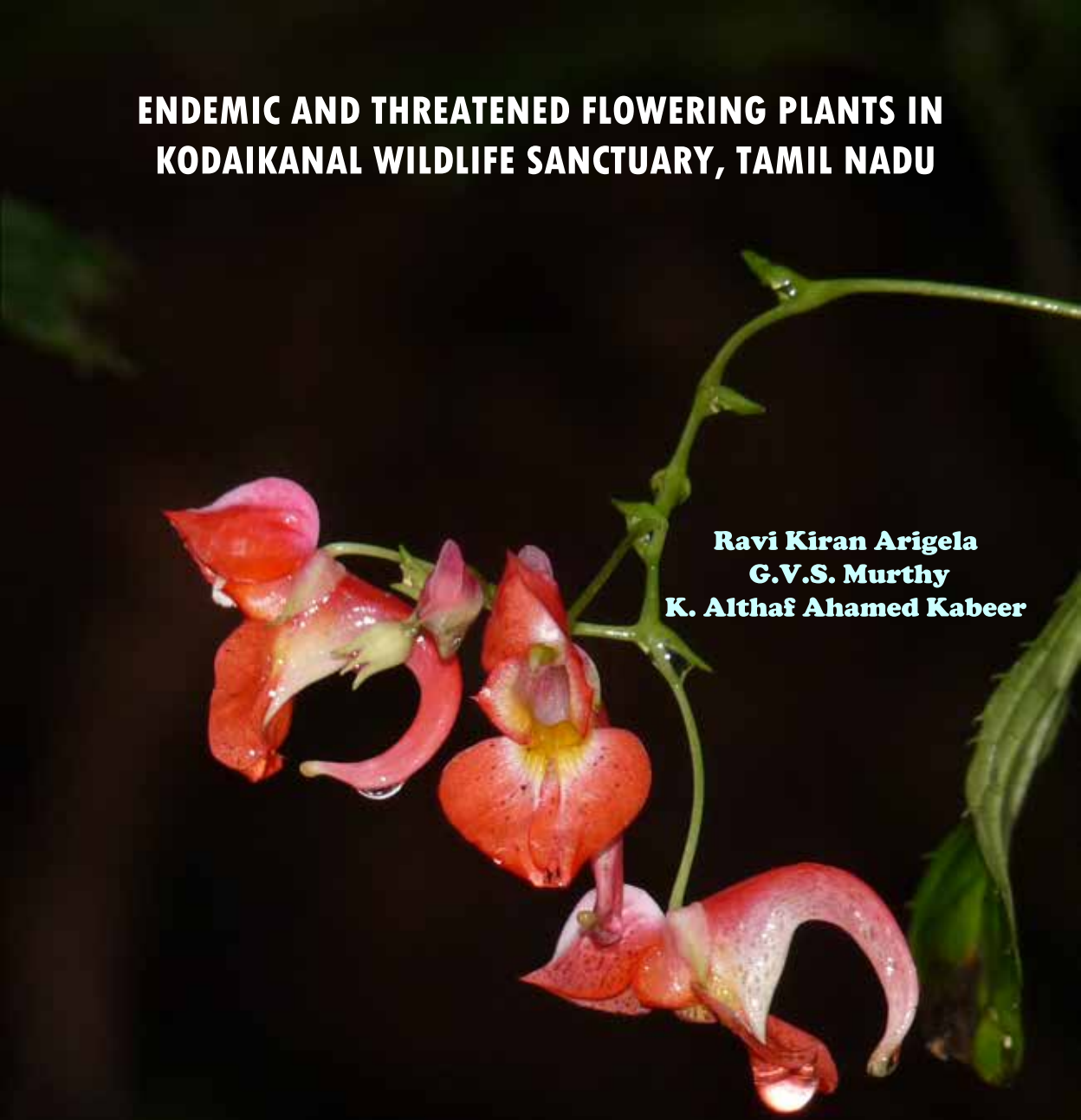
ENDEMIC AND THREATENED FLOWERING PLANTS IN KODAIKANAL WILDLIFE SANCTUARY, TAMIL NADU



Ravi Kiran Arigela
G.V.S. Murthy
K. Althaf Ahamed Kabeer

BOTANICAL SURVEY OF INDIA

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भारतीय वनस्पति सर्वेक्षण
BOTANICAL SURVEY OF INDIA

Botanical Survey of India
Ministry of Environment, Forest and Climate Change
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Endemic and Threatened Flowering Plants in Kodaikanal Wildlife Sanctuary, Tamil Nadu

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Message



It is well-established that the forests of India shelter a vast wealth of biodiversity. We in the Indian Forest Service have been protecting this life from any number of internal and external threats for over 150 years. As part of this ongoing effort, we have been partnering with key players in the governmental and private sectors. One such partnership has resulted in this remarkable book, "Endemic and Threatened flowering plants in Kodaikanal Wildlife Sanctuary" by Ravi Kiran Arigela, G.V.S Murthy and K. Althaf Ahamed Kabeer.

A comprehensive documentation of endemic and threatened flowering plants is a prerequisite for conservation of habitat and species and that is exactly what this book attempts to accomplish. The Kodaikanal Wildlife Sanctuary in the Palni Hills of Tamil Nadu was selected as the study area, since it is a key part of the Western Ghats Biodiversity Hotspot.

What makes this book especially compelling is the bringing together of two powerful wings of study. Satellite remote sensing and GIS mapping was used to map in great detail all the vegetation types of the KWLS. The team them conducted intensive ground truth surveys between 2015 and 2019, collecting thousands of herbarium samples and documenting over 1800 taxa of which 212 were found to be endemic and 28 identified as threatened. Besides providing a number of detailed tables and charts, the authors gift the reader with 116 beautiful colour plates of 212 endemic plants. Finally, they make a number of specific and practical recommendations for conservation.

One only has to read the acknowledgements to see the large number of forestry officials and staff who collaborated with the team to make this project a success. My wish is for the knowledge presented in this book to inspire current and future generations to enjoy, appreciate, and protect our valuable forest resources together.

Congratulations to the authors and team members for this beautiful and useful addition to the Indian forestry literature.

(Srinivas R. Reddy)
Principal Chief Conservator of Forests &
Chief Wildlife Warden



Brachycorythis splendida Summerh.

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Project Director, DOS-DBT Biodiversity Project
National Remote Sensing Centre, ISRO

Date: 14.11.2023

MESSAGE

Increasing habitat loss and fragmentation and associated impact of spread of invasive alien species as a result of human induced pressures have been identified as a main cause of declining biodiversity. Since 1992, the Convention on Biological Diversity has pushed the effort to halt or at least lower the accelerated loss of biodiversity, but certainly it remains one of the global challenges that require information from floristic inventory and an effective use of remote sensing to assess the habitats and species populations. India is one of the world's top 17 "mega-diversity" countries with high levels of taxonomic endemism and species richness. Conservation plans require baseline data on the occurrence and distribution of endemic and threatened species which is scarce. There is a need for creating geo-spatial data on all endemic and threatened species and vegetation types for effective conservation strategies. Floristic inventories carried out by the taxonomists are yielding increasing findings in the form of new taxa and new distributional records. It gives me immense pleasure to learn that Botanical Survey of India is bringing out a valuable document on floristic diversity of Kodaikanal wildlife sanctuary with special focus on endemic and threatened species. This e-publication "Endemic and Threatened Flowering Plants in Kodaikanal Wildlife Sanctuary, Tamil Nadu" documents 212 endemic flowering plant species found in Kodaikanal wildlife sanctuary with valuable information on their distribution, habitat type and photographs. The vegetation types has been characterized through remote sensing which will help in setting conservation priority.

I congratulate the authors and Botanical Survey of India for documenting this floristically important area within the Western Ghats and publishing the same in its present form. I am sure this book will be useful to foresters, students, conservationists, and ecologists to get fundamental information on species of conservation concern.

(C. SUDHAKAR REDDY)



Impatiens campanulata Wight

ए.ए. माओ
निदेशक
A. A. Mao
Director

सत्यमेव जयते

भारत सरकार
पर्यावरण वन एवं जलवायु परिवर्तन मंत्रालय
भारतीय वनस्पति सर्वेक्षण
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST
& CLIMATE CHANGE
BOTANICAL SURVEY OF INDIA



FOREWORD

During the past six decades the human population has increased many folds at global scale, consequently increased demand for more land for agriculture, urbanization and industrialization which lead to rapid degradation of ecosystems, forests and loss of habitats. In this process the plant species which have limited distribution, known as "endemics" are threatened and eventually pushed towards extinction. Hence there is an urgent need to identify the endemic plant species and conserve them on priority basis as envisaged by the Convention on Biological Diversity (CBD) and the International Union for Conservation of Nature and Natural Resources (IUCN).

India, being a signatory to the CBD, has declared and established a network of 106 National Parks, 567 Wildlife Sanctuaries and 18 Biosphere Reserves for Conservation of Wildlife (Flora and Fauna). Kodaikanal Wildlife Sanctuary located in Western Ghats of India, is rich in endemic species. The habitat in the wildlife sanctuary is typical of Western Ghats with widespread grasslands and shola forests. As a part of the Annual Research Programme of Botanical Survey of India, the Flora of this wildlife sanctuary has been thoroughly studied with special emphasis to endemic and threatened species.

The present book "Endemic and Threatened Flowering Plants in Kodaikanal Wildlife Sanctuary, Tamil Nadu", provides a comprehensive list of 212 Endemic and 28 Threatened plant species from Kodaikanal Hills. Each species is provided with GIS information and photographs, which would help in identification and proper monitoring.

I congratulate the authors for their meticulous efforts in bringing out this valuable data in its present form. This comprehensive work will surely serve as referral material to the students, researchers, forest officials, park managers and those concerned about plant conservation.

(A.A. MAO)

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Impatiens campanulata Wight

CONTENTS

	Page No.
INTRODUCTION	1
STUDY AREA	3
VEGETATION TYPE CLASSIFICATION	8
METHODOLOGY	9
ELEVATION RANGE	11
RESULTS & DISCUSSION	15
GRASSLANDS	26
DISTURBANCES IN THE KODAIKANAL WILDLIFE SANCTUARY	35
TAXONOMIC STUDY OF THE ENDEMIC AND THREATENED FLOWERING PLANTS	46
REVIEW OF LITERATURE	46
METHODOLOGICAL CONSIDERATIONS	46
TAXONOMIC STUDY RESULTS – ANALYSIS	47
ENDEMIC FLOWERING PLANTS	48
THREATENED TAXA	55
NARROWLY DISTRIBUTED TAXA	56
NEW ADDITIONS	57
ECO-SENSITIVE ZONES IN KODAIKANAL WILDLIFE SANCTUARY	58
TAXONOMIC TREATMENT	59
REFERENECES	210
INDEX TO SCIENTIFIC NAMES	228


Habenaria elliptica Wight

PREFACE

This study is an outcome of plant explorations in Kodaikanal Wildlife Sanctuary (KWLS) from 2015 to 2019 under the Annual Research Programme of Botanical Survey of India. The contents have been presented in two parts.

First part deals with mapping of different vegetation types (habitats of endemic and threatened plants) and species association in respective vegetation types like the grasslands and sholas of KWLS. The chapter provides quantitative data of each vegetation type and qualitative data of species composition at different elevations. This apart, it includes maps of grasslands, elevation zones and road network. During the study, the following areas were identified as priority eco-sensitive zones requiring regular and careful monitoring and protection: 1. Vattakanal Shola and its surrounding grasslands, 2. Vadakavunji– Pannaikkadu (*Zeronium*) Grasslands, 3. Pambar Shola and 4. Poolatur Piruvi and adjoining areas.

The second portion provides taxonomic treatment of the endemic (plants exclusively confined to the Palani Hills or restricted to the Western Ghats or the entire peninsular region or throughout the country) and threatened plants recorded from the KWLS during the present study. For each taxon, the correct botanical name is given in boldface, followed by the authority and original citation. Basionym and important synonyms (if any) were provided in italics. The standard abbreviation of the titles of the books and periodicals have been adopted. For each species, information has been provided on description, flowering and fruiting period, distribution and notes in the given sequence. Artificial keys to families, genera, species and infraspecific taxa, colour photo plates for as many plant species as possible and typification of a few names were also provided. The study has resulted in documentation of over 1800 plant taxa, of which 212 are endemic to India. One new species has been described from the sanctuary and 55 taxa were found as new distributional records for the Kodaikanal Wildlife Sanctuary. 28 species were identified as 'threatened' and require immediate conservation action. While the present study has reaffirmed the botanical richness of KWLS, the data presented here would be helpful in monitoring and conservation of this species rich habitat.

Authors



Strobilanthes consanguinea (Nees) T. Anderson

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Work of such a magnitude would not have been possible without receiving help and support from various source. The authors wish to express their sincere gratitude to the Director and former Directors (Dr. M. Sanjappa, Dr. P. Singh) Botanical Survey of India for providing the infrastructure and research facilities. The Head of Office and In charge of respective Regional Centres and Units of Botanical Survey of India [SRC, DRC, CNH, Technical section of HQ] are thankfully acknowledged for their constant support and guidance during the entire work. The officers and staffs of BSI, SRC, DRC and publication section at BSI, HQ are thanked for their continuous involvement and help in various ways.

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Authors



Mussaenda hirsutissima (Hook.f.) Hutch. ex Gamble

INTRODUCTION

The Kodaikanal Wildlife Sanctuary (KWLS) situated in the Palani Hills of Dindigul and Theni districts of Tamil Nadu, was established in the year 2013 to preserve the wildlife, forests and grasslands of the region. This sanctuary is rich in flowering plant diversity, and also harbours significant numbers of endemic and threatened species. It is part of the Western Ghats and Sri Lanka biodiversity hotspot, one of 36 biodiversity hotspots in the world (www.cepf.net). The rich floral and faunal diversity in the KWLS stems from its unique physiography with numerous isolated shola-grassland ecosystems and a monsoon climate. Tropical montane habitats (the shola-grassland complex in higher elevations) host a unique assemblage of endemic and threatened species of plants, birds, mammals and amphibians. Despite its economic and ecological significance, this ecologically unique tropical ecosystem is under tremendous pressure due to various anthropogenic developmental activities, especially the conversion of woodlands into agriculture fields, the rearing of livestock in grasslands, tourism and urbanisation.

These threats are compounded by changes in fire regimes, soil fertility and the spread of invasive alien species. The flawed perception that these grasslands are merely degraded habitats has also resulted in the establishment of extensive plantations of exotic species for timber, biofuels and carbon sequestration at vast scales (Arasumani *et al.*, 2018). Consequently, Bond & Parr (2010) characterise afforestation as `one of the most severe threats' to grasslands. Tropical montane habitats are thus amongst the most threatened habitats today and these threats are expected to amplify with anthropogenic global climate change.

India is one of the mega biodiversity countries of the world. It has about 21984 species of angiosperms, 82 species of gymnosperms, 1314 species of pteridophytes, 15602 species of fungi, 9008 species of algae, 2800 species of bryophytes, and 2989 species of lichens (Mao *et al*., 2022). In the view of Sir J.D. Hooker (1904), the founder of geographic botany, "The Indian flora is more varied than that of any other country of equal area in the Eastern Hemisphere, if not on the globe".

According to Jha *et al.* (2000) "The high levels of biodiversity in the Western Ghats face the similar stresses as other hotspots and no more than 25% of the original vegetation of this hotspot remains intact". Recent analysis that estimated changes in forest cover between 1973 and 1995 in the southern part of the Western Ghats using satellite data found that the area (approximately 40,000 km^2) had lost 25.6% of its forest cover". Only 20% of the natural forest vegetation of the Western Ghats remains (Collins *et al*., 1991) and that to in a highly fragmented state.

Endemic plants are confined to specific habitats of a particular geographical region. Because endemics are restricted to a particular region in limited populations, they easily fall into the threatened category when their habitats are altered adversely. Nayar (1996) mentioned 147 genera and 5725 species of flowering plants are endemic to Indian region [3471 to Himalayas, 2015 to Peninsular India and 239 to Andaman & Nicobar Islands]. Ahmedullah (2000) reported 140 endemic genera; 66 to Himalayas, 59 to peninsular India and 15 through India. Irwin & Narasimhan (2011) enumerated only 49 genera as strict endemics to India, excluded others due to extended distributional range and nomenclatural changes. Later Peninsular India has about 2100 endemic plants (Nayar, 1977), of which 1270 plant species are found in the Western Ghats alone (Nayar *et al.*, 2014). Most of the endemic plants of southern India are palaeoendemics, found in the hill ranges of Western Ghats and Eastern Ghats. A large number of endemics are found in the tropical moist deciduous and tropical semi-evergreen forests of Western Ghats. Singh *et al.* (2015) reported 4381 endemic vascular plants, which include 4303 angiosperms, 12 gymnosperms and 66 pteridophytes from India. The Western Ghats hotspot supports many monotypic and species-rich endemic genera such as *Anaphalis*, *Andrographis*, *Canscora*, *Capillipedium*, *Ceropegia*, *Crotalaria*, *Curcuma*, *Dicanthium*, *Elaeocarpus*, *Eriocaulon*, *Euphorbia*, *Habenaria*, *Hedyotis*, *Impatiens, Isachne, Ischaemum, Leucas, Litsea, Memecylon, Oberonia, Osbeckia, Phyllanthus, Pimpinella, Plectranthus, Smithia, Sonerila, Strobilanthes* and *Syzygium*.

In the year 1968 at an international conference (UNESCO, 1968) that the problem of conservation of flora was appreciated and several recommendations were made urging the international Biological Program (IBP), the International Union for Conservation of Nature and Natural Resources (IUCN) and various national and international organizations to initiate studies into these problems including the protection and preservation of wild fauna and flora in their natural habitats/ecosystems by establishment of natural reserves. In order to counter the threat of extinction to endemic species and conservation of wild habitats the Government of India introduced the Wildlife Protection Act of 1972 and the National Wildlife Action Plan of 1983. Currently India has 106 National Parks, 567 Wildlife Sanctuaries, 105 Conservation Reserves, 220 Community Reserves and 131 Marine Protected Areas (https://wii.gov.in/). Volume 5 of the Red Data Book on angiosperms started by the Survival Commission of the IUCN in the year 1970 (Melville, 1970), it is estimated that out of 3,00,000 plant species in the world over 20,000 were in the category of Threatened with extinction by 2000 AD.

Of India's 10 biogeographic zones (Rodgers *et al.*, 2002), the Western Ghats has the highest percentage of protected area coverage (15%), which is represented in 20 National Parks and 68 Wildlife Sanctuaries (Rodgers *et al.*, 2002). Since 2002, new sanctuaries have been established, namely Meghamalai, Kodaikanal, Kanyakumari, Malabar and Nellai in the Western Ghats.

The upgrade of reserve forests of Palani Hills to Wildlife Sanctuary has increased their IUCN status from level VI-Protected Area with sustainable use of natural resources to level IV-Habitat/Species Management Area. To effectively conserve the endemic and threatened flowering plants, a comprehensive documentation of endemic and threatened plants of the sanctuary is vital (Reddy *et al*., 2006). Intensive and extensive field explorations conducted during the present study from 2015 to 2018, to documente the endemic and threatened flowering plants of the KWLS comprehensively. Apart from this, GIS and remote sensing techniques were used in this study to delineate different species assemblages. The vegetation classification system was designed to more clearly understand and assess species and habitat diversity, ecological uniqueness and naturalness of the study areas.

The present study was carried with the following objectives:

1. To conduct a comprehensive taxonomic study on the endemic and threatened flowering plants of the Kodaikanal Wildlife Sanctuary.

2. To identify the threats to the endemic and threatened flowering plants found in the Sanctuary, and 3. To prepare vegetation type maps of the study area.

STUDY AREA

The Kodaikanal Wildlife Sanctuary (KWLS) lies between 10°07'13"–10°25'37" N and 77°15'01"–77°43'1" E, and covers an area of about 621.8 km^2 in Dindigul and Theni districts of Tamil Nadu, abutting the Kerala state boundary. This sanctuary occupies 30.06% of the Palani Hills, 0.47% of the state's and 0.048% of the Western Ghats geographical area (Map 1; Figs. 1 & 2).

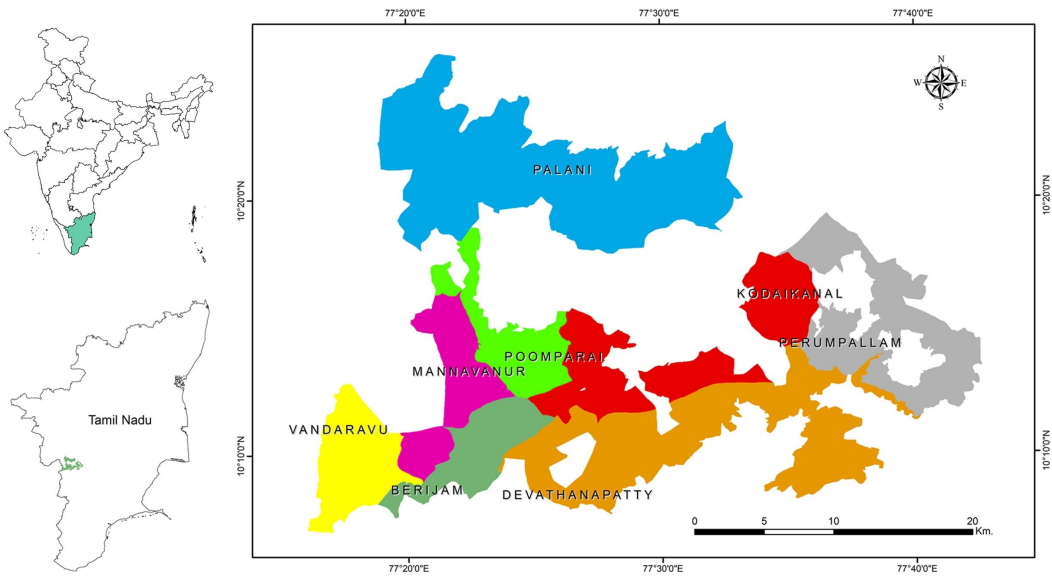
The Kodaikanal Wildlife Sanctuary consists of 25 Reserved Forest areas in Kodaikanal, Palani and Periyakulam Taluks and these areas are further organized into Eight Forest Ranges: 1. Kodaikanal, 2. Berijam, 3. Vandaravu, 4. Mannavanur, 5. Poomparai, 6. Perumpallam, 7. Devadanapatti and 8. Palani. The 25 Reserved Forest are namely, 1. Kudhiraiyar, 2. Oliyanuthu, 3. Poombarai-Vilpatty, 4. Velancombai, 5. Andipatti, 6. Gundar Valley, 7. Gundar Valley Extension, 8. Ampthill Downs, 9. Kookal, 10. Poombarai, 11. Shengalvarayar, 12. Karungalthanimedu, 13. Amburuvi, 14. Kilanavayal, 15. Samikanal, 16. Unjalanchi, 17. Palani Hills Southern Slope East, 18. Mulaiyar, 19. Pambar, 20. Perumalmalai, 21. Arunkanal, 22. Adukkam, 23. Maruthanadiyar, 24. Kaduguthadi and 25. Murugamalai (1).

Geology, History and Sociology of the Palani Hills

The Palani Hills are situated in south central Tamil Nadu, an east-west spur of the Western Ghats, extending roughly from the Kerala border near Munnar in the west, past the town of Kodaikanal as far as Dindigul in the east. The maximum length is 65 km and width 40 km with an area of about 2000 km^2. The elevations varied from 200 to 2500 m. and the highest peaks of the sanctuary are Vandaravu Peak (2531 m), Vembadi Peak (2515 m), Ibex Peak (2500 m) and Perumalmalai Peak (2250 m).

These hills in turn are divided into the upper Palanis (west) and the lower Palanis (east), separated by a north-south set of river valleys extending from Palani in the north to Periyakulam in the south. The upper Palanis have an average elevation of 2,200 m and consist of an undulating plateau interspersed with occasional peaks. The southern face has massive cliffs broken by ridges while the northern side consists of broad valleys and rivers that slope to the plains. The lower Palanis have an elevation less than 1800 m and are formed by a number of ridges broken by wooded valleys (Matthew, 1999)

Geographically, the Palani Hills are part of the Southern Granulite Terrane made of ancient metamorphic rock that was crushed and folded at ultra-high pressures deep below the earth's surface well before the formation of the supercontinent Gondwana in the Neoproterazoic Era, about 500 Ma years ago (Brandt, 2014).



Map 1. Kodaikanal Wildlife Sanctuary



Fig. 1. Landscapes of Kodaikanal Wildlife Sanctuary



Fig. 2. Landscapes of Kodaikanal Wildlife Sanctuary

The earliest known human artifacts in the Palani Hills are from the Megalithic Age or Iron Age, 1500–500 BC in India. These consisted of stone dolmens which were burial sites, often containing burial urns, iron or copper tools, weapons, ceramic items, and other materials. Although nobody knows who built them, the sheer numbers of similar structures across peninsular India (over 2200 sites) indicates that they would have been built by Megalithic South Indians, probably from well-organized agricultural communities on the plains. These tombs would have been built for wealthy noble people to assist them in the afterlife. (Ubhaykar, 2016)

The upper Palani Hills have a quasi-temperate climate with temperature ranges from 2° C to 17° C in the winter and 12° C to 21° C in the summer. The average year round temperature is 16° C. The lower Hills become progressively warmer and temperature ranges from 25° C to 40° C. Because the Palani Hills are east of the main spine of the Western Ghats, they are partially in the rain shadow of the southwest monsoon that drenches Kerala, and thus the Palani Hills may only receive rains during the Northeast monsoon between October and December. The period from January through May is relatively dry except for intermittent summer showers. The average annual rainfall of Kodaikanal is approximate 1700 mm (www.fallingrain.com).

The native vegetation of the Palanis has adapted to it various geographical zones. The upper Palanis (1700–2100 m) are predominantly grasslands interspersed with tropical montane shola forests which tend to cluster along the streams and rivers. Below this from 1300 to 1700 m is dry evergreen forest. From 800 to1300 m is dry deciduous forest, from 300 to 800 m is savanah interspersed with dry decidous trees and from the plains to approximately 300 m elevation is scrub forest (Matthew, 1999).

Important fauna such as Asiatic Elephant, Asian Wild Dog, Barking Deer, Black-naped Hare, Indain Gaur, Leopard, Grey Mongoose, Grizzled Giant Squirrel, Indian Crested Porcupine, Malabar Giant Squirrel, Nilgiri Langur, Nilgiri Tahr, Sambar Deer, Spotted Deer, Tiger and Wild Boar occur here. Birds such as Black and Orange Flycatcher, Black Bulbul, Crested Serpent Eagle, Greater Flameback, Grey Junglefowl, Grey-headed Canary Flycatcher, Indian Blackbird, Indian Dcimitar Babbler, Nightjar, Nilgiri Flycatcher, Nilgiri Pipit, Palani Laughingthrush, Oriental White Eye, Streak-throated Woodpecker, White-bellied Sholicola can be seen.

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Black-and-Orange flycatcher


Grey-headed canary-flycatcher


Nilgiri flycatcher


Palani laughingthrush © Prasenjeet Yadav



Nilgiri langur

VEGETATION TYPE CLASSIFICATION

Satellite Remote Sensing and GIS for Mapping Vegetation Systems

Vegetation is constantly changing across areas and time, reliable information on the extent and distribution of vegetation types is a pre-requisite for natural resource management and planning. Knowledge of vegetation types is becoming increasingly vital in assessing and monitoring potential vulnerability of natural ecosystems due to human-induced global environment change.

Champion & Seth (1968) recognized 16 major forest types with 221 minor types and 14 forest types in India. Gadgil & Meher-Homji (1990) distinguished 42 vegetation types in India based on association and dominance of species and the prevailing bioclimate. The existing classification systems use ground data precisely in deciphering the patterns of species assemblages, but do not provide spatial explicit boundaries of these assemblages. Such spatial explicit boundaries of vegetation types are important for studying the patterns of vegetation diversity and long term monitoring. As vegetation types in the tropical part of India represent diverse formations, an onscreen visual image interpretation approach was found to be suitable for delineating various vegetation types (Singh *et al*., 2005; Reddy *et al*., 2008; Reddy *et al*., 2009).

Maps are a convenient and effective form of storing the spatial database of natural resources like forest. In vegetation mapping, recent technologies such as satellite remote sensing and GIS are widely used. For mapping and identification of habitats with different mixed vegetation types, single species dominated systems, locale specific formations and degraded types, the spatial resolution of 20–30 m are appropriate. These resolutions are used for landscape scale studies of vegetation mapping (Singh *et al*., 2002). Vegetation mapping utilizes both qualitative and quantitative data collection techniques in order to create a database containing the spatial location and attribute tables of the plants (Hasmadi *et al*., 2009).

Porwal and Roy (1992) used landsat TM False Colour Composition to classify the highly heterogeneous forest environment of the Western Ghats. Lele *et al.* (1998) used mesoscale analysis of forest discussed and the extent of forest degradation and its causes in Western Ghats. Nagendra & Gadgil (1999) mapped the tropical forests of the Western Ghats, dividing them into 7 habitat types ranging from evergreen forest to paddy fields using supervised and unsupervised classification IRS-IB, LISS-II satellite imagery.

Jha *et al.* (2000) mapped the present status of forest cover and the changes it has undergone between 1973 and 1995 in the southern part of the Western Ghats forest region using IRS – IB LISS I and Landsat MSS digital data.

Vegetation type and landcover mapping of North-East India, Western Himalayas and Western Ghats of India were mapped on a 1:250000 scales by using IRS LISS data (IIRS, 2002). Tropical evergreen forest along with other phenological types and major disturbed habitats (grassland, orchards, mangroves, *Myristica* swamps and *Ochlandra*) were mapped. The spatial data generated by remote sensing is useful in many ways in biodiversity monitoring and conservation efforts.

Vegetation Type Classification Methodology

Satellite remote sensing has helped in generating products depicting coarser to very high resolution information on distribution of species at different levels of ecological hierarchy in the Kodaikanal Wildlife Sanctuary. The products include global vegetation type maps providing information on predominant climatic and physiognomic vegetation types, region specific vegetation type maps depicting local gregarious formations and unique habitats, communities, disturbance types, and land use.

On the other hand, very high resolution data has facilitated the development of species level distribution maps along with structural information on dominance, canopy diameters, and age class distribution. Visual interpretation of the vegetation types was carried out and different classes were interpreted using the onscreen digitization method. The interpreted product was further corroborated with ground truth information and phyto-sociological data. The interpreted vector layers of each district were mosaiced and the edge contrast and other inconsistencies were harmonized.

Vegetation type mapping was carried out using visual, digital and hybrid interpretation methods. The visual interpretation was done based on the size, shape, pattern, association, tone and textural variations of different vegetation classes within a given scene. The digital classification involved pattern recognition techniques which classified the image data into different vegetation types on the basis of reflectance information. The difference in the reflectance of different vegetation type classes basically depends on spatial, spectral, radiometric and temporal resolution. In addition, hybrid classification methods involving conjunctive use of visual and digital methods were also followed based on the requirements. In the present study, the visual interpretation method was used and ground truth data was incorporated to delineate different vegetation type classes. The steps given below were followed for vegetation type mapping in the Kodaikanal WLS.

A. Selection of Finest Season Satellite Data

Optimally, two season satellite data should be utilized to extract the vegetation types depending on forest phenology i.e. peak growth and leaf fall season. Satellite data pertaining to time windows of November to early January and February to early April should be used to account the phenological variations and delineate different vegetation types. Sentinel-2 satellite multi-seasonal images were procured from the U.S. Geological Survey (https://earthexplorer.usgs.gov/).

B. Reconnaissance survey

It is required to have a reconnaissance study of the area before attempting to classify the vegetation pattern. Initially major vegetation types and unique ecological zones of characteristic nature should be recorded and subjected to the intensive study of tone, texture, pattern and associated features from the enhanced False Colour Composite images (FCC).

A total of 15 plant explorations were conducted to the Kodaikanal Wildlife Sanctuary from August 2015 to September 2019, covering different seasons. Exploration sites were selected based on satellite imagery and the random sampling method was adopted for collection of plant specimens. During the study, nearly 1,500 taxa of flowering plants have been collected from the KWLS and also 2000 ground truth points of vegetation class along with the plant specimens in the each vegetation type. The location specific data gathered on different vegetation types were used to prepare: (1) a template for the visual interpretation of satellite data (2) training sets for digital classification of satellite data.

C. Map composition

The vegetation type map of Kodaikanal Wildlife Sanctuary was made with 25 December, 2016 and 3 February, 2017 Sentinel-2 satellite 10 m resolution images on 1:25,000 scales (Fig. 3). ERDAS Imagine 2013 version was used for interpreting the different vegetation classes and ArcGIS version 10.2.1 used for map composition. A Digital Elevation Model map was prepared to understand the species distribution at different altitude levels. Vegetation type classification images with appropriate legends and colour scheme printed on a 1:25000 scale using ArcMap were prepared. This study has followed the National Remote Sensing Centre (NRSC) cartographic models for map-use requirements (field/analysis/policy decision) and inferential content of the map. Sufficient space in each composition was retained in case in-depth analysis of selected themes would be planned. Results are shown in the finalized maps (Map 3.A).



Field work at Kookal Shola



Field work at Vattakanal Grassland



Field work at Ibex Peak Grassland



Field work at Palani

D. Elevation range

The elevation range of the KWLS varies from 250 to 2550 m and has been shown in the elevation map (Map 2.A). The native vegetation of the KWLS has adapted to the various geographical zones. Peaks of the mountains with naturalised plantations and grassland with small shola forest fragments share the agriculture landscape of Palamputtur, Pallangi, Poombarai, Poondi, Kavunji, Mannavanur and Perumalmalai villages at elevations between 1900 and 2500 m. Perumpallam, Shembirankulam, Sowrikkadu, Pannaikkadu, Adukkam villages are at mid-elevations ranging from 800 to 1700 m with a high number of private estates that share a boundary with semi-evergreen forest. Devadanapatty, Andipatty, Periyakulam–Chinnur path and Periyakulam–Periur path have dry deciduous forests surrounded by massive mango orchards in the foothills of the sanctuary.

1. Up to 300 m	–	Dry deciduous scrub with scattered trees
2. 300–800 m	–	Dry deciduous forest with bamboo and savannah
3. 800–1300 m	–	Moist deciduous forest and savannah
4. 1000–1600 m	–	Tropical semi-evergreen forest
5. 1300–1800 m	–	Wet evergreen forest
6. 1800–2550 m	–	Grasslands, sholas and naturalized plantations

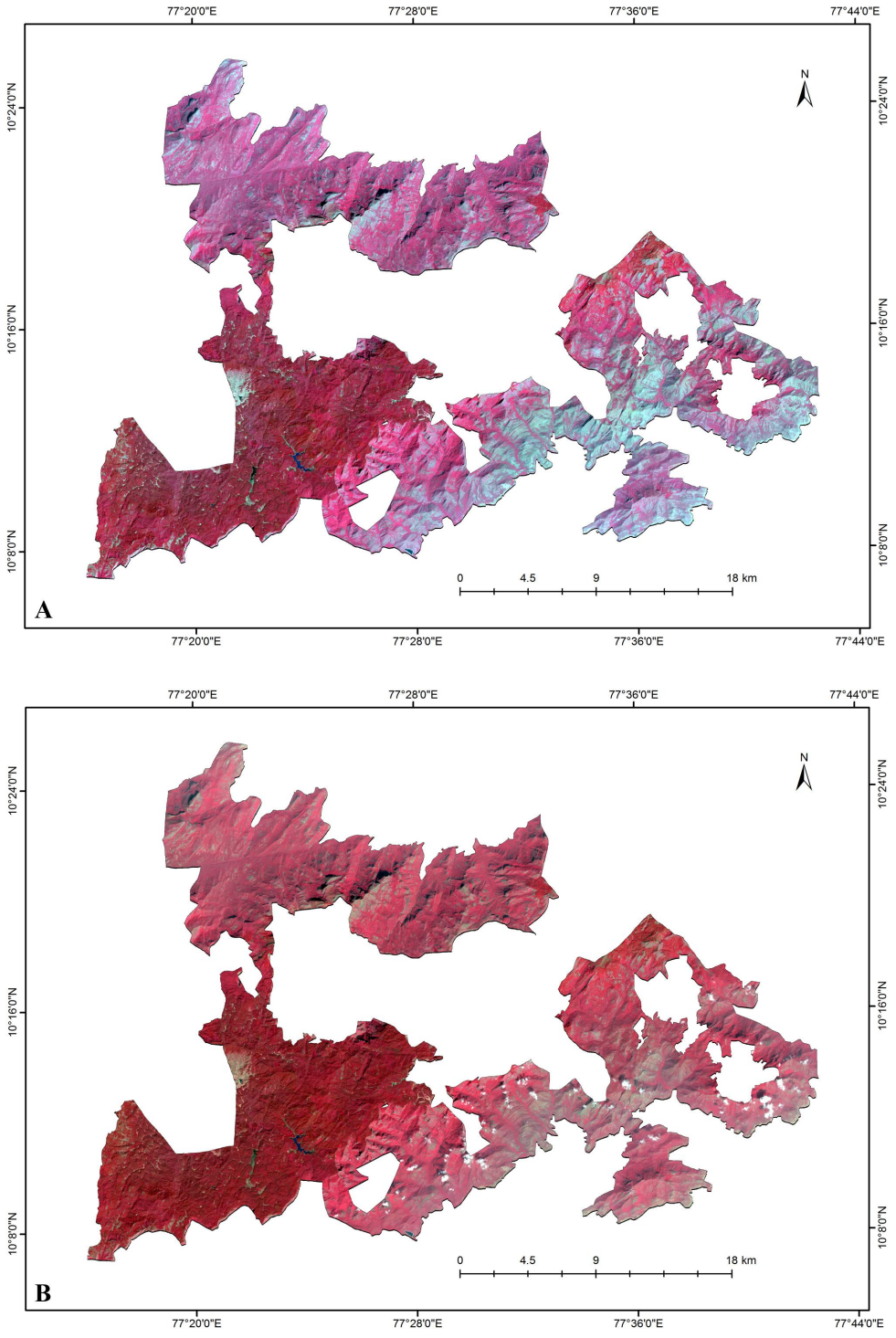
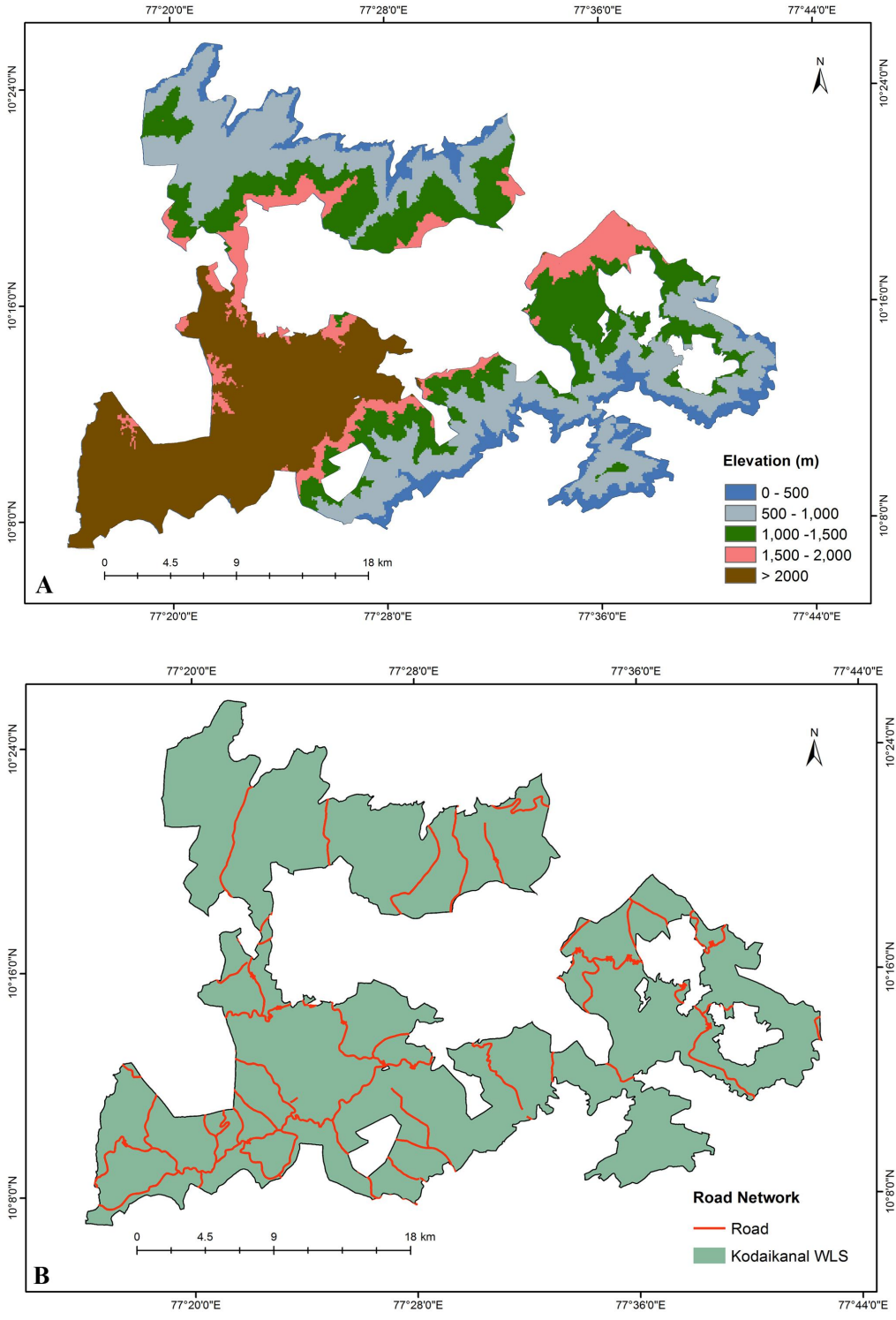
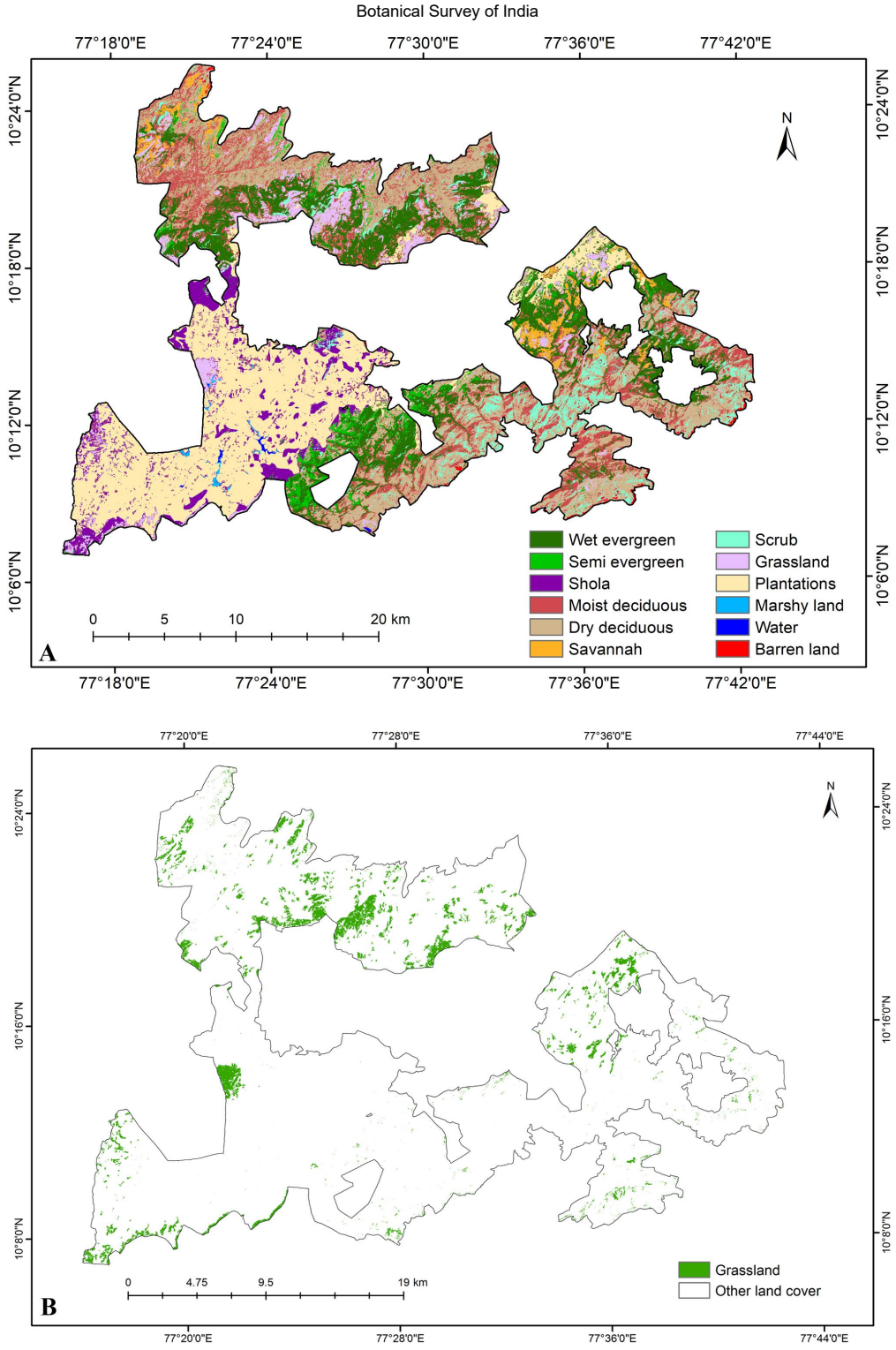


Fig. 3. **A**. 25.12.2016 & **B**. 03.02.2017 Sentinel-2 Satellite FCC images of Kodaikanal WLS



Map 2. A. Elevation & **B**. Road Network Maps of Kodaikanal Wildlife Sanctuary



Map 3. A. Vegetation type & **B**. Grassland maps of Kodaikanal Wildlife Sanctuary

Results & Discussion

The total geographic area of the Kodaikanal WLS was 608.95 km^2 in the year 2013 and later with a few inclusions it has increased to 621.8 km^2. After accurate interpretations with multi-seasonal satellite images, this study generated the vegetation type / land use classes map (Map 3A). Among 8 forest ranges, 5 namely: Berijam, Kodaikanal, Mannavanur, Poombarai and Vandaravu ranges (higher elevations) are invaded by naturalised plantation species such as *Acacia*, *Eucalyptus* and *Pinus*. The naturalised plantation class is the major vegetation type that occupies 25.1% of sanctuary's geographical area. Due to these naturalised plantations that turn invasive, all the 5 forest ranges have seen drastic reduction in the natural vegetation such as shola forests and grasslands affecting species diversity. Dry deciduous forest is the major vegetation type in Palani and Devadanapatty ranges (at lower elevations) and the second largest vegetation class of the sanctuary. Scrub fragments are also mainly found in these two forest ranges. Moist deciduous forest and small savannah fragments are the major vegetation types in Perumpallam (mid elevations) range. In spite of a Protected Area, a large area (25.1%) of the Sanctuary is occupied by plantations, followed by 24.3% of area covered by dry deciduous forests, wet evergreen forests (16%), moist deciduous forests (14.3%), shola forests (5%), grasslands (4.9%), scrub (4.8%), savannah (1.8%), barren land (0.6%), marshy areas (0.2%), and 0.1% covered by water (Figs. 4–14).

Table 1: Vegetation types of the Kodaikanal Wildlife Sanctuary

S. No	Vegetation Class	Area in Ha.	Area in km^2	% of area
1	Wet evergreen forest	9919.6	99.2	16.0
2	Semi-evergreen forest	1794.6	17.9	2.9
3	Moist deciduous forest	8912.0	89.1	14.3
4	Dry deciduous forest	15126.1	151.3	24.3
5	Scrub	2962.8	29.6	4.8
6	Grassland	3019.1	30.2	4.9
7	Barren land	393.3	3.9	0.6
8	Marshy land	98.0	1.0	0.2
9	Water	65.0	0.7	0.1
10	Savannah	1135.9	11.4	1.8
11	Shola forest	3122.9	31.2	5.0
12	Plantations	15626.8	156.3	25.1
Total		**62175.9**	**621.8**	**100**

A. Tropical dry deciduous forest

In this forest type the canopy is represented by deciduous species. These forests will become entirely leafless and soil is mostly exposed for 1–4 months during February to May. The canopy of the trees does not normally exceed 20 m. Bark of the tree species is thicker and rough. The number of species is lower compared to evergreen, semi-evergreen and moist deciduous forests. Epiphytes and ferns are occasional. Climbers are comparatively less but lianas such as *Spatholobus parviflorus*, *Entada rheedii* and *Derris scandens* substitute for the tree canopy. Herbaceous vegetation is quite common in the rainy season and is also associated with the few remaining patches of thorn forest at elevations between 300 and 600 m, particularly in the Devadanapatty and Palani forest ranges. In the green (rainy) season, dry deciduous forest in FCC satellite images looks dark red in tone and smooth in texture, but during the dry (leaf shedding) period, the areas take up a greenish shade with no evidence of foliage. Background reflectance of dry or often burnt undergrowth marks this system. Contiguity of these forests over large areas is common and can be generally found interspersed with contrasting linear riverine forests in dry season. The dominant tree species are: *Atalantia monophylla, Commiphora caudata*, *Diospyros montana*, *D. ebenum*, *Ficus mollis*, *Garuga floribunda*, *Givotia moluccana*, *Gyrocarpus asiaticus*, *Gardenia resinifera*, *Lepisanthes senegalensis*, *L. tetraphylla*, *Mitragyna parvifolia, Pleiospermium alatum*, *Pterocarpus marsupium, Schleichera oleosa*, *Sterculia urens*, *Streblus asper* and *Tectona grandis.*

B. Tropical wet evergreen forest

This forest canopy has green foliage throughout the year and it is characterized by evergreen trees more than 30 m high. Trees often have buttressed trunks or roots on three sides like a tripod that helps support a tree against storms. The bark of these trees is thin and smooth. The plants in this forest form a multi-layered pattern: shrubs cover the layer closer to the ground (under storey), followed by the short trees (middle storey) and then the tall tress (top storey). Ferns and different species of orchids grow on the trunks of the trees. Mosses and aroids are quite common. In FCC images, these areas are dark or bright red in tone with a rough texture in all seasons. Associated features include interior terrain and moist riverine areas characterized by the interspersion of shadows.

