEAE

108. *Exacum courtallensis* var. *bonaccordensis* Mohanan & Henry*

29. MENYANTHACEAE

109. *Nymphoides krishnakesara* Joseph & Sivaraj.
110. *Nymphoides macrospermum* Vasudevan
111. *Nymphoides sivarajanii* Joseph

30. CONVOLVULACEAE

112. *Lepistemon verdcourtii* P. Mathew & Biju
113. *Stictocardia sivarajanii* Biju, Pushpangadan & P. Mathew

31. SCROPHULARIACEAE

114. *Adenosma malabaricum* Hook.f.
115. *Lindernia tenuifolia* var. *pygmaea* Sivar. & Philip.*

32. OROBANCHACEAE

116. *Christisonia keralensis* Erady
117. *Christisonia indica* Anilkumar

33. LENTIBULARIACEAE

118. *Utricularia subramanii* Janarthanam & Henry

34. GESNERIACEAE

119. *Didymocarpus macrostachya* Barnes

35. BIGNONIACEAE

120. *Stereospermum colais* var. *shendurunii* Sasidh.*

36. ACANTHACEAE

121. *Andrographis chendurunii* Santhosh Kumar, Shanavas Khan & Seema
122. *Ecbolium ligustrinum* var. *aryankavensis* Remadevi & Binoj Kuma*
123. *Gymnostachyum febrifugum* var. *bracteatum* Ramachandran*
124. *Gymnostachyum latifolium* var. *decurrens* Gamble*
125. *Gymnostachyum sahyadricum* Mohanan, Remadevi & Binojkumar
126. *Justicia ekakusuma* Pradeep & Sivar.
127. *Justicia pathanamthittiensis* Remadevi & Binojkumar
128. *Lepidagathis keralensis* Madhusoodhanan & Singh
129. *Lepidagathis balakrishnanii* Remadevi & Binojkumar
130. *Ruellia sivarajanii* Sreedevi, Remadevi & Binojkumar
131. *Strobilanthes barbatus* var. *bonaccordensis* Santhosh Kumar & Rajvikraman*
132. *Strobilanthes dupenii* Bedd. ex Clarke
133. *Strobilanthes pushpangadanii* Santhosh Kumar, Jabbar & Shanavas Khan

37. LAMIACEAE

134. *Leucas beddomei* (Hook.f.) Sunojkumar & P. Mathew
135. *Leucas sebaldiana* Sunojkumar
136. *Leucas vestita* var. *devicolamensis* Shetty & Vivek.*
137. *Pogostemon peethapushpum* Pradeep
138. *Pogostemon travancoricus* var. *devicolamensis* Shetty & Vivek.*

38. PODOSTEMACEAE

139. *Podostemon munnarense* (Nagendran & Arekal) Mathew & Satheesh
140. *Willisia arekaliana* Shivamurthy & Sadanand.
141. *Zeylanidium maheshwarii* Mathew & Satheesh

39. ARISTOLOCHIACEAE

142. *Thottea abrahamii* Mathew Dan, Mathew, Unnithan & Pushpangadan
143. *Thottea idukkiana* Pandurangan & V. J. Nair
144. *Thottea ponmudiana* Sivar.
145. *Thottea sivarajanii* Santhosh Kumar, Shanavas Khan & Binu

40. PIPERACEAE

146. *Piper nigrum* var. *hirtellosum* Asokan & Ravindran*
147. *Piper silentvalleyensis* Ravindran, M.K.Nair & Asokan

41. LAURACEAE

148. *Cinnamomum nicolsianum* Manilal & Shylaja
149. *Cinnamomum palghtensis* M. Gangop.
150. *Litsea travancorica* Gamble
151. *Litsea beei* N.Mohanan & Santhosh Kumar

42. EUPHORBIACEAE

152. *Antidesma keralense* Chakrabarty & Gangopadhyay
153. *Aporusa bourdillonii* Stapf
154. *Chamaesyce katrajensis* var. *kasaragodensis* (V.J.Nair *et. al*) Raju*

155. *Cleistanthus sankunnianus* Sivar. & Indira Balachandran

43. BURMANNIACEAE

156. *Burmannia indica* Jonker
157. *Burmannia stricta* Jonker
158. *Haplothismia exannulata* Airy Shaw