This forest type mainly appears in Perumpallam, Poombarai and Kodaikanal ranges of the Kodaikanal Wildlife Sanctuary at elevations ranging from 1300 to 1700 m. The major tree species are *Acronychia pedunculata, Antidesma menasu, Casearia zeylanica, Celtis timorensis, Chionanthus ramiflorus, Cinnamomum wightii, Elaeocarpus glandulosus, Euonymus crenulatus,*



Fig. 4. Tropical dry deciduous forest



Fig.5. Tropical wet evergreen forest

Gordonia obtusa, Ilex wightiana, Litsea deccanensis, Myrsine wightiana, Mitrephora heyneana, Persea macrantha, Photinia integrifolia, Phoebe wightii, Schefflera racemosa, Symplocos cochinchinensis, Turpinia nepalensis, Vaccinium leschenaultii, Vaccinium neilgherrense, Viburnum cylindricum and *Xantolis tomentosa.*

C. Tropical semi-evergreen forest

This forest type has a predominance of evergreen broad-leaved trees. More than 75% of the trees remain green all over the year and the canopy is always with green foliage. This forest type is mostly dense, comprised of a large number of tree species of both wet evergreen and moist deciduous types. Climbers and epiphytes are abundant. In FCC images, these forests are bright red in tone or pinkish red with medium to rough texture in all seasons. These forests are situated in the proximity of Tropical Wet Evergreen forests and/or Tropical Moist Deciduous Forests. An important associated feature is the presence of moist riverine tracts. This kind of forest is situated only in the Kodaikanal forest range between 1000 and 1600 m elevations. The major tree species are: *Atalantia racemosa, Celtis tetrandra, Chrysophyllum roxburghii, Canarium strictum, Dalbergia paniculata, Diospyros ovalifolia, Drypetes roxburghii, Euonymus dichotomus, Ficus drupacea, F. tsjahela, Litsea deccanensis, Mangifera indica, Nothopegia beddomei, Meliosma pinnata, Melia dubia, Olea dioica, O. paniculata, Syzygium hemisphericum* and *Toona ciliata.*

D. Tropical moist deciduous forest

This forest type has a predominance of deciduous broad-leaf trees and consists of seasonal tree communities with a few evergreens that have an annual cycle of leaf-on and leaf-off periods. In tropical moist deciduous forests, the onset of leaf flushing starts in late May or early June. The trees typically form an irregular top storey and often have branching trunks and roots to hold them firmly in the ground. Most of the taller trees shed their leaves in the dry season. The lower storey is predominantly occupied by evergreen trees and shrubs. The bark of these trees tends to be thicker and rougher as compared to wet evergreen and semi-evergreen forests. Bamboos, canes and epiphytes are restricted to certain patches. Climbers are abundant. In FCC images this forest type appears bright red to brown-tinged red in tone with rough or medium texture in green season images and mottled dark in tone with a medium or smooth texture in the dry season. Formation is generally at the outer fringes of core semi-evergreen patches extending up to the forest limits at places. Wherever it is in proximity to dry deciduous forest, moist deciduous forests form the core of the vegetation system. Perumpallam, Palani and Kodaikanal ranges possess these forest fragments at elevations raninging from 800 to 1300 m. The key tree species are: *Aglaia elaeagnoidea, Aphanamixis*



Fig. 6. Tropical semi-evergreen forest



Fig. 7. Tropical moist deciduous forest

polystachya, Anogeissus latifolia, Artocarpus heterophyllus, Bischofia javanica, Cassine glauca, Chukrasia tabularis, Dimocarpus longan, Diospyros ovalifolia, Eriolaena hookeriana, Ficus amplissima, Garcinia gummi-gutta, Haldina cordifolia, Memecylon edule, Mitrephora heyneana, Psydrax dicoccos, Pterospermum diversifolium, Pterocarpus marsupium, Trichilia connaroides, Viburnum punctatum and *Ziziphus glabrata.*

E. Montane wet temperate forest

These closed evergreen forests occur at elevation about 1500 m upwards. Such forests are found in patches in the more sheltered sites on rolling grasslands in Western Ghats, popularly known as 'Shola'. Trees have bulky girth and branching crowns with a height up to 15 m. A few shola trees leaves are coriaceous and red during juvinile stage. The branches are densely clothed with mosses, ferns and epiphytes. Lianas are very frequent in this forest type. In FCC images, these areas are dark brown in tone with a medium to rough texture. Vandaravu, Poombarai, Berijam, Mannavannur and Kodaikanal ranges have this forest type at elevationas between 1700 and 2500 m. Very few patches remain due to the invasion of plantation species such as *Eucalyptus, Pinus* and *Acacia.* The common tree species are: *Actinodaphne bourneae, Beilschmiedia wightii, Chionanthus ramiflorus, Cinnamomum wightii, Cryptocarya bourdillonii, Daphniphyllum neilgherrens, Elaeocarpus variabilis, Elaeocarpus recurvatus, Glochidion zeylanicum, Gomphandra coriacea, Isonandra perrottetiana, Litsea floribunda, L. insignis, L. keralana, L. oleoides, Mahonia leschenaultia, Michelia nilagirica, Meliosma simplicifolia, Neolitsea fischeri, Nothapodytes nimmoniana, Rhododendron nilagiricum, Schefflera racemosa, Symplocos foliosa, Syzygium caryophyllatum, S. densiflorum, Viburnum cylindricum,* and *Xantholis tomentosa.*

F. Scrub

In this forest type, tree canopy cover is less than 10%. In the sanctuary, scrubs are mainly located in Palani and Devadanapatty ranges at elevations ranging from 250 to 600 m, often in association with dry deciduous forests. The main shrub species are: *Capparis sepiaria*, *Capparis divaricata*, *Commiphora berryi*, *Drypetes sepiaria*, *Dichrostachys cinerea*, *Dodonaea viscosa*, *Erythroxylum monogynum*, *Euphorbia antiquorum, Flueggea virosa, Grewia abutilifolia*, *G. hirsuta*, *Maytenus heyneana*, *Rhus mysorensis, Tarenna asciatica* and *Zizyphus nummularia*, with scattered trees such as *Cochlospermum religiosum, Lannea coromandelica*, and *Polyalthia cerasoides.*



Fig. 8. Montane wet temperate (Shola) forest



Fig. 9. Montane wet temperate (Shola) forest



Fig. 10. Scrub

G. Savannah

This vegetation type is dominated by naturally occurring grasses and forbs with scattered trees or shrubs. Indian savannahs result from human interference, replacing natural forest types ranging from tropical rain forest (rainfall >5000 mm) to thorny scrub (rainfall <400 mm). According to Gadgil *et al.* (1985), the rapidity of recent change has produced degradation due to the roles of savannah in providing communal grazing and fuel wood. The savannahs are situated at altitude ranges from 800 to 1300 m and are contiguous with wet evergreen forest, moist deciduous forest and dry deciduous forest fragments. This vegetation type mainly occurs in the Devadanapatty, Perumpallam and Kodaikanal forest ranges of the KWLS. Savannah is dominated by grass species *Cymbopogon* sp., *Heteropogon* sp., *Themeda* sp. few scattered trees such as *Bridelia retusa*, *Cassine glauca*, *Gardenia gummifera*, *Phyllanthus emblica*, *Terminalia chebula*, and *Wendlandia thyrsoidea*.

H. Grasslands

In this community, grasses predominate along with forbs as co-dominants. Trees are either absent or present in relatively small numbers. Smooth pink tones and lesser expanse associated with hill tops and plains mark the grassland cover in FCC imagery. Grassland is occasionally to frequently in the proximity of scrub or savannah vegetation and may mix with barren or other land use, if single season data is used.

The following grasslands of the Kodaikanal Wildlife Sanctuary (Figs.12–14) were covered during the surveys: 1. Palamputtur grassland (1850–1950 m), 2. Kookal grassland (2100–2200 m), 3. Perumalmalai grassland (1700–2250 m), 4. Vattakanal grassland 5. Ibex peak (2200–2500 m), 6. Vadakownji–Pannaikkadu (Zeronium) grassland (1800–2000 m), 7. Navamarathu Patty–Atukaram Patty grassland and Pallangi grassland (1200–1300 m). These grasslands contribute 4.9% of the total area of the sanctuary and occupy 30.2 km^2 (Map 3.B).

During extensive field surveys in these grasslands observed the following phenological events and provided the comprehensive list of grassland taxa. A total of 155 angiospermic taxa representing 33 families were recorded, which fall into two groups (a.) grasses (42 species) and (b). Grassland associated species (113). Among the grasses 13 species are endemic to peninsula India and Western Ghats (Kiran *et al.*, 2019). *Anthoxanthum borii* S.K. Jain & D.C. Pal is near threatened (Kumar, 2011a). Among the grassland associated species 43 are endemic. *Gynura travancorica* W.W. Sm. is Near Threatened (Rehel, 2011) and *Anaphalis beddomei* Hook.f. is Vulnerable (Kumar, 2011b).



Fig. 11. Savannah

The typical high altitude grassland associated species *Strobilanthes kunthiana* bloomed in the year 2018 in grasslands and slopes of the sanctuary. The previous blooming was in 2006. Most of the grasslands turn dry from January to May, during which time high-altitude grassland shrubs bloom: *Hypericum mysurense* blooms from March to September, *Berberis tinctoria* from February to May, and *Cotoneaster buxifolius* from March to May.

Based on species dominance in these 7 grasslands, a total of **4 grassland types** were categorized *viz*. **a**. *Arundinella–Chrysopogon* grassland, **b**. *Chrysopogon–Cymbopogon* grassland, **c**. *Apluda–Themeda–Cymbopogon* mixed grassland, and **d**. *Tripogon* grassland.

1. The Palamputtur **Chrysopogon–Cymbopogon and Tripogon Grasslands** are at elevations ranging from 1850 to 1950 m and are surrounded by agriculture fields. *Chrysopogon asper* and *Cymbopogon flexuosus* prevails on areas with thick layer of soil. *Tripogon pungens* and *T. narayanae* spread on rocky surfaces covered with a thin soil layer. These grasslands, which host the Nilgiri Pipit are shrinking due to the invasive fern *Pteridium aquilinum* and trees species of *Acacia* and *Eucalyptus*. Adjacent revenue lands are encroaching and threatening the sustainability of these grasslands. The present study strongly recommends the local authorities to stop the encroachments, anthropogenic pressure and to restricting the invasive trees.

2. The Kookal **Chrysopogon–Cymbopogon Grassland** at elevations between 2000 and 2200 m shares a boundary with the Anaimalai Tiger Reserve, Tamil Nadu. This grassland is rich in biodiversity and possesses much higher populations of *Rhododendron nilagiricum* compared to all the other grasslands of sanctuary. Though it is virgin grassland and less area invaded *by Acacia*, the invasive fern *Pteridium aquilinum* and the noxious weed *Ageratina adenophora* are altering the grassland composition. This grassland is in the migratory path for the Asiatic elephant (*Elephas maximus*) and the best habitat for Nilgiri pipit (*Anthus nilghiriensis*). Attention needs to be paid to control the population of above two invasive plant species, prevention of seasonal grassland fires, and control of garbage left by pilgrims visiting the Pappammal Kovil.

3. The Perumalmalai **Chrysopogon–Cymbopogon Grasslands** are at elevations ranging from 1700 to 2250 m, and are easily accessible from Kodaikanal town. This grassland is invaded by *Eucalyptus* sp. and *Pteridium aquilinum* and fragmented into patches less than 1 hectare. The present study strongly recommends that forest department to clear the *Eucalyptus* sp., *Lantana camara* and *Pteridium aquilinum* periodically to protect this Nilgiri Pipit habitat (Fig. 15A).



Fig. 12. Grasslands

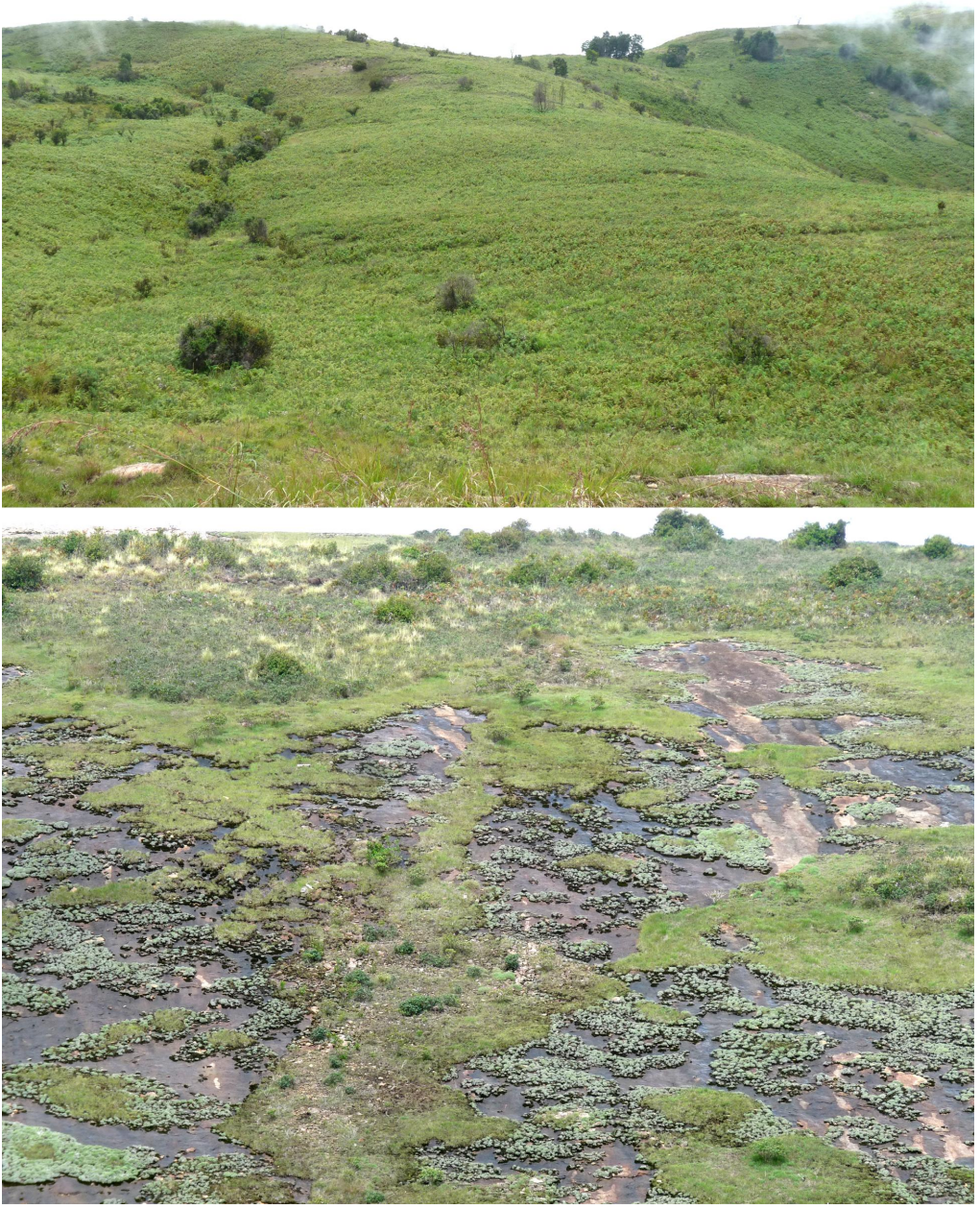


Fig. 13. Grasslands



Fig. 14. Grasslands



Fig. 15. **A**. Endangered bird Nilgiri Pipit; **B**. Vulnerable animal Gaur.

4. The Vattakanal **Chrysopogon–Cymbopogon Grassland** at elevation ranges from 1900 to 2050 m is less known and very close to Kodaikanal town. It is adjacent to Vattakanal Shola and shares boundaries with private estates. The dripping slopes of Vattakanal grassland are rich in endemic species like *Impatiens goughii I. tomentosa*, *Smithia gracilis* and *Strobilanthes kunthiana*. This grassland is slowly being altered by the invasion of species of *Acacia* and *Eucalyptus*. It is strongly suggested to clear these invasive trees to protect the habitat of gaur (*Bos gaurus*), a vulnerable animal (Duckworth *et al.*, 2016) (Fig. 15B).

5. The Ibex Peak **Arundinella–Chrysopogon Grassland** on the highest peaks of Kodaikanal WLS is situated in the Vandaravu Forest Range at elevations ranging from 2200 to 2500 m elevation. Ibex Peak is dominated by *Arundinella vaginata* and the extreme cliff by *Chrysopogon asper* with a scattered population of *Rhododendron nilagiricum*. Except for the cliffs of Ibex Peak which face south towards Theni, the majority of the hilly areas have been invaded by *Acacia mearnsii* and *Pteridium aquilinum.* The current study recommends wattle trees felling to augment the population of *Arundinella vaginata* which is the ideal grass to support the Nilgiri Pipit and many herbivores.

6. The Vadakavunji–Pannaikkadu **Chrysopogon–Cymbopogon Grasslands** and **Tripogon grasslands** present in small patches along the ghat road at elevations ranging from 1800 to 2000 m. These grassland patches are under extreme threat due to the invasion of *Acacia* sp., *Ageratina adenophora*, *Eucalyptus* sp. and *Pteridium aquilinum* from all sides. Periodical removal of exotic trees species is recommended.

7. The Navamarathu Patty–Atukaram Patty–Pallangi grasslands are composed of **Apluda–Themeda–Cymbopogon mixed grasses** and situated at elevations between 1200 and 1300 m. The main scattered trees of this savannah are *Cassine glauca*, *Phyllanthus emblica*, *Terminalia chebula* and *Wendlandia thyrsoidea*. These grasslands are highly forest fire prone and are facing much encroachment. Conservation of natural habitat of this grassland is urgently needed and the area should be declared as a medicinal plant conservation area.

I. Plantations

Between 1860 and 1915, *Acacia*, *Cinchona*, Eucalyptus and *Pinus* were introduced at Vandaravu, Marion Shola, Gundar, Parikombai and Shembaganur areas of the Kodaikanal division for commercial purposes. In the course of time, *Acacia*, *Eucalyptus* and *Pinus* species have aggressively invaded the grasslands and supressed the natural expansion of grasslands and shola forest. Satellite imagery and field surveys, revealed that 66% of native grasslands and



Fig. 16. Plantations

31% of native forests have been lost over the last 40 years (Arasumani *et al*., 2018). The most aggressive invading species are: *Acacia decurrens*, *A. dealbata*, *A. mearnsii*, *Eucalyptus globulus*, *E. saligna*, *E. grandis*, *Pinus roxburghii and P. radiata.* In the foothills, the major plantation species are *Tamarindus indicus* as Non Timber Forest Product and *Acacia planifrons* planted as a restoration species in the dry hills of the Devadanapatty forest range.

J. Barren land

These lands generally result from inherent/ imposed disabilities caused by location, environment, chemical and physical properties of the soil or financial or management constraints. These are areas with exposed soil, sand, rocks and never more than 10% vegetation cover during any season. Long fallow lands are also included in this category. In the sanctuary, barren land fragments with rocky hilltops have been found in Palani and Devadanapatty forest ranges. In rainy season *Anisochilus carnosus, Heliotropium scabrum*, *Oropetium thomaeum*, *Polycarpaea corymbosa*, and *Portulaca oleracea* were seen as ephemeral vegetation.

K. Water bodies

This category comprises areas that have surface water, either impounded in the form of ponds, lakes, tanks and reservoirs or flowing as streams, rivers and canals. Konalar Dam, Berijam Lake, and Poondi Lake are found in the upper hills. Sothuparai, Palar, Purandalar, Kudarayar, and Manjalar dams are found in the foothills.

IV. Disturbances in the Kodaikanal Wildlife Sanctuary

1. Natural factors

Changing climatic conditions cause changes in vegetation as well. The failure of the monsoon in 2016 and 2017, frequent forest and grassland fires and the 2018 Gaja cyclone played a major role in loss of populations of several species. Theni (Honey) Shola, Tiger Shola and Blackburn Shola were much damaged by Gaja cyclone with the loss of many Lauraceae trees and *Daphniphyllum neilgherrense* (Fig. 17).



Fig. 17. Gaja Cyclone effect of Shola Forests

2. Anthropogenic factors

a. Plantations and Invasive Species

During the colonial period (1870–1940), large numbers of plantation crops, trees, and weeds were introduced, both deliberately and accidentally. In addition to fruit trees, coffee, vegetables, ornamentals, huge tracts of forest land were planted with Wattle, Eucalyptus and Pine forever replacing grasslands. Continued invasion of timber plantations into grasslands is a major threat to the biodiversity of the sanctuary. Apart from these plantations, diverting the water illegally from shola springs to private estates by drip or hose pipes is a major threat to biodiversity.

The following species are invading grasslands and sholas: *Acacia dealbata* Link, *A. decurrens* (J.C. Wendl.) Willd., *A. melanoxylon* R. Br., *A. mearnsii* De Wild., *Alnus nepalensis* D. Don, *Eucalyptus* spp., *Pinus patula* Schltdl. & Cham., *P. radiata* D. Don., *P. roxburghii* Sarg. and *Senna septemtrionalis* (Viv.) H.S. Irwin & Barneby. Avenue tree species such as *Senna spectabilis* (DC.) H.S. Irwin & Barneby, *S. siamea* (Lam.) H.S. Irwin & Barneby have escaped from plantations. The invasive species *Prosopis juliflora* (Sw.) DC. and *Parthenium hysterophorus* L. are wildly spreading in the foothills of the sanctuary (Figs. 18–24).

A few more shrubs and herbs namely *Ageratum conyzoides* (L.) L., *A. houstonianum* Mill., *Ageratina adenophora* (Spreng.) R.M. King & H. Rob., *Artemisia japonica* Thunb., *Bidens pilosa* L., *Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Bercht. & J. Presl, *B. versicolor* Lagerh., *Buddleja madagascariensis* Lam., *Cestrum aurantiacum* Lindl., *C. elegans* (Brongn. ex Neumann) Schltdl., *Dodonaea viscosa* (L.) Jacq., *Fuchsia boliviana* Carrière, *Hypoestes sanguinolenta* Hook., *Pteridium aquilinum* (L.) Kuhn, *Passiflora mollissima* (Kunth) L.H. Bailey, *P. subpeltata* Ortega, *Pennisetum clandestinum* Hochst. ex Chiov., *Solanum auriculatum* Aiton, *S. pseudocapsicum* L. *S. viarum* Dunal and *Verbena rigida* Spreng. are showing aggressive growth as they compete with the native species at high elevation areas in the sanctuary. *Artemisia nilagirica* (C.B. Clarke) Pamp., *Calpurnia aurea* (Aiton) Benth. *Cestrum nocturnum* L., *Chromolaena odorata* (L.) R.M. King & H. Rob., *Clerodendrum philippinum* Schauer, *Coffea arabica* L., *Coffea canephora* Pierre ex A. Froehner, *Lantana camara* L. and *Solanum erianthum* D. Don are invading the mid-altitude areas from 800 to 1900 m in the sanctuary.



Fig. 18. Invasion of species of *Eucalyptus* and Wattle in Shola Forests



Fig. 19. Invasion of species of *Pinus* and Wattle in Grasslands



Fig. 20. Invasion of *Ageratina adenophora* in Grasslands and Shola Forests



Fig. 21. Invasion of *Pteridium aquilinum* in Grasslands



Fig. 22. Invasion of *Lantana camara* and *Chromolaena odorata*



Fig. 23. Encroachments



Fig. 24. Grassland fires

b. Tourism

Besides agriculture in the surrounding villages, another source of income for the people of Kodaikanal is the tourism industry with all of the accompanying services such as hotels, restaurants, transportation and shops. There are approximately 80 lakh tourist visits per year with up to 10,000 per day during peak season. Education is another industry with approximately 15 schools, three colleges, and one university. Construction work employs many people to meet the growing demand for homes and hotels. All these factors have drastically altered the natural environment.

Other anthropogenic factors that are damaging the Kodaikanal Wildlife Sanctuary include private estates, the expansion of Law's ghat road, the widening of the Palani–Kodaikanal ghat road, a new highway from Kumbakkarai to Perumalmalai, mining in the foothills, agricultural encroachment and runoff, plastics and other non-degradable products discarded by residents as well as tourists and pilgrims (Figure 25).



Fig. 25. Plastics and other non-degradable products discarded by tourists

TAXONOMIC STUDY OF THE ENDEMIC AND THREATENED FLOWERING PLANTS

Review of Literature

During the past 200 years, a number of botanists significantly contributed to the flora of Palani Hills. Robert Wight used many of his own collections from the Palani Hills for his book entitled, Illustrations of Indian Botany (1840–1850). Beddome, then Conservator of Forests, made sporadic plant collections in different parts of Palani Hills and used his collections for his monumental work on the flora of Peninsular India (1868–1874). M.A. Lawson who contributed the taxonomic account of the families Celastrinae, Rhamneae and Ampelidae for Hooker's Flora of British India (1872–1897), also relied on some of the specimens collected from the hills of Kodaikanal. A.G. Bourne prepared the list of species of plants indigenous to southern India (1897), in which he mentioned plants from Palani Hills. P.F. Fyson, a Professor of Botany, published an illustrated "Flora of the Nilgiri and Pulney Hill-tops" (1915), and "The Flora of the South Indian Hill Stations" (1932) based on his botanical explorations and plant collections from the hills of Nilgiris and Palanis. J.S. Gamble and C.E.C. Fischer in their monumental "Flora of the Presidency of Madras" (1915–1936) used many specimens and plant collections from Palani Hills. Fr. K.M. Matthew, a Professor of Botany, studied extensively the diverse vegetation types found across the entire Palani Hills, and made comprehensive publications on the vegetation and flowering plants of Palani Hills. His remarkable publications include: "The Vegetation of Kodaikanal grassy slopes" (1959), "The Exotic Flora of the Kodaikanal" (1969) and "The Flora of the Palni Hills, South India" (1999).

Methodological Considerations

Based on literature and phenology, a total of exploration tours were scheduled at periodical intervals from 2015 to 2019. The present study mainly focused on endemic and threatened flowering plants in the newly declared Kodaikanal WLS. In this study only angiosperms are taken into account. A total of 15 plant exploration tours were conducted to the Kodaikanal Wildlife sanctuary from August 2015 to September 2019 (150 Days), in different seasons. During the study, nearly 1,500 taxa of flowering plants have been collected from the KWLS. From these 1500 species, the endemic and threatened flowering plants were segregated and taxonomic enumeration was emphasized. With a special emphasis on endemic and threatened plants, adequate phenological data were collected from the previous literature to know the flowering and fruiting period of the vegetation before the explorations. Threat factors to the flora has been recorded based on proximity to the road and private lands, fire, grazing, anthropogenic activity, disease and insect attacks.



Field work at Vattakanal Grassland and Shola



Field work at Vattakanal Grassland

During the study, plant exploration surveys were conducted in the entire sanctuary and in transitional zones between different vegetation types for ecotype variants. Exploration sites were selected based on satellite imagery and random sampling method has been adopted for collections of plant specimens. The road network map (Map 2.B) was prepared with satellite imagery and information procured from Kodaikanal Government Hospital to carry out the field trips to remote tribal localities. Three samples of each individual plant species were collected and tagged with Madras Herbarium (MH) field numbers and processed by standard herbarium techniques. Photographs of habitat, habit and inflorescence of each individual species were taken to prepare the digital data base. Height, inflorescence size and colour, wildlife signs and threat factors were recorded for all plant species. GPS coordinates were collected for geo-tagging and for further studies, and also as ground truth points to crosscheck the accuracy of the vegetation map. Collected specimens were identified with the help of taxonomic literature, and other herbarium specimens. The plant materials of present study have been deposited at MH for future reference. This study has followed recent ecological assessments to understand the status and distribution of a species. Notes were provided for each species based on field observations.

Taxonomic Study Results – Analysis

During the study, nearly 1,800 taxa of flowering plants were studied from the KWLS, of which, only 212 taxa pertaining to 129 genera belonging to 53 families were identified as endemics. Among the 212 taxa, 176 were dicots, 35 are monocots and only one gymnosperm. The occurrence and distribution of these 212 endemic flowering plants are given in table 2.

The dicotyledonous families with number of endemic taxa recorded from KWLS are as follows: Acanthaceae (18), Rubiaceae (17), Lamiaceae (13), Asteraceae (12), Lauraceae (12), Fabaceae (10), Balsaminaceae (10), Melastomataceae (6), Apiaceae (6), Euphorbiaceae (6), Loranthaceae (5), Asclepiadaceae (5), Moraceae (5), Elaeocarpaceae (4), Oleaceae (4), Celastraceae (4), Cucurbitaceae (3), Sapindaceae (2), Burseraceae (2), Crassulaceae (2), Rutaceae (2), Rosaceae (2), Ericaceae (2), Symplocaceae (2), Gesneriaceae (2), Magnoliaceae (1), Cleomaceae (1), Flacourtiaceae (1), Pittosporaceae (1), Cluciaceae (1), Theaceae (1), Malvaceae (1), Mimosaceae (1), Vitaceae (1), Myrtaceae (1), Caprifoliaceae (1), Myrsinaceae (1), Sapotaceae (1), Ebenaceae (1), Gentianaceae (1), Apocynaceae (1), Convolvulaceae (1), Solanaceae (1) Piperaceae (1) and Viscaceae (1).

The monocotyledonous families with number of endemic taxa recorded from KWLS: Poaceae (16), Orchidaceae (11), Arecaceae (2), Cyperaceae (2), Eriocaulaceae (2), Commelinaceae (1) and Asparagaceae (1).

The dominant genera with maximum species are: *Strobilanthes* (11), *Impatiens* (10), *Anaphalis* (6), *Ficus* (5), *Litsea* (5), *Elaeocarpus* (4), *Leucas* (4) and *Osbeckia* (4). One endemic gymnosperm *Cycas circinalis* belonging to Cycadaceae was found. Furthermore, among the 212 taxa, 28 were found to be under different threatened categories: 14 are Vulnerable (VU), 11 Endangered (EN) and 3 Critically Endangered (CR). Two species were found to be near-threatened category. These 212 taxa belong to different forms as follows: herbs (61), trees (45), shrubs (37), undershrubs (32), grasses (16), lianas (8), climbers (8), stragglers (2), sedges (2) and trailers (1).

Table 2: Endemic flowering plants in Kodaikanal WLS

Sl. No.	Botanical Name	Family	Habit
1	*Magnolia nilagirica* (Zenker) Figlar	Magnoliaceae	Tree
2	*Cleome felina* L.f.	Cleomaceae	Herb
3	*Hydnocarpus pentandrus* (Buch.-Ham.) Oken	Flacourtiaceae	Tree
4	*Pittosporum neelgherrense* Wight & Arn.	Pittosporaceae	Tree
5	*Mesua ferrea* L. var. *coromandeliana* (Wight) N.P. Singh	Clusiaceae	Tree
6	*Gordonia obtusa* Wall. ex Wight & Arn.	Theaceae	Tree
7	*Abutilon neelgherrense* Munro	Malvaceae	Undershrub
8	*Elaeocarpus blascoi* Weibel	Elaeocarpaceae	Tree
9	*Elaeocarpus munroii* (Wight) Mast.	Elaeocarpaceae	Tree
10	*Elaeocarpus recurvatus* Corner	Elaeocarpaceae	Tree
11	*Elaeocarpus variabilis* Zmarzty	Elaeocarpaceae	Tree
12	*Impatiens campanulata* Wight	Balsaminaceae	Undershrub
13	*Impatiens dasysperma* Wight	Balsaminaceae	Herb
14	*Impatiens fasciculata* Lam.	Balsaminaceae	Herb
15	*Impatiens goughii* Wight	Balsaminaceae	Herb
16	*Impatiens leschenaultii* (DC.) Wall. ex Wight & Arn.	Balsaminaceae	Undershrub
17	*Impatiens phoenicea* Bedd.	Balsaminaceae	Herb
18	*Impatiens tangachee* Bedd.	Balsaminaceae	Herb
19	*Impatiens tanyae* R.Kr. Singh, Arigela & Kabeer	Balsaminaceae	Herb
20	*Impatiens tomentosa* B.Heyne ex Wight & Arn.	Balsaminaceae	Herb
21	*Impatiens viscida* Wight	Balsaminaceae	Herb
22	*Atalantia wightii* Yu.Tanaka	Rutaceae	Tree
23	*Clausena austroindica* B.C. Stone & K. Narayan	Rutaceae	Shrub
24	*Boswellia serrata* Roxb. ex Colebr.	Burseraceae	Tree

25	*Commiphora caudata* (Wight & Arn.) Engl. var. *pubescens* K.M. Matthew	Burseraceae	Tree
26	*Celastrus paniculatus* Willd. subsp. *aggregatus* K.T. Mathew ex K.M. Matthew	Celastraceae	Liana
27	*Euonymus crenulatus* Wall. ex Wight & Arn.	Celastraceae	Tree
28	*Glyptopetalum lawsonii* Gamble	Celastraceae	Tree
29	*Gymnosporia heyneana* M.A. Lawson	Celastraceae	Shrub
30	*Tetrastigma sulcatum* (M.A. Lawson) Gamble	Vitaceae	Liana
31	*Allophylus concanicus* Radlk.	Sapindaceae	Liana
32	*Allophylus serratus* (Roxb.) Kurz	Sapindaceae	Shrub
33	*Crotalaria beddomeana* Thoth. & A.A. Ansari	Fabaceae	Shrub
34	*Crotalaria fysonii* Dunn var. *fysonii*	Fabaceae	Herb
35	*Crotalaria fysonii* Dunn var. *glabra* Gamble	Fabaceae	Herb
36	*Crotalaria longipes* Wight & Arn.	Fabaceae	Shrub
37	*Derris brevipes* (Benth.) Baker	Fabaceae	Liana
38	*Derris heyneana* (Wight & Arn.) Benth.	Fabaceae	Liana
39	*Indigofera prostrata* Willd.	Fabaceae	Herb
40	*Rhynchosia filipes* Benth.	Fabaceae	Herb
41	*Smithia gracilis* Benth.	Fabaceae	Herb
42	*Smithia hirsuta* Dalzell	Fabaceae	Herb
43	*Albizia lathamii* Hole	Mimosaceae	Tree
44	*Cotoneaster buxifolius* Wall. ex Lindl.	Rosaceae	Shrub
45	*Rosa leschenaultiana* (Thory) Wight & Arn.	Rosaceae	Shrub
46	*Syzygium densiflorum* Wall. ex Wight & Arn.	Myrtaceae	Tree
47	*Kalanchoe bhidei* T.Cooke	Crassulaceae	Undershrub
48	*Kalanchoe grandiflora* Wight & Arn.	Crassulaceae	Undershrub
49	*Memecylon randerianum* S.M. Almeida & M.R. Almeida	Melastomataceae	Tree
50	*Osbeckia brachystemon* Naudin	Melastomataceae	Herb
51	*Osbeckia gracilis* Bedd.	Melastomataceae	Herb
52	*Osbeckia leschnaultiana* DC.	Melastomataceae	Herb
53	*Osbeckia reticulata* Bedd.	Melastomataceae	Shrub
54	*Sonerila pulneyensis* Gamble	Melastomataceae	Herb
55	*Trichosanthes lobata* Roxb.	Cucurbitaceae	Climber
56	*Zehneria hookeriana* (Wight & Arn.) Arn.	Cucurbitaceae	Climber

57	*Zehneria maysorensis* Arn.	Cucurbitaceae	Climber
58	*Bupleurum distichophyllum* Wight & Arn.	Apiaceae	Herb
59	*Heracleum candolleanum* (Wight & Arn.) Gamble	Apiaceae	Herb
60	*Heracleum rigens* Wall. ex DC.	Apiaceae	Herb
61	*Heracleum sprengelianum* Wight & Arn.	Apiaceae	Herb
62	*Hydrocotyle conferta* Wight	Apiaceae	Herb
63	*Vanasushava pedata* (Wight) P.K. Mukh. & Constance	Apiaceae	Herb
64	*Lonicera leschenaultii* Wall.	Caprifoliaceae	Straggler
65	*Canthium neilgherrense* Wight var. *chartacea* (Gamble) Swamin.	Rubiaceae	Shrub
66	*Gardenia gummifera* L.f.	Rubiaceae	Tree
67	*Hedyotis articularis* R. Br. ex Wight & Arn.	Rubiaceae	Undershrub
68	*Hedyotis leschenaultiana* DC.	Rubiaceae	Shrub
69	*Hedyotis swertioides* Hook.f.	Rubiaceae	Undershrub
70	*Ixora notoniana* Wall. ex G. Don	Rubiaceae	Tree
71	*Knoxia wightiana* Wall. ex Wight & Arn.	Rubiaceae	Herb
72	*Lasianthus acuminatus* Wight	Rubiaceae	Shrub
73	*Lasianthus parvifolius* Wight	Rubiaceae	Shrub
74	*Lasianthus venulosus* (Wight & Arn.) Wight	Rubiaceae	Shrub
75	*Mussaenda hursutissima* (Hook.f.) Hutch. ex Gamble	Rubiaceae	Shrub
76	*Neanotis longiflora* W. H. Lewis	Rubiaceae	Herb
77	*Ophiorrhiza roxburghiana* Wight	Rubiaceae	Herb
78	*Psychotria nilgiriensis* var. *astephana* Deb & M. Gangop.	Rubiaceae	Shrub
79	*Psychotria nilgiriensis* Deb & M. Gangop. var. *nilgiriensis*	Rubiaceae	Shrub
80	*Psychotria subintegra* (Wight & Arn.) Hook.f.	Rubiaceae	shrub
81	*Psydrax ficiformis* (Hook.f.) Bridson	Rubiaceae	Tree
82	*Anaphalis aristata* DC.	Asteraceae	Herb
83	*Anaphalis beddomei* Hook.f.	Asteraceae	Undershrub
84	*Anaphalis bournei* Fyson	Asteraceae	Herb
85	*Anaphalis meeboldii* W.W. Sm.	Asteraceae	Herb

86	*Anaphalis travancorica* W.W. Sm.	Asteraceae	Undershrub
87	*Anaphalis wightiana* (Wall ex DC.) DC.	Asteraceae	Herb
88	*Gynura nitida* DC.	Asteraceae	Herb
89	*Gynura travancorica* W.W. Sm.	Asteraceae	Herb
90	*Senecio lavendulaefolius* DC.	Asteraceae	Herb
91	*Vernonia bourneana* W.W. Sm.	Asteraceae	Shrub
92	*Vernonia fysonii* Calder	Asteraceae	Undershrub
93	*Vernonia peninsularis* (C.B. Clarke) C.B. Clarke ex Hook.f.	Asteraceae	Undershrub
94	*Rhododendron nilagiricum* Zenker	Ericaceae	Tree
95	*Vaccinium neilgherrense* Wight	Ericaceae	Tree
96	*Ardisia rhomboidea* Wight	Myrsinaceae	Shrub
97	*Isonandra perrottetiana* A. DC.	Sapotaceae	Tree
98	*Diospyros foliolosa* Wall. ex A. DC.	Ebenaceae	Tree
99	*Symplocos anamallayana* Bedd.	Symplocaceae	Shrub
100	*Symplocos foliosa* Wight	Symplocaceae	Tree
101	*Chionanthus mala-elengi* (Dennst.) P.S. Green subsp. *mala-elengi*	Oleaceae	Tree
102	*Jasminum brevilobum* DC.	Oleaceae	Liana
103	*Jasminum calophyllum* Wall. ex G. Don	Oleaceae	Straggler
104	*Ligustrum perrottetii* A. DC.	Oleaceae	Tree
105	*Alstonia venetata* R. Br.	Apocynaceae	Shrub
106	*Ceropegia intermedia* Wight	Asclepiadaceae	Climber
107	*Cryptolepis grandiflora* Wight	Asclepiadaceae	Climber
108	*Decalepis hamiltonii* Wight & Arn.	Asclepiadaceae	Climber
109	*Hoya wightii* Hook.f. subsp. *palniensis* K.T. Mathew.	Asclepiadaceae	Trailer
110	*Utleria salicifolia* Bedd. ex Hook.f.	Asclepiadaceae	Undershrub
111	*Exacum wightianum* Arn.	Gentianaceae	Undershrub
112	*Argyreia cuneata* (Willd.) Ker Gawl.	Convolvulaceae	Undershrub
113	*Solanum multiflorum* Roth	Solanaceae	Shrub
114	*Aeschynanthus perrottetii* A. DC.	Gesneriaceae	Herb
115	*Henckelia incana* (Vahl) Spreng.	Gesneriaceae	Herb
116	*Andrographis affinis* Nees	Acanthaceae	Undershrub
117	*Andrographis neesiana* Wight	Acanthaceae	Undershrub

118	*Barleria acuminata* Wight ex Nees	Acanthaceae	Undershrub
119	*Barleria cuspidata* B. Heyne ex Nees	Acanthaceae	Undershrub
120	*Justicia glauca* Rottler	Acanthaceae	Undershrub
121	*Rungia laeta* C.B. Clarke	Acanthaceae	Undershrub
122	*Strobilanthes consanguinea* (Nees) T. Anderson	Acanthaceae	Shrub
123	*Strobilanthes foliosa* (Wight) T. Anderson	Acanthaceae	Shrub
124	*Strobilanthes gracilis* Bedd.	Acanthaceae	Shrub
125	*Strobilanthes heteromalla* T. Anderson ex C.B. Clarke	Acanthaceae	Shrub
126	*Strobilanthes kunthiana* (Nees) T. Anderson ex Benth.	Acanthaceae	Shrub
127	*Strobilanthes lanata* Nees	Acanthaceae	Shrub
128	*Strobilanthes lurida* Wight	Acanthaceae	Shrub
129	*Strobilanthes micrantha* Wight	Acanthaceae	Shrub
130	*Strobilanthes pulneyensis* C.B. Clarke	Acanthaceae	Shrub
131	*Strobilanthes urceolaris* Gamble	Acanthaceae	Shrub
132	*Strobilanthes zenkeriana* (Nees) T. Anderson	Acanthaceae	Shrub
133	*Thunbergia tomentosa* Wall. ex Nees	Acanthaceae	Climber
134	*Anisochilus argenteus* Gamble	Lamiaceae	Herb
135	*Isodon nilgherricus* (Benth.) H. Hara	Lamiaceae	Herb
136	*Isodon rivularis* (Wight ex Hook.f.) H. Hara	Lamiaceae	Herb
137	*Isodon wightii* (Benth.) H. Hara	Lamiaceae	Herb
138	*Leucas helianthemifolia* Desf.	Lamiaceae	Undershrub
139	*Leucas hirta* (B. Heyne ex Roth) Spreng.	Lamiaceae	Herb
140	*Leucas lanceifolia* Desf.	Lamiaceae	Shrub
141	*Leucas vestita* Benth.	Lamiaceae	Herb
142	*Plectranthus bourneae* Gamble	Lamiaceae	Undershrub
143	*Plectranthus deccanicus* Briq.	Lamiaceae	Shrub
144	*Pogostemon mollis* Benth.	Lamiaceae	Undershrub
145	*Pogostemon wightii* Benth.	Lamiaceae	Herb
146	*Scutellaria colebrookeana* Wall. ex Benth.	Lamiaceae	Herb
147	*Piper wightii* Miq.	Piperaceae	Climber
148	*Actinodaphne bourneae* Gamble	Lauraceae	Tree
149	*Actinodaphne wightiana* (Kuntze) Noltie	Lauraceae	Tree
150	*Beilschmiedia wightii* Benth. & Hook.f.	Lauraceae	Tree

151	*Cinnamomum wightii* Meisn.	Lauraceae	Tree
152	*Cryptocarya stocksii* Meisn.	Lauraceae	Tree
153	*Litsea floribunda* Gamble	Lauraceae	Tree
154	*Litsea glabrata* Hook.f.	Lauraceae	Tree
155	*Litsea keralana* Kosterm.	Lauraceae	Tree
156	*Litsea oleoides* (Meisn.) Hook.f.	Lauraceae	Tree
157	*Litsea wightiana* (Nees) Hook.f.	Lauraceae	Tree
158	*Neolitsea fischeri* Gamble	Lauraceae	Tree
159	*Phoebe wightii* Meisn.	Lauraceae	Tree
160	*Dendrophthoe trigona* (Wight & Arn.) Danser ex Santapau	Loranthaceae	Undershrub
161	*Helicanthes elastica* (Desr.) Danser	Loranthaceae	Undershrub
162	*Helixanthera intermedia* Wight	Loranthaceae	Undershrub
163	*Helixanthera obtusatus* (Wall.) Danser	Loranthaceae	Undershrub
164	*Taxillus recurvus* (DC.) Tiegh.	Loranthaceae	Undershrub
165	*Viscum angulatum* B. Heyne ex DC.	Viscaceae	Undershrub
166	*Drypetes wightii* (Hook.f.) Pax & K. Hoffm.	Euphorbiaceae	Tree
167	*Euphorbia vajravelui* Binojk. & N.P. Balakr.var. *theniensis* B. DeJong & R.W. Stewart	Euphorbiaceae	Shrub
168	*Phyllanthus chandrabosei* Govaerts & Radcl.-Sm.	Euphorbiaceae	Undershrub
169	*Phyllanthus macraei* Müll.Arg. var. *macraei*	Euphorbiaceae	Undershrub
170	*Phyllanthus macraei* Müll.Arg. var. *hispidus* Gamble	Euphorbiaceae	Undershrub
171	*Phyllanthus narayanswamii* Gamble	Euphorbiaceae	Herb
172	*Ficus amplocarpa* Govind. & Masil.	Moraceae	Liana
173	*Ficus anamalayana* Sudhakar & G.V.S. Murthy	Moraceae	Tree
174	*Ficus beddomei* King	Moraceae	Tree
175	*Ficus dalhousiae* Miq.	Moraceae	Tree
176	*Ficus guttata* (Wight) King	Moraceae	Liana
177	*Aerides crispa* Lindl.	Orchidaceae	Herb
178	*Brachycorythis iantha* (Wight) Summerh.	Orchidaceae	Herb
179	*Brachycorythis splendida* Summerh.	Orchidaceae	Herb
180	*Brachycorythis wightii* Summerh.	Orchidaceae	Herb
181	*Coelogyne nervosa* A. Rich.	Orchidaceae	Herb

182	*Conchidium nanum* (A. Rich.) Brieger	Orchidaceae	Herb
183	*Habenaria elliptica* Wight	Orchidaceae	Herb
184	*Habenaria longicornu* Lindl.	Orchidaceae	Herb
185	*Habenaria rariflora* A. Rich.	Orchidaceae	Herb
186	*Oberonia balakrishnanii* R. Ansari	Orchidaceae	Herb
187	*Malaxis intermedia* (A. Rich.) Seidenf.	Orchidaceae	Herb
188	*Asparagus fysonii* J. F. Macbr.	Asparagaceae	herb
189	*Murdannia dimorpha* (Dalzell) G. Brückn.	Commelinaceae	Herb
190	*Arenga wightii* Griff.	Arecaceae	Tree
191	*Bentinckia condapanna* Berry ex Roxb.	Arecaceae	Tree
192	*Eriocaulon pectinatum* Ruhland	Eriocaulaceae	Herb
193	*Eriocaulon ritchieanum* Ruhland	Eriocaulaceae	Herb
194	*Fimbristylis kingii*Gamle ex Boeckeler	Cyperaceae	Sedge
195	*Fimbristylis uliginosa* Steud.	Cyperaceae	Sedge
196	*Agrostis peninsularis* Hook.f.	Poaceae	Grass
197	*Anthoxanthum borii* S.K. Jain & D.C. Pal	Poaceae	Grass
198	*Arundinella mesophylla* Nees ex Steud.	Poaceae	Grass
199	*Arundinella nervosa* (Roxb.) Nees ex Hook. & Arn.	Poaceae	Grass
200	*Arundinella vaginata* Bor	Poaceae	Grass
201	*Chrysopogon asper* B. Heyne ex Blatt. & McCann	Poaceae	Grass
202	*Eragrostis collinensis* Vivek, G.V.S. Murthy & V.J. Nair	Poaceae	Grass
203	*Garnotia elata* (Miq.) Janowski	Poaceae	Grass
204	*Heteropogon fischerianus* Bor	Poaceae	Grass
205	*Isachne bourneorum* C.E.C. Fisch.	Poaceae	Grass
206	*Isachne deccanensis* Bor	Poaceae	Grass
207	*Polypogon nilgiricus* Kabeer & V.J. Nair	Poaceae	Grass
208	*Streblochaete sanjappae* Kabeer & V.J. Nair	Poaceae	Grass
209	*Themeda sabarimalayana* Sreek. & V.J. Nair	Poaceae	Grass
210	*Tripogon narayanae* Sreek., V.J. Nair & N.C. Nair	Poaceae	Grass
211	*Tripogon pungens* C.E.C. Fisch.	Poaceae	Grass
212	*Cycas circinalis* L.	Cycadaceae	Shrub

Threatened and Near Threatened taxa

Among the 212 endemic species that are identified, 28 are Threatened or Near Threatened and fall under the IUCN catergories as follows: 4 Critically Endangered (CR), 10 Endangered (EN), 14 Vulnerable (VU), and 2 species Near Threatened (NT).

Table 3: Threatened and Near Threatened Flowering Plants in Kodaikanal WLS.

Sl. No	Botanical Name	Family	IUCN Status
1	*Elaeocarpus blascoi* Weibel	Elaeocarpaceae	Critically Endangered
2	*Utleria salicifolia* Bedd. ex Hook.f.	Asclepiadaceae	Critically Endangered
3	*Isodon rivularis* (Wight ex Hook.f.) H. Hara	Lamiaceae	Critically Endangered
4	*Psydrax ficiformis* (Hook.f.) Bridson	Rubiaceae	Critically Endangered
5	*Impatiens tanyae* R.Kr.Singh, Arigela & Kabeer	Balsaminaceae	Endangered
6	*Hydrocotyle conferta* Wight	Apiaceae	Endangered
7	*Psychotria nilgiriensis* var. *astephana* Deb & M. Gangop.	Rubiaceae	Endangered
8	*Symplocos anamallayana* Bedd.	Symplocaceae	Endangered
9	*Decalepis hamiltonii* Wight & Arn.	Asclepiadaceae	Endangered
10	*Actinodaphne bourneae* Gamble	Lauraceae	Endangered
11	*Cinnamomum wightii* Meisn.	Lauraceae	Endangered
12	*Euphorbia vajravelui* var. theniensis B. DeJong & R.W. Stewart	Euphorbiaceae	Endangered
13	*Phyllanthus narayanswamii* Gamble	Euphorbiaceae	Endangered
14	*Cycas circinalis* L.	Cycadaceae	Endangered
15	*Magnolia nilagirica* (Zenker) Figlar	Magnoliaceae	Vulnerable
16	*Hydnocarpus pentandrus* (Buch.-Ham.) Oken	Flacourtiaceae	Vulnerable
17	*Elaeocarpus recurvatus* Corner	Elaeocarpaceae	Vulnerable
18	*Glyptopetalum lawsonii* Gamble	Celastraceae	Vulnerable
19	*Cotoneaster buxifolius* Wall. ex Lindl.	Rosaceae	Vulnerable
20	*Syzygium densiflorum* Wall. ex Wight & Arn.	Myrtaceae	Vulnerable
21	*Anaphalis beddomei* Hook.f.	Asteraceae	Vulnerable
22	*Anaphalis wightiana* (Wall ex DC.) DC.	Asteraceae	Vulnerable

23	*Cryptocarya stocksii* Meisn.	Lauraceae	Vulnerable
24	*Neolitsea fischeri* Gamble	Lauraceae	Vulnerable
25	*Drypetes wightii* (Hook.f.) Pax & K. Hoffm.	Euphorbiaceae	Vulnerable
26	*Arenga wightii* Griff.	Arecaceae	Vulnerable
27	*Bentinckia condapanna* Berry ex Roxb.	Arecaceae	Vulnerable
28	*Eriocaulon pectinatum* Ruhland	Eriocaulaceae	Vulnerable
29	*Gynura travancorica* W.W. Sm.	Asteraceae	Near Threatened
30	*Anthoxanthum borii* S.K. Jain & D.C. Pal	Poaceae	Near Threatened

Narrowly distributed taxa

Based on critical field observations and an analysis of the factors threatening individual taxa, the following species show a very limited distribution within the sanctuary: *Actinodaphne malabarica*, *Arenga wightii*, *Artocarpus hirsutus*, *Bentinckia condapanna*, *Brachycorythis iantha, B. splendida*, *B. wightii, Canarium strictum*, *Canthium neilgherrense*, *Ceropegia intermedia*, *Chrysophyllum roxburghii*, *Elaeocarpus blascoii*, *Elaeocarpus munroii*, *Fimbristylis kingii*, *Impatiens leschenaultii*, *I. goughii*, *I. dasysperma*, *I. tangachee, I. tomentosa*, *Isonandra perrottetiana*, *Knoxia wightiana, Lasianthus parvifolius, Litsea insignis*, *L. keralana*, *L. floribunda*, *Neolitsea fischeri*, *Psydrax ficiformis*, *Ranunculus reniformis, Rhododendron nilagiricum*, *Sonerila pulneyensis*, *Strobilanthes urceolaris*, *Symplocos anamallayana* and *S. foliolosa*.

Novelties

Impatiens tanyae R.Kr.Singh, Arigela & Kabeer, is a new species named in honour of late Tanya Balcar for her exceptional contributions to conserve the shola forests and grasslands of the Palani hills, Tamil Nadu through Vattakanal Conservation Trust and local teams of concerned citizens. She was the pioneer locator of this new species in the grassland of Kodaikanal Wildlife Sanctuary, and also propogated and conserved 25–30 plants in her garden.

New additions

Current plant explorations from the year 2015 to 2019, revealed a number of species which were not mentioned in the *Flora of the Palni Hills* (Matthew, 1999). Among those, several are newly entered invasive species like *Hypoestes sanguinolenta* and *Solanum viarum*.

Table 5: Additions to the Flora of Palni Hills.

Si.No.	Botanical Name	Family
1	*Hypoestes sanguinolenta* Hook.	Acanthaceae
2	*Monothecium aristatum* (Nees) T.Anderson	Acanthaceae
3	*Strobilanthes heteromalla* T. Anderson	Acanthaceae
4	*Strobilanthes lanatus* Nees	Acanthaceae
5	*Pancratium triflorum* Roxb.	Amaryllidaceae
6	*Sphaeranthus indicus* L.	Asteraceae
7	*Dolichandrone atrovirens* (Roth) K.Schum.	Bignoniaceae
8	*Wahlenbergia hookeri* (C.B.Clarke) Tuyn	Campanulaceae
9	*Garcinia gummi-gutta* (L.) Roxb.	Clusiaceae
10	*Tradescantia fluminensis* Vell.	Commelinaceae
11	*Ipomoea aitonii* Lindl.	Convolvulaceae
12	*Ipomoea carnea* Jacq.	Convolvulaceae
13	*Ipomoea dichroa* (Roem. & Schult.) Choisy.	Convolvulaceae
14	*Ipomoea tuberculata* Ker-Gawl.	Convolvulaceae
15	*Acalypha ciliata* Forssk.	Euphorbiaceae
16	*Euphorbia tortilis* Rottler ex Ainslie	Euphorbiaceae
17	*Euphorbia vajravelui* var. *theniensis* B. DeJong & R.W. Stewart	Euphorbiaceae
18	*Phyllanthus narayanswamii* Gamble	Euphorbiaceae
19	*Dalbergia latifolia* Roxb.	Fabaceae
20	*Desmodium alysicarpoides* Meeuwen	Fabaceae
21	*Desmodium uncinatum* (Jacq.) DC.	Fabaceae
22	*Ormocarpum sennoides* (Willd.)DC	Fabaceae
23	*Spatholobus parviflorus* (DC.) Kuntze	Fabaceae
24	*Stylosanthes scabra* Vogel	Fabaceae
25	*Tephrosia vogelii* Hook.f.	Fabaceae
26	*Eleutherine bulbosa* (Mill.) Urb.	Iridaceae
27	*Isodon rivularis* (Wight ex Hook.f.) H. Hara	Lamiaceae
28	*Plectranthus glabratus* (Benth.) Alston	Lamiaceae
29	*Acacia mellifera* (M.Vahl) Benth.	Mimosaceae
30	*Albizia lathamii* Hole	Mimosaceae
31	*Ficus anamalayana* J.V. Sudhakar & G.V.S. Murthy	Moraceae
32	*Ficus dalhousiae* Miq.	Moraceae

33	*Ficus guttata* (Wight) King	Moraceae
34	*Brachycorythis wightii* Summerh.	Orchidaceae
35	*Eulophia graminea* Lindl.	Orchidaceae
36	*Oberonia maxima* C.S.P. Parish ex Hook.f.	Orchidaceae
37	*Zeuxine gracilis* (Breda) Blume	Orchidaceae
38	*Scoparia dulcis* L.	Plantaginaceae
39	*Eragrostis amabilis* (L.) Wight & Arn.	Poaceae
40	*Eragrostis atrovirens* (Desf.) Trin. ex Steud.	Poaceae
41	*Eragrostis collinensis* C.P. Vivek, G.V.S. Murthy & V.J. Nair	Poaceae
42	*Eragrostis unioloides* (Retz.) Nees ex Steud.	Poaceae
43	*Capillipedium assimile* (Steud.) A.Camus	Poaceae
44	*Chloris pycnothrix* Trin.	Poaceae
45	*Dichanthium foulkesii* (Hook.f.) S.K.Jain & Deshp.	Poaceae
46	*Garnotia exaristata* Gould.	Poaceae
47	*Poa leptoclada* Hochst. ex A.Rich.	Poaceae
48	*Polypogon nilgiricus* Kabeer & V.J.Nair	Poaceae
49	*Pseudanthistiria umbellata* (Hacak.) Hook.f.	Poaceae
50	*Setaria barbata* (Lam.) Kunth	Poaceae
51	*Setaria poiretiana* (Schult.) Kunth	Poaceae
52	*Streblochaete sanjappae* Kabeer & V.J.Nair	Poaceae
53	*Glycosmis macrocarpa* Wight	Rutaceae
54	*Solanum auriculatum* Aiton	Solanaceae
55	*Solanum viarum* Dunal	Solanaceae

Eco-sensitive zones in Kodaikanal Wildlife Sanctuary

After considering species diversity, richness, threatened species status and an on-going level of threat, this study has designated a number of areas in the sanctuary as eco-sensitive zones. Furthermore, this study recommends to the Tamil Nadu Forest Department that it is imperative to initiate conservation activities in the following critical zones: 1. Vattakanal Shola and its surrounding grasslands, 2. Vadakavunji–Pannaikkadu (Zeronium) grasslands, 3. Pambar Shola and 4. Poolatur Piruvi and adjoining areas.

TAXONOMIC TREATMENT

Key to the families

1a. Reproductive organs cones; formed by sporophylls……....53. Cycadaceae
1b. Reproductive organs flowers; formed by other than sporophylls……2
2a. Cotyledons 2; leaves with pinnately reticulate venation…….....3
2b. Cotyledons 1; leaves with parallel venation……..47
3a. Flowers polypetalous……...4
3b. Flowers gamopetalous or monochlamydeous……..24
4a. Ovary hypogynous……...5
4b. Ovary epigynous or perigynous……22
5a. Flowers in globose heads of axillary corymbs……16. Mimosaceae
5b. Flowers not in globose heads……6
6a. Corolla papilionaceous ……15. Fabaceae
6b. Corolla not papilionaceous ……7
7a. Leaves aromatic and gland dotted……...8
7b. Leaves non-aromatic……...9
8a. Stamens 5+5; fruit a berry……....10. Rutaceae
8b. Stamens 5; fruit a capsule……4. Pittosporaceae
9a. Leaves subsucculent……....18. Crassulaceae
9b. Leaves not subsucculent……....10
10a. Flowers with spur……9. Balsaminaceae
10b. Flower without spur……....11
11a. Stamens many on staminal column……7. Malvaceae
11b. Staminal column absent……...12
12a. Stamens less than 20……....13
12b. Stamens more than 20……17
13a. Inflorescence axillary thyrses……14. Sapindaceae
13b. Inflorescence other than axillary thyrses……14
14a. Leaves simple……...15
14b. Leaves compound……....16
15a. Flowers bisexual; fruit a capsule……...12. Celastraceae
15b. Flowers unisexual; fruit a berry……...3. Flacourtiaceae
16a. Trees; corolla 5-lobed……...11. Burseraceae
16b. Lianas; corolla 4-lobed ……....13. Vitaceae
17a. Herbs or Shrubs or stragglers……18
17b. Trees……....19
18a. Shrubs, flowers white ……17. Rosaceae
18b. Herbs, flowers blue……2. Cleomaceae

19a. Leaves alternate……...20
19b. Leaves opposite or sub-opposite……...5. Clusiaceae
20a. Leaf margins entire.....…….....1. Magnoliaceae
20b. Leaf margins crenate or serrate……..21
21a. Fruit a capsule, woody, 5 angled……..6. Theaceae
21b. Fruit a drupe, fleshy pericarp, obovoid……..8. Elaeocarpaceae
22a. Herbs……2. Apiaceae
22b. Shrubs or trees……....23
23a. Leaves pungent; stamens more than 10……...19. Myrtaceae
23b. Leaves without odour; stamens 10 or less……...20. Melastomataceae
24a. Flowers gamopetalous……30
24b. Flowers monochlamedeous ……...24
25a. Plants epiphytic parasites ……....26
25b. Plants autotrophs ……...27
26a. Leaves persistent; branches terete.....42. Loranthaceae
26b. Leaves caducous; branches 4-angled.....43. Viscaceae
27a. Vines; perianth absent……..40. Piperaceae
27b. Other than vines; perianth present……28
28a. Plants with milky latex; inflorescence a syconium…….....45. Moraceae
28b. Plants without milky latex; inflorescence other than synconium ……29
29a. Leaves with mango smell; stigma1.....……..41. Lauraceae
29b. Leaves without smell; stigmas 3…….....44. Euphorbiaceae
30a. Stamens free……31
30b. Stamens epipetalous……32
31a. Flowers unisexual; styles 2–8……...29. Ebenaceae
31b. Flowers bisexual; Styles 1……..26. Ericaceae
32a. Plants with latex……...33
32b. Plants without latex……36
33a. Fruit a berry.……28. Sapotaceae
33b. Fruit other than berry……34
34a. Leaves alternate; calyx persistent; stamens unequal height……35. Convolvulaceae
34b. Leaves opposite or whorled; calyx deciduous; stamens equal hight……..35
35a. Gynostegium, pollinia and corona present in flowers…….....33. Asclepiadaceae
35b. Anthers separable, pollens free and corona absent……32. Apocynaceae
36a. Inflorescence capitulum……...25. Asteraceae
36b. Inflorescence other than capitulum……37
37a. Leaves decussate; stipulate ……38
37b. Leaves alternate; estipulate……39

38a. Stipules inter or intra petiolar……...24. Rubiaceae
38b. Stipules lateral, inconspicuous……...23. Caprifoliaceae
39a. Plants with tendrils ……...21. Cucurbitaceae
39b. Plants without tendrils……40
40a. Ovary superior……42
40b. Ovary inferior……..41
41a. Stamens many……..30. Symplocaceae
41b. Stamens usually 5…….....27. Myrsinaceae
42a. Plants aromatic……..39. Lamiaceae
42b. Plants nonaromatic ……..43
43a. Plants terrestrial……..44
43b. Plants epiphytic……37. Gesneriaceae
44a. Calyx lobes winged……..34. Gentianaceae
44b. Calyx lobes simple.....45
45a. Inflorescence a spike; stamens didynamous; fruit a capsule…….38. Acanthaceae
45b. Inflorescence other than a spike; stamens equal or unequal; fruit a berry or a drupe..…46
46a. Flowers fragrant; stamens 2……...31. Oleaceae
46b. Flowers without fragrance; stamens 5……36. Solanaceae
47a. Leaves more than 2 m long, pinnatisect; inflorescence spadix……49. Arecaceae
47b. Leaves ca 1 m long, other than pinnatisect; inflorescence other than spadix……....48
48a. Leaves reduced as cladodes; stems spiny……47. Asparagaceae
48b. Leaves true, not reduced as cladodes; spines absent……49
49a. Flowers with spur……46. Orchidaceae
49b. Flowers spurless……..50
50a. Culms with nodes……51
50b. Culms without nodes……..52
51a. Flowers with disctinct perianth……...48. Commelinaceae
51b. Flowers without distinct perianth…….....52. Poaceae
52a. Inflorescence a terminal head……..50. Eriocaulaceae
52b. Inflorescence spikelets…….....51. Cyperaceae

1. **MAGNOLIACEAE**

Magnolia L.

Magnolia nilagirica (Zenker) Figlar in Proc. Internat. Symp. Fam. Magnoliac. 1998: 23. 2000. *Michelia nilagirica* Zenker, Pl. Ind. 21, t. 20. 1835; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 44. 1872; Gamble, Fl. Madras: 9. 1915; D.C.S. Raju in B.D. Sharma *et al*., Fl. India 1: 175. 1993; K.M. Matthew, Fl. Palni Hills 1: 16. 1999. **(Plate No. 01)**



Magnolia nilagirica (Zenker) Figlar

Tree, 15–25 m high; branchlets lenticellate. Leaves alternate, obovate to elliptic-obovate, 5–10 × 3–5.5 cm, base cuneate, apex acute to acuminate, margins entire, new foliage pubescent, glabrous by age, coriaceous; lateral veins 13–18 pairs, pinnate, slender; stipules 1–1.5 cm long, oblong; petioles 1–2 cm long. Flowers axillary or terminal, solitary, 6–8 cm across, covered by pubescent, spathaceous bracts; pedicels ca 7 mm long, stout. Perianth lobes 9–12, obovate, 3–5 × ca 1.5 cm, inner lobes smaller, white. Stamens numerous, aggregated at the base of gynophore; filaments short; anthers ca 8 mm long, connective appendage ca 0.6 mm long. Carpels many, superior, ovoid, sessile, pubescent. Fruit an aggregate of capsules, ca 1 × 1.5 cm, subglobose, lenticellate; seed 1, scarlet when matures.

Flowering & Fruiting: March–August.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Berijam, Gundar, Mediketton, Pambar, and Perumalmalai. *Kabeer & Ravi Kiran 132803*.

Notes: Vulnerable (Haridasan *et al*., 2015). The population of this species is slowly declining due to habitat loss. Sub-adult trees are very less and only a few individuals found at elevations between 1700 and 2500 m of the sanctuary, especially where shola forest exists. Recorded very old (probably over 500 years old) tree of 7 m girth on Perumalamali.

2. **CLEOMACEAE**

Corynandra Schrad. ex Spreng.

Corynandra felina (L.f.) Cochrane & Iltis, Novon 23(1): 23 (2014). *Cleome felina* L.f., Suppl. Pl. 300. 1782. Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 170. 1872; Gamble, Fl. Madras: 29. 1915; Sundararagh. in B.D. Sharma & N.P. Balakr., Fl. India 2: 308. 1993; K.M. Matthew, Fl. Palni Hills 1: 63. 1999. **(Plate No. 01)**

Decumbent herb, branched, woody, branches slender, usually branched from the base, branchlets densely strigose appressed hairs. Leaves tri-foliate, petiole ca 1–4 cm long, simple or uni-foliate leaves towards apex, leaflets sessile, covered with scabrid hairs, oblanceolate to obovate; middle leaflets ca 1.4–2.5 × 0.8–1.5 cm, base cuneate, margin ciliate, apex rounded; lateral leaflets 0.5–15 × 0.3–1.3 cm. Inflorescence axillary racemes, solitary. Flowers bisexual, pink or purple, ca 1.5 cm across, pedicels ca 2 – 4.5 cm long. Sepals 4, equal, linear lanceolate, scabrid, ca 4–6 × 0.5–1 mm across. Petals 4, obovate, pubescent without, ca 7–12 × 2–4 mm. Stamens 20–40, filament purple or violet, ca 3–4 mm long, anthers ovoid. Ovary superior, bicarpellary, sessile, ca 4.5–5.5 × 3–5 mm, ovules many. Capsule linear, flat, ca 2–4 × 0.2–0.4 cm, beaked at apex; seeds many, orbicular or reniform, ca 2 mm across.

Flowering & Fruiting: February–September.

Distribution: Andhra Pradesh, Karnataka, Maharashtra, Pondicherry, Tamil Nadu and Telangana. KWLS: Devadanapatty and Palani Ranges.

Notes: Very frequent at foot hills of the sanctuary.

3. **FLACOURTIACEAE**

Hydnocarpus Gaertn.

Hydnocarpus pentandrus (Buch.-Ham.) Oken in Allg. Naturgesch. 3(2): 1381. 1841; R. L. Mitra in B.D. Sharma & N.P. Balakr., Fl. India 2: 422. 1993; K.M. Matthew, Fl. Palni Hills 1: 63. 1999. *Chilmoria pentandra* Buch.-Ham. in Trans. Linn. Soc. London 13 501. 1822. *Hydnocarpus wightiana* Blume, Rumph. 4: 22. 1848; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 196. 1872; Gamble, Fl. Madras: 52. 1915. **(Plate No. 1.1)**

Tree, 10–20 m high; trunk fluted; branchlets brown pubescent. Leaves variable, ovate-elliptic, elliptic-oblong, oblong to oblanceolate, rarely ovate to ovate-lanceolate, 10–25 × 5–12 cm, cuneate or obtuse at base, obtusely acuminate at apex, margins serrate, dark green, shiny above, scarcely appressed pubescent along midvein and veins above, appressed puberulous below, sparsely so with age; veins 5–7 pairs; petioles 1–2.3 cm long, pubescent; stipules linear, puberulous, caducous. Male flowers ca 7 mm across, greenish yellow, 3–6 in a raceme; peduncle ca 1 cm long, tomentose; pedicels ca 8 mm long, tomentose. Calyx lobes 5, unequal, outer lobes broadly ovate; inner lobes suborbicular, ca 2.5 mm across, densely rusty puberulous outside, glabrous inside. Petals 5, ovate, ca 2 mm across, concave, margins ciliate, greenish. Stamens 5, ca 2 mm long; anthers reniform and didymous. Female flowers ca 1 cm across, solitary or 2 or 3 on peduncle. Staminodes 5. Ovary ovoid, 5-ribbed, beaked, hispid, brownish; stigmas 5-lobed. Berries globose, ca 5 cm; pericarp dark brown, stony, brown floccose; seeds 15–20, embedded in pulp, 1.5–2 × 1–1.5 cm, ovoid, angular.

Flowering & Fruiting: February–September.

Distribution: Goa, Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Ammamichi Saragam, Manjalar. *Kabeer & Ravi Kiran 139629.*

Notes: Found in moist deciduous and dry deciduous forests of sanctuary from 400 to 850 m elevation. A few individuals noticed in Devadanapatty range among streams. In vegetative stage resembles *Polyalthia cerasoides*.

4. **PITTOSPORACEAE**

Pittosporum Banks ex Gaertn., nom. cons.

Pittosporum neelgherrense Wight & Arn., Prodr. Fl. Ind. Orient.: 154. 1834; Hook.f. & Thomson in Hook.f., Fl. Brit. India 1: 198. 1872; Gamble, Fl. Madras: 55. 1915; M.P. Nayar & G.S. Giri in B.D. Sharma & N.P. Balakr., Fl. India 2: 446. 1993; K.M. Matthew, Fl. Palni Hills 1: 66. 1999. **(Plate No. 02)**

Tree, ca 15 m high; branches lenticellate. Leaves ovate to lanceolate, 3–7 × 3–4cm, glabrous, margins entire, sub-coriaceous, acute at apex, fragrant; petioles 0.8–1.2 cm long, fragrant. Inflorescence terminal racemes, 3–4 cm across; peduncles slender, 2 cm long; pedicels 1–1.8 cm long. Flowers fragrant, pentamerous. Sepals subulate, ca 2 × 1 mm, lenticellate. Petals oblong-lanceolate, obtuse or rounded at apex, 5–6 mm long, cremy yellow. Stamens 5; anthers 1–2 mm long; filaments ca 3 mm long, slender, inserted. Ovary densely tomentose, silvery hairs ca 1 mm long; styles ca 4 mm long, stigma capitate. Capsules globular, 0.8–1 cm across, with thick valves, orange, glabrescent, foveolate, 2 furrowed, beaked; funicle sub-basal; seeds 4–6 per capsule, ovoid, scarlet, smooth.

Flowering & Fruiting: February–September.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Berijam, Gundar and Poombarai. *Kabeer & Ravi Kiran 139695 & 133769.*

Notes: Typical shola element and frequently occurs in shola forests of Kodaikanal, Berijam ranges. A good number of individuals were found at Kishankovil Sragam, Poombarai road. Strong and long lasting fragrance is noted from the crushed leaves. This is the best suitable species for the shola forests restoration plantations.

5. **CLUSIACEAE**

Mesua L.

Mesua ferrea L. var. **coromandeliana** (Wight) N.P. Singh in J. Econ. Taxon. Bot. 10: 203. 1987 & in B.D. Sharma & Sanjappa, Fl. India 3: 137. 1993; K.M. Matthew, Fl. Palni Hills 1: 95. 1999. *M. ferrea* L. subsp. *pulchella* Vesque var. *coromandeliana* (Wight) Mahesh. in Bull. Bot. Surv. India 5: 336. 1964. *M. coromandelina* Wight, Icon. Pl. Ind. Orient. 1(6): 1, t. 117. 1839. **(Plate No. 02)**

Tree, 20–25 m high; bark brownish, scaly; branchlets terete, glabrous, nodes prominent. Leaves simple, opposite, sometimes subopposite, estipulate, lanceolate, 5–10 × 2–3 cm, base cuneate to obtuse, apex acuminate or acuminate, margins entire, glabrous, shiny, sub-coriaceous; lateral veins many, parallel, close, obscure, reticulate; petioles 1–1.5 cm, slender, glabrous. Flowers bisexual, solitary, axillary, ca 1.5 cm across; pedicel 4–8 mm long, 3 mm wide; Sepals 4, outer 2 oblong, ca 1 × 1 cm, inner 2 orbicular, ca 1.5 × 1 cm, glabrous. Petals 4, obovate, 2.5–3.5 × ca 1.5 cm, white. Stamens many; filaments of various length; anthers ca 3 × 5 mm. Ovary superior, 2–4 mm long, globose, bilocular; ovules 2 per locule; style ca 8 mm long; stigma peltate. Capsules ovoid, ca 3 cm long, woody, shortly acuminate at apex, subtended by calyx, greenish-yellow, pink tinged, one seeded.

Flowering & Fruiting: December–April.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Ammamichi Saragam and Thalayar. *Kabeer & Ravi Kiran 142639.*

Notes: Evergreen tree scarcely found along Palamalai streams and near Elival falls of Devadanapatty and Perupallam ranges at elevations ranges from 400 to 1400 m. It looks like a species of *Memecylon* in vegetative stage. Leaves are cream in colour when young.

6. **THEACEAE**

Gordonia J. Ellis, nom. cons.

Gordonia obtusa Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 87. 1834; Dyer in Hook.f., Fl. Brit. India 1: 291. 1874; Gamble, Fl. Madras: 79. 1915; A.S. Chauhan & T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 162. 1993; K.M. Matthew, Fl. Palni Hills 1: 99. 1999. **(Plate No. 03)**

Tree, 10–30 m high; trunk fluted; bark scaly. Leaves alternate, elliptic to oblong, 5–15 × 2–5 cm, cuneate at base, acute or attenuate at apex, margins crenate or serrate, glabrous, subcoriaceous; petioles 0.5–1 cm long, sparsely hairy. Flowers axillary, solitary or 2 or 3 fascicled at ends of branches, ca 3 cm across; pedicels ca 5 mm long, sparsely pubescent. Sepals 5, obovate, 3–8 × 6–10 mm, pubescent outside, glabrous inside. Petals 5, obovate, 2–3 × ca 1 cm, pubescent outside, white. Stamens many; anthers ca 3 mm long; filaments ca 1 mm long, unequal, connate at base. Ovary 5-locular, hairy; ovules many in each locule, 2–3 mm long; style ca 2 mm long; stigma 5-lobed. Capsules oblong, 2–3 × ca 1.5 cm, 5-angled, sparsely hairy, valves deeply grooved above, woody; seeds many, ellipsoid, ca 8 × 3 mm, hyaline-winged; wings 6–10 mm long, brownish.

Flowering & Fruiting: May–October.

Distribution: Karnataka, Kerala, Maharasatra and Tamil Nadu. KWLS: Blackbrn Shola, Gundar, Mailadamparai and Tiger Shola. *Kabeer & Ravi Kiran 133865 & 141032.*

Notes: Very frequent in shola forests at elevation ranges from 1500 to 2500 m. Bark fissured in older trees. Resembles *Syzygium* sp. in new foliage stage but is differentiated by its crenate leaves. Mainly appears at slopes and streams of shola forests and wetevergreen forest.

7. **MALVACEAE**

Abutilon Mill.

Abutilon neelgherrense Munro, Ill. Ind. Bot. t. 66 1831; Gamble, Fl. Madras: 91. 1915; T.K. Paul in B.D. Sharma & Sanjappa, Fl. India 3: 267. 1993; Sivar. & Pradeep, Malvac. Southern Peninsular India 198. 1996; K.M. Matthew, Fl. Palni Hills 1: 109. 1999. *Sida neelgherrensis* (Munro) Steud., Nomencl. Bot. ed. 2, 2: 578 1841. **(Plate No. 2.1)**

Undershrub, ca 1.5 m tall. Stems and branches with stellate hairs. Leaves simple, alternate, broadly ovate to suborbicular, ca 6–20 × 5–14 cm, base cordate, margins coarsely crenate-dentate, base 7–11 veined, apex acute to acuminate, stellate hairs on both surfaces; petiole, pubescent, ca 2.5–12 cm long; stipules subulate, about 1–2 mm long. Inflorescence axillary cymes, 2–6 flowered, sometimes solitary; pedicel slender, branched in the upper half, densely stellate pubescent, ca 0.5–7 cm long, calyx 5 lobed, campanulate, base connate, valvate, divided from middle, about 5–8 mm across; lobes ovate, apex acute, stellate pubescent, ca 6–12 × 3–7 mm. Petals 5, obovate, ca 1.5–2 × 0.8–1.7 cm, glabrous, yellow. Stamens many, shorter than petals, glabrous, ca 0.8–1 cm long; anthers basifixed, clustered. Ovary superior, 5–20 locular; style branched filiform; stigma capitate. Fruit schizocarp, subcylindric-subglobular, ca 1.3 × 2.2 cm, campanulate, apex biaristate or deeply indented, densely stellate pubescent, mericarps 8–12, oblong, margins densely stellate hairy, apex mucronate. Seeds 2–3, subreniform, ca 3.5 × 2.5 mm across, smooth, glabrous.

Flowering & Fruiting: November–March.
Distribution: Andhra Pradesh, Karnataka, Kerala, Odisha and Tamil Nadu. KWLS: Damdam Parai (Elival falls view point to Devadanapatty Ghat road).
Notes: Scarcely found in Devadanapatty forest range at elevations between 400 and 900 m.

8. **ELAEOCARPACEAE**

Elaeocarpus L.

Key to the species

1a. Leaves recurved……3. **E. recurvatus**
1b. Leaves flat……2
2a. Anthers bearded; drupes less than 2 cm……3
2b. Anthers not bearded; drupes ca 3.5 cm long.....4. **E. variabilis**
3a. Leaves ovate, sericeous below, margins serrate; drupes hairy……....1. **E. blascoi**
3b. Leaves ovate-lanceolate, glabrous below, margins crenate; drupes glabrous...2. **E. munroii**

1. Elaeocarpus blascoi Weibel in Candollea 27: 16. 1972; K.M. Matthew, Fl. Palni Hills 1: 146. 1999. **(Plate No. 03)**

Tree, 10–15 m high; roots buttressed; bark smooth, fluted, copyshoots raises from main trunk, branchlets sericeous. Leaves ovate, 5–12 × 3–8 cm, rounded at base, acuminate at apex, obscurely serrate, glabrous above, glabrescent beneath; veins prominent beneath; petioles 1–2 cm long, sparsely short silvery sericeous. Racemes 5–8 cm long, axillary, pubescent, 6–8-flowered. Flower-buds ovoid, acute, densely short sericeous; flowers 1–1.5 cm across; pedicels 1–1.8 cm long, densely short sericeous. Sepals lanceolate, 1–1.2 cm long,



Elaeocarpus blascoi Weibel

acute, densely short sericeous outside. Petals obovoid, ca 12 mm long, apex laciniate into 10–12 segments, sparsely sericeous outside. Stamens 30–40, densely appressed hirtellous; filaments 2–3 mm long; anthers 2.5–4 mm long, tip subulate, awn ca 1 mm; disk annular, 10-lobed. Ovary ovoid, 2 or 3-loculed, densely pubescent; ovules 6 in each locule; style hairy at base, 5–8 mm long. Drupes ellipsoid, ca 1 × 1.5 across, attached to disk, sparsely hispid, 1-seeded.

Flowering & Fruiting: Throught the year.
Distribution: Tamil Nadu. (Endemic to Vattakanal Shola of Kodaikanal Wildlife Sanctuary). *Kabeer & Ravi Kiran 133869 & 139649.*
Notes: Critically Endangered**.** This species assessed lastly in 1998 and stated as Endangered (World Conservation Monitoring Centre, 1998) but present study assessment raised the threat status from endangered to critically endangered based on IUCN criteria B1, B2 and D. Only one individual reported from the Vattakanal Shola as wild and two young trees were planted at Pambarpuram by Bob & Tanya, Vattakanal Conservation Trust, Kodaikanal. Many researchers are collecting explant material from this individual tree and none have reported that they have replanted the seedlings. Vigorous leaf shedding occurs in January and February. Habitat must be considered as eco-sensitive zone of the sanctuary.

2. **Elaeocarpus munroii** (Wight) Mast. in Hook.f., Fl. Brit. India 1: 407. 1874; Gamble, Fl. Madras: 124. 1915; Murti in B.D. Sharma & Sanjappa, Fl. India 3: 546. 1993; K.M. Matthew, Fl. Palni Hills 1: 147. 1999. *Monocera munroii* Wight, Ill. Ind. Bot. 1: 83. 1840. **(Plate No. 04)**

Tree, ca 35 m high; bark smooth, tender branchlets finely pubescent, crown compact. Leaves crowded towards ends of branchlets, ovate or lanceolate, 5–10 × 3–5 cm, obtuse or rounded at base, acuminate or attenuate at apex, margins undulate or crenate, crenations often with a gland, chartaceous, glabrous; lateral veins 5 or 6 pairs, prominent beneath; petioles 2.5–3 cm long, slender, glabrous. Inflorescence panicle, axillary at the end of branches. Flower-buds lanceolate; flowers 1–1.5 cm across; pedicels 1–1.5 gm long, glabrous, curved. Sepals 5, linear-lanceolate, 7–9 mm long, acute, glabrous. Petals 5, elliptic-oblong, 7–9 mm long, narrowed at base, broad at apex, laciniate to middle of the corolla lobe, silky hairy on both surfaces, white. Stamens 20–40; filaments ca 1 mm long, pubescent; anthers 3–4 mm long, oblong, awns ca 1 mm long, reflexed. Ovary 2 or 3-loculed, silky pubescent; ovules 2; styles longer than stamens, tapering, hairy at base. Drupes ellipsoid, ca 1.5 cm long, green, bluish when ripe, glossy; pyrenes bilocular, 1-seeded.

Flowering & Fruiting: September–April.



Elaeocarpus munroi (Wight) Mast.



Distribution: Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Blackburn and Bombay Sholas. *Kabeer & Ravi Kiran 141166, 142646, 142664 & 142691.*

Notes: Very few indivuals left in the wild but a few saplings were planted in and around Kodaikanal by Bob & Tanya, Vattakanal Conservation Trust. As per K.M. Matthew (1999), Blackburn Shola harbours many individuals of this species but this study found very few individuals and the oldest tree with 5.3 m girth.

3. **Elaeocarpus recurvatus** Corner in Gard. Bull. Straits Settlem. 10: 325 (319). 1939; Murti in B.D. Sharma & Sanjappa, Fl. India 3: 549. 1993; K.M. Matthew, Fl. Palni Hills 1: 148. 1999. *E. ferrugineus* (Wight) Bedd., Fl. Sylv. S. India: t. 112. 1871, *nom. illeg.*; Mast. in Hook.f., Fl. Brit. India 1: 406. 1874; Gamble, Fl. Madras: 124. 1915. *Monocera ferruginea* Wight, Icon. Pl. Ind. Orient. 1(11): 1, t. 205. 1839, non Jack., 1830. **(Plate No. 04)**

Tree, 10–20 m high; branchlets densely rusty tomentose. Leaves oblong-ovate or elliptic, 8–13 × 5–8 cm, recurved, appear as boat, obtuse at base, acuminate or attenuate at apex, margins shallowly serrate, serrations tipped with short hairs, coriaceous, hispid above; lateral veins 8–10, prominent beneath, densely hairy on veins beneath; petioles 1.5–2 cm long, stout, thickened at apex, rusty tomentose. Racemes 5–10 cm long, axillary, densely rusty tomentose. Flower-buds lanceolate; flowers, 1.5–1.8 cm across; pedicels 1.5–2 cm long, hispid. Sepals 5, lanceolate, ca 1.4 cm long, densely tomentose outside, scarcely tomentose inside. Petals 5, oblanceolate, ca 1.5 cm long, laciniate, creamy white, appressed long brown hairy. Stamens 25–30, in 2 rows; filaments ca 1 mm long, puberulous; anthers 3–5 mm long, oblong, puberulous, awns ca 1.2 mm long, slender, erect. Ovary elliptic, 4-locular, densely hairy; ovules 8 per locule; styles slender, ca 6 mm long. Drupes ellipsoid or oblongoid, 1.5–1.8 × ca 1 cm, tomentose, endocarp stony.

Flowering & Fruiting: March–October.

Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Bombay Shola, Gundar, Kookal and Mediketton Shola. *Kabeer & Ravi Kiran 132745.*

Notes: Vulnerable (World Conservation Monitoring Centre, 1998). Intermittent in all shola forests of the Kodaikanal Wildlife Sanctuary at elevations between 1800 and 2500 m. Easily identified by its recurved leaves which appear silvery in new foliage stage among other trees in shola.

4. **Elaeocarpus variabilis** Zmarzty in Kew Bull. 56: 429. 2001. *E. oblongus* sensu Wight & Arn., Prodr. Fl. Ind. Orient. 1: 82. 1834; Wight, Icon. Pl. Ind. Orient. 1: t. 46. 1838; *E. oblongus* sensu Fyson, Flora of the Nilgiri and Pulney [Palni] Hilltops. t. 37. 1915; *E. tectorius* sensu Ramamoorthy in Saldanha & Nicolson, Fl. Hassan: 131. 1976. *E. glandulosus* sensu Matthew,



Elaeocarpus recurvatus Corner

Botanical Survey of India



Elaeocarpus variabilis Zmarzty

Illustrations on the Flora of the Palni Hills, South India, t. 79. 1996, non *E. tectorius* (Lour.) Poir, 1812. **(Plate No. 05)**

Tree; bark grey, branchlets scarcely lenticellate; young leaves and buds glabrescent. Leaves simple, alternate, ovate, 8–12 × 4–7 cm, base cuneate or obtuse, apex abruptly acuminate with short tip, margins distantly crenate or serrate, glabrous, subcoriaceous, punctate; lateral veins prominent at both surfaces, 4 or 5 pairs, light pink, pinnate, intercostae reticulate, slender; petioles 1–3 cm, slender, ashy when young, swollen at base and tip, glands 2 at tip; stipules cauducous. Inflorescence raceme, axillary, ca 15 cm long; peduncle brown, puberulous when young; pedicel ca 3 mm long; flowers bisexual, white. Sepals 5, lanceolate, 4–8 mm long, puberulous, glandular inside. Petals 5, laciniate, 0.6–1 cm long, white, glandular, inserted round the base of glandular disk, disk red. Stamens 30–35; anthers brown, 3–5 mm long, tipped with hairs; filaments folded, 4–8 mm long. Ovary superior, subglobose, densely puberulous, trilocular; ovules 2 in each locule; style subulate, entire. Drupes oblong, ca 4 × 3 cm, fleshy; endocarp stony, ca 2.5 × 1.8 cm, pitted, 1-seed.

Flowering & Fruiting: March–December.

Distribution: Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Blackburn Shola, Bombay Shola, Gundar, Kookal, Permalmalai, Pommbarai, Tiger Shola and Vattakanal. *Kabeer & Ravi Kiran 132716, 132823 & 133024.*

Notes: Very frequent in all shola forests of the sanctuary at elevations between 1500 and 2500 m. During senescence leaves turn red in colour. Monkeys relish the fruits and honey bee activity is high in August, the peak flowering time. Highest number of individuals observed at Perumalamalai and Gundar to Poombarai road.

9. **BALSAMINACEAE**

Impatiens L.

Key to the species

1a. Leaves obscurely whorled or sub-verticillate……7. **I. tangachee**
1b. Leaves other than obscurely whorled or sub-verticillate……...2
2a. Leaves alternate……...3
2b. Leaves opposite……...6
3a. Flowers white; spur shorter than flower……...1. **I. campanulata**
3b. Flowers other than white; spur longer than flower……....4
4a. Leaves hairy; flowers pink, spur linear, ca 4 cm long……..5
4b. Leaves glabrous; flowers scarlet, spur stout, ca 2 cm……6. **I. phoenicea**
5a. Flowers viscid; standard sepal smaller than lateral petal……10. **I. viscida**
5b. Flowres not viscid; standard sepal equal to lateral petal……2. **I. dasysperma**

6a. Spur longer than flowers……3. **I. fasciculata**
6b. Spur equal or shorter to flowers……7
7a. Undershrubs; spur equal to flower length…….……..…..5. **I. leschenaultii**
7b. Herbs; spur smaller than flowers……..……..8
8a. Flowers in a raceme…….4. **I. goughii**
8a. Flowers solitary in axils……...9
9a. Flowers white; spur yellowish……...8. **I. tanyae**
9b. Flowers pink; spur pinkish…….9. **I. tomentosa**

1. **Impatiens campanulata** Wight in Madras J. Lit. Sci. Ser. 1, 5: 11. t. 7. 1837; Hook.f., Fl. Brit. India 463. 1874; Gamble, Fl. Madras: 143. 1915; Vivek. *et al.* in Hajra *et al.*, Fl. India 4:130.1997; K.M. Matthew, Fl. Palni Hills 1: 171. 1999; Bhaskar, Taxon. Monogr. *Impatiens* W. Ghats: 236. 2012. **(Plate No. 06)**

Herb ca 1.5 m high; glabrous, erect, branched. Leaves alternate, ovate or elliptic or broadly ovate-lanceolate, 6–13 cm long, short acuminate at apex, incurved, margins crenate to serrate, membranous; lateral veins 5 or 6 pairs, prominent; petioles 3–5 cm long, eglandular. Inflorescence axillary at towards apex; peduncle axillary, erect, 2–4-flowered, glabrous, 4–6 cm long; bracts large, deciduous; bracteoles minute, ovate. Lateral sepals 2, broadly ovate, aristately acuminate, 0.8–1 cm, pink tinged; posterior sepal with spur, very short, ca 4 mm long. Petals white, standard orbicular, ca 1.8 cm across, keeled on back, tinged red inside; lateral united petals unequally lobed, ca 2 × 1.5 cm, glabrous, white with prominent red streaks, throat yellow with red or purple tinged; lip smooth, cymbiform. Capsules ellipsoid, ca 2 × 0.7 cm, glabrous, angled, attenuate at both ends; seeds globose.

Flowering & Fruiting: June–September.
Distribution: Kerala and Tamil Nadu. KWLS: Kookal, Kudarayar, Pambar and Tiger Sholas. *Kabeer & Ravi Kiran 132982 & 133813.*
Notes: Very frequent and grows on dripping rocks and tree trunks at an altitude of 1800–2500 m. Leaf size, colour of nectar guides and throat colour vary within the same populations and between populations at different locations within the sanctuary. A good number of populations of this species are observed at Kookal Shola, Kudarayar Shola, Pambar Shola and Tiger Shola. In every wet season, the Highways Department clears roadside populations at Tiger Shola which may lead to a decline of the species. Ants and honey bees are the main pollinators and these are attracted by red-streaked lip and yellow with red-tinged nectar guides.

2. **Impatiens dasysperma** Wight in Madras J. Lit. Sci. Ser. 1, 5: 7, t. 2. 1837; Hook.f., Fl. Brit. India 1: 457. 1874; Gamble, Fl. Madras: 143. 1915; Vivek. *et al.* in Hajra *et al.*, Fl. India 4: 139. 1997; Bhaskar, Taxon. Monogr. *Impatiens* W. Ghats: 193. 2012. *Impatiens latifolia* sensu K.M. Matthew, Fl. Palni Hills 1: 173. 1999., non L., 1753. **(Plate No. 06)**

Herb, 30–80 cm high; erect, unbranched or branching above the middle. Leaves alternate, crowded at terminal, broadly ovate or lanceolate, 5–9 × 2–4 cm, acuminate at apex, margins crenate or serrate, scabrid above, sparsely on veins below; petioles 2–5 cm long, glandular. Flowers axillary, 1–3; pedicels 2–3 cm long, slender, decurved, puberulous. Lateral sepals 2, minute, ovate, ca 2 × 1 mm; posterior sepal obovate; spur ca 2 cm long, incurved, sparsely hairy. Petals pink; standard obcordate, cuspidate, ca 1.5 × 1.2 cm across; laterals divergently bilobed; lobes subequal, oblong, ca 1.5 × 1 cm. Capsules obliquely ovoid, ca 1.2 cm long, turgid in the middle, glabrous; seeds subglobose, papillose.

Flowering & Fruiting: October–January.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Gurusaradi. *Kabeer & Ravi Kiran 139710.*
Notes: This species was not found at the Mayiladumparai described by K.M. Matthew (1999) due to anthropogenic and developmental activities. This study has found it in the Kodaikanal range, on the Perumalmalai to Mailadamparai (1330m.) road which is highly threatened habitat by State Highway 154 expansion. It completes the life cycle within 3 to 4 months and the current study recorded the flowering in November 2017. In later surveys, the population was not found in the same locality. Highly recommended for its conservation at Forest Department nurseries of Kodaikanal WLS.

3**. Impatiens fasciculata** Lam., Encycl. 1: 363. 1785; Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 138. 1834; Wight, Icon. Pl. Ind. Orient. 3(1): 2, t. 748. 1846. *Impatiens chinensis* sensu K.M. Matthew, Fl. Palni Hills 1: 171. 1999, non L., 1753. *Impatiens vivekananthanii* J. Dessai & Janarth. Rheedea 21(1): 58.. 2011. *Impatiens aquatica* Bhaskar in Taxon. Monogr. *Impatiens* W. Ghats: 123. 2012. *Impatiens yercaudensis* Bhaskar in Taxon. Monogr. *Impatiens* W. Ghats: 180. 2012. **(Plate No. 05)**

Perennial herb; ca 1.5 m high, stem sraggling, stiff, terete, reddish, rooting at nodes, interrnodes swollen, older brachlets rugose. Leaves opposite decussate, elliptic or oblong-lanceolate, 3–7 × 1–2 cm across, base obtuse or subcordate, margins serrate, apex acute; lateral veins about 4–7, obscure above, slightly prominent beneath, glabrous; petioles 3–4 mm long, stipule subulate, reddish, sessile. Inflorescence axillary, solitary or paired per axil, in the upper parts of the plant, usually glabrous; pedicels ca 5 cm long, slender, reddish. Sepals 3,

imbricate, 2 laterals flat, small, linear, apex acute, glabrous; lip obovate, funnel shaped, white or pink; spur ca 5 cm long, deeply incurved. Petals lilac or purple or pink or mauve, upper standard keeled, orbicular, ca 1 cm long, margins entire or crested, apex acuminate, glabrous; wings ovate-oblong, apex obtuse, ca 5 × 3 mm; wing lobes ca 1.7 × 1.6 cm; throat with pinkish blotches, nectar guides inconspicous. Pistil ca 5 mm long, covered by 5 united stamens. Ovary 5-locular, superior, oblong-ovoid; ovules many. Capsules fusiform, ca 2.5 cm long, swollen in the middle, glabrous; seeds 5–12, globose or oval, shining, glabrous, black.

Flowering & Fruiting: Throughout the year.
Distribution: Karnataka, Kerala and Nadu (Palani and Shevaroy Hills). KWLS: Kombaikkadu and Edmankarai. *Kabeer & Ravi Kiran 132937 & 133083.*
Notes: Locally abundant at Sowrikkadu–Vadkownji, Edmanakarai–Kookal and scarce on Perumalmalai peak. It grows as rooted submerged herb in the swamps and rivulets of the sanctuary at elevation range from 1000 to 2400 m. Plants of Nilgiri Hills have white flowers with brown blotches on petals.

4. **Impatiens goughii** Wight, Ill. Ind. Bot. 1: 160. 1839; Hook.f., Fl. Brit. India 1: 452. 1874; Gamble, Fl. Madras: 144. 1915; Vivek. *et al.* in Hajra *et al.*, Fl. India 4: 152. 1997; K.M. Matthew, Fl. Palni Hills 1: 172. 1999; Bhaskar, Taxon. Monogr. *Impatiens* W. Ghats: 241. 2012. *I. pulniensis* Bedd., in Madras J. Lit. Sci.19: 176. 1858. *I. anamallayensis* Bedd., in Madras J. Lit. Sci. 20: 68, f. 8. 1859. *I. parvifolia* Bedd., in Madras J. Lit. Sci. 20: 66, f. 1. 1859. *I. circaeoides* Turcz., Bull. Soc. Imp. Naturalistes Moscou 36(1): 594. 1863, *nom. illeg*., non Wall. Ex Hook. f. & Thomson 1859. *I. omissa* Hook. f., Rec. Bot. Surv. India 4: 43 & 48. 1906. *I. microtheca* Hook. f., Hooker's Icon. Pl. 30: t. 2910. 1910. *I. danii* M.G. Govind, Sindhu Arya, V. Suresh & V.S.A. Kumar, in PhytoKeys 180: 162, f. 3–4. 2021. *I. raktakesara* M. Vishnu & Nampy, Brittonia 73(3): 319, f. 1–2. 2021. **(Plate No. 07)**

Herb, 10–35 cm high; stems branched, glabrous, obscurely grooved, reddish. Leaves opposite, ovate, 1.5–3 × 1–1.5 cm, acute at apex, margins serrate, hispid, sparsely hairy on veins beneath; petioles ca 1 cm long, reddish. Inflorescence terminal and in upper axils, racemes subumbellate, 1–1.3 cm across; peduncles ca 10 cm long, filiform; pedicel ca 2.5 cm long; bracts persistent, minute, ovate. Lateral sepals obliquely ovate, ca 1.8 × 1.2 mm; posterior sepal cymbiform; spur short, ca 3 mm long, straight. Petals pink or lilac; standard obovate, short acuminate at apex, ca 4 × 3 mm; posterior petals bilobed, obovate, ca 1.5 cm long; wings of posterior petals enclosed in throat, rounded at apex; nectar guides with pink blotches. Ovary ca 2 mm long, glabrous, covered by fused filaments. Capsules fisiform, ca 8 mm long, glabrous; seeds 8–10, hairy.