44. ORCHIDACEAE

159. *Acampe congesta* (Lindl.) Lindl.
160. *Bulbophyllum keralensis* Muktesh & Stephen
161. *Bulbophyllum orezii* Sathish
162. *Bulbophyllum rosemarianum* Sathish, Suresh & Saleem
163. *Bulbophyllum silentvalliensis* Sharma & Srivastava
164. *Cheirostylis seidenfadeniana* Sathish & F. Rasm.
165. *Eria tiagii* Manilal, Sathish & Wood
166. *Habeneria flabelliformis* Summerh. ex Fischer
167. *Habeneria periyarensis* Sasidh., Rajesh & Jomy
168. *Ipsea malabarica* (Reichb.f.) Hook. f.
169. *Kingidium niveum* Sathish
170. *Liparis walakkadensis* Muktesh & Stephen
171. *Oberonia agastyamalayana* Sathish
172. *Oberonia wynadensis* Sivad. & Balakr.
173. *Pteroceras monsooniae* Sasidh. & Sujanapal
174. *Schoenorchis manilaliana* Muktesh & Stephen
175. *Taeniophyllum scaberulum* Hook. f.
176. *Xenikophyton seidenfadenianum* Muktesh, Stephen & J.J.Wood

45. ZINGIBERACEAE

177. *Alpinia smithiae* Sabu and Mangaly
178. *Curcuma coriaceae* Mangalay and Sabu
179. *Curcuma ecalcarata* Sivar. and Indu.
180. *Curcumma haritha* Mangaly and Sabu
181. *Curcuma mutabilis* Skornickova, Sabu and Prasanth
182. *Curcuma raktakanta* Mangalay and Sabu
183. *Curcuma vamana* Sabu and Mangaly

46. ARECACEAE

184. *Calamus dransfieldii* Renuka
185. *Calamus gamblei* var. *sphaerocarpa* Becc.*
186. *Calamus neelagiricus* Renuka et al.
187. *Calamus renukae* Joemon Jacob, Mohanan & Kariyappa
188. *Calamus shendurunii* Anto, Renuka & Sreekumar

47. ARACEAE

189. *Amorphophallus bonaccordensis* Sivad. & N. Mohanan
190. *Amorphophallus nicolsonianus* Sivad.
191. *Amorphophallus commutatus* var. *wayanadensis* Sivad. & Jaleel*
192. *Arisaema agasthyanum* Sivad. & Sathish
193. *Arisaema attenuattum* Barnes and Fischer
194. *Arisaema peltatum* Fischer

195. *Arisaema psittacus* Barnes
196. *Arisaema sarracenioides* Barnes & Fischer
197. *Lagenandra keralensis* Sivad. & Jaleel
198. *Lagenandra nairii* Ramamurthy & Rajan
199. *Pothos keralensis* Pandurangan & V. J. Nair

48. ERIOCAULACEAE

200. *Eriocaulon ansarii* Pradeep & Sunil
201. *Eriocaulon devendranii* R. Vijaya Sankar, K. Ravikumar & N. M. Ganesh Babu
202. *Eriocaulon sivarajanii* Ansari and Balakr.
203. *Eriocoulon vasudevanii* Ansari and Balakr.

49. CYPERACEAE

204. *Fimbristylis angamoozhiensis* Ravi and Anil.
205. *Fimbristylis dauciformis* Govind.
206. *Fimbristylis hirsutifolia* Govind.
207. *Fimbristylis humerosa* Govind.
208. *Fimbristylis hyalina* Govind. and Sasidh.
209. *Fimbristylis manilaliana* Govind.
210. *Fimbristylis perspicua* Govind. and Sasidh.
211. *Fimbristylis pseudonarayanaii* Ravi and Anil.
212. *Fimbristylis stigmatotecta* Govind.
213. *Fuirena ponmudiensis* Ravi and Anil.
214. *Fuirena simpsonii* Ravi, Mohanan & Shaju
215. *Pycreus palghattensis* Govind.
216. *Pycreus similinervulosus* Govind.
217. *Scleria lithosperma* var. *muricata* Govind.*