Flowering & Fruiting: July–January.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Vattakanal. *Kabeer & Ravi Kiran 139648.*

Notes: Found only at Vattakanal Shola which is a different location (Perumalmalai) than in K.M. Matthew's Flora. This species is vulnerable in the Palani Hills due to habitat loss by invading *Acacia* and *Eualyptus* species. Size of the plant and petal colours varies within the same population. *Calceolaria mexicana* is competing with this species in its habitat by vigorous spreading.

5. **Impatiens leschenaultii** (DC.) Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 136. 1834; Hook.f., Fl. Brit. India 1: 450. 1874; Gamble, Fl. Madras: 141. 1915; Vivek. *et al.* in Hajra *et al.*, Fl. India 4: 173. 1997; K.M. Matthew, Fl. Palni Hills 1: 174. 1999; Bhaskar, Taxon. Monogr. *Impatiens* W. Ghats: 200. 2012. *Balsamina leschenaultii* DC., Prodr. 1: 586. 1824. **(Plate No. 07)**

Undershrub, ca 1.5 m high; branchlets pinkish brown, angled. Leaves opposite, alternate or whorled at apex of shoots, ovate-lanceolate, 4–8 × 2–4 cm, acute or acuminate at apex, margins crenate with pink appendages; lateral veins 6–8 pairs; petioles ca 4 cm long, glandular. Flowers usually solitary or 2 or 3 in an axil; pedicels ca 5 cm long, reddish. Lateral sepals ovate-lanceolate, ca 4 mm long, yellow with brownish tinge; posterior sepal cymbiform, ca 0.8 cm long, yellow; spur slender, incurved, 1–1.3 cm long, yellow. Petals lilac or cream or white; standard petal obcordate, keeled, ca 1.5 cm across; posterior lobes winged, oblong; wings ca 1 × 1.2 mm, basal part ca 1.5 × 0.7 cm, throat yellow with light pink streaks. Ovary ca 3 mm long, covered by filament tube. Capsules fisiform, beaked, ca 1.5 cm long, glabrous; seeds 3–5, obovoid, ridged.

Flowering & Fruiting: April–December.

Distribution: Kerala, Maharashtra and Tamil Nadu. KWLS: Poombarai. *Kabeer & Ravi Kiran 133105, 133762 & 141074.*

Notes: Reported only at Poombarai upper hills and their surroundings which are rapidly being destroyed by real estate and agriculture practices. Decrease in population of this species is observed (2012–2018. pers obs.) from these localities. It is suggested to conserve by seed spreading within the Mannavanur and Kodaikanal forest ranges.

6. **Impatiens phoenicea** Bedd. in Madras J. Lit. Sci. ser. 2, 19: 175. 1858; Hook.f., Fl. Brit. India 1: 466. 1875; Gamble, Fl. Madras: 145. 1915; Vivek. *et al.* in Hajra *et al.*, Fl. India 4:193. 1997; K.M. Matthew, Fl. Palni Hills 1: 175. 1999; Bhaskar, Taxon. Monogr. *Impatiens* W. Ghats: 265. 2012. **(Plate No. 08)**

Herb, ca 1 m high; erect, branched, glabrous, brown. Leaves alternate, lanceolate or ovate, 5–12 × 3–4 cm, chartaceous, cuneate at base, attenuate to acuminate at apex, margins crenate-serrate, dark-green, shining; lateral veins 6; petioles 1–2.5 cm long. Inflorescence axillary and terminal, slender, ca 8 cm long; bracts at base of pedicels, ovate, cordate, persistent. Flowers ca 2.5 cm long; lateral sepals ovate, ca 6 × 3 mm; posterior sepal funnel-shaped, ca 5 × 2 mm, with spur; spur trumpet-shaped, ca 2 cm long, crimson, incurved with swollen tip. Petals scarlet; standard petal ovate, apiculate, keeled, ca 1.5 × 0.7 cm; posterior petals winged, scarlet, throat yellow; basal lobes cordate, ca 1 × 0.8 cm; wings ca 0.7 × 0.7 cm. Ovary ca 2 mm long. Capsules fusiform, ca 1.5 × 0.5 cm; seeds 4–7, taberculed.

Flowering & Fruiting: May–November.
Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Mathikettan, Pambar and Vattakanal Sholas. *Kabeer & Ravi Kiran 132746.*
Notes: Good populations found in Mathikettan Shola, Pambar Shola and Vattakanal Shola at the altitude of 1800 to 2500 m. August is the peak flowering time and plants are mostly seen spreading at edges of Shola forest. Pambar Falls supports largest population and the habitat is under threat due to high tourist activity.

7. **Impatiens tangachee** Bedd., Madras J. Lit. Sci. ser. 2, 20: 66. 1859, & Ic. 30. t. 147. 1868-1874; Hook. f., Fl. Brit. India 1: 467. 1875; Gamble, Fl. Madras 145. 1915; Vivek. *et al.* in Hajra *et al.*, Fl. India 4: 215. 1997; K.M. Matthew, Fl. Palni Hills 1: 175. 1999; Bhaskar, Taxon. Monogr. *Impatiens* W. Ghats: 268. 2012. **(Plate No. 8.1)**

Herb, 10–40 cm high; sub-procumbent, branched, glabrous, rooting at lower nodes. Leaves obscurely whorled or sub-verticillate, crowded at apex, narrowly elliptic-lanceolate, ca 4–8 × 1–1.8 cm, glabrous, base attenuate, margins crenate-serrate, apex acuminate; lateral veins 4–5 obscure; subsessile. Inflorescence sub umbellate short racemes, sub terminal, peduncles 4–8 cm long. Flowers 2.5–3 cm across, pedicel slender, erect, 1.3–3.5 cm long, bracts ovate, coriaceous, ca 5 mm long. Lateral sepals flat, oblong, glabrous, 4–6 × 3–5 mm long, posterior sepal cymbiform, spurred, spur incurved or erect, slender, ca 3 cm long. Petals purple, pink, mauve or white; standard petal orbiculate, ca 1.2 × 1 cm, keeled or cucullate, slightly bent backward; posterior petals winged, bilobed; basal lobes broadly truncate, ca 1.3 × 0.8 cm; wings ovate or lanceolate, ca 0.8 × 0.6 cm, reflexed. Stamens 5, anthers bi-locular, pollen white. Ovary ca 3 mm long, 5 locular. Capsule fusiform, ca 8 mm long, glabrous. Seeds many, globose or oval, shining, glabrous.

Flowering & Fruiting: May–December.
Distribution: Kerala and Tamil Nadu. KWLS: Pambar Shola.

Notes: As Matthew (1999) stated, this species is extinct in the Palni Hills, but in the year 2000, Bob & Tanya collected seeds from Munnar and reintroduced at Pamabar Shola. A few reintroduced plants found at Pambar Shola by Kothareddy Prasad in 2016.

8. **Impatiens tanyae** R.Kr. Singh, Arigela & Kabeer in Kew Bull. 74 (3): 48. 2019. *Impatiens brevicornis* sensu K.M. Prabhukumar *et al.* in Nelumbo 60 (1): 16. 2018, non (Barnes) Bhaskar, 2012. **(Plate No. 08)**

Herb, erect or straggling, 35–70 cm high, succulent. Stem terete, usually unbranched, purplish-red, densely pubescent throughout, swollen at nodes, rooting at lower nodes. Leaves simple, opposite, decussate, ovate, 3–7 × 1–2 cm, cordate at base, acute at apex, margins spinous-serrate, scabrid and pubescent above, densely pubescent below, subsessile; lateral veins 4 or 5 pairs; petioles 1–2 mm long, pubescent; stipules 2, ca 1 mm long, subulate, apex pointed, purplish-red, gland dotted at tip. Flowers 1–5 per axil, 1–1.3 cm across, white with pinkish blotch on throat; bracts 1–1.5 mm long, narrowly triangular, densely pubescent, persistent, purplish-red; pedicels 3–4.2 cm long, pubescent throughout. Lateral sepals 2, linear, 4–6 × 0.5-–1 mm, apex acute, hyaline-pale yellow, membranous; lower sepal navicular, pale yellow, 7–9.5 × 4.5–5.5 mm, pubescent, tapering into a spur; spur 7–8 mm long, cylindric, incurved, pale yellow, pubescent. Petals white; dorsal petal broadly ovate, 5–6 × 4–5 mm, ventral surface white and glabrous, dorsal surface pale yellow and pubescent, cucullate, dorsally keeled, apex spinular; lateral united petals 1.2–1.4 × 0.5–0.6 cm, bilobed, equal or subequal, white with pinkish blotch in centre, basal lobe unevenly triangular, obtuse at apex, clawed; claw 2.5–3 mm long, oblong, white with pinkish blotch. Stamens 2.5–3 mm long, pale white, pendulous, glabrous, enclosing ovary; anthers ca 0.5 mm long, white. Pistil 1.8–2.1 × 0.5–1 mm; ovary oblong, glabrous. Capsules lanceoloid, 1–1.2 × 0.3–0.4 cm, turgid at middle, green, glabrous, apiculate at apex; seeds 10–12, ovoid, ca 1 mm across, smooth, shining, dark brown-black on maturity.

Flowering & Fruiting: July–November.

Distribution: Tamil Nadu (Polur, Vandaravu Range, Kodaikanal Wildlife Sanctuary). *Kabeer & Ravi Kiran 139616 & 139727.*

Notes: Known from only one location in the Polur forest beat, Kodaikanal Wildlife Sanctuary. Species is under threat due to seasonal bush clearing in agricultural canals as a routine practice at the type locality. This species should be conserved at the Mannavanur grassland which is the nearest similar habitat and highly suitable location. Recently Prabhkmar *et al.* (2019), reported this species from Munnar, Kerala and this area is exactly other side of the hill of its type locality. At present, this species is represented by about 250 mature individuals in type locality and it environs. This species is conserved in the garden of Late

Tanya Balcar having 10 mature individuals. According to present study and using the IUCN categories and criteria (IUCN 2013), it is currently classified as Endangered under criterion D. Further rigorous exploration is needed in the surroundings of Kodaikanal Wildlife Sanctuary and other areas of Western Ghats to determine the actual population status of the species.

9. **Impatiens tomentosa** B. Heyne ex Wight & Arn., Prodr. Fl. Ind. Orient.: 139. 1834; Hook.f., Fl. Brit. India 1: 449. 1874; Gamble, Fl. Madras: 141. 1915; K.M. Matthew, Fl. Palni Hills 1: 176. 1999; Bhaskar, Taxon. Monogr. *Impatiens* W. Ghats: 179. 2012. *I. eravikulamensis* Hareesh & Salish, in Webbia 74(2): 271. 2019. *I. dindigulensis* Ramas., Anjana & Chandra, in Taiwania 65(4): 426. 2020. *I. palniensis* Ramas., in Phytotaxa 460(4): 250. 2020, *nom. illeg*. *I. ramasubbuana* Kottaim. & P. Murugan, in Phytotaxa 500(1): 52. 2021. *I. thulunadensis* Sindhu Arya, P. Biju & V.S.A. Kumar, in Ann. Bot. Fennici 59: 207. 2022. **(Plate No. 09)**

Herb, 25–35 cm high; stems tomentose, rugose with age, reddish. Leaves opposite, elliptic to ovate-oblong, 2.5–3.5 × 0.5–1.2 cm, acute at apex, truncate at base, margins serrate, scabrid above, densely tomentose on veins beneath, glabrescent by age; petioles ca 3 mm long. Flowers axillary, solitary or paired, 0.8–1 cm across, red or pink; pedicels ca 4 cm long, pinkish, slender, hairy. Lateral sepals linear-lanceolate, ca 5 × 1 mm, ciliate, hyaline; posterior sepal cup shaped, ca 4 × 8 mm, hairy outside; spur 2–4 mm long, inconspicuous sometimes, incurved. Petals lilac or pink; standard petal orbicular, apiculate, ca 5 × 4 mm, keeled; posterior petals bilobed, deep into posterior sepal; basal lobes oblong, ca 8 × 4 mm; wings ovate, 2–3 mm across. Capsules fusiform, ca 1.2 × 0.5 cm; seeds 10, subglobose, glabrous.

Flowering & Fruiting: July–September.
Distribution: Goa, Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Vattakanal. *Kabeer & Ravi Kiran 138147.*
Notes: This species population is dwindling due to negative pressures in habitat. It has totally disappeared at the Kodaikanal Golf Course due to developmental work. Very sensitive ephemeral plant and found only in one population at the Vattakanal grassland. Highly polymorphic species and appears to have glabrous and tomentose forms.

10. **Impatiens viscida** Wight in Madras J. Lit. Sci. Ser. 1, 5: 12. 1837; Hook.f., Fl. Brit. India 1: 462. 1874; Gamble, Fl. Madras: 143. 1915; Vivek. *et al.* in Hajra *et al.*, Fl. India 4: 226. 1997; K.M. Matthew, Fl. Palni Hills 1: 176. 1999; Bhaskar, Taxon. Monogr. *Impatiens* W. Ghats: 257. 2012. **(Plate No. 09)**

Herb, ca 1 m high; crown deliquescent; stems angled, rigid, pink; rooting at lower nodes. Leaves alternate, ovate, 5–8 cm long, margins serrate, pubescent beneath and on veins at both

surfaces; petioles ca 2 cm long. Inflorescence axillary, racemes subumbellate, 3–6-flowered, viscid; peduncle ca 7 cm long; bracts ovate, ca 2 × 3 mm; pedicels ca 3 cm long, viscid. Lateral sepals oblique-ovate, ca 8 × 6 mm; posterior sepal boat shaped, ca 6 × 12 mm, spur slender, ca 3 cm long, incurved. Petals pink to purple; standard petal ovate, keeled, apiculate, smaller than sepals; posterior petals bilobed, basal lobes obovate, ca 2.4 × 1.5 cm; wings suborbicular or ovate. Capsules fusiform, ca 1.8 cm long, glabrous, beaked; seeds more than 10, globose, hairy.

Flowering & Fruiting: Throughout the year.
Distribution: Kerala and Tamil Nadu (Palani Hills). KWLS: Pambar falls, Perumalamalai, Tiger Shola and Vattakanal. *Kabeer & Ravi Kiran 133815.*
Notes: Good number of populations sighted at Tiger Shola but removed every season by Highways Department for clear visibility of the road margins. Aslo recorded on dripping rocks in Perumalamalai, Pambar Shola and Vattakanal Shola at elevations from 1800 to 2400 m. Restricted Spotted Flat butterfly is the main pollinator.

10. **RUTACEAE**

Key to the Genera

1a. Trees armed; leaves simple; fruit hesperidium……1. **Atalantia**
1b. Trees unarmed; leaves pinnate; fruit a berry……...2. **Clausena**

1. **Atalantia** Corrêa, nom. cons.

Atalantia wightii Tanaka in Bull. Soc. Bot. France 75: 714. 1928; K. Narayanan & M.P. Nayar in Hajra *et al.*, Fl. India 4: 274. 1997; K.M. Matthew, Fl. Palni Hills 1: 181. 1999; *A. ceylanica* auct. non Oilv., 1861: Hook.f., Fl. Brit. India 1: 512. 1875; Gamble, Fl. Madras: 160. 1915. **(Plate No. 10)**

Tree, 5–10 m high; branchlets armed or sometimes unarmed; spines strong, ca 3.5 cm long, glabrescent, lenticellate. Leaves alternate, ovate-oblong or elliptic-lanceolate, 6–10 × 4–5.5 cm, coriaceous, pale green beneath, obtuse to rounded or cuneate at base, entire at margins, acute at apex with emarginate tip; secondary veins prominent beneath; petioles 0.6–1 cm long. Inflorescences axillary racemes or fascicles, ca 8-flowered, ca 2 cm long; pedicels slender, ca 1 cm long. Flowers ca 8 mm long, fragrant, white. Calyx deeply 4 or 5-lobed; lobes ovate, acute or subacute, ca 1.5 mm long, cream-coloured, glandular. Petals 4 (or 5), oblong or elliptic, acute, clawed, ca 6 × 4 mm, white or cream-coloured, glandular. Stamens 8(10), 4+4(5+5), 3.5–5.5 mm long; filaments dilated at base, free; anthers cordate-ovoid, ca 1.5 mm long, yellowish. Disk annular, ca 1.8 mm. Ovary ovoid, ca 2.2 × 1.6 mm, smooth, 2-locular; styles cylindric, ca 2.3 mm long, glandular; stigma capitate, 2 or 3-lobed. Berries oblong-ovoid, ca 1.8 × 1.2 mm, smooth, glandular, yellowish when ripe.

Flowering & Fruiting: February–May.

Distribution: Goa, Gujarat, Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Tiger Shola. *Kabeer & Ravi Kiran 135568.*

Notes: During the present study, it was collected only from Tiger Shola at elevations ranging from 1650 to 1800 m and it is observed that, the population of this species is at downfall.

2. **Clausena** Burm.f.

Clausena austroindica B.C. Stone & K. Narayanan in Nordic J. Bot. 14(5): 491. 1994; K. Narayanan & M.P. Nayar in Hajra *et al.*, Fl. India 4: 322. 1997; K.M. Matthew, Fl. Palni Hills 1: 185. 1999. *C. heptaphylla* Wight & Arn., Prodr. Fl. Ind. Orient. 1: 95. 1834, nom. inval.; Hook.f., Fl. Brit. India 1: 504. 1875; Gamble, Fl. Madras: 155. 1915. **(Plate No. 10)**

Unarmed shrub, up to 6 m high, aromatic; branchlets glabrescent; bark lenticellate. Leaves ca 30 cm long, rachis puberulent or glabrous; leaflets generally 3 or 4 pairs, subopposite to alternate, 6– 12 × 5–7 cm, lanceolate to obovate, attenuate to cuneate at base, crenate or undulate at margins, acuminate, obtuse or rounded at apex, glandular beneath. Inflorescences terminal and from uppermost axils, paniculate, up to 15 cm long; peduncles ca 3 cm long; bracteoles 2, unequal, ca 1 mm long, ciliate. Flowers ca 0.7 cm wide, glabrescent; pedicels ca 6 mm long. Calyx cupular, 5(or 4)-lobed; lobes ca 0.5 mm long, glandular, sparsely ciliolate at margins. Petals 5(or 4), imbricate, elliptic, obtuse, ca 5 × 3 mm, obscurely glandular, white or cream-coloured. Stamens 10(5+5); anthers oblong or rhomboid, ca 1.5 mm long, with a gland on connective. Ovary seated on gynophore, subglobose, ca 1 × 1.5 mm, each with 2 collateral ovules; style short, caducous. Berries globose, ca 1.2 cm, flesh-coloured when ripe.

Flowering & Fruiting: April–August. *Kabeer & Ravi Kiran 142647.*

Distribution: Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. KWLS: Law's Ghat road.

Notes: Gregarious in moist deciduous forests of mid-Palnis at elevations ranging from 850 to 1500 m, and resembles *Murraya koenigii* but differs in leaflets size and fragrance.

11. **BURSERACEAE**

Key to the Genera

1a. Leaflets 15–30, apex obtuse; Drupe ovoid, trigonous……1. **Boswellia**

1b. Leaflets 3–7, apex attenuate or acute; Drupes globose or ellipsoid.....2. **Commiphora**

1. **Boswellia** Roxb. ex Colebr.

1. **Boswellia serrata** Roxb. ex Colebr., Asiat. Res. 9: 379. t. 5. 1807; Hook. f., Fl. Brit. India 1: 528. 1875; Gamble, Fl. Madras 168. 1915; V. Chithra & A.N. Henry in Hajra *et al.*, Fl. India 4: 432. 1997; K.M. Matthew, Fl. Palni Hills 1: 194. 1999. **(Plate No. 10.1)**

Deciduous tree, ca 20 m high, bark greyish to yellowish with dark blotches, exfoliating flakes thin, smooth; exudation trasnpirant resin; branchlets pubescent. Leaves imparipinnate, alternate, apically crowded, estipulate; rachis 10–45 cm, slender, pubescent, swollen at base; leaflets 15-31, sessile or subsessile, opposite or subopposite, 0.8–6.5 × 0.5–3.5 cm, elliptic-oblong, oblong-lanceolate, oblong-ovate, base oblique, rounded, apex obtuse, margin entire or crenate, subcoriaceous, glabrous; lateral nerves 8–14 pairs. Flowers in axillary or subterminal fascicled racemes, ca 23 cm long, flowers white to pinkish, pedicel 2–3 mm long. Calyx tube broadly campanulate; lobes 5–7, persistent, pubescent. Petals 5–7, ovate-oblong, 3.5–5.2 × 2.5–3.8 mm, white, shortly clawed, pubescent without, fragrant; disc annular, crenate, free from calyx. Stamens 10, free, filaments alternately shorter, ca 2.5 mm long, inserted on the fleshy nectary ring. Ovary superior, 3–4-celled, ovoid; style ca 3.3 mm, puberulous; stigma 3-lobed. Fruit a drupe, ovoid, 3 or 4-gonous; pyrenes 3 or 4; seeds 3 or 4.

Flowering & Fruiting: Throughout the year.
Distribution: India. KWLS: Thandigudi ghat Road to Damadam Parai towards Vathalagundu.
Notes: Very few individuals noticied in the dry deciduous forest patches from Damadam Parai to Thandigudi when compared with other dry deciduous forests of India. As K.M. Matthew (1999) stated, this species will disapper from Palani Hills.

2. **Commiphora** Jacq., nom. cons.

2. **Commiphora caudata** Engl. var. **pubescens** (Wight & Arn.) K.M. Matthew in Kew Bull. 46: 540. 1991 & Fl. Palni Hills 1: 196. 1999. *Protium pubescens* Wight & Arn., Prodr. Fl. Ind. Orient.: 176. 1834; A.W. Benn. in Hook.f., Fl. Brit. India 1: 530. 1875. *Commiphora pubescens* (Wight & Arn.) Engl. in A. DC. & C. DC., Monogr. Phan. 4: 21. 1883; Gamble, Fl. Madras: 171. 1915; V. Chithra & A.N. Henry in Hajra *et al.*, Fl. India 4: 444. 1997. **(Plate No. 11)**

Tree, ca 15 m high, bark green with reddish-brown stripes, peeling off in thin scales, spines on older trunk, branchlets puberulous. Leaves imparipinnate, alternate, petioles 4–10 cm long; rachis 6–10 cm long, slender, puberulous; leaflets 3–7, opposite, terminal larger than laterals, subsessile, puberulous; laterals 2.5–8 × 2–5 cm, ovate or ovate-lanceolate, base obtuse, attenuate or acute at apex, margins entire, puberulous; lateral veins 6–10 pairs, prominent; petiolule 2–5 mm. Inflorescence panicles, axillary; peduncle 4–7 cm long, flowers polygamous, small, greenish-yellow; bracts 2, opposite, glandular-hairy. Calyx campanulate, glandular-hairy, lobes 4, deltoid. Petals 4, broadly linear, reflexed at apex; disk cupular. Stamens 8, free, inserted on the margins of disk, alternately long and short; anthers oblong; ovary superior, oblong or ovoid, attenuate into style, bilocular; ovules 2 in each locule; stigma bilobed. Drupes globose or ellipsoid, lenticellate, red when ripe; seed solitary.

Flowering & Fruiting: Throughout the year.

Distribution: India. KWLS: Andipatty, Balasamdram Esat, Damdamparai, Palar, Purandalar, Southuparai and Sowrikkadu. *Kabeer & Ravi Kiran 133061*.

Notes: This typical dry deciduous forest element is very frequent at foot hills of the KWLS at elevations ranging from 250 to 600 m and very frequent at Palani–Kodaikanal ghat road.

12. **CELASTRACEAE**

Key to the genera

1a. Lianas ……..**1. Celastrus**
1b. Shrubs or trees ……...2
2a. Armed shrubs; leaves crenate-serrate throughout margins ……...4. **Gymnosporia**
2a. Unarmed trees; leaves crenate-serrate towards apex from middle ……3
3a. Flowers pentamerous; capsules obovoid, 5-locular, ca 2 cm across……2. **Euonymus**
3b. Flowers tetramerous; capsules subglobose, 4-locular, ca 1 cm across....3. **Glyptopetalum**

1. **Celastrus** L.

1. **Celastrus paniculatus** Willd. subsp. **aggregatus** K.T. Mathew ex K.M. Matthew in Kew Bull. 46: 540. 1991; K.M. Matthew, Fl. Palni Hills 1: 216. 1999. **(Plate No. 11)**

Liana; terminal branches aggregated into clusters, lenticellate. Leaves alternate, broadly elliptic, ca 10 × 6 cm, coriaceous, base obtuse, oblique, apex abruptly acute or retuse, margins crenulate to serrate; petioles ca 1 cm long. Inflorescence panicle, shorter than leaves, ca 8 cm long. Flowers greenish white, polygamous: Male flowers: 40–70 per cluster, ca 5 mm wide; pistillodes conical, ca 1 mm. Bisexual flowers: 10–30 per cluster, ca 5 mm wide. Calyx cupular; lobes 5, united, orbicular, ca 2 mm, imbricate. Petals 5, oblong, creamy yellow, reflexed. Disk 5-lobed. Stamens 5. Ovary on the disk, ovoid, 3-locular; ovules 2 per cell, erect; stigmas reflexed. Capsules subterete, longitudinally furrowed, ca 1.3 × 1.1 cm, beaked; seeds 2–6 per capsule, ellipsoid, completely orange fleshy aril.

Flowering & Fruiting: March–September.

Distribution: Karnataka, Maharashtra and Tamil Nadu. KWLS: Vattakanal. *Kabeer & Ravi Kiran 135478.*

Notes: It is found only in shola forest, and distinct from subsp. paniculatus by aggregate terminal branches, inflorescence of very short panicles on lateral shoots and capsules less in number. Population is scarce and found only in the Vattakanal Shola.

2. **Euonymus** L.

Euonymus crenulatus Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 161. 1834; M.A. Lawson in Hook.f., Fl. Brit. India 1: 608. 1875; Gamble, Fl. Madras: 203. 1918; K.M. Matthew, Fl. Palni Hills 1: 218. 1999; K. Ramam. in N.P. Singh *et al.*, Fl. India 5: 97. 2000. **(Plate No. 12)**

Tree; branchlets glabrescent, subterete, nodes prominent. Leaves opposite-decussate, subobovate to elliptic-oblong, 4–8 × 3–5 cm, crenate-serrate towards apex, subcoriaceous; petioles ca 1 cm long; stipules deciduous. Inflorescence dichasial cymes, axillary and on old trunks, 6–10-flowered; peduncles stout; pedicels jointed; bracts subulate, deciduous. Calyx 5-lobed; lobes imbricate, orbicular, reddish, ca 2 mm. Petals 5, orbicular, ca 6 mm long, crenate, flesh-coloured. Stamens 5, embedded in disk. Ovary sunk in the disk; styles short; stigma blunt. Capsules obovoid, 5-locular, lobed, light green, turning red when ripe; seeds 5, orange.

Flowering & Fruiting: March–December.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Blackburn Shola, Kookal, Pambar and Tiger Shola. *Kabeer & Ravi Kiran 133728, 133868 & 135567.*

Notes: Found in all shola forests of the sanctuary at elevations ranging from 1700 to 2500 m. Species of *Selaginella* found epiphytic on the trunk.

3. **Glyptopetalum** Thwaites, nom. cons.

Glyptopetalum lawsonii Gamble in Bull. Misc. Inform. Kew 1916: 131. 1916; Gamble, Fl. Madras: 204. 1918; K.M. Matthew, Fl. Palni Hills 1: 219. 1999; K. Ramam. in N.P. Singh *et al.*, Fl. India 5: 112. 2000. **(Plate No. 12)**

Tree; branchlets subterete, lenticellate; bark grey. Leaves elliptic-obovate, 5–10 × 3–6 cm, obtuse at base, entire up to middle, serrate from the middle to apex, acute at apex, coriaceous, glabrous; lateral veins 7–9 pairs, obscure; petioles ca 0.5 cm long; stipules subulate, deciduous. Inflorescences axillary, dichasial cymes, 6–9-flowered; peduncles ca 1 cm long. Flowers bisexual. Calyx lobes 4, short, orbicular, brown. Petals 4, ovate, ca 3 mm long, obtuse, 2 oblique pits towards apex. Stamens 4; filaments ca 3 mm long. Ovary immersed in the disk; styles ca 2 mm long. Capsules subglobose, 1.2–1.8 cm across, 4-locular, unequal (2 + 2); seeds subglobose, ca 1 × 0.5 cm, fleshy arillate.

Flowering & Fruiting: Throughout the Year.

Distribution: Kerala and Tamil Nadu. KWLS: Poolatur piruvi. *Kabeer & Ravi Kiran 139732.*

Notes: Vulnerable (World Conservation Monitoring Centre, 1998). Scarce and found at only one location on Law's Ghat Road, from where it was reported by K.M. Matthew earlier. During the present study, only one sub adult and one fully grown individual were found at

Poolatur piruvi, in association with *Arenga wightii*, *Drypetes wightii* and *Euonymus dichotomus* along stream.

4. **Gymnosporia** (Wight & Arn.) Benth. & Hook.f., nom. cons.

Gymnosporia heyneana M.A. Lawson in Hook.f., Fl. Brit. India 1: 620. 1875; Gamble, Fl. Madras: 210. 1918. *Maytenus heyneana* (Roth) D.C.S. Raju & Babu in Bull. Bot. Surv. India 10: 348. 1968; K.M. Matthew, Fl. Palni Hills 1: 221. 1999; K. Ramam. in N.P. Singh *et al*., Fl. India 5: 122. 2000. *Celastrus heyneana* Roth in Roem. & Schult., Syst. Veg. 5: 421. 1819. **(Plate No. 13)**

Armed shrub; spines ca 6 cm long, axillary; branchlets lenticellate. Leaves alternate, ovate-elliptic or lanceolate, 6–12 × 4–6 cm, cuneate at base, margins crenate-serrate, apex retuse, subcoriaceous; lateral veins 8–10 pairs, reticulate. Inflorescence polycahsial cyme, axillary, ca 8 cm. Sepals 5, ovate, ca 1.3 mm long, margins ciliate. Petals 5, ovate, ca 4 × 2.5 mm, reflexed, white or cream coloured. Stamens 5, arising from the margin of the disk; filaments ca 2 mm long. Ovary immersed in the disk; stigmas 3-lobed. Capsules obcordate, ca 1.5 cm long, 3-loculed, 6-seeded; seeds pitted, with fleshy white aril.

Flowering & Fruiting: July–March.

Distribution: Andhra Pradesh, Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Andipatty, Kudarayar, Palar, Purandalar and Thalayar. *Kabeer & Ravi Kiran 133689* & *135468.*

Notes: Capsule size slightly varying with the elevation. It is found very common in areas with elevations between 350 and 850 m. It is a suitable plant, for sunbirds to make their nests.

13. **VITACEAE**

Tetrastigma Planch.

Tetrastigma sulcatum (M.A. Lawson) Gamble, Fl. Madras: 229. 1918; K.M. Matthew, Fl. Palni Hills 1: 242. 1999; B.V. Shetty & P. Singh in N.P. Singh *et al*., Fl. India 5: 319. 2000. *Vitis sulcata* M.A. Lawson in Hook.f., Fl. Brit. India 1: 661. 1875. **(Plate No. 13)**

Liana; branches angled, sulcate, tuberculate, older branches scaly, glabrous; tendrils simple. Leaves pedately 5–7-foliolate, alternate, subcoriaceous, glabrous; petioles 5–10 cm long; terminal leaflets elliptic-lanceolate, 8–13 × 4–7 cm, cuneate at base, acuminate at apex, margins crenate or serrate; midvein prominent; petiolules 1.5–3 cm long; lateral leaflets 5–11 × 3–6 cm, oblique at base; petiolules 0.5–1.5 cm long. Inflorescences axillary, trichotomous, corymbose cymes, ca 7 cm long, pubescent. Flowers ca 3 mm long; pedicels ca 4 cm long, puberulent. Calyx cupular, 4-lobed, pubescent. Petals 4, oblong, ca 2 × 1.5 mm, hooded, pubescent, cream-coloured. Stamens ca 2 mm long; anthers oblong. Disk round, thick. Ovary ca 1.5 mm across; style short; stigma 4-lobed. Berries globose, 1.8–2.3 cm, tubercled.

Flowering & Fruiting: December–October.

Distribution: Andhra Pradesh, Goa, Karnataka, Kerala and Tamil Nadu. KWLS: Perumalamalai and Tiger Shola. *Kabeer & Ravi Kiran 133119*.

Notes: During the present study, it was collected in shola forests at elevation ranges from 1700 to 2000 m. Black bulbuls are feeding on the fruits.

14. **SAPINDACEAE**

Allophylus L.

Key to the species

1a. Lianas; thyrsus branched……..1. **A. concanicus**

1b. Shrubs; thyrsus unbranched…….2. **A. serratus**

1. Allophylus concanicus Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 20: 230 1890; P.C. Pant in N.P. Singh *et al*., Fl. India 5: 348. 2000. *Allophylus concanicus* Radlk. var. *lanceolatus* Gamble, Fl. Madras: 246. 1918; K.M. Matthew, Fl. Palni Hills 1: 246. 1999. **(Plate No. 13.1)**

Lianas; branchlets greyish, lenticellate. Leaves trifoliate, petiole ca 4–10 cm long, glossy; leaflets to 15 × 6 cm, ovate to lanceolate, acute to acuminate, 6-nerved, distantly serrate towards the apex; midrib pubescent; petiolules 2–3 mm; domatia hairy. Inflorescence axillary thyrse, longer than leaves, ca 20 cm long, branched, hispid; peduncle ca 10 cm long. Flowers solitary or paired, 2.5 mm across, white to cream; pedicel ca 1 mm long. Sepals 4, orbicular, ciliate, green. Petals 4, obovate, ca 5 mm across, densely white hairy within. Stamens 6–10; filaments hairy, reddish, inserted inside the disk; disk 4-lobbed, glands 4, subequal. Ovary bilocular, styles 2. Schizocarp subglobose, 0.8 mm across, glabrous, red when ripe.

Flowering & Fruiting: August–April.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Blackburn and Tiger Sholas.

Notes: Huge lianas scarsely occurs in the shola forests of the sanctuary at elevations between 1700 and 2100 m. Compared to Aanamamalis, very less individuls seen in the Palnis at Blackburn and Tiger Sholas.

2. **Allophylus serratus** (Roxb.) Kurz in J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 44(3): 185. 1876; Gamble, Fl. Madras: 176. 1918; K.M. Matthew, Fl. Palni Hills 1: 246. 1999; P.C. Pant in N.P. Singh *et al*., Fl. India 5: 349. 2000. *Ornitrophe serrata* Roxb., Pl. Coromandel 1: 44. 1796. **(Plate No. 14)**

Shrub; branchlets lenticellate, whitish. Leaves alternate, 3-foliolate; leaflets elliptic or obovate, 7–10 × 5–6 cm, cuneate at base, apex acuminate, greyish tomentose beneath, margins crenate-serrate or denticulate; petioles ca 10 cm long; petiolules ca 1.5 cm long. Inflorescence

axillary, thyrse, unbranched, shorter than leaves, ca 12 cm long; peduncles ca 3 cm long. Flowers ca 2.5 mm across, cream or white. Calyx 4 or 5, orbicular, 1.5 mm across. Petals 4 or 5, oblong-obovate, ciliate, clawed, cuneate at base, glandular-hairy; disk glabrous. Stamens 8–10; filaments unequal, glabrous; ovary pilose, lobed; style bifid, ciliate. Schizocarp globose to subglobose, ca 0.8 cm across, red when ripe.

Flowering & Fruiting: Throughout the year.

Distribution: Andhra Pradesh, Arunachal Pradesh, Karnataka, Kerala, Orissa, Tamil Nadu, Tripura and West Bengal. KWLS: Palar, Prandalar and Kudarayar dams. *Kabeer & Ravi Kiran*

Notes: Frequently occurs at the foot hills of the sanctuary at elevations between 400 and 700 m. Maximum populations were noticed in Palani forest range.

15. **FABACEAE**

Key to the genera

1a. Leaves simple……....…….....**1. Crotalaria**
1b. Leaves compound…….....…….....….....2
2a. Lianas….....…….....2. **Derris**
2b. Climbers and herbs …….....3
3a. Leaflets 3…….....……4
3b. Leaflets 6–8 ……5. **Smithia**
4a. Leaves gland-dotted ……...3. **Indigofera**
4b. Leaves non glandular…….....……..4. **Rhynchosia**

1. **Crotalaria** L., nom. cons.

Key to the species

1a. Prostrate herb …….....2. **C. fysonii**
1b. Erect shrubs …….....2
2a. Leaves elliptic-obovate; stipules auriculate; pods glabrous ……1. **C. beddomeana**
2b. Leaves oblong or oblanceolate; stipules absent; pods pubescent …...……...3. **C. longipes**

1. **Crotalaria beddomeana** Thoth. & A.A. Ansari in Bull. Bot. Surv. India 20: 180. 1979; Sanjappa, Legumes India: 117. 1992; K.M. Matthew, Fl. Palni Hills 1: 297. 1999; A.A. Ansari, *Crotalaria* India: 259. 2008. *C. lanata* Bedd. in Madras J. Lit. Sci. Ser. 2, 19: 178. 1858, non Thunb. 1796; Baker in Hook.f., Fl. Brit. India 2: 77. 1876; Gamble, Fl. Madras: 297. 1918. **(Plate No. 14)**

Shrub, bushy; stems angular, grooved, villous. Leaves elliptic-obovate, ca 14 × 8 cm, base obtuse, apex obtuse, apiculate, sparsely ciliate above, densely pubescent beneath, subcoriaceous; petioles ca 1.8 cm long; stipules ca 1.5 × 1 cm, falcate to auriculate. Racemes

terminal, lax, ca 20 cm long; bracts ca 1 cm, ovate, acuminate, tomentose; bracteoles ca 5 mm long, lanceolate. Calyx tube ca 6 mm long, pubescent; lobes ca 2 cm long, lanceolate, reflexed. Standard petal orbicular or obcordate, ca 3 × 2.5 cm, yellow with green and brownish streaks; wings ca 1.5 × 1.2 cm; keels ca 1.8 × 1.2 cm, incurved towards apex, beaked. Stamens 10. Ovary stalked, linear. Pods oblong, ca 6 × 2 cm, narrowed and flat at base, glabrous, beaked; seeds many, ca 8 × 6 mm, reniform, black.

Flowering & Fruiting: November–January.
Distribution: Andhra Pradesh, Kerala and Tamil Nadu. KWLS: Vattakanal. *Kabeer & Ravi Kiran 133195.*
Notes: Found only at Vattakanal Shola, however, grown as an ornamental in many home gardens at Kodaikanal and Shenbaganur.

2. **Crotalaria fysonii** Dunn in Bull. Misc. Inform. Kew 1914: 26. 1914; Fyson, Fl. S. Ind. Hill Stat.: 144, t. 108. 1932; K.M. Matthew, Fl. Palni Hills 1: 300. 1999; A.A. Ansari, Crotalaria India: 179. 2008.

Prostrate herb, 15–40 cm long; branchlets from woody base; branches terete, villous. Leaves ovate, 1.5–2.5 × 1.5–2 cm, cordate at base, acute or mucronate at apex, margins involute, adpressed hirsute on both surfaces, ciliate; lateral veins obscure above, prominent beneath; stipules linear-lanceolate, 1–2 mm long; petioles ca 2 mm long, hirsute. Racemes terminal; peduncles 5–15 cm long, hirsute. Flowers up to 8, towards apex of peduncle, ca 1.8 cm across; pedicels ca 6 mm long, hirsute; bracts ovate-lanceolate, 2–4 mm long, bracteoles 2, ovate, 1.5–3 mm long, hirsute. Calyx tube ca 4 mm long; lobes lanceolate, 1–1.4 × ca 0.3 cm, acuminate at apex, hirsute. Standard petal orbicular, ca 1.5 × 2 cm, slightly reflexed, yellow with reddish brown streaks; wings oblong, ca 1 × 0.8 cm, obtuse at apex; keels ovate, ca 1 × 0.6 cm, beaked, twisted. Staminal sheath ca 7 mm long; anthers dimorphic. Ovary oblong, ca 8 mm long, hirsute, stalked; style ca 7 mm long; stigma globose; ovules up to 15. Pods oblong, ca 2.5 × 1 cm, cylindrical, densely hirsute; seeds up to 12, reniform, smooth.

Key to the varieties

1a. Plants hirsute ……..……..2.1. var. **fysonii**
1b. Plants glabrous ……..…….2.2. var. **glabra**

2.1. var. **fysonii**: Dunn in Bull. Misc. Inform. Kew 1914: 26. 1914; Sanjappa, Legumes India: 120. 1992. **(Plate No. 15)**

Flowering & Fruiting: Throughout the year.

Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Ibex peak, Jamindar Shola, Katrikaodae, Kookal, Perumalmalai, Poombarai, Pulavichiar, Vattakanal and Vembadi peak. *Kabeer & Ravi Kiran 132739, 132778 & 141021.*

Notes: Very common in grasslands in the higher elevation of the sanctuary. Common Cerulean butterfly is the major pollinator.

2.2. var. **glabra** Gamble, Fl. Madras: 292. 1918; Sanjappa, Legumes India: 120. 1992; A.A. Ansari, *Crotalaria* India: 179. 2008. **(Plate No. 15)**

Prostrate herb; stems glabrous. Leaves subcoriaceous, ca 2.5 × 1.5 cm, ovate, obtuse, cordate at base, adpressed-pubescent beneath; stipules filiform. Racemes 4–7-flowered, axillary; pedicels ca 5 mm long, ciliate. Flowers ca 1.8 cm long; bract ovate, ca 0.5 mm long, ciliate; bracteoles 2; Calyx lanceolate, ca 1 × 0.3 cm, acuminate, glabrous. Standard petal obovate, ca 2 × 1.5 cm, glabrous, yellow inside, reddish outside; wings ca 1.3 × 0.8 cm; keels ca 1 cm long, glabrous. Ovary oblong; style 5–7 mm long. Pods ca 2 × 0.7 cm, oblong, densely fulvous-hairy, subsessile.

Flowering & Fruiting: November–January.

Distribution: Tamil Nadu (Palani Hills). KWLS: Berijam and Vandaravu Forest Ranges. *Kabeer & Ravi Kiran 141009.*

Note: Very scarce in the sanctuary and a few populations were located at Pundi Lake and Konalar marsh. These two areas are interconnected through a stream of Konalar dam. Konalar marsh is invading by species of *Acacia, Pinus* and Poondi is under high anthropogenic pressure.

3. **Crotalaria longipes** Wight & Arn., Prodr. Fl. Ind. Orient.: 181. 1834; Baker in Hook.f., Fl. Brit. India 2: 76. 1876; Gamble, Fl. Madras: 298. 1918; K.M. Matthew, Fl. Palni Hills 1: 302. 1999; A.A. Ansari, *Crotalaria* India 232. 2008. *C. candicans* Wight & Arn., Prodr. Fl. Ind. Orient.: 184. 1834; Gamble, Fl. Madras: 298. 1918; Sanjappa, Legumes Ind. 118. 1992; K.M. Matthew, Fl. Palni Hills 1: 299. 1999; A.A. Ansari, *Crotalaria* India 227. 2008. **(Plate No. 16)**

Shrub, ca 3 m high, bushy; branches subterete, obscurely angled, densely silky-pubescent. Leaves alternate, oblong or oblanceolate, 1.5–8 × 2–3 cm, cuneate at base, obtuse, and mucronate or apiculate at apex, adpressed silky-pubescent on both surfaces; lateral veins 6–8 pairs, prominent; petioles 1–5 mm long, hairy; stipules absent. Panicles terminal and lateral much-branched, ca 30 cm long. Flowers ca 3 × 2 cm, crowded; pedicels alternate, 0.2–1.2 cm long, hairy; bracts in pairs, spreading on the peduncle, foliaceous, reflexed or ovate or ovate-lanceolate, 4–8 × ca 2.5 mm, acuminate, hairy; bracteoles 2, ovate, ca 4 mm long, reflexed,

hairy above, glabrous beneath. Calyx-tube ca 4 mm long, sericeous outside, lanceolate, 0.8–1cm long, acuminate, incurved. Standard petal broadly orbicular-ovate, ca 2.5 × 2 cm, obtuse-acute or short apiculate at apex, silky-pubescent outside, margins ciliate, yellow; wings obovate, ca 1.5 × 0.5 cm; keels lanceolate, ca 1.6 × 0.7 cm, curved. Stamens 10, sheath ca 6 mm long; filaments free, 0.5–1.0 cm long. Ovary ca 5 mm long; style ca 1.5 cm long, densely pubescent. Pods oblong, 3–4 × 1–1.5 cm, sparsely hairy, stalked; stalks 4–7 mm long, base flat; seeds 8–12.

Flowering & Fruiting: Throughtout the year.
Distribution: Peninsular India. KWLS: Kombaikkadu. *Kabeer & Ravi Kiran 133139.*
Notes: Very common in the savannahs at elevations between 800 and 1500 m. Maximum number of population found in Palani to Vadakownji (Palani–Kodaikanal Ghat Road) grassy slopes. This habitat is under threat due to expansion of private estates and seasonal grassland fire.

2. **Derris** Lour. nom. cons.

Key to the species

1a. Leaflets ovate; inflorescence compact, rusty-tomentose….....1. **D. brevipes**
1b. Leaflets elliptic; inflorescence lax, glabrous……..…….2. **D. heyneana**

1. Derris brevipes (Benth.) Baker in Hook.f., Fl. Brit. India 2: 244. 1878; Gamble, Fl. Madras: 388. 1918; K.M. Matthew, Fl. Palni Hills 1: 314. 1999. *D. thothathrii* Bennet in Indian J. Forest. 1: 28. 1978; Sanjappa, Legumes India: 148. 1992. **(Plate No. 16)**

Liana; branchlets lenticellate, glabrous, young branches glabrescent. Leaves 3– 9-foliolate, ca 25 × 10 cm; petioles ca 8 cm long; rachis ca 15 cm long, 4-angled; leaflets ovate or ovate-lanceolate, 4–7 × 3–5 cm, coriaceous, abruptly acuminate at apex, rounded at base; lateral veins 9 pairs; petiolules ca 5 mm long. Panicles axillary and terminal, ca 30 cm long, copiously branched, dense, rusty-tomentose. Flowers ca 1.4 × 0.7 mm; pedicels ca 7 mm long. Calyx cupular, ca 4 mm long, rusty-hispid; lobes obtuse. Standard obovate, ca 10 × 8 mm, white, pink-tinged, emarginate, incurved, sericeous; wings oblong-lanceolate, ca 10 × 3 mm, sericeous; keels ovate-lanceolate, ca 8 × 7 mm, glabrate; stamens 10, monadelphous. Ovary hairy, ca 7 mm long. Pods ca 5 × 3 cm, ovate or oblong, brown-floccose, beaked; 1–3 seeded.

Flowering & Fruiting: March–June.
Distribution: Karnataka, Kerala, Maharastra and Tamil Nadu. KWLS: Kookal and Perumalmalai. *Kabeer & Ravi Kiran 135559 & 138177.*

Notes: One of the large lianas in shola forests at elevations between 1800 and 2500 m, and attracts many pollinators while in bloom. Found very good population at Perumalmalai. The study of the holotype specimen of *D. thothathrii* Bennet reveals that it is conspecific with *D. brevipes* (Benth.) Baker.

2. **Derris heyneana** (Wight & Arn.) Benth. in Miq., Pl. Jungh. 1: 252. 1852; Gamble, Fl. Madras: 388. 1918; K.M. Matthew, Fl. Palni Hills 1: 315. 1999. *Pongamia heyneana* Wight & Arn., Prodr. Fl. Ind. Orient.: 263. 1834. *Derris heyneana* Baker var. *paniculata* Baker in Hook.f., Fl. Brit. India 2: 244. 1878. *D. matthewii* Kottaim. in Webbia 72(1): 97. 2016. *D. gamblei* Soosairaj, P. Raja & Dhatchan. in Nordic J. Bot. 35(4): 423. 2017. **(Plate No. 17)**

Liana; stems glabrous, lenticellate. Leaves ca 20 × 13 cm; leaflets 5–9 pairs, ovate-oblong or elliptic, 3–5 × 1.5–2.5 cm, rounded to cuneate at base, obtuse, retuse at apex; lateral veins 7–10; stipules minute. Panicles axillary and terminal, lax; peduncles ca 3 cm long; rachis ca 20 cm long. Bracts and bracteoles minute, ovate, puberulous. Calyx campanulate, ca 4 mm long, puberulous, red to brownish. Corolla light pinkish outside, white inside, green-streaked; standard ovate, 0.5–0.8 cm across, acute, incurved; wings obovate, 4– 6 mm long; keels oblanceolate, ca 7 × 3 mm. Ovary 0.5–0.7 cm long, densely pubescent; style incurved; stigma capitate. Pods ovate, ca 5 × 3 cm, glabrescent.

Flowering & Fruiting: February–May.

Distribution: Goa, Gujarat, Karnataka, Maharashtra and Tamil Nadu. KWLS: Damdamparai. *Kabeer & Ravi Kiran 133780.*

Notes: Common in mid Palanis at altitude ranges from 600 to 1600 m. New foliage and massive blooming was recorded in March. Fragrant flowers attacts the pollinators while blooming. Recently described new taxa *Derris matthewii* Kottaim. (2016) and *D. gamblei* S. Soosairaj *et al.*, (2017) are conspecific with *D. heyneana* (Wight & Arn.) Benth. after the study of protologues and type specimens.

3. **Indigofera** L.

Indigofera prostrata Willd., Sp. Pl. 3: 1226. 1802; Gamble, Fl. Madras: 310. 1918; Sanjappa, Legumes India: 194. 1992 & in Hajra *et al.*, Fasc. Fl. India 21: 115. 1995; K.M. Matthew, Fl. Palni Hills 1: 336. 1999. *I. trifoliata* sensu Baker in Hook.f., Fl. Brit. India 2: 96. 1876, non L. 1753.

(Plate No. 17)

Decumbent herb; branchlets radiating, appressed-pubescent. Leaves 3-foliolate; leaflets obovate or elliptic-obovate or oblanceolate, 1–1.8 × 0.4–0.8 cm, base cuneate, apex obtuse, apiculate, appressed-pubescent, gland-dotted beneath; petioles 1–2.5 cm long; stipules

subulate. Racemes axillary, ca 1 cm long, 3–8-flowered. Flowers deep rose or brick-red; pedicels ca 2 mm long. Calyx-tube ca 0.7 mm long; lobes ca 1.2 mm long, setaceous. Corolla exserted, densely hairy outside; standard petal ca 6 mm long, obovate; wings oblong-obovate, ca 6 mm long; keels ca 5 mm long. Staminal sheath ca 3 mm long. Pods slender, 1–1.8 cm long, flat, beaked, pubescent; seeds 4–8, oblong.

Flowering & Fruiting: August–December.
Distribution: Andhra Pradesh, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Tamil Nadu and West Bengal. KWLS: Palamalai and Periapatty. *Kabeer & Ravi Kiran 139651*.
Note: Very common, like a weed in Mid-Palanis (elevation ranges from 800 to 1500 m.) and grows in grasslands as well.

4. **Rhynchosia** Lour., nom. cons.

Rhynchosia filipes Benth. in Linnaea 24: 644. 1852; Baker in Hook.f., Fl. Brit. India 2: 221. 1876; Gamble, Fl. Madras: 374. 1918; Sanjappa, Legumes India: 237. 1992; K.M. Matthew, Fl. Palni Hills 1: 354. 1999. **(Plate No. 18)**

Trailing herb; stems filiform, hispid. Leaves alternate, 3-foliolate; leaflets obovate, ca 4 cm long, obtuse, mucronate at apex, subcoriaceous, glaucous beneath and reticulate; petioles 4–8 cm long; petiolules 2–5 mm long. Inflorescence axillary, racemes ca 10 cm long, filiform. Flowers ca 8 mm across, solitary, bracts below the calyx; pedicels ca 1 cm long. Calyx cupular; lobes linear, the lowest longest, ca 6 mm long, hispid. Corolla exserted, hairy outside; standard petal orbicular, ca 1 cm, streaks red; wings ca 5 × 3 mm; keels obovate, obtuse, ca 1 × 0.7 cm. Stamens 10; anthers and filaments equal. Ovary subsessile, 1–3-ovuled; style filiform, much incurved; stigma capitate. Pods oblong, 1–1.8 cm long, softly pubescent, 1–3-seeded, beaked.

Flowering & Fruiting: August–February.
Distribution: Kerala and Tamil Nadu. KWLS: Kookal, Palamalai and Perumalmalai. *Kabeer & Ravi Kiran 141130*.
Notes: A common species in grasslands at elevations ranging from 1200 to 2500 m; good number of populations were observed at Colony Medu, Palamalai and Kookal. Plants growing in higher elevations are with thicker leaves and peduncles compare those growing in mid-Palani area.

5. **Smithia** Aiton

Key to the species

1a. Branchlets glandular-pubescent; Seeds ca 6……1. **S. gracilis**
1b. Branchlets glabrascent; Seeds more than 10.....2. **S. hirsuta**

1. **Smithia gracilis** Benth. in Linnaea 24: 642. 1851; Baker in Hook.f., Fl. Brit. India 2: 150. 1876; Gamble, Fl. Madras: 330. 1918; Sanjappa, Legumes India: 247. 1992; K.M. Matthew, Fl. Palni Hills 1: 360. 1999. **(Plate No. 19)**

Decumbant herb; branches radiating, branchlets glabrescent. Leaflets 3 or 4 pairs, elliptic-ovate, 3–6 × 1–2 mm, ciliate at margins and midvein beneath; petioles ca 8 mm long. Racemes axillary and terminal, few-flowered; bracts ovate-lanceolate, ca 2 mm long, hyaline. Calyx ca 0.4 cm long, 2-lipped; upper lip broad; lower 3-lobed, central lobe acuminate, glandular-hairy. Standard petal ca 0.7 cm across; wings ovate, ca 6 mm long; keels ovate, ca 5.5 mm long. Stamens 10 (5+5). Ovary curled; ovules 4 or 5. Pods ca 6 mm long, 3 or 4-jointed, twisted; seeds ca 1 mm diam.

Flowering & Fruiting: Throughout the year, but peak during August–December.
Distribution: Peninsular India. KWLS: Perumalmalai and Vattakanal Shola.
Notes: It is found in grasslands at elevations between 1800 and 2400 m of the sanctuary. It grows on dripping rocky slopes in association with species of *Impatiens* and *Neanotis*. It is observed that the habitat of this species is shrinking due to invasion of species of *Eucalyptus* and *Acacia*.

2. **Smithia hirsuta** Dalzell in Hooker's J. Bot. Kew Gard. Misc. 3: 135. 1851. Gamble, Fl. Madras: 330. 1918; Sanjappa, Legumes India: 247. 1992; K.M. Matthew, Fl. Palni Hills 1: 361. 1999. **(Plate No. 18.1)**

Decumbant herbs; brnachlets brownish, glandular-pubescent. Leaflets 2–3 pairs, ca 6–12 × 5 mm, obovate, obtuse at apex, oblique at base, ciliate along margins and midribs; stipules ca 10 mm long, acuminate, bristled along the margins. Racemes corymbose, ca 5 cm long; rachis densely villous. Cepals 5, 2-lipped, lower lip clearly 3 lobbed, green, 5 mm long, densely ciliate, cilia arisinf from a brownish glandular bulbous base. Petals 5, standard petal ca 9 × 5 mm, obovate, emarginate, mucronate, clawed, yellow with red lines on either half; wings ca 7 × 2.5 mm, yellow; keels 7 mm, spurred. Stamens 10 (5+5), staminal column 8 mm long. Ovary linear, ovules ca 12; Style filiform. Pods 8-10-jointed; joints 2 x 2 mm, orbicular, biconvex, minutely, mucronate, dark brown. Seeds ca 12, reniform to circular, pitted, ca 1.2 mm across, greyish.

Flowering & Fruiting: Throughout the year, but peak during August–December.
Distribution: Peninsular India. KWLS: Prakashpuram.
Notes: It grows on dripping rocky slopes at elevations between 1800 and 2400 m of the sanctuary. It is observed that the habitat of this species is shrinking due to landscape changes.

16. **MIMOSACEAE**

Albizia Durazz.

Albizia lathamii Hole, Indian Forest Rec. 4: 153, 157. 1913; Gamble, Fl. Madras: 432. 1919; Sanjappa, Legumes Ind. 56. 1992; Sampath Kumar *et al.*, Phytotaxa 446(4): 260–264. 2020. **(Plate No. 19.1)**

Small trees, ca 8 m high; densely branched from the base; bark greyish-brown, lenticellate; branchlets brownish or greyish, terete, lenticellate. Leaves bipinnate, alternate, stipulate; stipules caducous; rachis 3–7 cm, base pulvinate, with a gland near the base, greyish tomentose; pinnae 2–5 pairs, 2–8 cm long, opposite, evenly pinnate, slender, pilose, with a gland in between terminal 2 pinnae; leaflets 6–22, opposite, even pinnate, estipellate, sessile; lamina 1–1.5 × 0.4–0.8 cm, elliptic to oblong, base unequal, apex round or retuse, margin entire, tomentellous, densely pilose beneath, chartaceous, midrib more or less central. Inflorescence axillary corymbs, sessile flowers in globose heads arranged in corymbs; peduncle ca 6 cm long, brown, pubescent. Calyx campanulate, 4 × 2.5 mm across, puberulous, teeth triangular, brown tinged. Corolla funnel shaped, lobes 5, ovate-triangular, grey to pinkish, pubescent. Stamens many, monadelphous at the base, tube equal or above than the corolla tube. Ovary sessile, oblong, pubescent; style filiform; stigma minute. Pod oblong, 8–18 × 1.5–2.4 cm, flattened, thin walled, straight, often slightly undulate along margins, puberulous, obtuse to rounded, mucronulate at apex, cuneate at base, blackish-brown when mature. Seeds ca 4 – 12, ellipsoid.

Flowering & Fruiting: October–May.

Distribution: Chhattisgarh, Karnataka, Kerala and Tamil Nadu. KWLS: Palani Range, Andipatti Eest forest beat. *Kabeer & Ravi Kiran 133686.*

Notes: A few small trees left only in this drydeciduous forest patch at elevation between 400–450 m. and appears like species of *Acacia* from the long sight.

17. **ROSACEAE**

Key to the Genera

1a. Compact shrubs; leaves simple; flowers 1 cm across……....1. **Cotoneaster**
1b. Straggling shrubs; leaves compound; flowers more than 5 cm across……2. **Rosa**

1. **Cotoneaster** Medik., nom. cons.

Cotoneaster buxifolius Wall. ex Lindl. Bot. Reg. sub t. 1229. 1829; Hook.f., Fl. Brit. India 2: 387. 1878; Gamble, Fl. Madras: 446. 1919; K.M. Purohit & Panigrahi, Fam. Rosac. India 3: 60. 1995; K.M. Matthew, Fl. Palni Hills 1: 426. 1999. **(Plate No. 19)**

Shrub, ca 4 m high; compactly branched, bushy, rigid, branchlets pubescent, blacksh. Leaves elliptic-ovate, ca 1.5 × 0.5 cm, alternate, coriaceous, acute at apex, margins recurved, base acute, pubescent above, densely white tomentose below; petioles ca 2 mm long. Inflorescence at apex of new shoots, 2–5-flowered; bracts linear, ca 1.5 mm long, pedicle ca 1 mm long. Sepals 5, triangular, ca 2 mm long, densely pubescent outside. Petals 5, orbicular, ca 3 mm wide, white to light pinkish. Stamens ca 20; filaments unequal; anthers pink. Ovary inferior, bilocular; ovules 2; styles 2. Drupes globose, ca 7.5 mm, scarlet to red when ripe; seeds 2.

Flowering & Fruiting: February–September.
Distribution: Kerala, North East India and Tamil Nadu. KWLS: Mannavanur and Pulavichiar. *Kabeer & Ravi Kiran 132889 & 133737.*
Notes: Vulnerable (Nayar *et al*., 1987). This study has found nearly 30 individuals in Mannavanur grassland, but this area is excluded from the sanctuary. Also a few were located at Pulavichiar forest beat and this habitat is under invasion by Wattle and *Pinus*. Few *Cotoneaster* sp. are normally cultivated in gardens of Central Europe (Dickoré & Kasperek, 2010).

2. **Rosa** L., nom. cons.

Rosa leschenaultiana (Thory) Wight & Arn., Prodr. Fl. Ind. Orient.: 1: 301. 1834; Hook.f., Fl. Brit. India 2: 368. 1878; Gamble, Fl. Madras: 444. 1919; K.M. Matthew, Fl. Palni Hills 1: 440. 1999. **(Plate No. 20)**

Straggling armed shrub; prickles hooked. Leaves alternate, imparipinnate, ca 10 × 6 cm, chartaceous; petioles 2–3 cm long; stipules adnate to base of the petiole, ca 2 cm, glandular; leaflets 3–9, terminal leaflet oblong-ovate, ca 5 × 3 cm, margins serrate; petiolule 5–7 mm; lateral leaflets oblong-elliptic, ca 4 × 2.5 cm, subsessile. Inflorescence terminal, solitary or in a few-flowered corymbs; peduncle 1–2 cm; pedicel 4–5 cm long, glandular strigose. Sepals 5, lanceolate, ca 2.7 × 0.7 cm, distantly lacinate, glandular strigose, reflexed. Petals 5, obcordate or obovate, 1.5–3 × 2–4 cm, imbricate, margins wavy, white. Stamens many; filaments ca 1.3 cm long; pistils superior. Ovary unilocular, inferior; ovules 2. Fruit globular or ovoid, 1–2 cm across, red when ripe, hard; seed 5–8.

Flowering & Fruiting: March–August.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Kookal, Mannavanur and Poombrai. *Kabeer & Ravi Kiran 133744.*
Notes: Generally seen at shola borders at altitude ranges from 1900 to 2500 m. New foliage, massive flowering noticed in March. Found maximum populations at Poombarai and Kookal.

18. **CRASSULACEAE**

Kalanchoe Adans.

Key to the species

1a. Calyx lobes shoter than corolla tube, flowers white……....1. **K. bhidei**
1b. Calyx lobes almost equal to corolla tube, flowers yellow……..2. **K. grandiflora**

1. **Kalanchoe bhidei** T.Cooke, Fl. Bombay 1: 467. 1903. Gamble, Fl. Madras: 450. 1919; Srinivasan in N.C. Nair & A.N. Henry, Fl. Tamil Nadu Anal. 1: 145. 1983; N.B. Singh *et al*., Crassulaceae of India 54, t.2. 2011. *Kalanchoe floribunda* var. *glabra* sensu K.M. Matthew, Fl. Palni Hills 1: 455. 1999, non C.B.Clarke 1878. **(Plate No. 20.1)**

Succulent undershrubs, 40–100 cm high, straggling when grow on cliffs, branchlets stout, scarsely glandular, brick red oftenly, glabrous. Leaves opposite decussate, ca 7–11 × 3.5–5.5 cm, ovate to obovate, obtuse at apex, crenate, margins scarsely glandular, sessile, green to pinkish, grey ashed. Inflorescence terminal, corymbose cymes; Cymes ca 22 cm across, panicled; bracts foliaceous, ovate, ca 3 × 1.8 cm . Flowers dense; pedicels ca 5–12 mm long; braceoles lanceolate, ca 1.8 × 5 mm. Sepals 4, ovate to lanceolate, ca 7 × 4 mm, acuminate, fleshy, united at the base, greenish to tinged pink. Corolla tube 1.1 cm long, urceolate, 4 angled; lobes 4, ovate, 0.9 × 0.7 cm, cuspidate at apex, white to cream, often tinged pink. Stamens 8; filaments connate to corolla tube, 4 shorter and 4 longer, creamy; anthers reniform. Ovary urceolate, 4-gonus; style bulbous, 4-partite; stigmas 4, white. Follicle urceolate, 1cm long, four ribbed longitudinally. Seeds many, oblong, ellipsoid.

Flowering & Fruiting: November–April.
Distribution: Andhra Pradesh, Karnataka, Kerala, Maharshtra and Tamil Nadu. KWLS: Perumalmalai. *Kabeer & Ravi Kiran 141199*.
Notes: Restricted to elevations between 1900 and 2500 m of the sanctuary with scarse populations at rocky cliffs on Perumalmalai and Vembadi Peak.

2. **Kalanchoe grandiflora** (Wall) Wight & Arn. Prodr. Fl. Ind. Orient. 1: 359. 1834. C.B. Clarke in Hook.f., Fl. Brit. India 2: 415. 1879. Gamble, Fl. Madras: 451. 1919; K.M. Matthew, Fl. Palni Hills 1: 456. 1999. **(Plate No. 20.2)**

Succulent undershrubs, ca 60 cm high, branchlets stout, glabrous. Leaves opposite decussate, ca 10 × 5.5 cm, obovate, obtuse at apex, crenate at base, sessile, crenate towards apex from the middle, green to pinkish, grey ashed. Inflorescence terminal, corymbose cymes; Cymes ca 25 cm across, panicled; bracts foliaceous, ovate, ca 3 × 1.5 cm. Flowers lax; pedicels ca 2–4 cm long; braceoles foliaceous, ovate, 2.5 × 1 cm. Sepals 4, ovate to lanceolate, 1 × 0.6 cm,

acuminate, fleshy, united at the base, greenish. Corolla tube 1.2 cm long, urceolate, 4 angled; lobes 4, ovate, 1 × 0.8 cm, cuspidate at apex, yellow. Stamens 8; filaments connate to corolla tube, 4 shorter and 4 longer, yellow; anthers reniform. Ovary urceolate, 4-gonus; style bulbous, 4-partite; stigmas 4, white. Follicle urceolate, 1.2 cm long, four ribbed longitudinally. Seeds many, oblong, ellipsoid.

Flowering & Fruiting: February–September.
Distribution: Kerala, and Tamil Nadu. KWLS: Berijam. *Kabeer & Ravi Kiran 133720.*
Notes: Restricted to elevations between 2000 and 2500 m of the sanctuary with scarse populations at Beriam and Vembadi Peak. This species was introduced in USA.

19. **MYRTACEAE**

Syzygium P. Browne ex Gaertn.

Syzygium densiflorum Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 329. 1834; K.M. Matthew, Fl. Palni Hills 1: 496. 1999. *Eugenia arnottiana* Wight, Ill. Ind. Bot. 2: 17. 1841; Duthie in Hook.f., Fl. Brit. India 2: 483. 1878. *Syzygium arnottianum* (Wight) Walp., Rep. 2: 180. 1843. nom. superfl.; Gamble, Fl. Madras: 478. 1919. *Eugenia arnottiana* (Walp.) Wight var. *benthamiana* Wight ex Duthie in Hook.f., Fl. Brit. India 2: 484. **(Plate No. 20)**

Tree, ca 20 m high; bark grey, branchlets terete. Leaves opposite, elliptic, elliptic-lanceolate or elliptic-oblong, ca 7 × 4 cm, estipulate, slender, grooved above, glabrous, base attenuate or obtuse, apex acuminate or caudate acuminate, margins entire, glandular punctate, coriaceous; lateral veins parallel, compact, prominent; petioles ca 2 cm long. Inflorescence in uppers axils and terminal, trichotomous cymes of dense umbellules; peduncle obscurely 4-gonous, flowers 10–12 mm long, sessile. Calyx tube ca 5 mm long, turbinate; lobes 4, obscure. Petals cream, obovate, ca 4 × 3 mm, caduceus. Stamens many, free; filaments curved, ca 8 mm long. Ovary inferior, oblong, bilocular; ovules many; style 1; stigma pointed. Berries oblong-ovoid, ca 8 × 6 mm, dark purple, fleshy.

Flowering & Fruiting: February–August. (Flowering so irregular)
Distribution: Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Berijam Shola, Blackburn Shola, Jamindar Shola, Kookal Shola, Mathikettan Shola and Telegraph path. *Kabeer & Ravi Kiran 133726.*
Notes: Vulnerable (World Conservation Monitoring Centre, 1998). Evergreen shola tree, with red new foliage that stands out among the shola trees. One of the dominant trees in the shola forests of the sanctuary. A more than 500 year old tree is located in Bombay shola, with a hollow trunk large enough to fit two Indian Gaurs. Black Bulbuls and Malabar Giant Squirrel feed on the buds and fruits.





Syzygium densiflorum Wall. ex Wight & Arn.

20. **MELASTOMATACEAE**

Key to the genera

1a. Trees, midnerve prominent; lateral veins obscure……..1. **Memecylon**
1b. Shrubs or herbs; leaves 3–5 prominent nerved from the base……..2
2a. Leaves glabrous, margins serrate; sepals 3……3. **Sonerila**
2b. Leaves densely hirsute or scabrid, margins entire; sepals 4 or 5……2. **Osbeckia**

1. **Memecylon** L.

Memecylon randerianum S.M. Almeida & M.R. Almeida in J. Bombay Nat. Hist. Soc. 85: 521. 1989; K.M. Matthew, Fl. Palni Hills 1: 500. 1999. *M. amplexicaule* Roxb. var. *malabarica* C.B. Clarke in Hook.f., Fl. Brit. India 2: 559. 1879. *M. malabaricum* (C.B. Clarke) Cogn. in A. DC. & C. DC., Monogr. Phan. 7: 1148. 1891; Gamble, Fl. Madras: 505. 1919. **(Plate No. 21)**

Small tree, 4–8 m high; bark fischurred. Leaves decussate, elliptic-ovate, ca 9 × 5 cm, apex acute, cordate at base, sessile, coriaceous, glabrous, pale green below; veins obscure. Flowers fascicled at nodes, many-flowered umbels; peduncles 1–3 mm long; pedicels 6–8 mm long. Calyx campanulate, tube ca 2 × 2 mm; lobes 4, truncate at apex. Petals 4, obovate, ca 2 × 2 mm, blue to violet. Stamens 8; anthers oblong, curved; filaments 5–7 mm long. Ovary inferior, ovoid, unilocular; ovules 6–10 in each locule; style subulate, 3–4 mm long. Berries globose to urceolate, ca 6 mm, red when ripe.

Flowering & Fruiting: April–September.
Distribution: Karnataka, Kerala, Maharashtra, Tamil Nadu (Nilgiris & Palni Hills). KWLS: Perumalmalai. *Kabeer & Ravi Kiran 135553 & 138191.*
Notes: Restricted to elevations between 1700 and 2400 m of the sanctuary with a colossal population on Perumalmalai. This study has found stray flowering in March and gregarious blooming in April 2017 at Perumalmalai.

2. **Osbeckia** L.

Key to the species

1a. Herbs; flowers tetramerous……1. **O. brachystemon**
1b. Shrubs; flowers pentamerous ……2
2a. Leaves 7-viened from the base……..4. **O. reticulata**
2b. Leaves 5-veined from the base……....3
3a. Cymes sessile; filaments shorter or equal to anthers……...3. **O. leschnaultiana**
3b. Cymes pedunculate; filaments longer than anthers……...2. **O. gracilis**

1. Osbeckia brachystemon Naudin in Ann. Sci. Nat. Bot. Ser. 3, 14: 57. 1850; K.M. Matthew, Fl. Palni Hills 1: 504. 1999. *O. truncata* D. Don ex Wight & Arn., Prodr. Fl. Ind. Orient.: 322. 1834 p.p.; C.B. Clarke in Hook.f., Fl. Brit. India 2: 514. 1879; Gamble, Fl. Madras: 494. 1919. *O. cupularis* D. Don ex Wight & Arn., Prodr. Fl. Ind. Orient.: 323. 1834, p.p.; C.B. Clarke in Hook.f., Fl. Brit. India 2: 514. 1879; Gamble, Fl. Madras: 494. 1919. **(Plate No. 21)**

Decumbent herbs. Leaves opposite, ovate or elliptic, 2–4 × 1.5–3 cm, subcoriaceous, densely strigose, 3-veined, base obtuse, margins entire, apex acute; petioles ca 4 mm long, strigose. Cymes umbellate, terminal, also axillary. Flowers ca 2 cm wide; pedicels ca 3 mm long. Hypanthium urceolate, ca 6 × 4 mm, calyx lobes 4, epicalyx projections 4, green with pink blotches, lanceolate densely bristle hairy. Petals 4, obcordate, ca 1 × 1 cm, ciliate at margins, white with scattered pink blotches,. Stamens 8; filaments ca 6 mm long; anthers ovoid, lobed. Ovary 4-locular, apically strigose, basally with 8 tongue shaped appendages; style ca 4 mm, curved. Capsules urceolate, 4–5 mm long, crowned at apex, reddish to purpulish when ripe, densely hairy; seeds many.

Flowering & Fruiting: July–January. (Dried capsules appears throughout the year.)
Distribution: Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Berijam. *Kabeer & Ravi Kiran* 132788, 140907 & 141010.
Notes: Restricted to Berijam slopes and Konalar marsh area at an altitude of above 2000 m. This species was noticed in August 2015 on Kodaikanal – Berijam road but in 2017 and 2018, it was not found in the same location due to landscape change. Gregarious colony recorded at Parathalar dam near Konalar marsh where plants grows erect to compete with other inhabitants like *Cyperus* and *Juncus* sp.

2. **Osbeckia gracilis** Bedd. in Madras J. Lit. Sci. Ser. 3, 1: 45. 1864; C.B. Clarke in Hook.f., Fl. Brit. India 2: 518. 1879; Gamble, Fl. Madras: 494. 1919; K.M. Matthew, Fl. Palni Hills 1: 504. 1999. *O. sublaevia* Cogn. in A. DC. & C. DC., Monogr. Phan. 7: 321.1891; Gamble, Fl. Madras: 492. 1919. *O. lineolata* Gamble, Bull. Misc. Inform. Kew 1918: 241. 1918 & Fl. Madras: 492. 1919. **(Plate No. 22)**

Shrub, ca 1 m high; branchlets 4-angled, glabrescent. Leaves opposite, ovate to elliptic-oblong, to 2–5 × 2–3 cm, obtuse at apex, subcordate to rounded at base, cuspidate, light green, densely hairy, 3-ribbed; petioles 2–4 mm long, strigose. Flowers in terminal cymes, also axillary, 2–4 cm across; 2rlppeduncle ca 2 cm long; pedicel ca 3 mm long; bracts ovate, caducous. Hypanthium urceolate, ca 1 cm long, densely hairy, lobes 5, ovate-oblong, ca 4 × 3 mm, obtuse, ciliate. Petals 5, obovate, ca 2 × 1.5 cm, pink, ciliate at margin. Stamens 10, ca 1.5 cm long; anthers shorter than filaments. Ovary 5-locular, strigose. Capsules urceolate, ca 1.2 × 0.8 cm; seeds many.
Flowering & Fruiting: July–December.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Vadakownji–Pannaikkadu and Vattakanal. *Kabeer & Ravi Kiran 141039.*

Notes: Vadakownji–Pannaikkadu grassalnds and Vattakanal grassland possess the maximum number of individuals at elevations between 1700 and 2500 m. Leafless dormant plants appear almost like dried plants from January to March.August is the peak flowering season and honey bees are common pollinators.

3. **Osbeckia leschenaultiana** DC., Prodr. 3: 142. 1828; C.B. Clarke in Hook.f., Fl. Brit. India 2: 520.1879; Gamble, Fl. Madras: 493. 1919; K.M. Matthew, Fl. Palni Hills 1: 505. 1999. *Osbeckia gardneriana* Wight, Icon. Pl. Ind. Orient. 3(3): 10, t. 997. 1845. **(Plate No. 22)**

Shrub, ca 1.2 m high; branchlets angled, reddish, strigose, internodes short. Leaves elliptic-ovate, 1.5–3 × 1–2 cm, acute at apex, base rounded, densely silvery pubescent, 3–5 nerved; petioles ca 3 mm. Inflorescence terminal, umbellate, sessile, flowers pink to purple, ca 2 cm across. Hypanthium urceolate, ca 0.8 × 0.6 cm, lobes 5, ca 4 mm long, densely reddish brown hairy. Petals 5, obovate, ca 2.2 × 1.3 cm, ciliate at margin, pink. Stamens 10, ca 1.2 cm long; anthers equal to filaments; filaments and anthers ca 7.5 mm long. Ovary 5-locular; style reddish, ca 1.5 cm long. Capsules urceolate, ca 1 cm long, densely pilose.

Flowering & Fruiting: April–January.

Distribution: Kerala and Tamil Nadu. KWLS: Ibex peak, Perumalamalai and Vadakownji–Pannaikkadu. *Kabeer & Ravi Kiran 139715.*

Notes: Restricted to grasslands in Perupallam and Kodaikanal forest ranges at elevations between 1700 and 2500 m. The largest poplutions are found on Ibex peak at 2400 m altitude. Due to invasion of *Acacia* spp (Wattle), the habitat of this species is shrinking at Ibex peak.

4. **Osbeckia reticulata** Bedd. in Trans. Linn. Soc. London 25: 216. 1865; C.B. Clarke in Hook.f., Fl. Brit. India 2: 520. 1879; Gamble, Fl. Madras: 493. 1919; Hansen, Ginkgoana 4: 115. 1977; K.M. Matthew, Fl. Palni Hills 1: 506. 1999. **(Plate No. 23)**

Shrub, 4 m high; branchlets rusty, subterete. Leaves ovate, 5–9 × 2–5 cm, coriaceous, strigose, dark green above, pale below, sometimes reddish brown, 5–7-nerved, base obtuse to subcordate, margins serrulate, acute at apex; petiole ca 1 cm long. Inflorescence terminal cymes, 5–8 cm long, 4–6-flowered, sessile; bracts foliaceous, ovate, ca 1 cm long. Flowers pentamerous, ca 7 cm wide. Hypanthium urceolate, ca 1.5 × 1.2 cm; lobes 5, oblong, ca 8 × 4 mm; stellate hairy. Petals 5, orbicular or obovate, ca 4.3 × 3.2 cm, purple to pink. Stamens 10, ca 2.4 cm; filaments ca 1.2 cm; anthers equal or slightly longer than filaments, oblong,

obscurely beaked. Ovary 5-locular, 10-lobed; style ca 2.7 cm long. Capsules urceolate, ca 2 × 1.9 cm; seeds many.

Flowering & Fruiting: February–September.
Distribution: Kerala and Tamil Nadu. KWLS: Kodaikanal, Perumalmalai and Shenbaganur. *Kabeer & Ravi Kiran 132723 & 135558*.
Notes: Gregarious shrub at shola borders at elevations between 1900 and 2500 m. Good populations observed at Gundar Shola, Vattakanal Shola, Blackburn Shola and Perumalamalai.

3. **Sonerila** Roxb., nom. cons.

Sonerila pulneyensis Gamble in Bull. Misc. Inform. Kew 1919: 226. 1919 & Fl. Madras: 500. 1919; A.N. Henry *et al.* in J. Bombay Nat. Hist. Soc. 75: 688. 1978 (1979); K.M. Matthew, Fl. Palni Hills 1: 507. 1999. **(Plate No. 23)**

Decumbent herb; branchlets glabrous, subsucculent. Leaves decussate, ovate, 2–3 × 1–2 cm, coriaceous, glabrous, 3-veined, base obtuse, margins serrate, apex acute; petioles 1–2 cm long. Inflorescence terminal, also axillary, cymes umbellate, 4–6-flowered. Flowers 3-merous; pedicel 4–8 mm long. Hypanthium pyriform, glabrous, glossy, reddish; lobes 3, ovate, ca 4 × 3 mm, fleshy. Petals 3, pink, ovate, ca 1 × 0.7 cm, attenuate at apex. Stamens 3; anthers basifixed, 5 mm long; filaments ca 1 cm long. Ovary trilocular; ovules many; style subulate, reddish, ca 1 cm long. Capsules urceolate, ca 1.3 × 0.6 cm, obscurely trigonous, glabrous, redish; stalk ca 1.2 cm long; seeds many.

Flowering & Fruiting: February–May.
Distribution: Kerala and Tamil Nadu. KWLS: Pambar Shola. (*Specimen not collected due to less number of individuals and Pamabr Shola is the type locality of this species*).
Notes: Less than 5 individuals left at type locality near Pambar falls and the type locality is under extreme threat due to uncontrolled tourist activities and other anthropogenic activities. A few individuals have been conserved by Bob & Tanya in Vattakanal Conservation Trust nursery, Kodaikanal.

21. **CUCURBITACEAE**

Key to the genera

1a. Leaves lobed; fruits more than 3 cm long……..1. **Trichosanthes**
1b. Leaves not deeply lobed; fruits not more than 3 cm long……...2. **Zehneria**

1. Trichosanthes L.

Trichosanthes lobata Roxb., Fl. Ind. 3: 703. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 2: 610. 1879; Chakrav., Fasc. Fl. India 11: 117. 1982; K.M. Matthew, Fl. Palni Hills 1: 543. 1999. *T. perrottetiana* Cogn. in A. DC. & C. DC., Monogr. Phan. 3: 362. 1881; Gamble, Fl. Madras: 529. 1919. *T. villosula* Cogn. in A. DC. & C. DC., Monogr. Phan. 3: 362. 1881; Gamble, Fl. Madras: 529. 1919; Chakrav., Fasc. Fl. India 11: 122. 1982. **(Plate No. 24)**

Climber; stem angled, glandular strigose. Leaves alternate, 5-lobed, cuspidate, ca 15 cm across, toothed, densely strigose beneath; petioles 5–8 cm long, angled; tendrils slender, leaf opposed, branched. Male racemes axillary, ca 10 cm long, glandular strigose, covered with ash. Flowers ca 15 in a raceme; pedicel 2–4 cm long; bracts oblanceolate, ca 7 mm long. Calyx tube ca 2 cm long, puberulous; lobes linear. Corolla lanceolate, ca 2.5 × 0.8 cm, white, margins deeply fimbriate into narrow lobes. Female flowers solitary, axillary; calyx tube ca 4 cm long; lobes lacinate; petals 5, lobes shorter than calyx lobes. Berries linear-oblong, ca 12 × 4 cm, narrow at apex, strigose, green with white stripes, scarlet when ripe; seeds 12 mm long, oblong, rugose along margins.

Flowering & Fruiting: March–September.

Distribution: Andhra Pradesh, Kerala and Tamil Nadu. KWLS: Tiger Shola and Vadakownji. *Kabeer & Ravi Kiran 141028.*

Notes: Closely allied to *Trichosanthes cucumerina* but flower, fruit shape and size are very small. Hangs from tree tops in shola forests at an elevations ranging from 1400 to 1800 m.

2. **Zehneria** Endl.

Key to the species

1a. Leaves thick, scabrid; fruits globose…….....1. **Z. hookeriana**

1b. Leaves membranous, glabrous; fruits oblong…….....2. **Z. maysorensis**

1. **Zehneria hookeriana** (Wight & Arn.) Arn. in Hooker's J. Bot. 3: 275. 1841; Hook. f., Fl. Brit. India 2: 624. 1879. *Bryonia hookeriana* Wight & Arn., Prodr. Fl. Ind. Orient. 1: 345. 1834. *Zehneria scabra* (L. f.) Sond. sensu K.M. Matthew, Fl. Palni Hills 1: 545. 1999, non Sond., 1862. **(Plate No. 24.1)**

Climbing monoecious herbs, stems scaberulous to scabrid, obscurely bullate; tendrils simple, leaf opposed, scabrid. Leaves cordate, ca 8 × 7.5 cm, sharply repand-toothed, acutely angled or obscurely 3-lobed, deeply cordate at base; scabrous above, slightly hairy beneath along the nerves and veins; petiole 3–4 cm long, scabrid. Male flowers in a simple or proliferous umbel

at the apex of peduncle; peduncle 1 – 2 cm long; 0.4–0.7 × 0.2–0.3 mm. Females in an umbel at the apex of a long peduncle, in a different axil from the males or solitary on a short peduncle in the same axils; calyx-tube cupular, petals white, hairy within; ovary globose; stigma 3-partite, floccose; pedicel 2 – 3 mm long, scabrid. Berry globose, ca 1 cm across, glabrous when mature; seeds flat.

Flowering & Fruiting: Throughout the year
Distribution: Kerala and Tamil Nadu. KWLS: Gundar and Kookal sholas. *Kabeer & Ravi Kiran 132726*.
Notes: Scarsely seen at shola forest borders and shola grasslands.

2. **Zehneria maysorensis** (Wight & Arn.) Arn. in Hooker's J. Bot. 3: 275. 1841; K.M. Matthew, Fl. Palni Hills 1: 544. 1999. *Bryonia maysorensis* Wight & Arn., Prodr. Fl. Ind. Orient. 1: 345. 1834. *Pilogyne maysorensis* (Wight & Arn.) W.J.de Wilde & Duyfjes, Reinwardtia 12(5): 410. 2009. *Zehneria maysorensis* (Wight & Arn.) Arn. var. umbellata (Chakrav.) Kumari, Fl. Tamil Nadu Ind., Ser. 1: 175. 1983. *Z. maysorensis* (Wight & Arn.) Arn. var. oblonga V.P. Prasad & M. Prasad J. Econ. Taxon. Bot. 17(2): 471. 1993. **(Plate No. 24.1)**

Climbing herbs, dioecious or rarely monoecious; stems glabrous, smooth; tendrils simple. Leaves cordate to deltoid, ca 7.5 × 7cm, 5-angled or lobed, acuminate at apex, margin repand-toothed, obscurely cordate at base; slightly scabrous; petiole 3–4 cm long. Male flowers in a proliferous umbel at the apex; 8 mm across; petals ovate, acute; anthers 1 mm long, connective pubescent; peduncle slender, 1.2–1.8 cm long. Female umbels solitary, often in the same axils with the males, rarely several umbellate at the apex of a long peduncle; peduncle 4–8 cm long; flowers 5 mm across; calyx tube 2 mm long, campanulate; petals 2.5 × 2 mm, obovate; stigma 3-lobed; ovary narrow-oval. Berry oblong, glabrous, copiously marked at young; reddish when ripe; seeds smooth, flat on the sides.

Flowering & Fruiting: September – May.
Distribution: Peninsular India. KWLS: Perupallam. *Kabeer & Ravi Kiran 135544*.
Notes: Very common in the dry deciduous and the dry evergreen forests at elevations between 400 and 900m.

22. **APIACEAE**

Key to the genera

1a. Plants prostrate; rooting at nodes……...2
1b. Plants erect; roots absent at nodes……3
2a. Leaves simple, orbicular-reniform……..3. **Hydrocotyle**

2b. Leaves compound, palmate……...4. **Vanasushava**
3a. Leaves simple, linear……1. **Bupleurum**
3b. Leaves compound, pinnate……...2. **Heracleum**

1. **Bupleurum** L.

Bupleurum distichophyllum Wight & Arn., Prodr. Fl. Ind. Orient.: 370. 1834; C.B. Clarke in Hook.f., Fl. Brit. India 2: 677. 1879. Gamble, Fl. Madras: 558. 1919; K.M. Matthew, Fl. Palni Hills 1: 557. 1999. **(Plate No. 24)**

Herb; branchlets grooved, obscurely zig-zag. Basal leaves petiolate, oblong-ovate, ca 4 × 0.3 cm; lower cauline leaves distichous, linear-subulate, ca 8 × 0.4 cm, acuminate; lateral veins 6 or 7, parallel; cauline leaves gradually smaller towards tip of the branch. Umbels terminal and in upper axils; peduncle ca 4 cm long. Involucral bracts 5, ca 1 cm long, ca 2 mm wide. Primary rays 5–8, slender, ca 2 cm long. Umbellules 15–20-flowered. Involucel bracts 5–6, lanceolate, 0.7–0.9 cm long. Petals 5, ovate, minute, incurved, caducous, yellow. Stylopodium conical. Capsules obovoid, ca 3 mm, concave, ribbed.

Flowering & Fruiting: September–November.
Distribution: Kerala and Tamil Nadu. KWLS: Perumalamali. *Kabeer & Ravi Kiran 141087*.
Notes: Slender, flexuous herb only seen at Perumalamali where populations are very scarce. Common in grasslands at elevations ranging from 1800 to 2500 m and facing extreme threat due to habitat shrinking.

2. **Heracleum** L.

Key to the species

1a. Lower leaves pinnate; leaflets obtuse at apex……...2. **H. ringens**
1b. Lower leaves bipinnate; leaflets acuminate……2
2a. Involucre bracts obscure……..3. **H. sprengelianum**
2b. Involucre of several linear-lanceolate bracts…….....1. **H. candolleanum**

1. Heracleum candolleanum (Wight & Arn.) Gamble, Fl. Madras: 565. 1919; P.K. Mukh. & Constance, Umbell. India 243. 1993; K.M. Matthew, Fl. Palni Hills 1: 562. 1999. *Pastinaca candolleana* Wight & Arn., Prodr. Fl. Ind. Orient.: 372. 1834. *Heracleum rigens* Wall. ex DC. var. *candolleana* (Wight & Arn.) C.B. Clarke in Hook.f., Fl. Brit. India 2: 715. 1879, p.p. *Tetrataenium rigens* (Wall. ex DC.) Manden., Trudy Tbilis. Bot. Inst. 20: 17 1959. **(Plate No. 25)**

Herb, ca 2 m high; branchlets strigose, aromatic. Leaves ternate or pinnate, ovate, ca 35 × 25 cm; leaflets oblong or ovate, sheathed, serrate, apex acute or acuminate, ca 10 × 6 cm;

petiole ca 15 cm long, hirsute. Inflorescence terminal umbel, involucral bracts lanceolate, ciliate at margin, 2–5 cm long, caudate-acuminate, hirtellous. Rays 20, unequal, ca 5 cm long, strigose. Umbellules to 2 cm across, 15–20-flowered; pedicels 5–7 mm long, hirsutulous. Involucel bracts foliaceous, linear-lanceolate, ciliate at margin, acuminate, ca 5 mm. Calyx 5-toothed; teeth linear-lanceolate, acuminate, 2–3 mm long, keeled. Petals 5, obovate, ca 2 × 1.3 mm, incurved, acuminate apex, ca 0.8 mm long, greenish yellow. Stamens 5; filaments ca 3 mm long, obscurely winged; anthers oblong, brown, ca 1 mm long. Ovary ca 1 mm long; styles 0.5–1 mm long; stigma capitate; stylopodium conical, ca 2 mm long. Capsules ellipsoid or obovate, ca 11 × 8 mm, laterally winged, ribbed, yellowish brown.

Flowering & Fruiting: July–October.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Perumalmalai, Polur, Poondi and Pulavichiar. *Kabeer & Ravi Kiran 132900.*
Notes: Good populations found at Polur and Pulavichar beats of Vandaravu forest range. Occurs in high altitude grassland slopes and the habitat is shrinking due to *Pinus* and *Acacia* sp. invasion.

2**. Heracleum rigens** Wall. ex DC., Prodr. 4: 191. 1830; Gamble, Fl. Madras: 564. 1919. P.K. Mukh. & Constance, Umbell. India 240. 1993. K.M. Matthew, Fl. Palni Hills 1: 563. 1999. *Pastinaca rigens* (Wall. ex DC.) Wight, Icon. Pl. Ind. Orient. 3(3): 12, t. 1009. 1845. T*etrataenium rigens* (Wall. ex DC.) Manden. in Trudy Tbilis. Bot. Inst. 20: 17. 1959. **(Plate No. 25)**

Rhizomatous herb; branchlets hispid, radiating, grooved. Leaves 2–3 pinnate, 30 × 15 cm; petioles ca 6 cm long, sheathed at base; rachis 10–25 cm long; leaflets lobed, varying in size, ca 4– 8 cm long, smaller towards tip; terminal leves 3-lobed, margins serrate, pubescent on both surfaces. Flowers in compound umbels; peduncles stout, hairy, ca 40–60 cm long; rays of varying length from 5–10 cm long, scabrous; involucre bracts 2–3 × ca 1 cm long, ovate lanceolate. Calyx teeth 5, minute, lanceolate. Petals ovate, ca 1 × 1.5 mm long, cream to yellow, early caducous. Stamens 5; anthers brown; filaments 2.5–3 mm long, exserted. Ovary 0.5–1 mm long; disk 2-lobed, lobes orbicular; styles 2, recurved. Capsules elliptic, ca 1.5 × 1 cm, laterally compressed, 3-ridged, scabrid, pinkish.

Flowering & Fruiting: July–October.
Distribution: Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Kookal and Vattakanal. *Kabeer & Ravi Kiran 141038.*
Notes: Very common in all high altitude grasslands of the sanctuary and completes its life cycle between July and December. Observed maximum populations from Kookal and Vattakanal grasslands. Peak flowering and fruiting observed in August. Habitat is under threat due to invasion of *Eucalyptus, Acaicia* and *Pteridium* species.

3. **Heracleum sprengelianum** Wight & Arn., Prodr. Fl. Ind. Orient.: 372. 1834; Gamble, Fl. Madras: 565. 1919; P.K. Mukh. & Constance, Umbell. India 241. 1993; K.M. Matthew, Fl. Palni Hills 1: 564. 1999. *Pastinaca sprengeliana* (Wight & Arn.) Wight, Icon. Pl. Ind. Orient. 3(3): 12, t. 1008. 1845. *Tetrataenium sprengelianum* (Wight & Arn.) Manden., Trudy Tbilis. Bot. Inst. 20: 17 1959. **(Plate No. 26)**

Herb, ca 1.5 m high; branched. Leaves pinnate, ternate or alternate, ca 40 × 30 cm; leaflets pinnatifid, 10–15 cm long, cuneate, margins serrate or double serrate or crenate-serrate, glaucescent below; petioles ca 7 cm long; sheath broadly ovate, auriculate, adnate to petiole above, 2–4 × ca 2 cm, parallel nerved. Umbels terminal and in upper axils, ca 10 cm long; umbellules 15–20-flowered; involucral bracts 1–2, caducous; pedicels ca 8 mm long, greyish-pubescent, hirsutulous. Calyx rudimentary, lobes 5, linear-lanceolate, acuminate, ca 1.5 mm long, caducous. Petals 5, elliptic-lanceolate, ca 2 × 1 mm, acuminate and incurved at apex, with a thick midnerve, greenish yellow. Stamens 5; filaments incurved at apex, ca 2 mm long; anthers oblong-ovoid, ca 0.5 mm, yellow. Ovary ca 0.7 mm, hairy; style ca 0.3 mm long. Capsules elliptic, 8–12 × 4–8 mm, laterally compressed.

Flowering & Fruiting: July–October.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Perumalmalai and Vadakownji. *Kabeer & Ravi Kiran 142654.*

Notes: Frequently seen in the mid Palanis at altitude ranges from 800 to 1700 m. Plants will turn yellow by December. During the study, several individuals noticed on Perumalamali to Shembiranculam path via Vadakownji.

3. **Hydrocotyle** L.

Hydrocotyle conferta Wight, Icon. Pl. Ind. Orient. 3(3): 11, t. 1002. 1845; Gamble, Fl. Madras: 556. 1919; P.K. Mukh. & Constance, Umbell. India 13. 1993; K.M. Matthew, Fl. Palni Hills 1: 565. 1999. **(Plate No. 26)**

Prostrate herb; rooting at nodes, branchlets scabrid. Leaves orbicular-reniform, 2–4 cm across, densely strigose on both surfaces, 7-lobed, margins crenate-dentate, palmately 7-nerved; petioles ca 12 cm, strigose; stipules ovate, ca 3 mm across, transpirant. Inflorescence umbellate, leaf-opposed, 10–15-flowered; peduncle 2–3 mm; bracts obscure, caduous. Flowers sessile; calyx obsolete; petals 5, oblong, ca 1 × 1 mm, inflexed, cream. Stamens 5. Disk 2-partite; style ca 1 mm long; stigmas 2. Capsules suborbicular or cordate, ca 1.1 × 1.25 mm, laterally compressed, aggregated cluster of 5–10, bistipitate at apex, seed 1.

Flowering & Fruiting: Throughout the year.

Distribution: Kerala and Tamil Nadu. KWLS: Berijam and Pambar falls. *Kabeer & Ravi Kiran 138153.*

Notes: Endangered (Anitha, 2011). During the current explorations it was collected from Pambar falls and also from Berijam range at elevations between 2000 and 2300 m. Pamabar Shola is one of the eco-sensitive zones of the sanctuary, having a high number of endemic plants with much anthropogenic pressure. K.M. Matthew (1999) has expressed his doubt on *H. javanica* and *H. conferta* hesitating to separate the two species in Flora of the Palni Hills. Both species are very much similar vegetatively but differ in flowers and fruits.

4. **Vanasushava** P.K. Mukh. & Constance

Vanasushava pedata (Wight) P.K. Mukh. & Constance in Kew Bull. 29: 595. 1974 & Umbell. India 90. 1993; K.M. Matthew, Fl. Palni Hills 1: 569. 1999. *Heracleum pedatum* Wight, Icon. Pl. Ind. Orient. 2(1): 3, t. 342. 1840; Gamble, Fl. Madras: 565. 1919. **(Plate No. 27)**

Trailing herb; rooting at nodes, ca 1 m long, branchlets turns purplish by age. Leaves alternate, 3-foliolate, 12 × 10 cm; petioles 8–12 cm long; sheathing at base,; leaflets ovate-lanceolate or ovate-elliptic, acute or cuneate, spinulose-serrate or double serrate, acuminate; terminal leaflet larger than laterals, deeply lobed, ca 7 × 3.5 cm, sparsely strigulose on veins; petiolules 1–1.5 cm long, strigose; lateral leaflets deeply lobed into apparently 2 leaflets. Inflorescence compound umbel, terminal, also in upper axils, rays 2–5, ca 5 cm long, 5–20-flowered, polygamous; peduncles slender, ca 6 cm long, ribbed and grooved, hirsutulous. Involucel lanceolate, acuminate, ca 5 × 2 mm, midvein distinct; pedicels 1.5–2.2 mm long, minutely hirsutulous. Calyx teeth linear-lanceolate, 1–1.5 mm. Petals 5, oblong-obovate, ca 1.5 mm long, inflexed at apex, unequal, obtuse at apex, white. Stamens 5; filaments subulate, ca 1.7 mm long, curved; anthers subglobose-ovoid, obtuse, ca 0.6 mm, 2-loculed. Ovary ca 1 mm; style erect, ca 0.5 mm long, 2-lobed. Capsules ovoid-oblong, 5–6 mm long, obscurely ribbed.

Flowering & Fruiting: Throughout the year.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Berijam, Blackburn, Pambar, Poombarai and Tiger Sholas. *Kabeer & Ravi Kiran 132749*.

Notes: Very common shola forest element growing as under storey trailing herb at elevations between 1800 and 2500. *Acaica* sp. invasion and anthropogenic pressure by tourists in the habtat are the threat factors to this species.

23. CAPRIFOLIACEAE

Lonicera L.