50. POACEAE

218. *Arundinella cannanorica* V. J. Nair, Sreekumar & N. C. Nair
219. *Arundinella ravii* Shaju and N. Mohanan
220. *Bothriochloa parameswaranii* Sreekumar, Malathi & V. J. Nair
221. *Chrysopogon purushothamanii* Ravi, N.Mohanan and Kiranraj
222. *Chrysopogon tadulingamii* Sreekumar, V.J. Nair & N. C. Nair
223. *Dimeria agasthyamalayana* Ravi, Mohanan & Kiranraj
224. *Dimeria borii* Sreekumar, V. J. Nair & N. C. Nair
225. *Dimeria chelariensis* Ravi,
226. *Dimeria copeana* Sreekumar, V. J. Nair & N. C. Nair
227. *Dimeria copei* Ravi
228. *Dimeria eradii* Ravi,
229. *Dimeria idukkiensis* Ravi and Anil
230. *Dimeria jainii* Sreekumar, V. J. Nair & N. C. Nair
231. *Dimeria josephii* Ravi, Mohanan & Kiranraj
232. *Dimeria kalavoorensis* Ravi
233. *Dimeria keralae* N. C. Nair, Sreekumar & V. J. Nair
234. *Dimeria kurunthotticalana* Jacob
235. *Dimeria namboodiriana* Ravi & N. Mohanan
236. *Dimeria sivarajanii* Mohanan & Ravi
237. *Dimeria sreenarayanii* Ravi and Anilkumar
238. *Isachne fischeri* Bor

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239. *Isachne henryi* Srinivasan and Sreekumar
240. *Isachne jayachandranii* Gopalan & Chandras.
241. *Ischaemum abrahamii* Ravi, Mohanan & Rajesh
242. *Ischaemum agasthyamalayanum* Sreekumar, Janarth. & Henry
243. *Ischaemum calicutensis* Sreekumar, V. J. Nair & N. C. Nair
244. *Ischaemum copeanum* Sreekumar, V. J. Nair and N. C. Nair
245. *Ischaemum elimalayanum* Sreekumar, V. J. Nair & N. C. Nair
246. *Ischaemum jayachandranii* Ansri, Ramachandran & Sreekumar
247. *Ischaemum cannanorensis* Sreekumar, Nair V. J. & N. C. Nair
248. *Ischaemum kumarakodiensis* Ravi, Mohanan & Kiranraj
249. *Ischaemum lanatum* Ravi, Mohanan & Shaju
250. *Ischaemum malabaricum* Sreekumar, V. J. Nair & N. C. Nair
251. *Ischaemum nairii* V. J. Nair & Sreekumar
252. *Ischaemum pappinisseriensis* Ravi, Mohanan & Rajesh
253. *Ischaemum pushpangadanii* Ravi, Mohanan & Kiranraj
254. *Ischaemum quilonensis* Ravi and Shaju
255. *Ischaemum raui* Sreekumar, V. J. Nair & N. C. Nair
256. *Ischaemum tadulingamii* N. C. Nair & Sreekumar
257. *Ischaemum vembanadense* Patil & D'cruz
258. *Ischaemum wayanadense* Ravi, Mohanan & Shaju
259. *Ochlandra ebracteata* Raiz. & Chatterjee
260. *Ochlandra keralensis* Muktesh, Ramesh & Stephen
261. *Ochlandra soderstromiana* Muktesh & Stephen
262. *Ochlandra spirostylis* Muktesh, Seethalakshmi & Stephen
263. *Ochlandra travancorica* var. *hirsuta* Gamble *
264. *Silentvalleya nairii* V. J. Nair, Sreekumar, Vajravelu & Bhargavan
265. *Tripogon sivarajanii* Sunil
266. *Tripogon vellarianus* Pradeep
267. *Zenkeria jainii* N. C. Nair, Sreekumar & V. J. Nair

Appendix II

District-wise distribution of Exclusive endemic taxa of Kerala

Family	Endemic taxa	TVM	KLM	PTA	ALP	KTM	ENK	IDK	TSR	PLK	MAP	KKD	KNR	WYD	KSD
DICOTS															
Dilleniaceae	*Acrotrema agastyamalayanum* Santhosh Kumaret al.	✓													
Annonaceae	*Orophea malabarica* Sasidh. & Sivar.								✓				✓		
	O. sivarajanii Sasidh.													✓	
	Phaeanthus malabaricus Bedd.	✓	✓	✓			✓	✓	✓				✓	✓	
	Polyalthia shendurunii Basha & Sasidh.		✓												
	Sageraea grandiflora Dunn		✓					✓							
Flacourtiaceae	*Hydnocarpus pendulus* Manila et al.			✓				✓		✓					
Malvaceae	*Hibiscus sreenarayanianus* Anil Kumar & Ravi		✓	✓											
	Julostylis ampumalensis										✓				