Lonicera leschenaultii Wall. in Roxb., Fl. Ind. 2: 178. 1824; C.B. Clarke in Hook.f., Fl. Brit. India 3: 10. 1880; Gamble, Fl. Madras: 577. 1919; K.M. Matthew, Fl. Palni Hills 2: 577. 1999. **(Plate No. 27)**

Straggler; branchlets pubescent, younger branchlets pinkish. Leaves opposite, ovate, ca 7 × 4 cm, acute or shortly acuminate, subcordate to cordate at base, grey pubescent below; petioles ca 1.3 cm; stipules lanceolate, deciduous, 2–4 mm long. Inflorescence terminal, also in upper axills, flowers paired, white, turns to yellow with maturity; bracteoles 2, lanceolate, ca 5 mm long, pubescent. Calyx tube ca 2 mm long, adnate with the ovary, 5-toothed. Corolla bilabiate, 3 + 1, tube 4–6 cm long, hispid bothsides. Stamens 5, exserted, attached at the throat of corolla tube; filaments ca 3 cm long. Ovary ca 2 mm long, villous; style ca 3.5 cm; stigma capitate. Berries combined at base, dark blue when ripe, hispid.

Flowering & Fruiting: July–November.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Blackburn Shola, Kookal Shola and Kudarayar Shola. *Kabeer & Ravi Kiran 133126*.

Notes: Frequent in wet evergreen forests of the sanctuary at elevations between 1400 and 2500 m. The largest numbers of individuals of this species noticed in Blackburn Shola and Kookal Shola. Molecular study is needed to confirm the status of this species, because it is very similar to *L. macrantha* (Trautv.) Trautv. ex Regel (Complex).

24. **RUBIACEAE**

Key to the genera

1a. Trees……2
1b. Other than trees……4
2a. Flowers solitary; corolla lobes 2 cm long……2. **Gardenia**
2b. Flowers in a corymbose cymes or in a umbel; corolla lobes less than 5 mm long……3
3a. Inflorescence corymbose cymes; flowers pink, tetramerous……4. **Ixora**
3b. Inflorescence umbel; flowers cream, pentamerous……11. **Psydrax**
4a. Herbs……...5
4b. Undershrubs or shrubs……...6
5a. Leaves linear, glabrous; flowers purple to lilac; corolla lobes fleshy……...5. **Knoxia**
5b. Leaves ovate to lanceolate, hirsute; flowers white; corolla lobes hyaline……...8. **Neanotis**
6a. Foliaceous bract ovate ……..…….7. **Mussaenda**
6b. Foliaceous bract absent……...7
7a. Flowers ca 3 cm long; corolla hispid both surfaces, tube ca 2 cm long…....9. **Ophiorrhiza**
7b. Flowers less than 2 cm long; corolla hairy inside, tube less than 1 cm long……..8
8a. Leaves chartaceous.....…….....1. **Canthium**
8b. Leaves subcoriaceous to coriaceous……...9
9a. Fruit is a capsule……....3. **Hedyotis**
9b. Fruit is a drupes……10
10a. Inflorescence terminal……....10. **Psychotria**

10b. Inflorescence axillary……...6. **Lasianthus**

1. **Canthium** Lam.

Canthium neilgherrense Wight, Icon. Pl. Ind. Orient. 3(4): 4, t. 1064. 1846; Hook.f., Fl. Brit. India 3: 133. 1880. *Plectronia neilgherrensis* (Wight) Bedd., Fl. Sylv. S. India: 134/6. 1872; Gamble, Fl. Madras: 625. 1921. var. **chartacea** (Gamble) Swamin. in Biol. Mem. 2(1–2): 67. 1977, K.M. Matthew, Fl. Palni Hills 2: 588. 1999. **(Plate No. 28)**

Shrub; branchlets pendulous, glabrescent. Leaves opposite, ovate or elliptic lanceolate, ca 8 × 4 cm, charteceous; petioles ca 4–7 mm long; stipules ovate, acute, keeled. Inflorescence axillary fascicles, 3–12-flowered, pentamerous; peduncle ca 2 mm long; pedicels 2–5 mm long. Calyx teeth 5, 2–3 mm long, cupular, triangular, glabrous. Corolla tube clavate, 3–4 mm long; lobes 5, campanulate, hairy on both surfaces; lobes ca 3.5 × 1.8 mm, oblong. Stamens 5; filaments adnate to sepals, bearded. Ovary subglobose; style 2–3 mm long; stigmas 2. Drupes obovate or obcordate, ca 1.5 × 1 cm, creamy yellow when ripe; seeds 1 or 2, 0.7–10 × 0.4–0.6 mm, black.

Flowering & Fruiting: January–May.

Distribution: Kerala and Tamil Nadu. KWLS: Tiger Shola. *Kabeer & Ravi Kiran 139792*.

Notes: Small shrub in the shola forests and very scarce in the sanctuary at altitude ranges from 1700 to 2000 m. Current exploration in this sanctuary noticed only 2 individuals at Tiger Shola slopes and as K.M. Matthew mentioned, this species may shows a localised extinction.

2. **Gardenia** J. Ellis, nom. cons.

Gardenia gummifera L.f., Suppl. Pl. 164. 1781; Hook.f., Fl. Brit. India 3: 116. 1880; Gamble, Fl. Madras: 618. 1921; K.M. Matthew, Fl. Palni Hills 2: 595. 1999. **(Plate No. 28)**

Small tree; bark greyish-brown, resin yellowish, young parts pubescent, glabrescent by age. Leaves decussate, oblong-ovate or elliptic-ovate, 4–10 × 2–4 cm, ovate, base rounded or cuneate or subcordate, apex acute or obtuse, margins entire, glabrescent, coriaceous; lateral veins parallel, 10–20 pairs, prominent; petioles 1–3 mm long, glabrous. Flowers axillary, solitary, white turns to yellow. Calyx truncate, ca 8 × 3 mm, lobes 5 toothed, triangular, ca 3 × 2 mm, puberulous outside, acute. Corolla tube ca 3 cm long, cylindrical, lobes 5, oblanceolate or obvate, ca 2.5 × 1.5 cm, puberulous, obtuse. Stamens 5, ca 1 cm long, included. Ovary terete or subglobose, ca 6 × 3.5 mm, inferior; ovules many; style ca 4 cm long; stigma 5 angled, fusiform. Berries ellipsoid, ca 4 × 2.5 cm, exocarp hard, hispid.

Flowering & Fruiting: Throughout the year.

Distribution: Andhra Pradesh, Karnataka, Kerala, Maharashtra, Odisha and Tamil Nadu. KWLS: Palamputtur, Palamalai and Sottimalai. *Kabeer & Ravi Kiran 139660.*

Notes: Scattered populations were noted in the mid Palanis especially at Palamputtur, Palamalai and Colonymedu savannahs. Gum extraction is not observed here as compared to other states. Local people are eating the ripen berries.

3. **Hedyotis** L., nom. cons.

Key to the species

1a. Plants ca 2 m high; leaves petiolate…….2. **H. leschenaultiana**
1b. Plants less than 2 m high; leaves sessile……..2
2a. Leaves thick, subsucculent, crowded, ca 2 cm long; cymes ca 4 cm long…1. **H. articularis**
2b. Leaves subcoriaceous, 4–8 cm long; cymes 6–12 cm long, lax……..3. **H. swertioides**

1. **Hedyotis articularis** R. Br. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 407. 1834; Hook.f., Fl. Brit. India 3: 51. 1880; K.M. Matthew, Fl. Palni Hills 2: 597. 1999; Dutta & Deb, Taxonomic Revision Hedyotis: 85. 2004. *Oldenlandia articularis* (R. Br. ex Wight & Arn.) Gamble, Fl. Madras: 597. 1921. **(Plate No. 29)**

Undershrub, 1–1.5 m high; branches obscurely 4-angled. Leaves apically crowded, lanceolate, ovate-lanceolate or oblong-lanceolate, 1.5–2 × ca 1 cm, rounded at base, acute to acuminate at apex, margins entire and recurved, sessile, coriaceous; midnerve prominent, lateral veins parallel; stipules subulate-lanceolate, acuminate, sheathing, ca 8 mm long, pectinate. Cymes terminal, dense, trichotomously branched, ca 4 cm long; flowers tetramerous. Calyx cupular, ca 1.5 mm long, 4-lobed; lobes ovate-lanceolate, ca 1 × 1 mm. Corolla infundibuliform, lilac to purple; tube 3–4 mm long; lobes 4, oblong-ovate, acute at apex, ca 3.5 × 1.5 mm, recurved, pubescent inside. Stamens 4, exserted, adnate to corolla at throat; filaments ca 2 mm long; anthers oblong, acute, ca 1.6 mm long. Ovary ca 0.8 mm long, obtusely 4-lobed; style ca 1.2 mm long; stigmas 2, oblong, pubescent. Capsules obovate, ca 4 mm long, glabrous, 4-loculed, septicidal.

Flowering & Fruiting: March–November. (Peak flowering season is August)

Distribution: Kerala and Tamil Nadu. KWLS: Ibex peak, Berijam, Mannavanur and Vembadi peak. *Kabeer & Ravi Kiran 132773.*

Notes: Strictly confined to high altitude (1900–2500 m) grasslands and slopes. During the present study good populations observed at Ibex peak, Berijam slopes and Vembadi peak. Habitat shrinkage is the major concern for this species future existence.

2. **Hedyotis leschenaultiana** DC., Prodr. 4: 422. 1830; K.M. Matthew, Fl. Palni Hills 2: 598. 1999. *H. stylosa* R. Br. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 407. 1834; Hook.f., Fl. Brit. India 3: 51. 1880. *Oldenlandia stylosa* (R. Br. ex Wight & Arn.) Kuntze, Revis. Gen. Pl. 1: 293. 1891; Gamble, Fl. Madras: 598. 1921. *Hedyotis leschenaultiana* var. *leschenaultiana*; Deb & Dutta, Taxon 34: 296. 1985; Dutta & Deb, Taxonomic Revision Hedyotis: 75. 2004. **(Plate No. 29)**

Shrubs, 2 m high; branchlets often bluish black, 4-angled, glabrous. Leaves decussate, ovate or lanceolate, 4–8 × 2–4 acute, cuneate or rounded at base, glabrous, lateral veins 5–7 pairs, rugose; petioles ca 1 cm long; stipule lanceolate, ca 1.5 cm long, laciniate, densely hirtus. Cymes terminal, also in upper axills, dichotomously branched, panicled, 4–8 cm across; peduncle 5–8 cm long; pedicel ca 5 mm long, glabrous. Calyx campanulate, tube ca 3 mm long; lobes 4, obtuse, ca 2 mm long, glabrous. Corolla salver-shaped, white or lilac; tube slender, ca 5 mm long, villous inside; lobes 4, lanceolate, ca 5 mm long, acute, reflexed, throat densely pubescent. Anthers ca 1 mm long, pink; filaments ca 1 mm long. Ovary subglobose, bilocular; style ca 1cm long; stigma bifid. Capsules obovate, ca 3 mm lon, glabrous.

Flowering & Fruiting: Throughout the year.
Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Gundar, Jamindar Shola, Kookal, Mediketton Shola Perumamalai and Poombarai. *Kabeer & Ravi Kiran 132725*.
Notes: Frequent at shola forest edges at elevations between 1800 and 2500 m. Peak flowering is observed from August to December. Honey bees are the major pollenators.

3. **Hedyotis swertioides** Hook.f., Fl. Brit. India 3: 51.1880; K.M. Matthew, Fl. Palni Hills 2: 599. 1999; Dutta & Deb, Taxonomic Revision Hedyotis: 59. 2004. *Oldenlandia swertioides* (Hook.f.) Kuntze, Revis. Gen. Pl. 1: 292. 1891; Gamble, Fl. Madras: 598. 1921. **(Plate No. 30)**

Undershrub, ca 1 m high; younger branches pubescent, striate, obscurely winged. Leaves ovate, oblong-elliptic or elliptic-ovate, 4–8 × 3–5 cm, sessile towards apex, subsessile below, base cuneate or rounded, margins entire, acute or acuminate, subcoriaceous; lateral veins 3 pairs, subparallel; stipules lacinate, ca 1 cm long, violetish, sparsely pubescent at base. Cymes terminal, also axillary, pubescent, 6–12 cm long, lax; flowers tetramerous. Calyx campanulate, densely puberulous; tube ca 2 mm long, 4-lobed; lobes ovate-oblong, acute, ca 3 long, slightly reflexed. Corolla lilac or violet; tube ca 4 mm long, 4-lobed; lobes oblong or subulate-ovate, acute, ca 2.5 × 1.2 mm, reflexed, pubescent both surfaces, throat densely pubescent. Stamens 4, exserted; filaments ca 2 mm long, adnate to corolla; anthers oblong, ca 1.5 mm long, included. Style ca 3 mm long; stigmas 2, oblong-elliptic, papillose, lilac. Capsules obovate, ca 3 mm long, hispid; seeds many.

Flowering & Fruiting: June–December.
Distribution: Kerala and Tamil Nadu. KWLS: Berijam slopes, Palamputtur grasslands, Ibex peak and Vadakownji–Pannaikkadu grasslands. *Kabeer & Ravi Kiran 132776 & 132743*.
Notes: Very frequent at elevations ranges from 1400 to 2500 m in the sanctuary grasslands. A major grassland element associated with *Strobilanthes knthiana* and *Exacum wightianum*. Peak flowering attracts many honey bees in August.

4. **Ixora** L.

Ixora notoniana Wall. ex G. Don, Gen. Hist. 3: 571. 1834; Hook.f., Fl. Brit. India 3:139.1880; Gamble, Fl. Madras 630.1921; K.M. Matthew, Fl. Palni Hills 2: 600. 1999. **(Plate No. 30)**

Small tree, 4–8 m high; branchlets lenticellate, glabrous. Leaves elliptic, ovate-elliptic, ovate or oblanceolate, ca 15 × 8 cm, acute at apex or attenuate, cuneate or rounded at base, margins entire, coriacous, bullate at upper surface, shiny; petioles ca 1.5 cm long; stipules ovate, ca 0.8 cm long. Cymes corymbose, dichasial, ca 25 cm long; peduncle ca 12 cm long, rachis ca 8 cm long, reddish; bracts foliaceous, 2–5 cm long. Calyx cupular, 4-lobed; lobes oblong or ovate-lanceolate, acute, 2–3 × ca 1 mm. Corolla salverform, pink to white by maturity; tube ca 2.5 cm long, 4-lobed; lobes oblong, elliptic or ovate-lanceolate, subacute, 4–6 × ca 2 mm, margins recurved. Stamens 4; filaments minute; anthers linear-oblong, 2–3 mm long. Ovary subglobose, ca 1 × 1 mm, puberulous; style ca 2.5 cm long; stigmas bifid, grooved in middle, slightly recurved. Drupes globose or subglobose, 4–7 × 8–10 mm, blakish brown when ripe, smooth.

Flowering & Fruiting: June–October.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Blackburn, Perumalmalai and Vattakanal Sholas. *Kabeer & Ravi Kiran 138148.*
Notes: Very few individuals seen in the shola forests at elevations between 1700 and 2500 m. Vegetatively very similar to *Tarenna flava*. Peak flowering time is August and flowers are mild fragrant.

5. **Knoxia** L.

Knoxia wightiana Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 440. 1834; Hook.f., Fl. Brit. India 3: 129. 1880; Gamble, Fl. Madras: 622. 1921; Bhattacharjee & Deb in J. Econ. Taxon. Bot. 6: 81. 1985; K.M. Matthew, Fl. Palni Hills 2: 602. 1999. **(Plate No. 66)**

Herb; branchlets linear, reddish, subterete. Leaves at nodes, decussate, linear-lanceolate, ca 8 × 2 cm, slightly curved towards apex from the middle, folded inside, glabrous, sessile, coriaceous, puberulous below; lateral veins 4–6 pairs; stipules ovate, ca 6 mm long, acute,

lacinate with 2 or 3 glandular teeth. Cymes terminal, 5–8 cm across; peduncle ca 8 cm long. Flowers ca 7 mm long, sessile, 4 merous. Calyx lobes obtuse, ca 1.5 mm long, greyish. Corolla lobes 4, fleshy, tube ca 3 mm long, tube and lobes densely villous inside, purple to lilac; lobes linear-ovate, acuminate. Stamens 4, adnate at throat of corolla tube; filaments 1.5 mm long; anthers 1 mm. Ovary bilocular, globose; style ca 5 mm long; stigma ca 1 mm long, linear, bifid. Capsule obovoid, ca 2.5 × 2 mm; mericarps compressed, dorsally flat, glabrous.

Flowering & Fruiting: August–February.
Distribution: Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. KWLS: Kombaikkadu and Vadkownji Piruvi. *Kabeer & Ravi Kiran 133179.*
Notes: Very scarce, collected on Palani–Kodaikanal ghat road at 1623 m elevation. Habitat is surrounded by private estates and seasonal savannah fires were noticed between May and June. Very soon species may show localised extinction.

6. **Lasianthus** Jack, nom. cons.

Key to the species

1a. Calyx lobes linear, more than 5 mm long; calyx tube shorter than lobes…3. **L. venulosus**
1b. Calyx lobes minute, less than 2 mm long; calyx tube longer than lobes……....2
2a. Leaves recurved; lateral veins 6–8 pairs, cymes sub-sessile……...1. **L. acuminatus**
2b. Leaves flat; lateral veins strictly 4 pairs, cymes sessile…….....2. **L. parvifolius**

1. **Lasianthus acuminatus** Wight in Calcutta J. Nat. Hist. 6: 511. 1846; Hook.f., Fl. Brit. India 3: 185. 1880, p.p.; Gamble, Fl. Madras: 647. 1921; Deb & M. Gangop. in J. Econ. Taxon. Bot. 15: 274. 1991; K.M. Matthew, Fl. Palni Hills 2: 604. 1999. *L. coffeoides* Fyson in Bull. Misc. Inform. Kew 1914: 185. 1914; Gamble, Fl. Madras: 647. 1921. **(Plate No.31)**

Shrub, ca 3 m high; branchlets puberulous, subterete, greyish. Leaves elliptic, oblong-elliptic, elliptic-lanceolate, ca 12 × 4.5 cm, cuneate, margins entire, subcoriaceous, shiny, recurved; petioles 0.5–0.8 cm long; stipules subulate, acute to acuminate, ca 2 mm long, pubescent. Cymes axillary, subsessile. Calyx campanulate, ca 3 × 2 mm, blackish green or purplish green, puberulous, 4-lobed; lobes subulate, acute, ca 2 mm. Corolla tube ca 3 mm long, villous at throat, white, 4-lobed, ca 1 cm across; lobes ovate, acute, 2–3 × 1.5–2 mm, villous inside. Stamens 4, adnate to corolla throat; filaments 0.5–1 mm long; anthers oblong, ca 1 mm long. Ovary obovoid, ca 1 mm long; style ca 5 mm long, pubescent; stigma 4-fid, obovate, ca.1 mm long. Drupes globose, ca 7 mm across, black when ripe.

Flowering & Fruiting: June–December.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Blackburn and Berijam Sholas. *Kabeer & Ravi Kiran 132747, 133828 & 142657.*

Notes: Scarcely distributed at elevations ranging from 1900 to 2500 m of Berijam, Gundar and Poombarai Shola forests. Small populations were also seen at Kishan kovil saragam, Poombarai range. Habitat is shrinking due to Wattle invasion and highway road expansion.

2. **Lasianthus parvifolius** Wight in Calcutta J. Nat. Hist. 6: 512. 1846; Hook.f., Fl. Brit. India 3: 186. 1880; Gamble, Fl. Madras: 647. 1921; K.M. Matthew, Fl. Palni Hills 2: 605. 1999.

(Plate No. 31)

Shrub, ca 1.8 m high; branchlets adpressed hairy. Leaves elliptic to oblanceolate, ca 7 × 3 cm, attenuate to cuneate at base, acuminate to cuspidate at apex, glabrous, subcoriaceous, margins slightly recurved; lateral veins 4 pairs, prominent; petioles 5–8 mm long; stipule ca 5 × 3 mm, oblong, obtuse, villous inside, margins fimbriate. Cymes axillary, sessile, flowers 3–5 in a cyme. Calyx tube ca 4 mm long, puberulous; lobes 4, minute, triangular. Corolla white to pinkish, tube ca 2 mm; lobes 4, reflexed, villous inside. Stamens 4, ca 1 mm long; anthers purpulish. Ovary subglobose, 4-locular; style slender; stigma 4-fid, hairy. Drupes globose, ca 6 mm acroos, glabrous, shiny, dark blue when ripe.

Flowering & Fruiting: June–September.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Berijam, Kodakanal and Poombarai Foretst Ranges. *Kabeer & Ravi Kiran 132986 & 133110.*

Notes: Frequently found in all shola forests of the sanctuary at an altitude of 1750–2500 m. Gregarious understorey populations in shola forests acts as habitat for Shortwing, a shola bird.

3. **Lasianthus venulosus** (Wight & Arn.) Wight, Icon. Pl. Ind. Orient. 3(4): 15, t. 1032. 1845 & in Calcutta J. Nat. Hist. 6: 508. 1846; Hook.f., Fl. Brit. India 3: 190. 1880; Gamble, Fl. Madras: 648. 1921; K.M. Matthew, Fl. Palni Hills 2: 605. 1999. *Santia venulosa* Wight & Arn., Prodr. Fl. Ind. Orient.: 422. 1834. *Litosanthes venulosa* (Wight & Arn.) Deb & M. Gangop. in Candollea 44: 220. 1989. **(Plate No. 32)**

Shrub, 2–4 m high; branchlets sparsely hirsute, congested. Leaves elliptic ovate to oblong, 6–12 × 2.5–4 cm, acute, acuminate or apiculate at apex, round to broadly attenuate at base, lateral veins 6–8, hirsute on veins beneath, coriaceous; petioles ca 7 mm long; stipules triangular ovate, hirsute. Inflorescence axillary cymes; peduncle ca 1 cm long, strigose; bracteoles subulate, ca 3 mm long. Calyx tube 1–2 mm long; lobes 4, linear, 4–8 mm long, strigose. Corolla white or cream; tube ca 8 mm long, lobes 4, ovate, densely villous inside,

obscurely reflexed. Stamens 4; anthers ca 1 mm; filaments 1 mm long. Ovary 4-locular; stigma 4-fid, hairy. Drupes globose, ca 7 mm long, dark blue to purple when ripe.

Flowering & Fruiting: March–October.
Distribution: Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Poombarai.
Notes: Very scarce in the sanctuary and found only one individual at Kishan kovil saragam, Poombarai range (Kodai–Poombarai road). Habitat degradation by *Ageratina adenophora, Solanum auriculatum* is the main threat for this species.

7. **Mussaenda** L.

Mussaenda hirsutissima (Hook.f.) Hutch. ex Gamble, Fl. Madras: 610. 1921; K.M. Matthew, Fl. Palni Hills 2: 610. 1999. *Mussaenda frondosa* L. var. *hirsutissima* Hook.f., Fl. Brit. India 3: 90. 1880. **(Plate No. 32)**

Shrub; branchlets densely hirsute. Leaves opposite, broadly elliptic, ca 11 × 5 cm, acuminate at apex, rounded to obtuse at base, densely hirsute; lateral veins 5–7 pairs, prominent below; petioles ca 1 cm long; stipule ca 12 mm long, oblong-lanceolate, densely hispid. Cymes terminal; peduncle ca 3 cm long; pedicel ca 4 mm long; bracts and bracteoles linear. Calyx lobes 5, linear-lanceolate, ca 1.5 cm long, foliaceous bract ca 8 × 5 cm, ovate, acute, claw ca 8 cm long, white. Corolla tube ca 3 cm long, linear, densely hispid, saffron to scarlet; lobes 5, ovate, ca 1.3 × 1 cm, cuspidate, throat yellow, densely villous. Stamens 5, inserted. Ovary globose, ca 3 mm across, densely hispid. Berries globose, ca 1 cm, villous.

Flowering & Fruiting: April–October.
Distribution: Peninsular India. KWLS: Kudarayar Shola, Pulavichiar and Perumalamali. *Kabeer & Ravi Kiran 132909.*
Notes: Very scattered in the sanctuary at elevations ranges from 1600 to 2500 m. Growth is luxuriant along streams and peak flowering noticed in August.

8. **Neanotis** W.H. Lewis

Neanotis longiflora (Hutch.) Lewis in Ann. Missouri Bot. Gard. 53: 39. 1966. *Anotis longiflora* Hutch. in Bull. Misc. Inform. Kew 1916: 35. 1916, *nom. illeg*.; Gamble, Fl. Madras: 604. 1921. *Neanotis hutchinsonii* Deb & R. Dutta in J. Bombay Nat. Hist. Soc. 87: 333. 1990, *nom. illeg*; K.M. Matthew, Fl. Palni Hills 2: 612. 1999. **(Plate No. 33)**

Herb; internodes lax, branchlets strigose. Leaves opposite, ovate to lanceolate, ca 7 × 3 cm, attenuate to acuminate at apex, base truncate to obtuse, 6–10 nerved, villous; petioles 1–1.5 cm long. Inflorescence terminal, cymes corymbose; peduncle 1–2 cm long; bracts and

bracteoles lanceolate, ca 2 mm long. Flowers tertamerous. Calyx-tube short; lobes 4, erect or recurved, strigose, linear, 5 mm long with usually broad sinuses. Corolla tube 0.6–1 cm long, lobes oblong-ovate, ca 3 × 2 mm long, mucronate at apex, white, strigose both side. Stamens 4, adnate to mouth of corolla; anthers exserted. Ovary 2 or rarely 3or 4-locular; style filiform, 2.5 cm long; stigmas linear, bifid. Capsules obovid, 2–4 mm long.

Flowering & Fruiting: July–November.

Distribution: Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Gundar, Poombarai and Vattakanal. *Kabeer & Ravi Kiran 142669.*

Notes: Prostrate herb on dripping rocks of shola floor and very scarcely distributed in the sanctuary. This species is facing extreme threat due to wattle invasion at shola borders.

9. **Ophiorrhiza** L.

Ophiorrhiza roxburghiana Wight, Icon. Pl. Ind. Orient. 3(4): 4, t. 1068. 1846; Hook.f., Fl. Brit. India 3: 81.1880; Gamble, Fl. Madras: 608. 1921; Deb & Mondal in Bull. Bot. Surv. India 39:105.1997; K.M. Matthew, Fl. Palni Hills 2: 619. 1999. **(Plate No. 33)**

Undershrub, ca 1.3 m high; branchlets appressed pubescent. Leaves elliptic-lanceolate to ovate-lanceolate, ca 12 × 5 cm, base obliquely cuneate to attenuate, margins entire, acuminate at apex, membranous, shiny; obscurely pubescent on veins below; petioles 1.5–2.5 cm long; interpetiolar stipules ovate, acuminate ca 1 cm long. Inflorescence terminal, cymes corymbose, 4–8 cm long, puberulous; peduncle 4–8 cm long, pinkish; bracts 1–2.5 cm long; bracteoles ovate-lanceolate, 2–3 mm long, pinkish. Calyx tube 2–3 mm long, lobes 5, lanceolate, ca 3 × 1 mm, puberulous outside, pinkish. Corolla salver-shaped, tube ca 2.5 cm long; lobes 5 or 6, ovate, ca 8 × 6 mm, lilac or white, puberulous. Stamens 5; filaments ca 1 mm long; anthers linear-oblong, ca 3 mm long. Ovary ca 1 mm; style ca 1.5 cm long; stigmas 2, linear-lanceolate, ca 5 mm long, grooved. Capsules globose, 6–8 mm, shiny.

Flowering & Fruiting: July–October.

Distribution: Kerala and Tamil Nadu. KWLS: Blackburn, Gundar and Tiger Sholas. *Kabeer & Ravi Kiran 142692.*

Notes: Very scarce in the sanctuary as under storey in Shola forest.Good numbers found in Blackburn Shola. August is the peak flowering season. *Solanum viarum* Dunal is invading the habitat.

10. **Psychotria** L.

Key to the species

1a. Flowers white; drupes blackish blue when ripe……....1. **P. nilgiriensis**

1b. Flowers creamy yellow; drupes red when ripe……2. **P. subintegra**

1. Psychotria nilgiriensis Deb & M. Gangop. in Taxon 31: 546. 1982. *Grumilea congesta* Wight & Arn., Prodr. Fl. Ind. Orient.: 432 1834. *Psychotria elongata* Bedd. Fl. Sylv. S. India: t. 17. 1872. *Uragoga congesta* (Wight & Arn.) Kuntze, Revis. Gen. Pl. 2: 960 1891.

Shrub; branchlets glabrous. Leaves decussate, obovate, 5–9 × 3–5 cm, obtuse, apex acute at apex, cuneate at the base; lateral veins 7 or 8 pairs, domatia glandular; petioles ca 2 cm long; stipule ca 6 mm long, ovate, acute. Inflorescence terminal, cymes ca 8 × 4 cm; peduncle 2–3 cm long. Flowers ca 5 mm long. Calyx cupular, lobes obtuse, ciliate. Corolla campanulate, tube shorter than lobes, throat villous; lobes 5, white, ca 5 mm long. Stamens 5; anthers ca 0.8 mm long; filaments ca 1.5 mm long. Ovary bilocular; style ca 3 mm; stigma flat, bilobed. Drupes ellipsoidal, ca 11 × 7 mm, glabrous.

Key to the varieties

1a. Cymes dense; calyx limb tubular, toothed……...1.1 var. **nilgiriensis**
1b. Cymes less crowded; calyx limb obscure in fruit…….....1.2 var. **astephana**

1.1. var. **nilgiriensis**: Deb & M. Gangop. in Taxon 31: 546. 1982; K.M. Matthew, Fl. Palni Hills 2: 625. 1999. **(Plate No. 34)**

Flowering & Fruiting: Throughout the year.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Tiger and Blackburn Sholas. *Kabeer & Ravi Kiran 135565.*
Notes: Frequently seen in all sholas of the sanctuary and gregarious populations were seen in Tiger Shola and Blackburn Shola. Due to Gaja cyclone in 2018 at both locations, populations were seriously damaged.

1.2. var. **astephana** (Hook.f.) Deb & M. Gangop. in Taxon 31: 546. 1982; Deb & M. Gangop. in J. Econ. Taxon. Bot. Addit. Ser. 7, 87. 1989; K.M. Matthew, Fl. Palni Hills 2: 625. 1999. *P. congesta* (Wight & Arn.) Hook.f. var. *astephana* Hook.f., Fl. Brit. India 3: 162. 1880; Gamble, Fl. Madras: 640. 1921. **(Plate No. 34)**

Shrub, ca 2 m high. Leaves obovate to oblanceolate or oblong-obovate, 5–10 × 3–4 cm, acute or acuminate at apex, cuneate at base, margins entire, coriaceous; stipules oblong-ovate or subulate, acuminate, ca 7 × 4 mm, puberulous inside. Cymes 3–5 cm long, congested; peduncle ca 2.5 cm long, terminal; bracts deciduous, ovate, hyaline. Calyx campanulate, ca 3 mm long, 5(4)-lobed; lobes subulate, ciliate at margin, ca 1 mm long. Corolla tube ca 3 mm long, 5(4)-lobed; lobes subulate-ovate, acute, ca 3 × 2 mm, white. Stamens 5(4); filaments ca 1.2 mm long; anthers oblong, ca 1mm long. Ovary bilocular; style ca 4 mm long, slightly

dialated; stigmas capitate, ovate, ca 1 mm across, recurved. Drupes subglobose, ca 8 mm wide, blackish blue when ripe.

Flowering & Fruiting: July–September.
Distribution: Kerala and Tamil Nadu. KWLS: Kookal, Mathikettan Shola and Tiger Shola. *Kabeer & Ravi Kiran 132985 & 132731*.
Notes: Endangered (World Conservation Monitoring Centre, 1998). Very scarce and collected from Mathikettan Shola and Tiger Shola borders at elevation ranges from 1800 to 2400 m. Species is under extreme threat and may well become extinct from Palani hills very soon due to *Acacia* species invasion.

2. **Psychotria subintegra** (Wight & Arn.) Hook.f., Fl. Brit. India 3: 162. 1880; Gamble, Fl. Madras: 641. 1921; Deb & M. Gangop. in J. Econ. Taxon. Bot. Addit. ser. 7, 52. 1989; K.M. Matthew, Fl. Palni Hills 2: 626. 1999. *Grumilea subintegra* Wight & Arn., Prodr. Fl. Ind. Orient.: 432. 1834. **(Plate No. 35)**

Shrub, 1.5–2 m high. Leaves elliptic, elliptic-lanceolate, oblong-obovate or oblanceolate, 6–14.5 × 2–6.5 cm, acute or acuminate at apex, cuneate at base, margins entire, punctate; petioles 2.5–3.5 cm long; stipules ovate-lanceolate, acuminate, ca 6 mm long, pubescent inside, caducous. Cymes corymbose, terminal, also axillary, ca 10 cm across, flowers subsessile; peduncle ca 5 cm long. Calyx cupular, ca 1.5 mm long, green, 5-toothed. Corolla tube ca 3 mm long, tomentose at throat, cream to yellow, 5-lobed; lobes subulate-ovate, acute, ca 2.5 mm long, reflexed. Stamens 5; filaments ca 1 mm long; anthers oblong, ca 1 mm long. Ovary bilocular, globose; style ca 4 mm long; stigmas 2, ovate, ca 0.5 mm long. Drupes globose, 4–6 mm long, subsessile, faintly striate, red when ripe.

Flowering & Fruiting: Throughout the year.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Pannaikkadu to Vathalagundu ghat road and Kumbakkarai to Vellagavi path. *Kabeer & Ravi Kiran 133007.*
Notes: Frequently found near forest borders at altitude ranges from 400 to 1400 m. Maximum populations were observed beside streams at foothills of the sanctuary.

11. **Psydrax** Gaertn.

Psydrax ficiformis (Hook.f.) Bridson in Kew Bull. 48: 762. 1993; K.M. Matthew, Fl. Palni Hills 2: 627. 1999. *Canthium ficiforme* Hook.f., Fl. Brit. India 3: 133. 1880. *Plectronia ficiformis* (Hook.f.) Gamble, Fl. Madras: 624. 1921. **(Plate No. 35)**

Small tree, 5–12 m high; bark fissured; younger branchlets angled, nodes prominent, swollen. Leaves ovate, 8–12 × 4–7.5 cm, glabrous, acuminate at apex, base obtuse, thick-coriaceous, margine entire, slightly recurved; midnerve prominent on lower and upper surfaces, lateral veins 3 pairs; petioles ca 1 cm, obscurely decurrent towards leaf base; stipule broad, ca 4 × 5 mm. Inflorescence axillary umbels; peduncle ca 1.5 cm, branched; flowers pentamerous, ca 8 mm wide; bracts sub-cupular, ca 1.5 mm; pedicels 1.5–2 cm long. Calyx 5-toothed, 3–4 mm long. Corolla tube ca 4 mm long; lobes 5, ca 4 mm long, reflexed, cream. Stamens 5, excerted. Ovary bilocular; ovules one in each locule; style columnar; stigma 2-lobed. Drupes pyriform, 2.5–3 × ca 2 cm, stalk stout, ca 2 cm long; seeds 2, putamen thick, woody, deeply sinuously grooved.

Flowering & Fruiting: July–September.

Distribution: Kerala and Tamil Nadu. KWLS: Blackburn Shola (Shenbaganr). *Kabeer & Ravi Kiran 139608.*

Notes: Endangered (World Conservation Monitoring Centre, 1998). Very scarce and only 2 individuals found in the Blackburn Shola. One individual is at check dam which is supplying water to Perumalmalai village and if further development of check dam takes place, this tree might be removed. CALI – 14323 by Jomy Augustine lacks fruits, and identity of this species is not be possible without fruits. Lastly it was collected in 1917 from the same locality of the Palani hills and the type is from Shevagri hills, Tirunelveli. K.M. Matthew couldn't trace out this species in Palani hills but included it in Flora of Palni hills based on field number 1719 by Anglade.

Type citation: MYSORE; Shevagherry Hills, *R. Wight.*

Type: India, Tamil Nadu, Shevagherry Hills, August 1836, *R. Wight 1409* (lectotype K000031522!, designated by Arigela & Singh, 2019; isolectotypes CAL0000016128!, K000031521!, MH00006876!).

25. **ASTERACEAE**

Key to the genera

1a. Capitula homogamous…….2
1b. Capitula heterogamous……...3
2a. Stem winged; flowers yellow……...2. **Gynura**
2b. Stem terete; flowers violet……..4. **Vernonia**
3a. Leaf margins distantly dentate; phyllaries absent; flowers ca 2.5 cm wide……3. **Senecio**
3b. Leaf margins entire; phyllaries present; flowers less than 1 cm wide…….....1. **Anaphalis**

1. **Anaphalis** DC.

Key to the species

1a. Undershrubs ……...2
1b. Herbs……..3
2a. Leaves 5-veined from the base……..2. **A. beddomei**
2b. Leaves 3-veined from the base…….5. **A. travancorica**
3a. Leaves silvery, ca 2 cm long, 2 mm wide……4
3b. Leaves green, ca 6 cm long, ca 1 cm wide……..5
4a. Corymbs lax; capitula white …….3. **A. bournei**
4b. Corymbs dense; capitula yellow, ……..4. **A. meeboldii**
5a. Leaf base broad; capitula 3 mm wide…….1. **A. aristata**
5b. Leaf base narrow; capitula 6 mm wide……..5. **A. wightiana**

1. Anaphalis aristata (DC.) DC., Prodr. 6: 274. 1838; Hook.f., Fl. Brit. India 3: 285. 1881; Gamble, Fl. Madras: 696. 1921; P.C. Pant in Hajra *et al*., Fl. India 13: 55. 1995; K.M. Matthew, Fl. Palni Hills 2: 661. 1999. *Gnaphalium aristatum* DC. in Wight, Contr. Bot. India 21. 1834.

(Plate No. 36)

Decumbent herb, ca 70 cm high; sparsely branched, viscidly pubescent, branches striate, glandular-pubescent. Leaves lanceolate, ca 6 × 0.8 cm, clustered towards above, acute at apex, mucronate tip, auricled or amplexicaul at base, margins recurved, hairy on both surfaces, densely on the lower surface, 1-veined, sessile. Inflorescence terminal, panicles corymbose, ca 4 cm across; peduncle 1–4 cm long, densely woolly tomentose. Involucral bracts glaucous, lanceolate, ca 1 cm long. Phyllaries tinged with pink, 3 or 4-seriate, 2 mm long, lanceolate. Capitula yellow, ray florets 10–15, 2–5 series, florets ca 2 mm long, 5-toothed. Corolla of central disk florets florets ca 2 mm long, yellow; stamens 5. Achenes oblong, ca 0.5 mm long, oblong, papillose.

Flowering & Fruiting: June–December.

Distribution: Kerala and Tamil Nadu. KWLS: Konalar Marsh and Perumalmalai. *Kabeer & Ravi Kiran 139777.*

Notes: Very similar to *A. wightiana.* Molecular studies required to delimit the species. Habitat shrinking by expansion of private estates and habitat loss is the major threat for this species.

2. **Anaphalis beddomei** Hook.f., Fl. Brit. India 3: 282. 1881; Gamble, Fl. Madras: 695. 1921; P.C. Pant in Hajra *et al*., Fl. India 13: 56. 1995; K.M. Matthew, Fl. Palni Hills 2: 662. 1999.

(Plate No. 36)

Undershrub, ca 2 m high, bushy, much branched, indumentum woolly. Leaves alternate, crowded, sparse in flowering shoots, elliptic to lanceolate, ca 8 × 2 cm, subcoriaceous, densely woolly, prominently 5-veined, base narrow, semi-amplexicaul, apex acute. Corymbs terminal, ca 10 cm wide; peduncle 8–10 cm; bracts lanceolate. Capitula white with yellow centre, ca 3.5 mm wide; stalk ca 2 mm; receptacle ca 2 mm wide. Phyllaries 3–5-seriate, white; outer ones oblong-elliptic, 4 mm; inner ones oblong-lanceolate, ca 3.5 mm; pappus 15–20, bristly, 3mm long. Ray florets ca 25 in 2 or 3-series; corolla tube ca 2 mm; lobes 5. Disk florets 15–20 in 3 or 4-seriate. Corolla tube ca 2 mm; lobes 5, yellowish, glanded. Stamens 5; style arms distally dialated. Achenes ca 1 mm long, faintly ribbed, spinulose.

Flowering & Fruiting: June–October.
Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Ibex peak and Vattakanal. *Kabeer & Ravi Kiran 132772.*
Notes: Vulnerable (Kumar, 2011). Restricted to high altitude grasslands and very scarcely distributed in the sanctuary at elevations between 1800 and 2550 m. This species habitats are under extreme threat due to Wattle (*Acacia* sp.) invasion.

3. **Anaphalis bournei** Fyson in Bull. Misc. Inform. Kew 1914: 209. 1914; Gamble, Fl. Madras: 697. 1921; P.C. Pant in Hajra *et al.*, Fl. India 13: 56. 1995; K.M. Matthew, Fl. Palni Hills 2: 663. 1999. **(Plate No. 37)**

Herb, erect and decumbent, ca 50 cm high; stems densely greyish white-tomentose. Leaves linear or linear-lanceolate, 1.5–2.5 × 2–3 mm, densely congested, reflexed, subamplexicaul, acute, greyish white-woolly, obscurely 1-veined. Corymbs terminal, heads compact, ca 1 cm across. Involucral bracts 3 or 4-seriate; lower bracts lanceolate, acute to acuminate, ca 3 × 1 mm, woolly, inner bracts lanceolate to spathulate, ca 4 × 1 mm, pubescent outside, glabrous inside, shiny, midnerve at base. Phyllaries 2–4-seriate, white; outer ones oblong-elliptic, ca 4 mm; inner ones oblong-lanceolate, ca 2.5 mm; ray florets filiform, ca 2 mm long, yellow. Disk florets: corolla ca 2.2 mm long, yellow, 5-lobed; lobes subulate, acute, ca 0.25 mm long. Stamens 5; filaments ca 1 mm long; anthers linear-oblong, ca 1.5 mm long. Style ca 1.5 mm long, recurved. Achenes oblong, ca 0.8 mm long, brown; pappus ca 3 mm long, white.

Flowering & Fruiting: June–September.
Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Konalar marsh and Vembadi peak. *Kabeer & Ravi Kiran 141011.*
Notes: Very narrow distribution in the sanctuary. Good populations at Berijam slopes towards Vembadi peak. Habitat is highly threatened due to invasion of *Acacia* and *Eucalyptus* species.

4. **Anaphalis meeboldii** W.W. Sm. in Rec. Bot. Surv. India 4: 284. 1911; Gamble, Fl. Madras: 696. 1921; P.C. Pant in Hajra *et al.*, Fl. India 13: 69. 1995; K.M. Matthew, Fl. Palni Hills 2: 664. 1999. **(Plate No. 37)**

Tufted herb, ca 40 cm high, branchlets cottony. Leaves linear-lanceolate, 1–2 × 0.2–0.4 cm, decurrent and subauriculate, revolute, subacute, greyish woolly, 1-veined. Corymbs terminal, compact, ca 3 cm across, yellow. Heads ca 5 mm across, sessile. Involucral bracts 3 or 4-seriate; outer bracts oblanceolate, ca 3 × 2 mm, densely woolly-tomentose, 1-ribbed ovate-lanceolate base; innermost bracts obovate, obtuse, ca 2.5 × 1.5 mm, woolly-pubescent outside. Phyllaries oblong-spathulate, ca 2 × 1 mm, compact. Ray florets filiform, ca 2 mm long; corolla 4-toothed, yellow. Disk florets: corolla 2–2.5 mm long, 5-lobed; lobes subulate, acute, ca 0.6 mm long, yellow. Stamens 5; filaments ca 0.7 mm long; anthers oblong, subulate-acute, ca 1 mm long. Style ca 1.5 mm long, reflexed. Achenes oblong, ca 1 mm long, angular and faintly ribbed, minutely papillose, brown; pappus as long as corolla, white.

Flowering & Fruiting: October–February.
Distribution: Kerala and Tamil Nadu (Anamalai, Nilgiris & Palni hills). KWLS: Ibex peak. *Kabeer & Ravi Kiran 139721*.
Notes: Very scarce and recorded only at Ibex peak grassland at an elevation of 2500 m. Species is under extreme threat due to habitat loss by Wattele invasion.

5. **Anaphalis travancorica** W.W. Sm. in Rec. Bot. Surv. India 4: 284. 1911; Gamble, Fl. Madras: 695. 1921; P.C. Pant in Hajra *et al.*, Fl. India 13: 76. 1995; K.M. Matthew, Fl. Palni Hills 2: 665. 1999. **(Plate No. 38)**

Undershrub, to 1 m high, branchlets white woolly tomentose. Leaves oblong-obovate or oblanceolate, ca 6 × 1 cm, succulent, decurrent at base, obtuse, acute at apex, obscurely 3-veined, deflexed. Corymbs terminal, 4–6 cm across; peduncle ca 5 cm long. Involucral bracts many-seriate; outer bracts oblanceolate, obtusely acute, ca 4 × 2.5 mm, densely woolly-tomentose, midnerved, inner bracts linear-oblanceolate, ca 6.5 × 2 mm, scarious; the innermost ca 5.5 × 1 mm, more linear than others. Phyllaries 4–5 seriate, ovate, ca 3 × 2 mm, white. Ray florets filiform, ca 2.5 mm long, 5-toothed. Disk florets numerous; corolla ca 4 mm long, 5-toothed; teeth ovate-subulate, acute, ca 5 mm long. Stamens 5; filaments ca 1 mm long; anthers linear-oblong, ca 2 mm long, tailed below for ca 0.4 mm. Style dialated at base, ca 3 mm long; 2 fid, ca 1 mm long, exserted. Achenes oblong, ca 1 mm long, scaly, pappus 3.5 mm long, white.

Flowering & Fruiting: November–February.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Berijam slopes, Ibex peak, Gundar and Vattakanal grassland. *Kabeer & Ravi Kiran 135497*.

Notes: Typical grassland element at an altitude of 1900–2500 m. Wattle invasion in its habitat is threatening its existence.

6. **Anaphalis wightiana** (Wall ex DC.) DC., Prodr. 6: 273. 1838; Hook.f., Fl. Brit. India 3: 286.1881; Gamble, Fl. Madras: 696. 1921; P.C. Pant in Hajra *et al.*, Fl. India 13: 81. 1995; K.M. Matthew, Fl. Palni Hills 2: 665. 1999. *Gnaphalium wightianum* Wall ex DC. in Wight, Contr. Bot. India21. 1834. **(Plate No. 38)**

Erect herb, branched, ca 50 cm high; stems grooved, pinkish red, younger parts arachnoid. Leaves linear-oblanceolate, ca 5 × 0.8 cm, base narrow, sub-amplexicaul, obtuse to acute at apex, margins recurved, scabrid above, densely white woolly beneath, 1-veined, sessile. Cymes corymbose, terminal clusters, ca 4 cm across; peduncle ca 5 cm long, densely woolly tomentose. Involucral bracts 3 or 4-seriate; outer white, ovate with a short brown suffused limb, enveloped by woolly tomentum; inner linear-oblong, brown suffused at lower end. Phyllaries 3–5 seriate, white, pink tinged, ovate to oblanceolate, ca 3 × 2 mm. Ray florets: corolla ca 2 mm long, minutely 4-toothed, yellow. Disk florets: corolla 2 mm long, 5-toothed, yellow. Achenes ca 0.5 mm long, terete or papillose; pappus hairs white, minutely barbed.

Flowering & Fruiting: July–September.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Konalar marsh and Vadakownji–Pannikkadu grasslands. *Kabeer & Ravi Kiran 140995, 141013.*

Notes: Vulnerable (Rehel, 2011). Very scarce in the sanctuary at elevations between 1850 and 2500 m. Dring the present study this species was collected from Konalar marsh and Vadakownji–Pannikkadu grasslands. Habitat loss due to *Pinus*, *Acaica* species invasion and seasonal grassland fires are major threats to this species.

2. **Gynura** Cass., nom. cons.

Key to the species

1a. Branchlets glabrous; leaves on stem towards apex……..1. **G. nitida**

1b. Branchlets hispid; leaves basally congested……..2. **G. travancorica**

1. **Gynura nitida** DC. in Wight, Contr. Bot. India 24. 1834; Hook.f., Fl. Brit. India 3: 333. 1881; Gamble, Fl. Madras: 714. 1921; Davies in Kew Bull. 35: 366. 1981; R. Mathur in Hajra *et al.*, Fl. India 13: 221. 1995; K.M. Matthew, Fl. Palni Hills 2: 712. 1999. **(Plate No. 39)**

Herb, to 1.5 m high; subsucculent, branchlets glabrous or sparsely pubescent, angled, obscurely winged. Leaves obovate or oblanceolate, 5–12 × 2–3 cm, decurrent, auriculate, coarsely dentate, acute, sparsely pubescent. Inflorescence terminal corymbs, heads homogamous, 3–6 in corymbs, tubular-campanulate or cylindric, ca 2 × 1 cm, dark yellow. Involucral bracts 10–15, with ca 8 accessory bracts at base, linear-lanceolate, scarious at margin, papillose-hairy at apex, 8–15 × 1–1.5 mm. Phyllaries basally united, ca 1 cm long; corolla tube 1 cm long, yellow. Stamens 5; filaments ca 1.5 mm long; anthers oblong, rounded at base, small empty lance like at apex, ca 1.3 mm long. Style ca 1 cm long; bifid, linear, arms ca 2 mm long. Achenes oblong, ca 4 × 0.7 mm, ribbed, pubescent between ribs, brown; pappus ca 1 cm long, white.