	Pradeep & Sivar.														
Tiliaceae	*J. polyandra* Ravi & Anil Kumar	✓		✓											
	Sida fryxellii Sivar. & Pradeep											✓			
	S. ravii Sivad. & Anil Kumar		✓	✓											
	Grewia palodensis Santhosh Kumar et al.	✓													
Tiliaceae	*Grewia palodensis* Santhosh Kumar et al.					✓		✓							
Oxalidaceae	*Biophytum congestiflorum* Govind.	✓							✓						
	B. longipedunculatum Govind.					✓									
	B. reinwardtii var. *keralanum* Santhosh Kumar	✓													
	B. veldkampii Shanavas						✓								
Balsaminaceae	*Impatiens cochinica* Hook.f.							✓							
	. *I. coelotropis* Fischer														
	I. concinna Hook.f.*							✓							
	I. johnii Barnes							✓							
	I. kulamavuensis Pandurangan & V. J. Nair							✓							
	I . macrocarpa Hook.f.							✓							
	I. munnarensis Barnes							✓							

	I. pallidiflora Hook.f.							✓							
	I. pandata Barnes							✓							
	I. platyadena Fischer,								✓						
	I. sholayarensis M. Kumar & S. Seq.									✓					
	I. sivarajanii M. Kumar & S. Seq.														
	I. tilo (DC) Suresh*							✓							
	I. verecunda Hook.f.							✓							
	I. violacea M. Kumar & S. Seq.		✓						✓						
Meliaceae	*Aglaia malabarica* Sasidh.							✓							
	Dysoxylum beddomei Hiern			✓											
	D. swaminathanianum Anil Kumar & Sivad.									✓					
Celastraceae	*Cassine kedarnathii* Sasidh. & Swarupan.		✓	✓					✓						
Rhamnaceae	*Colubrina travancorica* Bedd.	✓													
Anacardiaceae	*Buchanania barberi* Gamble									✓					
Fabaceae	*Dalbergia beddomei* Thoth.										✓				
	Geissaspis tenella var. *malabarica* Sivar. & Babu	✓	✓	✓											
	Kunstleria keralensis Mohanan & Nair							✓							
	Macuna pruriens var.								✓						

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	thekkadiensis Thoth. & Ravik.														
	Smithia venkobarowii Gamble														
	Tephrosia travancorica Thoth. & Das*													✓	
	T. wynaadensis Drumm.	✓													
	Cynometra beddomei Prain	✓													
	Dialium travancoricum Bourd.							✓							
	Humboldtia sanjappae Sasidh. & Sujanapal	✓													
	H. unijuga var. *trijuga J.* Joseph & V. Chandras.		✓												
	Inga cynometroides (Bedd.) Bedd. ex Baker													✓	
Myrtaceae	*Eugenia argentea* Bedd.	✓													
	Syzygium bourdillonii (Gamble) Rathakr. & N. C. Nair.									✓					
	S. palghatense Gamble							✓							
	S. periyarensis Jomy & Sasidh.			✓				✓		✓					
Melastomataceae	*Medinilla anamalaiana* Sasidh. & Sujanapal	✓													
	Memecylon agastyamalaianum Santhosh Kumar	✓													
	M. sivadasanii N. Mohanan	✓													

	M. wightianum Triana								✓	✓					
	Osbeckia abrahamii G. S. Giri & M. P. Nayar														
	Sonerila barnesii Fischer*												✓		
	S. cannanorensis Giri & Nayar									✓					
	Sonerila . var. *beddomei* G. S. Giri & M. P. Nayar							✓							
	S.nemakadensis Fischer													✓	
	S. waynaadensis M. P. Nayar										✓				
Lythraceae	*Rotala cookii* Joseph and Sivar.												✓		
	R. malabarica Pradeep						✓								
	R. *vasudevanii,* Joseph & Sivar.												✓		
Cucurbitaceae	*Cucurbita maxima* var.*badagarensis* C. R. Mudaliar									✓					
	Cucumella silentvalleyii Manilal et al.														
	Luffa umbellate (Klein) Roem.							✓							
	Zehneria maysorensis var. *oblonga* V. P. Prasad & Mini			✓											
Begoniaceae	*Begonia malabarica* Lam.							✓							
Araliaceae	*Schefflera chandrasekharanii* Ramam. & Rajan	✓													