Flowering & Fruiting: September–December.
Distribution: Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Gurusaradi and Tiger Shola. *Kabeer & Ravi Kiran 139701*.
Notes: Scarce in the sanctuary on dripping rocky grassland slopes at elevation ranges from 1500 to 2500 m. Few individuals were recorded at Tiger Shola, near Kodaikanal entrance toll gate and Perumalamalai to Mailadamparai ghat road. Seasonal weeding by highways department and habitat loss are the major threats to this species.

2. **Gynura travancorica** W.W. Sm. in Rec. Bot. Surv. India 6: 29. 1914; Gamble, Fl. Madras: 714. 1921; Davies in Kew Bull. 35: 364. 1981; R. Mathur in Hajra *et al.*, Fl. India 13: 224. 1995; K.M. Matthew, Fl. Palni Hills 2: 713. 1999. **(Plate No. 39)**

Herb, ca 1 m high; stems strongly grooved, fulvous-tomentose. Leaves alternate, congested at base, elliptic-lanceolate, oblong-lanceolate towards apex, ca 10 × 4.5 cm; lower leaves cuneate at base; upper leaves sessile, amplexicaul, distantly serrate, acute, densely hispid; lateral veins obscure. Corymbs terminal, lax; peduncle 8–10 cm; peduncle 5–8 cm long; heads homogamous, tubular-campanulate, 1.5–2 × 1 cm, yellow; bracteoles ca 15, 1 or 2 on middle of peduncle, few closely arranged at base of head, brownish. Involucral bracts ca 12, linear-oblong to lanceolate, scarious at margin. Disk florets ca 1–1.5 cm long; corolla tube 1–1.2 cm long; limb ca 4 mm long, 5-lobed; lobes lanceolate, marginate, acute, ca 1.3 mm long. Stamens 5; filaments ca 2 mm long; anthers oblong-lanceolate, rounded at base, ca 0.5 mm long. Ovary cylindric, ca 2 mm long; style ca 1 cm long, yellow; stigmas bifid, elliptic-lanceolate, hispid. Achenes oblong, ca 6 mm long, strongly ribbed, sparsely pubescent; pappus minutely barbed, white.

Flowering & Fruiting: June–February.

Distribution: Kerala, Maharashtra and Tamil Nadu. KWLS: Poombarai and Vattakanal. *Kabeer & Ravi Kiran 135583.*

Notes: Near Threatened (Rehel, 2011). Typical grassland element at shola forest edges and on rocky surfaces in grassland. Few populations seen at Poombarai village and Vattakanal grassland at altitude ranges from 2200 to 2500 m. Habitat loss is playing a major role in the extinction of this species from Palani Hills.

3. **Senecio** L.

Senecio lavendulaefolius DC. in Wight, Contr. Bot. India 23. 1834 & Prodr. 6: 368. 1838; Hook.f., Fl. Brit. India 3: 343. 1881; Gamble, Fl. Madras: 721. 1921; K.M. Matthew, Fl. Palni Hills 2: 714. 1999. *Pseudojacoboea lavandulaefolius* (DC.) R. Mathur in R.R. Rao *et al.*, Fl. India Enum. Asteraceae 59. 1988; R. Mathur in Hajra *et al.*, Fl. India 13: 304. 1995. **(Plate No. 40)**

Herb, 50–80 cm high; woolly tomentose, branched towards apex. Leaves sessile, linear-oblong to oblong-lanceolate, 1.5–2.5 × ca 1 cm, acute at apex, cordate or auriculate, distantly dentate, strongly recurved, hispid above, fluffy beaneath. Heads in terminal corymbs, heterogamous, 5–10 heads in a corymb, 1.5–2.5 cm across; peduncle of each capitula 2–8 cm long; bracteoles to 10, closely arranged at base of head. Involucral bracts 1 or 2-seriate, lanceolate, ca 10 × 1 mm. Ray florets 15–25, yellow; linear oblong-elliptic, 1.5 cm, obscurely emarginate at apex; corolla tube ca 4 mm long. Ovary ca 1.5 mm long; style ca 4 mm long; stylar arms 2, 0.8–1 mm long. Staminodes 5, oblong. Disk florets ca 6 mm long; tube ca 5 mm long, dilated above; lobes triangular, minute. Stamens 5; filaments ca 1 mm long; anthers oblong, beaked, ca 1.5 mm long. Achenes oblong, ca 3 mm long, ribbed, brown; pappus ca 4 mm long, white.

Flowering & Fruiting: November–January.

Distribution: Kerala and Tamil Nadu. KWLS: Ibex peak. *Kabeer & Ravi Kiran 139716.*

Notes: Occurs only at an elevation above 2300 m of the sanctuary and few individuals seen at Ibex peak. The habitat is highly vulnerable due to *Acacia* and *Pinus* species invasion. K.M. Matthew mentioned the occurence of this species on tallest peaks, the Vembadi peak was completely invaded by Wattle and the *S. lavendulaefolius* existence is questionable on this peak.

4. **Vernonia** Schreb., nom. cons.

Key to the species

1a. Shrubs; leaves coriaceous, subentire……....1. **V. bourneana**

1b. Undershrubs; leaves chartaceous, serrate……..2

2a. Leaves bullate above, green below; heads 1.5 cm across……..3. **V. peninsularis**

2b. Leaves not bullate, glaucous below; heads 5 mm across ……...2. **V. fysonii**

1. **Vernonia bourneana** W.W. Sm. in Rec. Bot. Surv. India 6: 101. 1914; Gamble, Fl. Madras: 675. 1921; Uniyal in Hajra *et al.*, Fl. India 13: 364. 1995; K.M. Matthew, Fl. Palni Hills 2: 644. 1999. **(Plate No. 40)**

Shrub, to 3 m high; branchlets pendulous, densely rusty tomentose, woody. Leaves elliptic, oblong-elliptic or obovate, 5–10 × 4–6 cm, oblique or cuneate at base, margins subentire, obtuse, mucronate, coriaceous, grey-tomentose beneath, scabrid above. Inflorescence a corymbose panicle, terminal; heads campanulate, with 10–15 florets, 1 cm wide, homogamous. Phyllaries 4 or 5-seriate; outer ones filiform, ca 3 × 0.6 mm, pubescent outside, 1-nerved, greenish; middle bracts subulate-lanceolate; inner bracts ovate-lanceolate, ovate-elliptic or oblong-elliptic, 3-nerved. Corolla 5–6 mm long; tube 3–4 mm long, 5-lobed; lobes linear-subulate, hairy and glandular outside at apex, ca 2.2 × 0.6 mm, purpulish. Stamens 5; filaments to 1.6 mm long; anthers sagittate, ca 2 mm long. Ovary oblong, ca 1 mm long, angular, glandular; style 3–4 mm long, pubescent, stylar arms 2, linear, ca 1.5 mm long, pubescent. Achenes linear-cylindric, ca 2 mm long, 4-angular, densely globose white-glandular, brown; pappus 2-seriate, with a ring of white hairs.

Flowering & Fruiting: November–April.
Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Kishan kovil saragam and Poombarai. *Kabeer & Ravi Kiran 133099 & 133721.*
Notes: Restricted to shola forest edges of Pommbarai and Berijam ranges at an altitude of 2000–2400 m. Peak blooming observed in December and March. Decline of the individuals is observed during the explorations due to habitat shrinking.

2. **Vernonia fysonii** Calder in Rec. Bot. Surv. India 6: 343. 1914; Gamble, Fl. Madras: 673. 1921; Uniyal in Hajra *et al.*, Fl. India 13: 371. 1995; K.M. Matthew, Fl. Palni Hills 2: 646. 1999. **(Plate No. 41)**

Scandent undershrubs, 2–3 m high; branchlets striate, brown tomentose. Leaves alternate, ovate or lanceolate, 4–10 × 2–4 cm, acute to attenuate, serrate, hispid above, obscurely glaucous beneath; petioles 1–1.5 cm long, obscurely winged. Inflorescence terminal corymbs, also in upper axils; heads ca 5 mm across, ca 15-flowered, heads homogamous; peduncle tomentose, ca 1 cm long. Phyllaries ca 4-seriate; outer ovate, ca 1 mm long, apiculate, sparsely tomentose on the upper margins; inner linear, ca 5 mm long, acute-apiculate. Corolla tube 5 mm long, lobes 5, linear, ca 2 mm long, purple. Stamens 5. Style 8–10 mm long, pubescent; stigma 2. Achenes ca 3 mm long, 10-ribbed, grey, pappus white.

Flowering & Fruiting: November–March.

Distribution: Kerala and Tamil Nadu. KWLS: Mailadamparai and Tiger Shola. *Kabeer & Ravi Kiran 139708.*

Notes: Hanging over the bushes at shola and evergreen forest edges at altitudes between 1150 and 1800 m. Tiger Shola and Mailadamparai harbouring the remarkable individuals. Seasonal weeding especially in November by Highways Department is restricting this species population.

3. **Vernonia peninsularis** (C.B. Clarke) C.B. Clarke ex Hook.f., Fl. Brit. India 3: 233. 1881, Gamble, Fl. Madras: 674. 1921; Uniyal in Hajra *et al.*, Fl. India 13: 378. 1995; K.M. Matthew, Fl. Palni Hills 2: 646. 1999. *V. bracteata* Wall. ex C.B. Clarke var. *peninsularis* C.B. Clarke, Compos. Ind. 18. 1876. *V. pulneyensis* Gamble in Bull. Misc. Inform. Kew 1920: 341. 1920. Fl. S. Ind. Hill Sta. 311. t. 249, 1932. **(Plate No. 41)**

Straggling undershrub, ca 1.5 m high; branchlets flexuosus, ribbed, villous. Leaves ovate or elliptic-ovate, 3–8 × 2–5 cm, cuneate at base, margins crenate-serrate, acute or acuminate at apex with mucro, bullate above, scabrid above, densely villous on veins beneath; petioles ca 1 cm long. Inflorescence corymbose, terminal, aslo in upper axils; heads 3–5 or solitary, urceolate or hemispherical, ca 1.5 cm across, 20–40 florets; peduncle 2–8 cm long. Phyllaries 5–7-seriate; outer 4 series linear-lanceolate, ca 4 × 2 mm, hispid, greyish brown, 3-ribbed; arista ca 5 mm long, reflexed; inner 2 or 3 series oblong or oblong-lanceolate, 5–8 × ca 3 mm, hispid, arista ca 2 mm long, slightly recurved. Corolla tube ca 7 mm long, 5-lobed; lobes oblong-lanceolate, ca 5 mm long, purplish. Stamens 5; filaments 2–4 mm long; anthers oblong, ca 4 mm long. Ovary obconic; style ca 1.2 cm long; stylar arms 2, linear-lanceolate, ca 3 mm long, recurved, pubescent. Achenes 10-ribbed, linear, 4 mm long, pappus 8 mm long, 2 or 3-seriate, white.

Flowering & Fruiting: November–April.

Distribution: Kerala and Tamil Nadu. KWLS: Pambar shola. *Kabeer & Ravi Kiran 139784.*

Notes: Restricted to Pambar falls at elevations ranges from 1900 to 2200 m. The habitat is shrinking due to species of *Acacia*, *Pinus* and *Prunus* invasion and extreme anthropogenic pressure by tourists. Very few understorey individuals left in Pambar Shola forest. Habitat is one of the eco-sensitive zones of the sanctuary.

26. **ERICACEAE**

Key to the genera

1a. Leave oblong; flowers in fasicle; ca 5 cm long, crimson……....1. **Rhododendron**

1b. Leaves linear-lanceolate; flowers in a raceme; ca 1.2 cm long, white to lilac...2. **Vaccinium**

1. **Rhododendron** L.

Rhododendron nilagiricum Zenker in Amer. Sci. Nat. ser. 2. 6: 150. 1836 & Pl. Ind. t. 15. 1836; Gamble, Fl. Madras: 743. 1921. *R. arboreum* subsp. *nilagiricum* (Zenker) Tagg. in Stevenson, Sp. Rhod.: 15. 1930; K.M. Matthew, Fl. Palni Hills 2: 740. 1999. *R. arboreum* J.E. Smith var. *nilagirica* (Zenker) C.B. Clarke in Hook.f., Fl. Brit. India 3: 466. 1881. **(Plate No. 42)**

Tree, 7–10 m high; bark deeply fissured. Leaves oblong-elliptic, 5–12 × 3–5 cm, cuneate or rounded, obscurely recurved, apiculate at apex, coriaceous, scabrid above, brownish tomentose beneath; petioles 2–3 cm long. Fascicles terminal, also in upper axils, ca 5–15-flowered; pedicels ca 1cm long. Flowers 3–5 × ca 3 cm, slightly zygomorphic; bracts ovate; bracteole linear, multiseriate, imbricate, broadly ovate, long-ciliate at margin, mucronate, ca 2 cm, appressed hairy outside. Calyx 5-lobed, lobes subulate, ciliate, ca 2 mm long, greyish. Corolla tubular-campanulate, crimson, brown tinged at throat; tube 2–2.5 cm long, lobes 5; lobes suborbicular, ca 1.6 cm across, emarginate. Stamens 8–10, unequal; filaments ca 2.5 cm long; anthers oblong, ca 3 mm long. Disk annular; ovary obovoid, ca 5 × 4 mm, tomentose, 10-locular; style ca 3 cm long; stigma capitate, ca 2 mm across. Capsules oblong-cylindric, ca 2.5 × 0.8 cm, woody, septicidal, 5-valved, densely hispid; seeds many, ciliate at both ends.

Flowering & Fruiting: Throughtout the year.

Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Kodaikanal and Poombarai. *Kabeer & Ravi Kiran 132768.*

Notes: Good populations found in Kookal grassland and scattered pouplations noticed at Ibex peak, Jamindar Shola, Berijam slopes, Blackburn Shola and Vattakanal Grassalnd. Shrinking tropical montane grasslands is a major threat to this species. Local people are collecting it as firwood, thus it is declining in Gundar Shola.

2. **Vaccinium** L.

Vaccinium neilgherrense Wight in Calcutta J. Nat. Hist. 8:173.1847; C.B. Clarke in Hook.f., Fl. Brit. India 3: 454. 1882; Gamble, Fl. Madras: 743. 1921; K.M. Matthew, Fl. Palni Hills 2: 743. 1999. **(Plate No. 42)**

Tree, 4–10 m high; bark scaly, greyish, branchlets terete, puberulous. Leaves simple, alternate, linear-lanceolate, 4–10 × 1–2 cm, apex acuminate, attenuate to cuneate at base, margins crenate-serrate, glabrous, subcoriaceous, glands on the midvein beneath; obscurely pubescent when young; lateral veins 4–6 pairs; petioles 3–6 mm long. Inflorescence axillary and terminal racemes, raceme lax; pedicels ca 1 cm long. Calyx campanulate, tube ca 2 mm long, lobes 5, triangular, 1 mm. Corolla urceolate, tube 1–1.5 cm long, lobes 5, ca 1 mm long, pubescent outside, white to lilac, pink tinged. Berries globose, ca 0.8 cm, smooth; seeds many.

Flowering & Fruiting: February–May.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Adukkam, BEL Shed, Colony medu and Melpallam. *Kabeer & Ravi Kiran 140920.*

Notes: Confined to mid elevations (800–1600 m) of the sanctuary, scattered population were seen on Perumalmalai to Adukkam road. Newly laid highway from Kumbakkarai to Perumalamlai. Expansion of private estates are the worst threat to this species.

27. **MYRSINACEAE**

Ardisia Sw., nom. cons.

Ardisia rhomboidea Wight, Icon. Pl. Ind. Orient. 4(1): 8, t. 1213. 1848; C.B. Clarke in Hook.f., Fl. Brit. India 3: 529. 1882; Gamble, Fl. Madras: 755. 1921; K.M. Matthew, Fl. Palni Hills 2: 750. 1999. **(Plate No. 43)**

Shrub, ca 3 m high; branchlets rusty pubescent. Leaves alternate, rhomboid, 3–6 × 2–3 cm, subcoriaceous, cuneate or attenuate at base, acuminate at apex, distantly serrate from middle to apex, gland-dotted beneath, puberulous beneath; petioles ca 1.5 cm long. Inflorescence terminal or upper axillary, cymes umbellate, 2–6-flowered; peduncle ca 1 cm long; pedicels 5–7 mm long; bracts linear, ca 0.8 cm long, rusty. Calyx rotate, 5 or 6-lobed; lobes subulate-ovate, ca 1.5 × 1 mm, hyaline and ciliate at margin, acute, red gland-dotted, pubescent outside. Corolla campanulate or rotate; tube ca 1 mm long, 5 or 6-lobed; lobes ovate or oblong-ovate, acute, ca 4 × 3 mm, sparsely red gland-dotted, imbricate. Stamens 5 or 6, opposite corolla lobes; filaments subulate, ca 1 mm long; anthers rhomboid-lanceolate, sagittate at base, acuminate or apiculate, 2–2.3 × 1–1.3 mm. Ovary globose, ca 1 mm; style linear-subulate, 4–5 mm long; stigma terminal, simple. Berries globose, ca 1 cm, with persistent calyx and style, purple to dark blue, beaked.

Flowering & Fruiting: February–May.

Distribution: Kerala and Tamil Nadu. KWLS: Kookal. *Kabeer & Ravi Kiran 135588, 133727.*

Notes: Occurs only in Kookal Shola as widespread understory Shola vegetation. Anthropgenic pressure is a major disturbance factor affecting this species in its habitat.

28. **SAPOTACEAE**

Isonandra Wight

Isonandra perrottetiana A. DC. in DC., Prodr. 8: 188. 1844; C.B. Clarke in Hook.f., Fl. Brit. India 3: 539. 1882; Gamble, Fl. Madras: 761. 1921; K.M. Matthew, Fl. Palni Hills 2: 756. 1999. *I. candolleana* Wight, Icon. Pl. Ind. Orient. 4(1): 9, t. 1220. 1848; C.B. Clarke in Hook.f., Fl. Brit. India 3: 539. 1882; Gamble, Fl. Madras: 761. 1921. **(Plate No. 43)**

Tree, ca 10–20 m high; latex milky, branchlets scabrous. Leaves alternate, oblanceolate or oblong-elliptic, 3–10 × 4–6 cm, acute or acuminate at apex, cuneate at base, recurved, subcoriaceous, scabrid, recurved. Flowers in fascicles, axillary, subsessile. Calyx campanulate, deeply 4-lobed, 2 bigger and 2 small, 2–3 mm long, lobes oblong-ovate. Corolla tubular campanulate, 4-lobed, basally connate; lobes oblong-elliptic to oblong-ovate, 5 mm long, cream to pale yellow. Stamens 8, exserted; filaments ca 5 mm long; anthers oblong, sagittate, acute or apiculate, ca 2 mm long. Ovary globose or ovoid, ca 2 mm long, hirsute; style slender, ca 4 mm long, excerted. Berries oblong-ellipsoid, ca 2 cm long, scarlet when ripe; seed 1, flattened.

Flowering & Fruiting: February–May.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Berijam and Kodaikanal. *Kabeer & Ravi Kiran 135572.*
Notes: Typical shola forest element and occurs in all shola forests of the sanctuary. A few individuals seen in Tiger Shola, Berijam Shola and Mediketton Shola. Flowers mildly fragrant, ripening fruits turn orange to scarlet colour. Wattle invasion is limiting this species spread at Berijam Shola.

29. **EBENACEAE**

Diospyros L.

Diospyros foliolosa Wall. ex A. DC. in DC., Prodr. 8: 234. 1844; C.B. Clarke in Hook.f., Fl. Brit. India 3: 556. 1882; Gamble, Fl. Madras: 774. 1923; K.M. Matthew, Fl. Palni Hills 2: 762. 1999; V. Singh, Monogr. Ind. Diospyros 107. 2005. **(Plate No. 44)**

Dioecious tree, 5–12 m high; bark greyish, branchlets slender, terete, glabrous. Leaves simple, alternate, lanceolate, 5–12 × 2–3 cm, glabrous, apex acute or acuminate with blunt tip, cuneate to attenuate at base, margins entire, subcoriaceous, glabrous; petioles ca 1 cm long. Male flowers in axillary cymes; peduncule slender. Calyx ca 0.3 cm long, 4-lobed. Corolla urceolate, gibbous at base; tube 0.8–1 cm long; lobes 4, bright yellow. Stamens 12–16, in pairs, equal; anthers apex inflexed, acuminate; filaments slightly hairy; pistillode rudimentary. Female axillary, solitary; pedicels ca 2 cm long. Calyx lobes 4, foliaceous, ovate cordate, slightly folded, ca 2 × 2 cm. Corolla urceolate, tube 0.8–1 cm; lobes 4, reflexed, ovate, ca 3 × 3 mm. Ovary globose, ca 5 mm wide, 4-locular; stigma capitate. Berries subglobose, ca 3.5 × 2.5 cm, densely tomentose, hairs brown when ripe; fruiting calyx persistant; seeds 4.

Flowering & Fruiting: February–May.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Periyur path. *Kabeer & Ravi Kiran 140950 & 140951.*

Notes: Very scarce and few individuals seen in Periakulam–Periur path, Devadanapatty range at an altitude of 450–800 m. March is the peak flowering time. Fruits are edible. Malabar Giant Squirrel frequently feed on its fruits.

30. **SYMPLOCACEAE**

Symplocos Jacq.

Key to the species

1a. Leaves ovate or elliptic, ca 5 cm long; flowers solitary; drupe linear…1. **S. anamallayana**
1b. Leaves elliptic-oblong, > 8 cm long; flowers in a spike; drupe obovoid……..2. **S. foliosa**

1. **Symplocos anamallayana** Bedd., Fl. Sylv. S. India: 150. 1873 & Icon. Pl. Ind. Or. t. 116. 1868–1874; C.B. Clarke in Hook.f., Fl. Brit. India 3: 581. 1882; Gamble, Fl. Madras: 784. 1921; K.M. Matthew, Fl. Palni Hills 2: 764. 1999. **(Plate No. 44)**

Shrub, ca 4 m high; densely branched, Leaves simple, ovate, elliptic, obovate or elliptic-obovate, 3–5 × 2–3 cm, alternate, glabrous, slightly grooved above, rounded or obtuse at base, apex obtuse, acute, margins distantly serrate, revolute, glabrous, coriaceous; petioles ca 6 mm long. Flowers axillary, solitary; peduncle 1–1.5 cm long, slender, recurved; bracteoles deciduous. Calyx tube adnate to ovary, lobes 5, ovate, ca 1 mm long, puberulous. Corolla 5-lobed, connate at base, obovate, ca 4 × 3 mm, white. Stamens many; filaments unequal, adnate to corolla tube, ca 4 mm long. Ovary trilocular; style filiform, ca 3 mm; stigma lobed. Drupes linear-oblong, 1–1.5 × 0.3 cm, glabrous, calyx persistant at apex; seeds oblong.

Flowering & Fruiting: May–January.
Distribution: Kerala and Tamil Nadu (Anamalais, Nilgiris & Palni Hills). KWLS: Jamindar Shola. *Kabeer & Ravi Kiran 135499.*
Notes: Endangered (World Conservation Monitoring Centre, 1998). Collected from Berijam at an altitude of 2300 m and noticed only one individual along with Shola trees. Very scarce in the sanctuary and the habitat is under *Acaica* and *Eucalyptus* species invasion. This species must be conserved by *in vitro* techniques.

2. **Symplocos foliosa** Wight, Icon. Pl. Ind. Orient. 4(1): 11, t. 1234. 1848; C.B. Clarke in Hook.f., Fl. Brit. India 3: 582. 1882; Gamble, Fl. Madras: 783. 1921; K.M. Matthew, Fl. Palni Hills 2: 765. 1999. *S. nervosa* Wight, Icon. Pl. Ind. Orient. 4(1): 11, t. 1235. 1848, non DC. 1844. **(Plate No. 45)**

Tree, 5–15 m high; branchlets lenticellate, fulvous tomentose, glabrous by age. Leaves simple, alternate, elliptic-oblong, 8–15 × ca 3 cm, estipulate, base acute, apex attenuate or acuminate,

margins serrate, glabrous, coriaceous, midvein hispid beneath; petioles 1–2 cm long, tomentose. Spikes axillary, ca 6 cm long, unbranched, densely fulvous tomentose; bracts ca 6 × 3 mm, cauducous, rusty tomentose; bracteoles early cauducous, flowers bisexual, white. Calyx lobes 5, ovate, ca 3 × 2 mm, pubescent. Corolla lobes 5, ovate or orbicular, ca 6 × 3 mm, white to lilac, ciliate. Stamens many; filaments unequal, many seriate, adnate to the corolla tube. Ovary trilocular, ca 3 mm long; style filiform, ca 4 mm long; stigma capitate, 3-lobed. Drupes obovoid, ca 1.5 × 1 cm, dark blue at ripe.

Flowering & Fruiting: November–May.

Distribution: Kerala and Tamil Nadu. KWLS: Gundar and Pillar Rock Sholas. *Kabeer & Ravi Kiran 133102 & 139665.*

Notes: Shola component rarely occuring at elevations between 2000 and 2500 m. in the sanctuary. A few individuals occur at Gundar and Moir point and the habitat is shrinking by invasion of *Acacia* species.

31. **OLEACEAE**

Key to the genera

1a. Liana or stragglers……...2. **Jasminum**
1b. Trees……....2
2a. Calyx cupular; drupe oblique, ovoid, angled……1. **Chionanthus**
2b. Calyx non-cupular; drupe ellipsoid, terete……3. **Ligustrum**

1. **Chionanthus** D. Royen

Chionanthus mala-elengi (Dennst.) P.S. Green in Bull. Bot. Surv. India 26. 124. 1984; K.M. Matthew, Fl. Palni Hills 2: 768. 1999. *Forsythia mala-elengi* Dennst., Schluss. Hort. Malab. 12, 21, 31. 1818. *Linociera malabarica* Wall. ex G. Don, Gen. Hist. 4: 53. 1837–1838; C.B. Clarke in Hook.f., Fl. Brit. India 3: 607. 1882; Gamble, Fl. Madras: 794. 1923. *Chionanthus malabaricus* (Wall. ex G. Don) Bedd., Fl. Sylv. S. India: t. 239. 1872. subsp. **mala-elengi (Plate No. 45)**

Tree, 8–12 m high; densely branched. Leaves opposite, sometimes subopposite, elliptic or oblong-elliptic, 5–10 × 3–5 cm, coriaceous, slightly recurved, obtuse at base, acute or acuminate at apex; petioles ca 5 mm. Cymes axillary, dichasial, flowers subseesile, fragrant. Calyx campanulate, 4-lobed, lobes ovate, ca 1.5 mm long, ciliate at margin. Corolla 4-lobed, 2+2, lanceolate, ca 5 mm long, incurved at margin, acute, recurved, white. Stamens 2; filaments ca 0.8 mm; anthers oblong, apiculate, 1–1.2 mm long. Ovary ovoid; style, ca 1.5 mm long; stigma bifid. Drupes obliquely oblong ovoid, 1–1.5 × ca 0.8 cm, angled, slightly curved, sparsely hispid, dark blue when ripe.

Flowering & Fruiting: January–May.

Distribution: Andhra Pradesh, Bihar, Karnataka, Kerala, Maharashtra, Odisha and Tamil Nadu. KWLS: Balasamudram East. *Kabeer & Ravi Kiran 135525.*

Notes: Restricted to foot hills of the sanctuary and during the current survey it was collected from Palani–Kodai ghat road at an altitude of 400 m. A few individuals located in Tegamtottam, Balasamudram East, and Palani Range. Habitat is under threat due to invasion of *Senna siamea* and *S. spectabilis.*

2. **Jasminum** L.

Key to the species

1a. Liana; lateral leaflets very small, caducous, tomentose……....1. **J. brevilobum**

1b. Straggler; lateral leaflets subequal to middle one, glabrous……....2. **J. calophyllum**

1. **Jasminum brevilobum** A. DC. in DC., Prodr. 8: 307. 1844; C.B. Clarke in Hook.f., Fl. Brit. India 3: 600. 1882; Gamble, Fl. Madras: 791. 1923; K.M. Matthew, Fl. Palni Hills 2: 772. 1999. P.S. Green in Kew Bull. 58: 278. 2003. **(Plate No. 46)**

Liana; branchlets desely villous, indumentum brown, bark corky. Leaves 3-foliolate, opposite; petioles ca 4 mm; terminal leaflet ovoid, ca 6 × 4 cm, rounded or subcordate at base, apex aciute, mucronate, subcoriaceous, fulvous-tomentose; lateral leaflets small, caducous, ovoid, ca 1 × 1 cm; pitiolules 2 mm. Cymes terminal, also in upper axils, corymbose, 10–15-flowered; peduncle ca 5 mm. Flowers sessile; bracts and bracteoles minute, ensiform. Calyx tube 2–3 mm; lobes 5, ovate, ca 1 mm long, densely pubescent. Corolla ca 2.5 cm wide; tube 3 cm long; lobes 5–8, oblong-ovate, ca 1 × 0.5 cm, apiculate, margins folded, white inside, lilac out side. Stamens 2, included. Ovary ca 2 mm long, tomentose; stigma capitate. Berries globose, 0.8–1 cm wide, sparsely hispid, dark blue when ripe.

Flowering & Fruiting: Throughout the year.

Distribution: Kerala and Tamil Nadu (Nilgiris & Palni Hills) KWLS: Blackburn Shola, Kookal Poombarai and Tiger Shola. *Kabeer & Ravi Kiran 132978, 138160.*

Notes: Frequent in all shola forests of the sanctuary at elevations between 1750 and 2500 m. Remarkable populations were recorded in Kookal and Poombarai. Gaja cyclone in 2018 destroyed several individuals of this species at Blackburn Shola and Tiger Shola.

2. **Jasminum calophyllum** Wall. & G. Don, Gen. Hist. 4: 63 1837; C.B. Clarke in Hook.f., Fl. Brit. India 3: 602. 1882; Gamble, Fl. Madras: 791. 1923; K.M. Matthew, Fl. Palni Hills 2: 773. 1999; P.S. Green in Kew Bull. 58: 280. 2003. *J. courtallense* Wight, Icon. Pl. Ind. Orient. 4(1): 11, t. 1252. 1848. **(Plate No. 46)**

Straggler; branchlets glabrous. Leaves opposite, 3-foliate; petioles ca 2 cm long; leaflets subequal, ovate or deltaoid, ca 4 × 3.5 cm, rounded at base, acute or acuminate at apex, tip recurved, membranous, glabrous, shiny; lateral veins 3 or 4 pairs; petiolules unequal, ca 1 cm long. Cymes terminal and in upper axils, 8–15 cm long; peduncle slender, ca 10 cm long, puberulous; bracts lacinate. Flowers subsessile; bracteoles linear, ca 1 mm long. Calyx tube ca 2 mm long, 5-toothed, puberulous. Corolla subtruncate, tube 1–1.8 cm long; lobes 5 or 6, oblong-ovate, ca 7 × 3 mm, acute, apiculate, glabrous, white. Stamens 2, included; anthers acute. Ovary glabrous, ca 2 mm long; style ca 2 cm long; stigma capitate. Berries globose, ca 0.6 cm, smooth, blue when ripe.

Flowering & Fruiting: February–May.
Distribution: Andhra Pradesh, Karnataka, Kerala, Odisha and Tamil Nadu. KWLS: Palar dam, Kudarayar Dam and Periakulam–Periur path. *Kabeer & Ravi Kiran 133648.*
Notes: Restricted to foothills of the sanctuary at altitude ranges from 300 to 600 m. March is the peak flowering time.

3. **Ligustrum** L.

Ligustrum perrottetii A. DC. in DC., Prodr. 8: 294. 1844; C.B. Clarke in Hook.f., Fl. Brit. India 3: 615. 1882; Gamble, Fl. Madras: 797. 1923; K.M. Matthew, Fl. Palni Hills 2: 776. 1999; P.S. Green in Kew Bull. 58: 267. 2003. *L. decaisnei* C.B. Clarke in Hook.f., Fl. Brit. India 3: 616. 1882; Gamble, Fl. Madras: 798. 1923. **(Plate No. 47)**

Evergreen tree, 10–15 m high; bark fissured, branchlets lenticellate. Leaves opposite, ovate or elliptic-ovate, ca 7 × 4 cm, cuneate or obtuse at base, acute at apex, margins entire, toung leaves sparsely hairy; petioles ca 1 cm long. Inflorescence terminal, also in upper axils, cymes paniculate, pubescent; flower clusters at node of rachis; peduncle ca 6 cm long; pedicels ca 2 mm; bracts ovate to lanceolate, ca 5 mm long, glabrescent. Calyx campanulate, 2–2.5 mm long, minutely toothed, puberulous. Corolla tube ca 2 mm long; lobes 4, oblong-elliptic to oblong-ovate, 3–4 × 2–3 mm, incurved at margin, reflexed, white, fragrant. Stamens 2, exserted; filaments ca 2 mm long; anthers oblong, vertical, ca 2 mm. Ovary ca 1 mm long, 2-loculed; ovules 2 per locule; style ca 2.2 mm long; stigma capitate. Drupes ellipsoid, 6–8 mm long, dark blue when ripe; seeds 1–3.

Flowering & Fruiting: July–January.
Distribution: Goa, Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Matchur, Pannaikkadu, Poombarai and Oothu. *Kabeer & Ravi Kiran 142662.*
Notes: Very frequent in the sanctuary at elevations ranging from 800 to 2500 m. Good populations observed at Law's Ghat from Poolatur to Perumalmalai and Poombarai. Habitat loss and highway expansion are altering this species distribution. The indumentum nature

varies with altitude and it is observed that, inflorescence of this species in shola forests is glabrous and pubescent in Mid-Palani plants.

32. **APOCYNACEAE**

Alstonia R. Br., nom. cons.

Alstonia venetata R. Br. in Mem. Wern. Nat. Hist. Soc. 1: 77. 1811; Hook.f., Fl. Brit. India 3: 642. 1882; Gamble, Fl. Madras: 810. 1923; K.M. Matthew, Fl. Palni Hills 2: 784. 1999. **(Plate No. 47)**

Shrub to small tree; compactly branched, branchlets glabrous. Leaves whorled, 4–6 at each node, dense toward apex, linear-lanceolate, ca 15 × 3 cm, attenuate at both ends, glabrous; lateral veins many, closely parallel; petioles ca 1 cm long. Cymes terminal, corymbose, dense; peduncle ca 1.5 cm; rays 4–6 cm long; pedicels ca 1.5 cm long. Calyx cupular; theeths 5, ovate, ca 1 mm long, acute, ciliate. Corolla tube slender, ca 2 cm long; lobes 5, oblong, ca 1.5 × 0.5 cm, acute, twisted, white, throat ciliate. Stamens 5, included; filaments ca 1 mm. Pistil 2, free; ovules many; style ca 2 cm long. Follicles terete, 5–12 cm long, beaked, lenticellate, acute; seeds many, ca 1 cm long.

Flowering & Fruiting: Throughout the year.

Distribution: Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Gurusaradi and Sowrikkadu. *Kabeer & Ravi Kiran 133043 & 133129.*

Notes: Very frequent at Palani–Kodai ghat road and Law's Ghat road at elevations between 500 and 1700 m. A scarce population also is seen in the wet evergreen forest at Perumalmalai.

33. **ASCLEPIADACEAE**

Key to the Genera

1a. Plants erect shrubs……...5. **Utleria**
1b. Plants other than erect shrubs……....2
2a. Trailing herbs; leaves subsuccullent …….....4. **Hoya**
2b. Twiners or climbers; leaves not subsucculent…….....3
3a. Leaves sub-coriaceous; flowers cream or yellowish….....4
3b. Leaves membranous; flowers brick red colour.....1. **Ceropegia**
4a. Cymes lax, flowers creamy, petals glabrous……....2. **Cryptolepis**
4a. Cymes dense, flowers yellow, petals hispid……3. **Decalepis**

1. **Ceropegia** L.

Ceropegia intermedia Wight, Icon. Pl. Ind. Orient. 4(1): 15, t. 1263. 1848. Huber in Mem. Soc. Bro. 12: 61. t. 2. f. 26. 1957; Hook.f., Fl. Brit. India 4: 71. 1883; Gamble, Fl. Madras: 858. 1923; M.Y. Ansari, Fasc. Fl. India 16: 17. 1984; K.M. Matthew, Fl. Palni Hills 2: 803. 19999. **(Plate No. 48)**

Herbaceous twiner. Leaves narrowly ovate-lanceolate, 4.5–11 × 1–4 cm, apex acute-acuminate, base obtuse or rounded, entire along margins, membranous, glabrous on both surfaces; petioles 1– 2 cm long. Flowers in axillary, 3–10-flowered cymes, purple; peduncles 1–2 cm long; pedicels 0.8–1.6 cm long. Calyx lobes 5, linear, 3.5–4.5 mm long, glabrous. Corolla 2.6–3.2 cm long; tube 1.8–2.3 cm long, inflated at baser; lobes 5, 0.8–1cm long, connate at apex, pubescent or ciliate; corona biseriate. Follicles linear-lanceolate, 10–12 cm long.

Flowering & Fruiting: June–February.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Bombay and Kookal Sholas. *Kabeer & Ravi Kiran 142665.*
Note: Populations are gradually declining in the sanctuary and are only seen at Bombay Shola and Kookal Shola borders at elevations between 1800 and 2300 m.

2. **Cryptolepis** R. Br.

Cryptolepis grandiflora Wight, Icon. Pl. Ind. Orient. 3(2): 3, t. 831. 1844–45; Hook.f., Fl. Brit. India 4: 5. 1883; Gamble, Fl. Madras: 580. 1923; K.M. Matthew, Fl. Palni Hills 2: 810. 1999. **(Plate No. 48.1)**

Twiner; latex milky, branchlets lenticellate. Leaves opposite, elliptic-oblong, ca 9 × 4 cm, base obtuse to rounded, apex acute, muronate, closely parallel, subcoriaceous, obscurely pubescent, bullate above; lateral veins 6–10 pairs; petiole ca 1.8 cm long, lenticellate. Inflorescence terminal and axillary cymes, 3–7-flowered; peduncle ca 8 cm long; bracts caducous. Calyx lobes 5 or 6, ovate, ca 0.8 × ca 0.3 cm, glabrous. Corolla tube ca 4 mm long; lobes 5 or 6, linear lanceolate, ca 2 × 0.35 cm, twisted to right in bud, imbricate, cream coloured. Stamens 5 or 6, connivent around stigma; corona of 5 or 6 fleshy scales at corolla tube. Ovary oblong; style ca 5 mm long; stigma conic. Follicles linear-terete, ca 12 cm long.

Flowering & Fruiting: November–May.
Distribution: Andaman & Nicobar Islands and Peninsular India. KWLS: Balasamudram East (Palani – Kodai ghat road). *Kabeer & Ravi Kiran 135446.*
Notes: Very common on foot hills of the sanctuary at altitudes ranges from 200 to 600 m. One of the dominant twiners in dry deciduous forests of the sanctuary. Peak flowering of this species was noticed in December at Devadanapatty and Palani forest ranges. Road widening is the major threat to this species.

3. **Decalepis** Boeckeler

Decalepis hamiltonii Wight & Arn. in Wight, Contr. Bot. India 64. 1834; Hook. f., Fl. Brit. India 4: 11. 1883; Gamble, Fl. Madras 582. 1923; K.M. Matthew, Fl. Palni Hills 2: 806. 1999.

(Plate No. 48.1)

Twining shrubs; branchellets terete, lenticellate; nodes swollen. Leaves decussate, ca 8 × 6 cm, obovate-elliptic or oblanceolate, apex obtuse, base cuneate, subcoreaceous; petiole ca 1.5 cm. Cymes trichotomous, peduncle ca 2 cm long, pedicel ca 1 cm long; bracts and bracteoles 1.5 mm, Calyx deeply 5 lobed, oblong, 2 mm, brownish, valvate, acute at apex. Corolla tube 1 mm, lobes 5, oblong, recurved, 3.5 × 2 mm, villous within, valvate, creamy yellowish. Stamens 5, attached at corolla base, alternating with glands, filaments 1 mm, anthers attached to style apex; pollinia horizontal, pollen masse granular. Corona of 10 scales, alternately long hooked and short; bicarpellary; ovules many, ovaries 1 mm. Follicles 2, lanceolate, ca 5.5 × 3 cm, epicarp thick, subterete. Seeds many, Ovate, ca 6 × 4 mm, coma silky, ca 3 cm long.

Flowering & Fruiting: August –April.

Distribution: Tamil Nadu (Palni Hills). KWLS: Pambar Shola. *Kabeer & Ravi Kiran 138106.*

Notes: Only 3 individuals were noticed in the entire Pambar Shola. As Matthew (1999) mentioned, this may become extinct from the Palani hills very soon due to tourist activity. The only healthy individual growing on a rock is facing extreme anthropogenic pressure.

4. **Hoya** R. Br.

Hoya wightii Hook.f. subsp. **palniensis** K.T. Mathew in Hoyan 14(1): 3, t. 1. 1992; K.M. Matthew, Fl. Palni Hills 2: 810. 1999. **(Plate No. 48)**

Lithophytic trailing herb; perennial. Leaves broadly elliptic, 2–4 × 1.7–3 cm, apex obtuse-rounded or mucronate or sometimes retuse, base rounded, entire along margins, faintly reflexed, coriaceous, glabrous, waxy; petioles 0.4–1 cm long, glabrous. Flowers at nodes in between leaves pairs (not axillary), in 7–15-flowered umbellate cymes; peduncles 0.7–1 cm long, glabrous; pedicels 1.5–2 cm long, glabrous. Calyx 5-lobed, imbricate; lobes ovate-triangular, 1.7–2 mm long, margins puberulous. Corolla 5-lobed, 1.4–1.6 cm across, white, rotate, waxy; lobes ovate-triangular, 4.7–5 mm long, apex acute; corona 5-lobed, purple; lobes obovoid, 2.2–2.5 mm long, fleshy. Follicles lanceolate, 5–6 cm long, narrowed at both the ends, glabrous; coma 0.9–1.3 cm long, silky.

Flowering & Fruiting: April–August.

Distribution: Tamil Nadu (Palni Hills). KWLS: Pambar Shola. *Kabeer & Ravi Kiran 138106.*

Notes: Only 3 individuals were noticed in the entire Pambar Shola. As Matthew (1999) mentioned, this may become extinct from the Palani hills very soon due to tourist activity. The only healthy individual growing on a rock is facing extreme anthropogenic pressure.

5. **Utleria** Bedd. ex Benth. & Hook.f.

Utleria salicifolia Bedd. ex Hook.f., Fl. Brit. India 4: 7. 1883; Gamble, Fl. Madras: 827. 1923; K.M. Matthew, Fl. Palni Hills 2: 818. 1999. **(Plate No. 48.2)**

Undershrubs, profusely branched from the base, branchlets rugose, covered with white ash; roots rhizomatous. Leaves whorled, crowded towards apices of branches, linear-lanceolate, ca 8–20 × 2–3 cm, midnerve pinkish, lateral nerves ca 35 pairs, closely parallel, acuminate at apex, acute at base, margin wavy; petiole ca 3 cm long, pinkish. Cymes dichotomous, axillary; peduncle ca 10 cm long; pedicel 5 mm long; bracts and bracteoles linear, ca 3 mm; flowers ca 6.5 mm across; Calyx minute, lobes 5, ovate, ca 3 mm, each lobe 2 glandular. Corolla rotate, lobes 5, ovate, 3 mm wide, obscurely overlapping to right, greenish yellow. Corona scales 5, rounded; stamens 5, inserted at base of the corolla tube; anthers ovate; connivent; pollen-masses in pairs. Pistles 2; oblong, ovules many. Follicles 2, ca 7 × 1.3 cm, lanceolate, subterete to obscurely 2 edged; tinged reddish. Seeds many, ovoid, coma white.

Flowering & Fruiting: April–August.
Distribution: Kerala and Tamil Nadu. KWLS: Pambar falls. *Kabeer & Ravi Kiran 142672.*
Notes: Few Individuals left at Pambar falls right side grassland cliffs and this area is under illegal encroachment.

34. GENTIANACEAE

Exacum L.

Exacum wightianum Arn. in Ann. Sci. Nat Bot. Ser. 2, 1: 176. 1839; C.B. Clarke in Hook.f., Fl. Brit. India 4: 97. 1883; Gamble, Fl. Madras: 873. 1923; Klackenberg in Opera Bot. 84: 74. 1985; K.M. Matthew, Fl. Palni Hills 2: 828. 1999. *E. atropurpureum* Bedd. var. *palghatense* Gamble, Fl. Madras: 874. 1923. **(Plate No. 49)**

Undershrub, ca 1.2 m high; branchlets 4-angular. Leaves decussate, ovate, 5–8 × 2–5 cm, rounded or subcordate at base, acute or acuminate at apex, membranous, glabrous, 5-nerved from base, sessile. Cymes 3–5 cm long, axillary and terminal, generally 3–5-flowered, rarely solitary; pedicels 2–4 cm long in solitary flower. Calyx 5-lobed, connate at base; lobes lanceolate, winged, hyaline at margin, acuminate, ca 1.5 cm × 3 mm; wing broad and rounded at base and tapering above, acuminate, ca 2 mm across, glandular, green. Corolla tube ca 7 mm long, 5-lobed; lobes ovate, ca 2.5 × 1 cm, acuminate, glandular, lavender or dark blue,



Exacum wightianum Arn.

throat yellow. Stamens 5; filaments ca 2 mm long; anthers oblong, retuse, 5–6 mm long, base cordate. Ovary oblong or obovoid, ca 4 × 3 mm, 2-loculed; ovules many; style ca 1.5 cm long; stigma subcapitate, ca 1 mm across. Capsules broadly ovoid, ca 1 cm across, with persistent calyx lobes.

Flowering & Fruiting: July–November.
Distribution: Kerala and Tamil Nadu. KWLS: Pappaliamman Kovil, Ibex peak and Vattakanal. *Kabeer & Ravi Kiran 133731*.
Notes: High altitude grassland element at elevations between 1900 and 2500. Gregarious pouplations were recorded in Kookal grassland, Ibex peak and Vattakanal grassland.

35. **CONVOLVULACEAE**

Argyreia Lour.

Argyreia cuneata (Willd.) Ker Gawl. in Bot. Reg. 8. t. 661. 1822; C.B. Clarke in Hook.f., Fl. Brit. India 4: 191. 1883; Gamble, Fl. Madras: 909. 1923; K.M. Matthew, Fl. Palni Hills 2: 845. 1999. *Convolvulus cuneatus* Willd., Sp. Pl. 1: 873. 1798. *Rivea cuneata* (Willd.) Wight, Icon. Pl. Ind. Orient. 3(2): 8, t. 890. 1844–45. **(Plate No. 49)**

Undershrub, ca 2.5 m high; much branched from the base, branchlets linear, pendulous, puberulous. Leaves alternate, elliptic ovate, 5–8 × 3–4 cm, margins entire, cicliate along margin, obtuse at base, obtusely apiculate, greyish silky-pubescent beneath; petioles ca 0.5–1 cm long. Cymes axillary, ca 5 cm long, 3 or more-flowered, sometimes solitary; bracts and bracteoles leafy, strigose; peduncle 2–5 cm long; pedicels ca 1.5 cm long. Calyx lobes broadly ovate or orbicular-obovate, 4–6 mm long, thick, margins hyaline, acute or acuminate, slightly refled at apex, green, strigose. Corolla infundibuliform, tube ca 3 cm long, 5-lobed, sericeous outside, purple or marron. Stamens 5, unequal; filaments 2 cm long, pubescent at base; anthers oblong, ca 3 mm long. Disk annular. Ovary ovoid, ca 1.5 cm long, 4-locular, ovule 1 in each locule; style ca 2 cm long; stigma globose, 2-lobed. Berries ovoid, ca 2 mm long, cream, brown tinged, with persistent calyx, beaked; seeds oblong, ca 8 × 5 mm, pubescent, black.

Flowering & Fruiting: August–November.
Distribution: Karnataka, Kerala, Maharastra and Tamil Nadu. KWLS: Palamalai and Sottimalai. *Kabeer & Ravi Kiran 141112.*
Notes: Very frequent in the Mid-Palanis at altitude ranges from 1300 to 1500 m. *Lantana camara* is altering the habitat and seasonal savannah fires threatening this species.

36. **SOLANACEAE**

Solanum L.

Solanum multiflorum Roth ex Roem. & Schult., Syst. Veg., ed. 15 bis 4: 669. 1819; Roth, Nov. Pl. Sp.: 130. 1821. *S. indicum* L. var. *multiflorum* (Roth) C.B. Clarke in Hook.f., Fl. Brit. India 4: 235. 1883; Gamble, Fl. Madras: 938. 1923. *S. anguivi* Lam. var. *multiflora* (Roth ex Roem. & Schult.) Chithra in A.N. Henry *et al*., Fl. Tamil Nadu 2: 115. 1987. *S. violaceum* Ortega subsp. *multiflorum* (Roth) K.M. Mathew in Kew Bull. 46: 545. 1991& Fl. Palni Hills 2: 877. 1999. **(Plate No. 50)**

Armed shrub; branchlets densely pubescent; prickles flat, broad at base, curved. Leaves shallowly sinuate, 10–18 × 8–13 cm, base truncate, apex acute, densely woolly both surfaces; petioles 3–4 cm long, prickled. Raceme axillary, 10–20-flowered, subopposite on rachis; peduncle short, rachis ca 7 cm long, densely pubescent; pedicels ca 1.5 cm long, curved, prickled. Calyx lobes 5, densely pubescent, prickled. Corolla ca 2 cm across, lobes 5, elliptic-ovate, ca 7 × 5 mm, hispid both surfaces, blue. Stamens 5; filaments ca 1 mm; anthers ca 5 mm long, base cordate. Ovary globose, ca 2 mm; style ca 8 mm long; stigma capitate. Berries globose, ca 1 cm, orange-scarlet, hairy; seeds many, pitted.