Rubiaceae	*Ixora agasthyamalayana* Sivad. & N. Mohanan			✓		✓								
	I. johnsoni Hook. f.										✓		✓	
	I. sivarajanii Pradeep													
	Ophiorrhiza barnesii Fischer						✓							
	Ophiorrhiza brunonis var. *johnsonii* Hook. f.													
	Ophiorrhiza caudata Fischer *							✓						
	O. munnarensis Fischer							✓						
	O. nairii Ramam. & Rajan		✓											
	O. shendurunii Shanavas et al.	✓												
	P. bourdillonii Sivad. & N. Mohanan													
	Pavetta nemoralis Bremek.								✓					
	P.oblanceolata Bremek.													
	Pavetta travancorica Bremek. *													
	Psilanthus malabaricus Sivar., Biju & Philip Mathew *											✓		
	Psychotria keralensis Deb & M. Gango.										✓	✓		
	Spermacocce malabarica (Sivar. & Manilal) Sivar.							✓						
	Tarenna trichurensis Sasidh. &													

	Sivar.														
Asteraceae	*Anaphalis barnesii* C. Fischer *												✓		
	Blumea membrnacea var. *gracilis* Hook. f.							✓							
	Vernonia anaimudica B. V. Shetty & Vivek.	✓	✓												
	V. beddomeii Hook. f.														
	V. multibracteata Gamble *							✓		✓					
Myrsinaceae	*Antistrophe glabra* Pandurangan & V. J. Nair								✓						
	Ardisia stoneii Sasidh. & Sivar.													✓	
	Mesa velutina Mez							✓	✓						
Sapotaceae	*Palquium ravii* Sasidh. & Vink														
Ebenaceae	*Diospyros sulcata* Bourd.*	✓													
Symplocaceae	*Symplocos macrophylla* ssp. *namboodirianus* Sivad., & Mohanan	✓													
Oleaceae	*Jasminum agastyamalayanum* Sabeena et al.									✓					
	J. rottlerianum var. *glabrior* C. B. Clarke		✓					✓							
Asclepiadaceae	*Ceropegia beddomei* Hook. f.		✓												
	Heterostemma vasudevanii Swarupan. & Mangaly	✓													

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Gentianaceae	*Exacum courtallensis* var. *boneccordensis* M. Mohanan & A. N. Henry											✓		
Meneyanthaceae	*Nymphoides krishnakesara* Joseph & Sivaraj.											✓		
	N. macrospermum Vasudevan										✓				
	N.sivarajanii Joseph			✓											
Convolvulaceae	*Lepistemon verdcourtii* Philip Mathew & Biju							✓							
	Stictocardia sivarajanii Biju, Pushpangadan					✓									
Scrophulariaceae	*Adenosma malabaricum* Hook.f.,											✓			
	Lindernia tenuifolia var. *pygmaea* Sivar. & Philip Mathew									✓					
Orobanchaceae	*Christisonia keralensis* Erady			✓											
Lentibulariaceae	*Utricularia subramanii* Janarth. & A. N. Henry							✓							
Gesneriaceae	*Didymocarpus macrostachya* Barnes		✓												
Bignoniaceae	*Stereospermum colais* var. *shendurunii* Sasidh. et al.		✓												
Acanthaceae	*Andrographis chendurunii* Santhosh Kumar et al.		✓												
	Andrographis chendurunii Santhosh Kumar et al.											✓			

	Gymnostachyum febrifugum var. *bracteatum* V. S. Ramach. & V. J. Nair												✓		
	G. latifolium var. *decurrens* Gamble		✓												
	G. sahyadricum C. N. Mohanan et al.												✓		
	Justicia ekakusuma Pradeep & Sivar.												✓		
	Lepidagathis keralensis Madhus. & N. P. Singh				✓										
	Ruellia sivarajanii Sreedevi	✓													
	Strobilanthes barbatus var. *bonaccordensis* Santhosh Kumar & Raj Vikraman							✓							
	S. dupenii Bedd. ex Clarke	✓													
	S. pushpangadanii Santhosh Kumar et al.													✓	
Lamiaceae	*Leucas beddomei* (Hook.f.) Sunojkumar & Philip Mathew													✓	
	L. sebaldiana Sunojkumar							✓							
	L. vestita var. *devicolamensis* B. V. Shetty & Vivek.											✓			
	Pogostemon peethapushpum Pradeep							✓							
	P. travancoricus var. *devicolamensis* B. V. Shetty &							✓							

	Vivek.														
Podostemaceae	*Podostemon munnarense* (Nagendran & Arekal) Mathew & Satheesh									✓					
	Willisia arekaliana Shivamurthy & Sadanand							✓							
	Zeylanidium maheshwarii Mathew & Satheesh	✓													
	Thottea abrahamii Mathew Dan			✓				✓							
	T. idukkiana Pandurangan & V. J. Nair	✓													
	T. ponmudiana Sivar.											✓		✓	
	T. sivarajanii Santhosh Kumar									✓					
Piperaceae	*Piper nigrum* var. *hirtellosum* Asokan Nair & Ravindran									✓					
	P. silentvalleyensis Ravindran et al.											✓			
Lauraceae	*Cinnamomum nicolsonianum* Manilal & Shylaja	✓													
	Litsea beei N.Mohanan & Santhosh Kumar	✓	✓												
	L. travancorica Gamble		✓												
Euphorbiaceae	*Antidesma keralense* Chakrab. & M. G. Gangop.							✓	✓						
	Aporusa bourdillonii Stapf														✓

	Chamaesyce katrajensis var. *kasaragodensis* (V.J.Nair et al.) Raju		✓							✓					
	Cleistanthus sankunnianus Sivar. & Balach.														
MONOCOTS															
Burmanniaceae	*Burmannia indica* Jonker						✓								
	B. stricta Jonker									✓					
	Haplothismia exannulata Airy Shaw														
Orchidaceae	*Acampe congesta* (Lindl.) Lindl. *									✓					
	Bulbophyllum keralensis M. Kumar & S. Seq.									✓					
	B. orezii Sath. Kumar			✓				✓					✓		
	B. rosemarianum Sath. Kumar et al.									✓					
	B. silentvalliensis M. P. Sharma & S. K.Srivast.	✓						✓							
	Cheirostylis seidenfadeniana Sath. Kumar & F. Rasm.									✓					
	Eria tiagii Manilal et al.							✓							
	Habenaria flabelliformis Summerh. ex Fischer							✓							
	H. periyarensis Sasidh., et al.									✓					
	Ipsea malabarica (Reichb.f.)									✓					

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	Hook. f.														
	Kingidium niveum Sath. Kumar									✓					
	Liparis walakkadensis M. Kumar & S. Seq.	✓													
	Oberonia agastyamalayana Sath. Kumar													✓	
	O.wynadensis Sivad. & R. T. Balakr.									✓					
	Pteroceras monsooniae Sasidh. & Sujanapal									✓					
	Schoenorchis manilaliana M. Kumar & S. Seq.							✓							
	Taeniophyllum scaberulum Hook. f.									✓					
	Xenikophyton seidenfadenianum M. Kumar, S. Seq.									✓					
Zingiberaceae	*Alpinia smithiae* M. Sabu & Mangaly							✓							
	Curcuma coriaceae Mangaly & M. Sabu			✓		✓				✓					
	C. ecalcarata Sivar. & Balach.			✓						✓		✓			
	C. haritha Mangaly & M. Sabu										✓				
	C. mutabilis Skornickova					✓	✓								
	C. raktakanta Mangaly & M. Sabu		✓							✓					

	C. vamana M. Sabu & Mangaly	✓	✓							✓					
Arecaceae	*Calamus dransfieldii* Renuka			✓											
	C. gamblei var. *sphaerocarpa* Becc.									✓					
	C. neelagiricus Renuka et al.									✓					
	C. renukae Joemon Jacobet al.		✓												
	C. shendurunii Anto et al.	✓													
Araceae	*Amorphophallus bonaccordensis* Sivad. & N. Mohanan											✓		✓	
	A. commutatus var. *wayanadensis* Sivad. & Jaleel	✓								✓					
	A. nicolsonianus Sivad.	✓													
	Arisaema agasthyanum Sivad. & Sath. Kumar	✓						✓		✓					
	A. attenuattum E. Barnes & Fischer							✓							
	A. peltatum Fischer							✓							
	A. psittacus E. Barnes							✓							
	A. sarracenioides E. Barnes & Fischer						✓								
	Lagenandra keralensis Sivad. & Jaleel								✓						
	L. nairii Ramam. & Rajan							✓							
	Pothos keralensis								✓						

	Pandurangan & V. J. Nair														
Eriocaulaceae	*E. ansarii* Pradeep & Sunil									✓					
	E. devendranii R. Vijaya Sankar et al.										✓				
	E.sivarajanii R. Ansari & N. P. Balakr.									✓					
	E. vasudevanii R. Ansari & N. P. Balakr.	✓		✓											
Cyperaceae	*Fimbristylis angamoozhiensis* Ravi & Anil Kumar								✓						
	F. dauciformis Govind.										✓				
	Fimbristylis hirsutifolia Govind.								✓						
	F.humerosa Govind.								✓						
	F. hyalina Govind.										✓				
	F. manilaliana Govind.								✓						
	F. perspicua Govind. & Sasidh.	✓	✓			✓									
	F.pseudonarayanaii Ravi & Anil Kumar							✓							
	F.stigmatotecta Govind.	✓													
	Fuirena ponmudiensis Ravi & Anil Kumar												✓		
	F. simpsonii Ravi et al.									✓					
	Pycreus palghattensis Govind.								✓						
	P. similinervulosus Govind.														✓

	Scleria lithosperma var. *muricata* Govind.														✓
Poaceae	*Arundinella cannanorica* V. J. Nair et al.							✓							
	A. ravii Shaju & N. Mohanan							✓							
	Bothriochloa parameswaranii Sreek., et al.			✓											
	Chrysopogon purushothamanii Ravi et al.														✓
	C. tadulingamii Sreek., et al.	✓													
	Dimeri .agasthyamalayana Ravi et al.											✓			
	D. borii Sreek., et al.										✓				
	D. chelariensis Ravi				✓										
	D. copeana Sreek., et al.				✓										
	D. copei Ravi										✓				✓
	D. eradii Ravi							✓							
	D idukkiensis Ravi & Anil Kumar											✓			
	D. jainii Sreek., et al.									✓					
	D josephii Ravi et al.				✓										
	D. kalavoorensis Ravi														✓
	Dimeria keralae N. C. Nair														

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	et al.														
	D. kurumthotticalana Jacob			✓											
	D. namboodiriana Ravi & N. Mohanan			✓											
	D. sivarajanii N. Mohanan & Ravi					✓									
	D. sreenarayanii Ravi & Anil Kumar							✓							
	Isachne fischeri Bor													✓	
	I. henryi Srinivasan & Sreek.	✓													
	I. jayachandranii Gopalan & V. Chandras.										✓				
	Ischaemum. abrahamii Ravi et al.	✓													
	I. agasthyamalayanum Sreek., et al.											✓			
	I. calicutensis Sreek., et al.														✓
	I. cannanorensis Sreek., et al.												✓		✓
	I. copeanum Sreek., et al.	✓											✓		
	I. elimalayanum Sreek., et al.														✓
	I. jayachandranii R. Ansari et al.				✓										
	I. kumarakodiensis Ravi et al.														✓
	I. lanatum Ravi et al.														✓
	I. malabaricum Sreek., et al.											✓			
	I. nairii V. J. Nair & Sreek.												✓		

	I. pappinisseriensis Ravi et al.											✓			
	I. pushpangadanii Ravi et al.		✓												
	I. quilonensis Ravi & Shaju												✓		
	I. raui Sreek., et al.							✓							
	I. tadulingamii N. C. Nair & Sreek.				✓										
	I. vembanadense Patil & D'cruz													✓	
	I. wayanadense Ravi	✓	✓												
	Ochlandra ebrateata Raiz. & Chatterjee		✓												
	O. keralensis M. Kumar, Ramesh & S. Sq.							✓							
	O. soderstromiana M. Kumar et al.							✓							
	O. spirostylis M. Kumar et al.		✓												
	O. travancorica var. *hirsuta* Gamble									✓					
	Silentvalleya nairii V. J. Nair et al.							✓							
	Tripogon sivarajanii Sunil											✓			
	T. vellarianus Pradeep							✓							
	Zenkeria jainii N. C. Nair et al.														

* Locality not specified.

APPENDIX III

List of publications

Shaju, T. & N. Mohanan. 2004. A new species of *Arundinella* Raddi (Poaceae) from Kerala, India. *Rheedea* 14: 47-50.

Ravi, N., N. Mohanan & T. Shaju. 2002. *Fuirena simpsonii* (Cyperaceae) – a new species of sedge from Kerala, India. *Nord. J. Bot.* 22: 329-332.

Ravi, N., N. Mohanan, T. Shaju, M. S. Karan Raj & R. Rajesh. 1998. Three new species of *Ischaemum* L. (Poaceae) from Kerala, India. *Rheedea* 8: 159-158.

Ravi, N., N. Mohanan, M. S. Karan Raj, T. Shaju & R. Rajesh. 2000. Another new species of *Ischaemum* L. (Poaceae) from Kerala, India. *Rheedea* 10: 49-53.

Ravi, N., N. Mohanan, M. S. Karan Raj, T. Shaju & R. Rajesh. 2000. Two new species of Poaceae from Kerala, India. *Rheedea* 10: 91-98.

Ravi, N., N. Mohanan, T. Shaju, M. S. Karan Raj & R. Rajesh. 2001. Three more new species of *Ischaemum* L. (Poaceae) from Kerala, India. *Bot. Bull. Acad. Sin.* 42: 223-230.

Mohanan, N., N. Ravi, M. S. Karan Raj & T. Shaju. 2001. A new species of *Memecylon* (Melastomataceae) from India. *Nord. J. Bot.* 21: 493-496.

Santhosh Kumar, E. S., T. Shaju, M. Abdul Jabbar & A. G. Pandurangan. 2002. Rediscovery of *Buchanania barberi* Gamble (Anacardiaceae), an endangered and endemic species from the Western Ghats of Kerala, India. *Rheedea* 12: 197-200.

Mohanan, N., T. Shaju, M. S. Kiranraj & N. Ravi. 1999. Rediscovery of *Poeciloneuron pauciflorum* Bedd. (Bonnetiaceae), An endemic and little known species of Western Ghats, presumed to be extinct. Ann. For. 7: 87-89.

Mohanan, N., R. Jayakumar, T. Shaju & M. S. Kiran Raj. 2000. On the discovery of *Nothopegia aureo-fulva* Bedd. ex Hook. f. (Anacardiaceae), a rare and narrow endemic species of Western Ghats. *J. Econ. Taxon. Bot.* 24: 78-80.

Mohanan, N., & T. Shaju. 2004. On the rediscovery of *Pavetta wightii* Hook. f. (Rubiaceae), A rare and little known endemic species of Western Ghats. *J. Econ. Taxon. Bot.* 28: 78-80.

Mohanan, N., T. Shaju, G. Rajkumar & A. G. Pandurangan. 1997. Rediscovery of *Garcinia imberti* Bourd. (Clusiaceae), A little known endemic species of Western Ghats. *Ind. J. For.* 20: 383-385.

Santhosh Kumar, E. S., M. P. Geetha Kumary, A. G. Pandurangan & T. Shaju. 2003. Rediscovery of *Cinnamomum heyneanum* Nees (Lauraceae) - A species endemc to the Western Ghats. *Ind. J. For.* 26: 409-411.

Ravi, N., N. Mohanan, M. S. Karan Raj, T. Shaju & R. Rajesh. 2000. *Garnotia micrantha* Thwaites var. *micrantha* (Poaceae): A new record for India. *J. Econ. Taxon. Bot.* 24:297-300.

Geetha Kumary, M. P., E. S. Santhosh Kumar, A. G. Pandurangan & T. Shaju. 2007. *Cinnamomum dubium* Nees (Lauraceae) – A new record for India. *Ind. J. For.* 30: 73-74.

Rajendraprasad, M., S. L. Prathapan, A. G. Pandurangan & T. Shaju. 2006. *Memecylon royenii* Blume (Melastomataceae) – A new record for India. Ind. For. 132: 229-231.

Shaji, P. K., T. Shaju, P. K. K. Nair & M. Sivadasan. 2009. *Lepironia* "(Cyperaceae): A New Genus Record for Kerala, *Rheedea* 19: 41-44.

Shaju, T., P. K. Shaji., M. P. Geetha Kumary & E. S. Santhosh kumar. 2010. *Begonia tenera* Dryander: A new report for India, *The Begonian* 77: 129-131.

NB 5995