Flowering & Fruiting: July–January.
Distribution: Peninsular India. KWLS: Gundar and Kownji. *Kabeer & Ravi Kiran 132701*.
Notes: Highly restricted to elevations between 2200 and 2500 m of the shola forest borders. Scattered populations were observed in Berijam, Kodaikanal, Pulavichiar and Poondi.

37. **GESNERIACEAE**

Key to the Genera

1a. Trailing herbs; leaves linear lanceolate, flowers axillary or terminal…....1. **Aeschynanthus**
1b. Erect herbs; leaves obovate, flowers on terminal scape……2. **Henckelia**

1. **Aeschynanthus** Jack, nom. cons.

Aeschynanthus perrottetii A. DC. in DC., Prodr. 9: 261. 1845; C.B. Clarke in Hook.f., Fl. Brit. India 4: 339. 1884; Gamble, Fl. Madras: 985. 1924; K.M. Matthew, Fl. Palni Hills 2: 908. 1999. *A. perrottetii* A. DC. var. *planiculmis* C.B. Clarke in Hook.f., Fl. Brit. India 4: 340. 1884. *A. planiculmis* (C.B. Clarke) Gamble, Fl. Madras: 985. 1924. **(Plate No. 50)**

Epiphytic or lithophytic trailing herb; rooting at nodes. Leaves decussate, linear-lanceolate, ca 10 × 2 cm, attenuate at both ends, margins entire, glandular, acuminate, succulent, brown tinged, midnerve prominent below; petioles ca 5 mm long, dark brown. Flowers terminal or axillary, solitary or paried or few flowered in terminal fascicle; bracts and bracteoles minute. Calyx cupular, tube ca 2 mm long, lobes deeply 5-partite, linear-lanceolate, ca 1 × 0.1 cm,

green with brown tinged. Corolla tubular-ventricose, curved; pinkish or dark orange or scarlet, tube gradually widening into limb above, ca 5 × 1 cm; limb 2-lipped, pubescent intside, lobes yellow with red streaks; upper lip 2-lobed, lobes rounded, ca 5 mm; lower lip 3-lobed, oblong or oblong-suborbicular, obtuse, ca 7 × 5 mm. Stamens 4, didynamous; filaments 2–2.5 cm long, curved; anthers oblong, ca 3 × 1.5 mm, anthers apically connate. Ovary ca 1 × 1.5 mm, truncate at apex; style 4–5 cm long, curved dilated towards stigma; stigma flat, hairy. Capsules linear, ca 20 cm long, beaked, 2-valved; seeds numerous, hairy at hilum.

Flowering & Fruiting: July–January.
Distribution: Karnataka, Kerala, Maharastra and Tamil Nadu. KWLS: Kookal, Pambar and Tiger Sholas. *Kabeer & Ravi Kiran 133888.*
Notes: Very scarce and restricted distribution in a few sholas among the sanctuary.

2. **Henckelia** Spreng.

Henckelia incana (Vahl) Spreng., Syst. Veg. 1: 38. 1824; K.M. Matthew, Fl. Palni Hills 2: 909. 1999. *Rottlera incana* Vahl, Enum. pl. 1: 88. 1804. *Didymocarpus tomentosus* Wight, Icon. Pl. Ind. Orient. 4(2): 10, t. 1349. 1848; C.B. Clarke in Hook.f., Fl. Brit. India 4: 353. 1884; Gamble, Fl. Madras: 989. 1924. **(Plate No. 51)**

Herb. Leaves rosette, ovate, obovate or elliptic-obovate, 5–15 × 4–10 cm, glandular-hairy, subcoriaceous, decurrent or attenuate base, margins shallowly lobed and crenate, obtuse. Scapes ca 25 cm; cymes terminal on scape, glandular-pubescent; btracts minute, caducous; pedicels 1–2 cm long. Calyx lobes 5, linear, 2–3 mm long, purpulish, glandular-pubescent. Corolla tubular-ventricose, tube ca 1 cm long, curved, sparsely glandular pilose outside, 5-lobed; lobes unequal, 3+2, white to lilac or purple to violet; throat yellow. Fertile stamens 2; staminodes 2, 3.5–4 mm long. Ovary unilocular, linear, ca 4 mm long; ovules many; style ca 3 mm long; stigma capitate, ciliate. Capsules linear, ca 3.5 cm long, beaked, pilose, brown; seeds many.

Flowering & Fruiting: July–January.
Distribution: Karnataka, Kerala, Maharastra and Tamil Nadu. KWLS: Palani-Kodai, Vathalagundu–Kodai ghat roads, Periakulam–Periur path and Kumbakkarai–Vellagavi road. *Kabeer & Ravi Kiran 133066.*
Notes: Very frequent at elevations ranging from 500 to 1400 m in the sanctuary and grows in rock crevices after the first monsoon showers of July.

38. **ACANTHACEAE**

Key to the genera

1a. Climbers……...6. **Thunbergia**
1b. Shrubs and undershrubs……..2
2a. Corolla tube linear-tubular…….2. **Barleria**
2b. Corolla tube ventricose above……....3
3a. Flowers one sided on spike……..4. **Rungia**
3b. Flowers all around the spike or raceme…….4
4a. Shrubs; flowers more than 2 cm long, corolla lobes equal ……5. **Strobilanthes**
4b. Undershrubs; flowers ca 1.5 cm long, corolla lobes unequal…….5
5a. Raceme spike; bracts foliaceous, ovate; corolla lobes 2 upper 3 below……3. **Justicia**
5b. Raceme paniculate; bracts linear-lanceolate; corolla lobes 3 upper 2 below…1. **Andrographis**

1. **Andrographis** Wall. ex Nees

Key to the species

1a. Leaves elliptic-lanceolate; racemes lax, paniculate, more than 10 cm long……1. **A. affinis**
1b. Leaves elliptic-ovate; racemes compact, subcapitate, less than 8 cm long…2. **A. neesiana**

1. Andrographis affinis Nees in DC., Prodr. 11: 517. 1847; Gamble, Fl. Madras: 1050. 1925; K.M. Matthew, Fl. Palni Hills 2: 928. 1999. *A. neesiana* Wight var. *affinis* (Nees) C.B. Clarke in Hook.f., Fl. Brit. India 4: 504. 1884. **(Plate No. 51)**

Straggling undershrub; stem 4-angled, pendulous, striate, puberulous, nodes sloween. Leaves decussate, elliptic-lanceolate, ca 6 × 2 cm, subcoriaceous, base truncate or subcordate, margins thickened, sparsely strigose; petioles 2–3 mm long. Racemes terminal, also axillary, paniculate, lax, glandular-pubescent, 10–20 cm; pedicels 4–7 mm; bracts ca 3 mm long, lanceolate; bracteoles 2, minute. Calyx lobes 5, lanceolate, ca 4 mm long, glandular-pubescent, green with brown tinged. Corolla tube ca 8 mm long, bilabiate, viens light purple, upper lip 3-lobed, lower lip 2-lobed, glandular-hairy, white, tinged maroon, glandular-hairy outside. Stamens 2; filaments flat, 3–4 mm long, glandular-hairy, fringed at connective. Ovary bilocular, ca 1 mm long, puberulous; style linear, ca 6 mm long, curved, hairy, pinkish; stigma pointed. Capsules oblong, ca 1.5 cm, glandular-pubescent, green with brown tinged.

Flowering & Fruiting: August–January.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Kombaikkadu and Perumalmalai. *Kabeer & Ravi Kiran 135454, 133180.*
Notes: Found in grassland slopes at Kombaikkadu at an altitude of 1400 m and on Perumalmalai at elevations between 1900 and 2200 m. Dominant herb on Perumalmalai

grassland trekking path. This species is under extreme threat due *Eucalyptus* invasion in its habitat.

2. **Andrographis neesiana** Wight, Icon. Pl. Ind. Orient. 4(4): 8, t. 1561. 1850; C.B. Clarke in Hook.f., Fl. Brit. India 4: 504. 1884; Gamble, Fl. Madras: 1049. 1925; K.M. Matthew, Fl. Palni Hills 2: 928. 1999. **(Plate No. 52)**

Straggling undershrub; branchlets pendulous, often purplish brown, stems 4-angular, glandular-pubescent, glabrous when old. Leaves decussate, elliptic-ovate or ovate-lanceolate, 4–8 × 2–4 cm, acuminate at apex; cuneate at base, ciliate at margin, acuminate, scabrid; petioles 0.5–1 cm. Racemes terminal and in upper axils, 5–8 cm long, compact; bracts lanceolate, glandular-hairy, 1–1.5 cm long; bracteoles linear, ca 4 mm long. Calyx lobes 5, linear-subulate, ca 5 × 1 mm, glandular-pubescent. Corolla tube ca 7 mm long, purpulish, slightly ventricose, glandular-hairy, 2-lipped; upper lip oblong, ca 1 cm, margins folded back, obtuse and minutely lobed, ca 5 parallel-nerved, white inside with purple blotches; lower lip obscurely lobed, reflexed, ca 1 cm long, 3-nerved, glabrous inside. Stamens 2; filaments ca 1.4 cm long, flat, pubescent below, fringed at connective; anthers oblong, ca 3 mm long. Ovary ovoid-ellipsoid, ca 2 mm long, glandular-pubescent; style ca 1.8 cm long, sparsely pubescent; stigma pointed. Capsules oblong-obovoid, ca 2.5 cm long, green with brown tinged, glandular-pubescent.

Flowering & Fruiting: July–February.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Gundar, Pambar falls, Poombarai and Vadakownji–Pannaikkadu grassland. *Kabeer & Ravi Kiran 133015.*
Notes: Frequently occurs at shola borders and long shola streams of the sanctuary. The habitats are under extreme threat due to invasion of *Acacia* sp.

2. **Barleria** L.

Key to the species

1a. Spines abscent; flowers blueish……1. **B. acuminata**
1b. Spines present; flowers yellow……...2. **B. cuspidata**

1. **Barleria acuminata** Wight ex Nees in Wall., Pl. Asiat. Rar. 3: 93. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 4: 484. 1884; Gamble, Fl. Madras: 1059. 1924; K.M. Matthew, Fl. Palni Hills 2: 931. 1999. *B. tomentosa* Roth var. *acuminata* (Nees) C.B. Clarke in Hook.f., Fl. Brit. India 4: 485. 1884. **(Plate No. 52)**

Undershrub, ca 1.5 m high; branchlets pubescent. Leaves decussate, ovate, 5–9 × 3–5 cm, acute to acuminate at apex, rounded or subcordate at base, appressed-greyish-tomentose;

petioles 2–3 cm long. Racemes axillary, compact; bracts lanceolate, 1–2 cm long, pubescent. Calyx lobes 4, in opposite pairs, outer lobes larger than inner lobes, oblong-lanceolate or ovate-lanceolate, connate at base, ca 1.5 × 0.4 cm, pubescent outside, hyaline, veins brown. Corolla slaver shaped, tube cylindrical, 3–4.5 cm long, 5-lobed, violet, throat dark violet. Stamens 2; filaments 3.5–5 cm long; anthers 3 mm long. Ovary oblong, ca 3 mm long; style ca 5 cm long; stigma capitat. Capsules oblong-ovoid, ca 1.5 cm long, beaked, flattish, 4 angled; seeds 2–4, compressed, appressed pubescent.

Flowering & Fruiting: December–April.
Distribution: Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. KWLS: Devadanapatty and Palani Forest Ranges. *Kabeer & Ravi Kiran 142649.*
Notes: Very frequent at the foot hills of the sanctuary and associated with dry deciduous forests.

2. **Barleria cuspidata** B. Heyne ex Nees, Pl. Asiat. Rar. 3: 93. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 4: 483. 1884; Gamble, Fl. Madras: 1058. 1924; K.M. Matthew, Fl. Palni Hills 2: 931. 1999. **(Plate No. 53)**

Armed undershrub, ca 80 cm high; stems obscurely 4-angled; spines 2–6, axillary, ca 4 cm long. Leaves decussate, elliptic-lanceolate, 4–8 × 2–4 cm, attenuate at base, cuspidate or apiculate at apex, glabrescent, pale beneath; lateral veins 3–6 pairs, coriaceous; petioles 0.5–1 cm long. Flowers axillary at upper nodes, solitary or few, 4–6 cm long; bracts linear-lanceolate, ca 2 × 0.5 cm, cuspidate at apex, appressed pubescent. Calyx 2 seriate; outer lobes ovate-lanceolate, subequal, ca 2.5 × 1 cm, cuspidate at apex, pubescent inside; inner lobes linear-lanceolate, shorter than outer, 3–4 mm across, acute at apex. Corolla blipped; tube ca 3 cm long, obscurely hairy outside; lobes 5, 4 +1, oblong or oblong-obovate, 2–3 × 1–1.5 cm, obtuse at apex, creamy or yellowish orange. Stamens 2, exserted; filaments 4–5 cm long, hairy at base; anthers ca 4 mm long; staminodes 2. Ovary ovoid, ca 5 mm long, glabrous; style slender, 5–6 cm long; stigma ca 1 mm long, papillate. Capsules ovoid, ca 2 × 0.7 cm; seeds ovoid, compressed appressed hairy, brown.

Flowering & Fruiting: October–May.
Distribution: Eastern and Peninsular India. KWLS: Devadanapatty and Palani Forest Ranges.
Notes: Associated with scrub forests at the foothills of the sanctuary. A good number were seen at Manjalar dam and the Murugamalai.

3. **Justicia** L. nom. cons.

Justicia glauca Rottler in Neue Schriften Ges. Naturf. Freunde Berlin 4: 219. 1802; C.B. Clarke in Hook.f., Fl. Brit. India 4: 529. 1885; Gamble, Fl. Madras: 1059. 1924; K.M. Matthew, Fl. Palni Hills 2: 942. 1999. **(Plate No. 54)**

Herb, ca 80 cm high; branchlets greyish, glabrescent; nodes prominent. Leaves decussate, ovate, 2–5 × 2.5 cm, membranous, acute at apex, obtuse or rounded at base, sparsely pubescent, ciliate at margin, glaucous beneath; petioles 1–2.5 cm long. Spikes axillary and terminal, 5–10 cm long; bracts foliaceous, ovate, ca 1.5 × 1 cm, ciliate at margin; sometimes flowers solitary in lower axils; bracteoles 2, linear, ca 4 mm. Calyx lobes 5, linear-lanceolate, ca 5 mm long, pubescent. Corolla tube ca 3 mm long, 2-lipped; upper lip subentire, thick, ca 5 mm long, gery with pink tinged; lower obscurely 3-lobed, obovate, ca 1 cm, white or pink with purple streaks at throat. Stamens 2; filaments ca 4 mm long; anthers ca 1.5 mm long. Ovary ovoid, ca 1.5 mm long, bilocular; ovules 2 in each locule; style ca 6 mm long, hairy; stigma bifid. Capsules obovoid, ca 1 cm, acute, pubescent; seeds 4, spinulose, flat.

Flowering & Fruiting: August–April.

Distribution: Wider distribution in entire India. KWLS: Devadanapatty, Palani and Perupallam Forest Ranges. *Kabeer & Ravi Kiran 138125.*

Notes: Frequently occurs from the foothills to mid elevation of the sanctuary. February to March is the peak flowering time and capsule dehisces by May.

4. **Rungia** Nees

Rungia laeta C.B. Clarke in Hook.f., Fl. Brit. India 4: 546. 1885; Gamble, Fl. Madras: 1071. 1924; K.M. Matthew, Fl. Palni Hills 2: 947. 1999. **(Plate No. 54)**

Undershrub; diffuse, branchlets glabrescent, subterete, striate, zigzag. Leaves decussate, ovate-lanceolate, 6–12 × 3–5 cm, apex acute or acuminate, glabrous, ciliate at margin; lateral veins 6–8 pairs; petioles ca 2 cm long, decurrent. Spikes terminal and axillary, 3–6 × 2 cm, oblong; peduncle 2–3 cm long, floral bracts green with pink tinged, arranged in 4 rows, chaffy, margins ciliate, ovate to ovate-lanceolate 1.2–1.6 × 0.4–0.7 cm, lateral bracts sterile, elliptic to obovate, acute, ciliate; bracteoles ca 1 × 0.3 cm, linear. Calyx lobes 5, lanceolate, aristate, ca 0.7 cm long. Corolla tube ca 1 cm long, bilabiate; lips swallowly lobed, lower lip longer than upper, white pink tinged, hairy outside. Stamens 2; filaments glabrous, ca 1.2 cm long; anthers white with pink blotches, ca 2 mm. Ovary bilocular; ovules 2 per locule; style ca 1.3 cm long, curved; stigma capitate. Capsules lanceolate, ca 8 mm long, pubescent; seeds 4, tuberculate.

Flowering & Fruiting: July-February

Distribution: Kerala and Tamil Nadu. KWLS: Bombay Shola and Pambar Falls. *Kabeer & Ravi Kiran 133729.*

Notes: Scarce in the sanctuary and restricted to ravines of shola forests at elevations between 1900 and 2400 m. Massive bushes appears on dripping rocks of sholas.

5. **Strobilanthes** Blume

Key to the species

1a. Fertile stamens 2……2
1b. Fertile stamens 4……5
2a. Racemes condensed; bracts foliaceous……2. **S. foliosa**
2b. Racemes elongate; bracts not foliaceous ……...3
3a. Branchlets densely cottony-tomentose, young branches rusty……6. **S. lanata**
3a. Branchlets appressed or glandular pubescent, young branches glabrascent……..4
4a. Leaves coriaceous, elliptic-lanceolate; flowers more than 3 cm long……....5. **S. kunthiana**
4b. Leaves chartaceous, cuspidate or ovate; flowers less than 2 cm long....1. **S. consanguinea**
5a. Inflorescence elongated……...6
5b. Inflorescence compressed……10
6a. Leaves oblong; spikes interrupted…….....3. **S. gracilis**
6b. Leaves ovate; spikes uninterrupted…….....7
7a. Bracteoles glandular-pubescent……...8
7b. Bracteoles nonglandular, glabrous……11. **S. zenkeriana**
8a. Flowers browninsh or dark purple, less than 1.5 cm long…….....9
8b. Flowers lilac-mauve, more than 2 cm long……....4. **S. heteromalla**
9a. Leaves coriaceous; bracts orbicular, flowers dark purple.....7. **S. lurida**
9b. Leaves chartaceous; bracts lanceolate, flowers brownish……8. **S. micrantha**
10a. Indumentum silvery; bracts compacted, orbicular; corolla tube mauve...9. **S. pulneyensis**
10b. Indumentum reddish; bracts loose, obovate; corolla tube with brown blotches……10. **S. urceolaris**

1. **Strobilanthes consanguinea** (Nees) T. Anderson in Thwaites, Enum. Pl. Zeyl. 226. 1860; C.B. Clarke in Hook.f., Fl. Brit. India 4: 435. 1884; Gamble, Fl. Madras: 1036. 1924; K.M. Matthew, Fl. Palni Hills 2: 951. 1999; Venu, *Strobilanthes* Penins. India 86. 2006. *Endopogon consanguineus* Nees in Wall., Pl. Asiat. Rar. 3: 99. 1832. *Strobilathes cuspidatus* sensu K.M. Matthew, Fl. Palni Hills 2: 952. 1999, non (Benth) T. Anderson, 1860. **(Plate No. 55)**

Shrubs ca 2 m high; bushy, brachlets pendulous, hanging when grows on slopes, lenticellate. Leaves decussate, ovate, 4–13 × 2–8 cm, acuminate at apex cuneate or decurrent, margins dentate-crenate, chartaceous, scabrid above, slightly glaucescent below; lateral veins 5–7;

petioles 5–8 cm long. Spikes axillary and terminal, 2–3 in each axil, 8–12 × ca 1.5 cm, branched, glabrescent or glandular villous; bracts ovate-lanceolate, clasping, acuminate, ca 1 × 0.4 cm, glandular-ciliate; bracteoles 2, linear-lanceolate, glandular-ciliate, acuminate, ca 5.6 × 1 mm. Calyx ca 1 cm long, lobed up to half of the tube; lobes 5, unequal, lanceolate, glandular-ciliate, acuminate, ca 4 × 1 mm, pubescent. Corolla tube ca 5 mm long, ventricose above for ca 1cm long; lobes 5, 2 + 3, unequal, ovate or ovate-subulate, acute to acuminate, 4–8 × 3–5 mm, hairy inside, mauve. Stamens 2; filaments ca 1 cm long; anthers oblong, ca 3 mm long. Ovary bilocular, oblong, acute and hairy at apex, slightly grooved; ovules 2 per locule; style ca 2 cm long; stigmas 3 mm long. Capsules oblong-ellipsoid, ca 1 cm long; seeds 4, ca 2 mm long.

Flowering & Fruiting: November–March.

Distribution: Andhra Pradesh, Odisha, Karnataka, Kerala and Tamil Nadu. KWLS: Devadanapatty, Kodaikanal Palani and Perupallam Forest Ranges. *Kabeer & Ravi Kiran 133142, 142622 & 142631.*

Notes: Based on careful field observations for the past 5 years, the glaucous nature of the leaves and glandular pubescent spikes can be seen in the same plants when tempertature increases and at lower altitudes. Also noticed the sporadic flowering in December 2015, gregarious flowering in November–December 2017 and November–December 2018 in different populations between 400 and 1000 m elevation.

2. **Strobilanthes foliosa** (Wight) T. Anderson in J. Linn. Soc., Bot. 9: 467. 1867; C.B. Clarke in Hook.f., Fl. Brit. India 4: 433. 1884; Gamble, Fl. Madras: 1035. 1924; K.M. Matthew, Fl. Palni Hills 2: 952. 1999; Venu, *Strobilanthes* Penins. India 99. 2006. *Endopogon foliosus* Wight, Icon. Pl. Ind. Orient. 4(3): 20, t. 1501. 1849. **(Plate No. 55)**

Shrub, 1–3 m high, branchlets subterete to angular, glabrous, glandular pilose at inflorescence, younger branches purpulish. Leaves decussate, elliptic-ovate or obovate, 4–8 × 2–4 cm, acute at apex, attenuate at base, coriaceous, glaucous below, serrulate; petioles ca 3 cm long. Spikes condenced, axillary, also terminal, 3–5 cm long, lanceolate; basal bracts 4, in two opposite pairs, foliaceous, ca 3.5 × 1.5 cm; floral bracts lanceolate, ca 2.5 × 0.5 cm, glabrous; bracteoles 2, ca 2 × 0.4 cm, linear. Calyx lobes 5, connate at base, ca 1.7 cm long, lanceolate, glabrous. Corolla tube narrow cylindrical, 2 cm, curved; ventricose above, ca 2.8 × 1.7 cm; lobes 5, rounded, ca 8 × 5 mm, sericeous, mauve. Stamens 2, included; filaments ca 1.4 cm, hairy; staminodes 2; filaments ca 5 mm. Ovary bilocular; ovules 2 in each locule; style ca 3 cm long. Capsules oblong, ca 1.7 cm long; seeds 4, ca 8 × 7 mm, flattened.

Flowering & Fruiting: May–July.

Distribution: Peninsular India. KWLS: Pambar shola and Vattakanal. *Kabeer & Ravi Kiran 139750, 141169 & 142656.*

Notes: Gregarious populations were observed in Pambar Shola and Vattakanal Shola. Habitat of this species is shrinking due to invasion of *Acacia* and *Eucalptus* species.

3. **Strobilanthes gracilis** Bedd., Icon. Pl. Ind. Or. t. 207. 1868–1874; C.B. Clarke in Hook.f., Fl. Brit. India 4: 474. 1884; Gamble, Fl. Madras: 1043. 1924; K.M. Matthew, Fl. Palni Hills 2: 953. 1999; Venu, *Strobilanthes* Penins. India 103. 2006. *Mackenziea gracilis* (Bedd.) Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. Sect. 2,41: 182. 1944. **(Plate No. 56)**

Shrubs, 3–7 m high; stems obtusely quadrangular, lenticellate, glabrous. Leaves opposite, oblong-lanceolate, 15–20 × 4–6 cm, acuminate at apex, serrate, glabrousdecurrent and auricled at base; petioles 3–5 cm long.; lateral veins 6 or 7 pairs. Panicle lax, ca 20 cm long, terminal and upper axillary; peduncle 3 cm long; bracts ovate to oblanceolate, ca 1 × 0.3 cm, glandular-hairy; flowers 1–3 in a spike. Calyx tube ca 1 mm long, lobes 5, basally connate, lobes ca 9 × 1.5 mm, oblanceolate. Corolla tube narrow below, 4 mm long, ventricose above, ca 2.5 cm long, hairy; lobes 5, blue to violetish. Stamens 4, unequal pairs; filaments hairy. Ovary bilocular, ovate; style ca 2 cm long, hairy. Capsules lanceolate, ca 12 × 7 mm, compressed; seeds orbicular, flat.

Flowering & Fruiting: May–July.

Distribution: Kerala and Tamil Nadu. KWLS: Kookal, Pambar and Vattakanal. *Kabeer & Ravi Kiran 141173.*

Notes: Scarce in the sholas at elevations ranging from 1900 to 2300 m. and scattered individuals seen in Pambar Shola and Vattakanal Shola. About 6 to 7 m tall individuals were noticed in Kookal Shola. As Venu (2006) mentioned *Strobilanthes homotropa* is abundant in Kookal Shola, the present study has also noticed those 6 m high individuals in vegetative stage and it is very similar to *S. gracilis*.

4. **Strobilanthes heteromalla** T. Anderson *ex* C.B. Clarke in Hook.f., Fl. Brit. India 4: 437. 1884; Gamble, Fl. Madras: 1040. 1924; Venu, *Strobilanthes* Penins. India 107, f. 21. 2006. *Xenacanthus heteromallus* (T. Anderson *ex* C.B. Clarke) Bremek. in Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk., Sect. 2. 41(1): 176. 1944. **(Plate No. 56)**

Bushy shrub, 1–3 m high; branches many from middle upwards, rigid, sparsely lenticellate, usually angular or quadrangular upwards, villous. Leaves ovate or lanceolate or elliptic-broadly elliptic, 5–22 × 2.5–11 cm, apex acute-acuminate, base cuneate-obtuse, obscurely decurrent into petiole, margins crenulate-crenate or sometimes subentire, subcoriaceous, rugose and

sparsely hirsute or hirsute with tubercular bases above, pubescent or villous beneath; lateral veins 5–10 pairs; petioles 1–6 cm long, pubescent or villous. Inflorescence trichotomous panicle with a pair of spathulate involucral bracts, densely glandular-pubescent; bracts 1.5–2.5 cm long, elliptic-obovate, margins crenate, glandular-pubescent; bracteoles 1–1.5 cm long, narrow lanceolate-lanceolate, glandular-pubescent. Calyx 0.8–1.1.3 cm long, divided nearly to the base, glandular-pubescent; lobes 5, equal or subequal, linear-lanceolate. Corolla 2.2–3 cm long, campanulate, pale lilac or mauve, glabrous or puberulous outside, nectar guide area hairy; lobes 5, suborbicular, apex acute or obtuse or slightly emarginate, margins entire. Stamens 4, included; filaments unequal, hairy at base. Ovary subglobose, hairy at apex; style 1.5–2 cm long, included, sparsely hairy. Capsules narrowly ellipsoid, 1–1.5 cm long; seeds usually 4, sometimes 2, 2.5–3 mm across, suborbicular, brownish, glabrous, flattened, exareolate.

Flowering & Fruiting: October–March

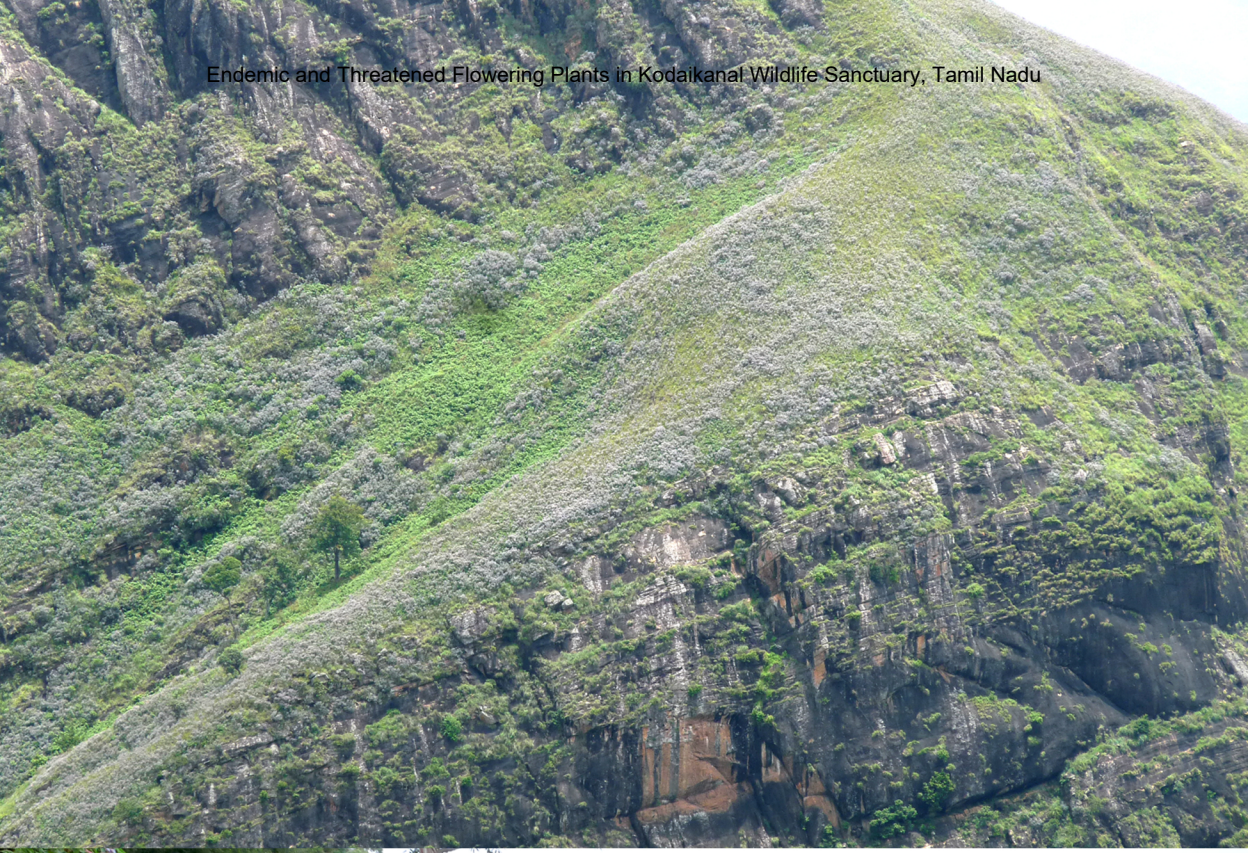
Distribution: Karnataka and Tamil Nadu. KWLS: Perumalmalai, Tiger Shola and Vadakownji. *Kabeer & Ravi Kiran 139692.*

Type: India, Neelgherry hill (Nilgiri hill), February 1850, *R. Wight 2207* (lectotype K000882901!, isolectotypes C10005199!, CAL!, P00719344!. (Singh & Arigela, 2019)

Notes: This study has noticed sporadic flowering in November 2017 at Perumalmalai check post, Adukkam road and Mass blooming in Oct – Dec 2018 in Tiger Shola and also at Vadakownji. Very frequent at 1400–1800 m. Vadakownji villagers are keeping it as hedge plant for their estates.

5. **Strobilanthes kunthiana** (Nees) T. Anderson *ex* Benth., Fl. Hongk. 262. 1861; T. Anderson in J. Linn. Soc., Bot. 9: 465. 1867; C.B. Clarke in Hook.f., Fl. Brit. India 4: 434. 1884; Gamble, Fl. Madras: 1036. 1924; Fyson, Fl. S. Ind. Hill Sta. 445, t. 384. 1932; K.M. Matthew in J. Bombay Nat. Hist. Soc. 67: 502. 1971; Carine *et al.* in Kew Bull. 59: 14, f. 4. 2004; Venu, *Strobilanthes* Penins. India 129, f. 28. 2006. *Phlebophyllum kunthianum* Nees in Wall., Pl. Asiat. Rar. 3: 83. 1832; Wight, Icon. Pl. Ind. Orient. 2(2): 3, t. 448. 1843. **(Plate No. 57)**

Shrub, ca 2 m high. Leaves decussate, ovate-elliptic or ovate-lanceolate, 3–8 × 2–3.5 cm, acute or acuminate at apex, cuneate at base, serrate, greyish-white-villous beneath except on veins. Spikes terminal and axillary, ca 5 cm long; bracts in 4 imbricate rows, ovate-lanceolate, densely ciliate at margin, acuminate, ca 13 × 5 mm, appressed-pubescent outside; bracteoles 2, linear-lanceolate or very narrowly oblanceolate, ciliate at margin, acuminate, 10.9–11.2 × 1.5–2 mm, densely pubescent outside, 3-veined at base. Calyx tube 5–7.2 mm long, 5-lobed, shallowly 2-lipped (3+2); lobes lanceolate, ciliate at margin, acuminate, 3.5–7 × 1.5–2.2 mm, densely pubescent outside. Corolla ca 2.5 cm long, mauve; tube 5–6 mm long, ventricose





Strobilanthes kunthiana (Nees) T. Anderson ex Benth.

above, ca 1.2 cm long, pubescent outside, 5-lobed; lobes rounded, ca 7 mm long, wavy, ciliate at margin. Stamens 2; filaments to 8 mm long, hairy at base; anthers 2.2–2.5 mm long. Ovary oblong, ca 2 × 0.7 mm, acute and densely villous at apex; style ca 15 mm long, unevenly thickened, pilose; stigma linear, 2–2.3 mm long. Capsules oblong-ellipsoid, ca 1.5 × 0.4 cm; seeds 4, compressed, densely hairy.

Flowering & Fruiting: August–January.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Kookal, Pallangi, Periapatty, Prakashpuram and Vattakanal. *Kabeer & Ravi Kiran 133034, 138149, 138174 & 139674.*
Type: India, Nilghiry (Nilgiri), *s.d.*, *R. Wight 39* (lectotype GZU000280285!, isolectotype MH00007564!). (Designated by Singh & Arigela, 2019)
Notes: Occurs in grassy slopes and edges of moist deciduous forests and shola grasslands, between 700 and 2000 m elevations. Sporadic flowering seen in August 2015, 2016 and 2017 and mass blooming recorded in 2018 August to October at all high altitude grasslands of the sanctuary. In recent past, Ian Lockwood recorded the Kurinji blooming periodically at Kodaikanal in the year 1994 and 2006.

6. **Strobilanthes lanata** Nees in DC., Prodr. 11: 191. 1847; Venu, *Strobilanthes* Penins. India 132. 2006. *S. gossypina* T. Anderson, J. Linn. Soc., Bot. 9: 466. 1867; C.B. Clarke in Hook.f., Fl. Brit. India 4: 434. 1884; Gamble, Fl. Madras: 1037. 1924. **(Plate No. 57)**

Shrub, ca 1.5 m high, branchlets 4-angled, densely cottony-tomentose, young branches rusty. Leaves decussate, broadly elliptic-ovate, ca 14 × 6 cm, rounded at base, margins entire, acute or acuminate at apex, coriaceous, pubescent above, floccose tawny woolly beneath; lateral veins 10–13 pairs, parallel; petioles 2–5 cm long, densely tomentose. Spikes axillary and terminal, solitary or branched, uninterrupted, 5–8 cm long, with grey or tawny tomentose; bracts ovate or lanceolate, acute, ca 1.2 cm long, white-yellow-tomentose outside, glabrous and shining inside; bracteoles linear-oblong, ca 1 cm long, gery tomentose. Calyx ca 1.2 cm long, tube ca 2 mm long, lobes 5, linear, equal, ca 1 cm long, pubescent. Corolla infundibuliform, ca 3.5 cm long, mauve or violet, tube faintly curved, ca 5 mm long; ventricose above, ca 3 cm long, 5-lobed; lobes orbicular, acute, ca 7 mm. Stamens 2; filaments ca 1.5 cm long, included, hairy. Ovary ca 2 mm long, hairy; style linear, ca 1.5 cm glabrous. Capsules oblong-ellipsoid, 1.2 cm long.

Flowering & Fruiting: September–April.
Distribution: Karnataka, Kerala, Tamil Nadu. KWLS: Gundar. *Kabeer & Ravi Kiran 142663.*
Notes: Only 3 individuals were seen at Gundar and it was introduced recently in the sanctuary. Seeds collected from The Nilgiris were thrown in the different places in the Palani

hills and also planted in Vattakanal conservation trust nursery by Bob Stewart and Tanya Balcar. Further survival is bit doubtful and Wattle invasion and highway road expansion are threatening its existence.

7. **Strobilanthes lurida** Wight, Icon. Pl. Ind. Orient. 4(4): 3, t. 1515. 1850; C.B. Clarke in Hook.f., Fl. Brit. India 4: 450. 1884; Gamble, Fl. Madras: 1042. 1924; K.M. Matthew, Fl. Palni Hills 2: 955. 1999; Venu, *Strobilanthes* Penins. India 140. 2006. **(Plate No. 57.1)**

Shrub, ca 4 m high; oftenly straggling, young branchlets quadrangular, pubescent, swollen at nodes. Leaves opposite, ca 20 × 10 cm, ovate-elliptic, obtuse at base, crenulate at margin, acuminate at apex, coriaceous, pilose, densely pilose below; petioles ca 5 cm long. Spikes strobilate, ca 8 x 4.5 cm, hispid, from older stems, often from near ground, opposite, ascending, uninterrupted, compact; peduncles ca 5 cm long, usually with one or 2 joints; bracts obovate to orbicular, ca 2.5 × 2 cm, emarginated or retuse at tip, ribbed, glandular-pubescent, purple with black tinge or greenish; bracteoles 2, ligulate, ca 2.5 × 0.5 cm, apex reflexed. Calyx ca 2 cm long, 5-lobed, divided up to the base; lobes lanceolate, slightly enlarged in fruit, finely ridged, ca 2.2 cm long. Corolla ca 2.8 cm long, exceeding large dull bracts, tubular-ventricose, purple; tube ca 2 mm long; ventricose portion widening above gradually, glabrous outside, hairy inside, 5-lobed; lobes ovate, obtuse, ca 3 mm long. Stamens 4, equal, united in pairs at base forming a staminal sheath, exserted; filaments ca 1.5 cm long. Ovary on a prominent disc, ca 2.5 mm; style slender, ca 2.2 cm long; stigma bilobed. Capsules ovoid-ellipsoid, ca 2 cm long, acuminate, glabrous; seeds rounded, lenticular, ca 6 × 6 mm, smooth, glabrous on both faces.

Flowering & Fruiting: September–May.
Distribution: Karnataka, Kerala, Tamil Nadu. KWLS: Tiger Shola.
Notes: Few individuals were seen at Tiger Shola as middle story and flowers once in 6 years. Landslides at Tiger Shola due to Gaja cyclone, some of these plants uprooted and washed off. This species may extinct from Palni Hills very soon.

8. **Strobilanthes micrantha** Wight, Icon. Pl. Ind. Orient. 4(4): 3, t. 1519. 1850; C.B. Clarke in Hook.f., Fl. Brit. India 4: 444. 1884; Gamble, Fl. Madras: 1040. 1924; K.M. Matthew, Fl. Palni Hills 2: 956. 1999; Venu, *Strobilanthes* Penins. India 147. 2006. *Taeniandra micrantha* (Wight) Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. Sect. 2, 41: 175. 1944. **(Plate No. 58)**

Shrub, ca 4 m high; branchlets quadrangular, oftenly straggling, coiled, glabrous. Leaves ovate or elliptic-ovate, ca 18 × 10 cm, acuminate at apex, cuneate at base, decurrent, crenulate, scabrid; lateral veins 8–10 pairs, pubescent below; petioles ca 6 cm long. Spikes 5–15 cm long,

oblong, solitary, axillary, also at nodes on older branches, branched; peduncles 2–3 cm long; deflexed, hispid; bracts ca 2.8 × 1 cm, lanceolate, hirtus; bracteoles ca 2 × 0.3 cm, glandular-hairy. Calyx divide nearly to base, lobes 5, lanceolate, ca 1.5 × 0.4 cm, hispid. Corolla tube ca 4 mm long; ventricose above, ca 8 mm long, campanulate with deflexed lobes, reddish-purple or brownish. Stamens 4; filaments ca 1.5 cm, glabrous; anthers ca 2 mm long, purpulish. Ovary oblong, ca 2 mm; style ca 1.2 cm long, shorter than filamnts; stigma pointed. Capsules oblong, ca 1.3 × 0.4 cm, narrow at both ends; seeds 4, glabrous, ca 5 × 3 mm, oblong.

Flowering & Fruiting: September–February

Distribution: Kerala, Tamil Nadu. KWLS: Tiger and Vattakanal Sholas. *Kabeer & Ravi Kiran 135566.*

Notes: Stray flowering seen at Tiger Shola in April 2017 and massive blooming noticed in November 2017 at Tiger Shola and Vattakanal Shola. Plants wilted by February 2018. Several individuals were removed by the Highways Department before seed setting at Tiger Shola as part of their regular practice of weeding road margins to avoid accidents.

9. **Strobilanthes pulneyensis** C.B. Clarke in Hook.f., Fl. Brit. India 4: 438. 1884; Gamble, Fl. Madras: 1038. 1924; K.M. Matthew, Fl. Palni Hills 2: 957. 1999; Venu, *Strobilanthes* Penins. India 164. 2006. *Xenacanthus pulneyensis* (Hook.f.) Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. Sect. 2, 41: 176. 1944. *Strobilanthes orbiculata* Thomas, Mani & Britto in Phytotaxa 369(1): 47. 2018. **(Plate No. 58)**

Shrub, ca 2.5 m high; branchlets densely hirtus, angled. Leaves ovate to elliptic-ovate, ca 9 × 5 cm, acuminate at apex, cuneate to rounded, obscurely decurrent, densely hirtus; veins 5–7 pairs, margins serrate; petioles ca 5 cm long. Spikes terminal, also axillary; peduncle 2–5 cm, flattened, 1–3 in axils; bracts foliaceous, 1–3 × 1.5 cm, ovate to sub-orbicular, serrate, densely white hairy at base; bracteoles linear, hairy. Calyx tube narrow, ca 6 mm long, hairy, lobes linear, 10 mm long, hairy. Corolla mauve, tube curved, narrow, 8 mm long; ventricose above, 1–1.5 cm long; lobes 5, ovate, 0.7 – 1 × ca 0.6 cm, acute, throat ciliate, sparsely hispid outside. Stamens 4; filaments didynamous, ca 1.5 cm long; anthers purple, ca 3 mm long, Ovary ovate, hairy apically; style ca 1.8 cm long. Capsules oblong, ca 8 × 4 mm; seeds 4.

Flowering & Fruiting: August–February.

Distribution: Andhra Pradesh, Odisha, Chattisgarh, Karnataka, Kerala and Tamil Nadu (Palani and Nilgiri form vary from Andhra and Odisha form by having short spike). KWLS: Bombay Shola and Dolphn Nose. *Kabeer & Ravi Kiran 138157, 141005.*

Notes: Frequent at Bombay Shola and Dolphin's Nose at elevations between 2200 and 2300 m. Stray flowering noticed in April 2016 at Pambar Shola and gregarious blooming in August – November 2017 at Dolphin nose and in August – November 2018 at Bombay Shola.

Strobilanthes pulneyensis C.B. Clarke

Type:—INDIA. Tamil Nadu: Dindigul district, Pulney (Palani) hills, 1866, *R. H. Beddome s.n.* (lectotype K000882895!, designated by Arigela & Singh, 2019; isolectotypes MH00116226!).

Strobilanthes circarensis Gamble (1923: 373).

Type:—INDIA. Andhra Pradesh: Vizagapatam (Visakhapatnam) district, Peddavalsa, 2000 ft., January. 1890, *Gamble 21779* (lectotype K000883174!, designated Arigela & Singh, 2019; isolectotypes BSI!, DD!).

10. **Strobilanthes urceolaris** Gamble in Bull. Misc. Inform. Kew 1923: 374. 1923 & Fl. Madras: 1038. 1924; K.M. Matthew, Fl. Palni Hills 2: 957. 1999; Venu, *Strobilanthes* Penins. India 184. 2006. *Nilgirianthus urceolaris* (Gamble) Bremek., Verh. Kon. Ned. Akad. Wetensch., Afd. Natuurk. Sect. 2, 41: 173. 1944. **(Plate No. 59)**

Shrub, ca 1 m high; branchlets hirsute, lenticellate, greyish, hairs pinkish on young branches and leaves. Leaves decussate, ovate to elliptic ovate, 5–7.5 × 3–5 cm, rounded at base, acuminate at apex, membranous, rugose, densely hirsute above, sparse beneath. Spikes compact, 2 involucral leaves at base; bracts obovate, ca 1.5 × 0.5 cm, margins crenate towards apex; bracteoles linear, ciliate at margin, ca 1.4 cm long. Calyx 5-lobed, glandular-hairy; lobes subequal, linear-lanceolate, obtuse, 1–1.4 cm long, pilose, accrescent and glandular in fruit. Corolla tube cylindric at base; urceolate above, ca 1.2 cm long, 5-lobed; lobes elliptic, ca 8 × 4 mm, obtuse, subequal, pink. Stamens 4, didynamous. Capsules obovoid, ca 1 cm long; seeds 4.

Flowering & Fruiting: March–May.

Distribution: Kerala and Tamil Nadu. KWLS: Kookal. *Kabeer & Ravi Kiran 140916.*

Notes: During the present explorations it was seen only in Kookal Shola at elevations ranging from 1900 to 2100 m. The species is facing extreme threat from cattle grazing.

11. **Strobilanthes zenkeriana** (Nees) T. Anderson in J. Linn. Soc., Bot. 9: 467. 1867; C.B. Clarke in Hook.f., Fl. Brit. India 4: 439. 1884; Gamble, Fl. Madras: 1038. 1924; K.M. Matthew, Fl. Palni Hills 2: 958. 1999; Venu, *Strobilanthes* Penins. India 197. 2006. *Goldfussia zenkeriana* Nees in Prodr. 11: 172. 1847. **(Plate No. 59.1)**

Shrub, 2–4 m high; branchlets angled, glabrous. Leaves elliptic-ovate, 4–12 × 4–7 cm, subcoriaceous, base cuneate, margins serrulate, apex acuminate; petioles 4–9 cm long. Spikes terminal and in upper axils, erect, oblong, ca 7 × 3 cm; bracts ovate, spathulate below, ca 2.8

× 1.5 cm; bracteoles 2, linear-lanceolate, ca 1.5 × 0.2 cm, glabrous. Calyx ca 1.8 cm; tube ca 3 mm; lobes 5, lanceolate, ca 1.5 cm long. Corolla tube ca 1cm; ventricose above, ca 2.7 cm; lobes 5, ca 1.3 × 1 cm, mauve. Stamens 4; filament didynamous, ca 5 and ca 9 mm long. Ovary ovate, ca 2 mm long; style ca 3 cm long; stigma pointed. Capsules ellipsoid, ca 1.8 × 0.4 cm; seeds 4, flat.

Flowering & Fruiting: August–October.
Distribution: Kerala and Tamil Nadu. KWLS: Pambar and Vattakanal Sholas. *Kabeer & Ravi Kiran 139751 & 141171.*
Notes: Gregarious populatons located at Vattakanal Shola at an elevation of 2200 m. Flowering was not observed during present exploraions.

6. **Thunbergia** Retz., nom. cons.

Thunbergia tomentosa Wall. ex Nees in Wall., Pl. Asiat. Rar. 3: 78. 1832; C.B. Clarke in Hook.f., Fl. Brit. India 4: 392. 1884; Gamble, Fl. Madras: 1008. 1924; K.M. Matthew, Fl. Palni Hills 2: 960. 1999. **(Plate No. 59)**

Twiner; branchlets 4-angular, desely strigose. Leaves hastate, ca 7 × 4 cm, strongly 3-veined from base, strigose, base truncate or hastate, margins lobed, distantly dentate, apex acute or attenuate; petioles ca 3 cm long. Flower axillary, solitary; bract 2, ovate to lanceolate, ca 2.5 × 1.8 cm; pedicels ca 5 cm, striate. Calyx-teeth ca 15, filiform, cream. Corolla ca 5 cm wide; tube ca 3.5 cm; lobes 5, obovate, ca 2.2 × 1.7 cm, white. Stamens 4; filaments didynamous, ca 3 cm long. Ovary ovoid, 4-locular, hairy; style ca 3.2 cm; stigma flat, angular. Capsules depressed-globose, ca 1cm across, hispid, beak ca 3 cm long.

Flowering & Fruiting: August–March.
Distribution: India. KWLS: Kookal. *Kabeer & Ravi Kiran 132983.*
Notes: Frequently occurs at shola and evergreen forest edges at elevations between 1400 and 2500 m. Large populations recorded in Edamankarai Shola and Kookal Shola. Expansion of private estates without any buffer area is the major threat to this species. Morphologically it is very similar to T. *fragrans.*

39. **LAMIACEAE**

Key to the genera

1a. Inflorescence verticillaster; calyx tube ca 10-lobed…….3. **Leucas**
1b. Inflorescence spike or thyrsi; calyx tube 5-lobed……...2
2a. Calyx lobes equal, not bilipped……..5. **Pogostemon**
2b. Calyx lobes unequal, bilipped……..3

3a. Upper lip of calyx 3-lobed……6. **Scutellaria**
3b. Upper lip of calyx 1-lobed……...4
4a. Leaves whorled……1. **Anisochilus**
4b. Leaves decussate……5
5a. Herbs; calyx subequally 5-lobed, flowers white tinged riddish……2. **Isodon**
5b. Undershrubs or shrubs; calyx obscurely 2-lobed, flowers purple……....4. **Plectranthus**

1. **Anisochilus** Wall. ex Benth.

Anisochilus argenteus Gamble in Bull. Misc. Inform. Kew 1924: 265. 1924 & Fl. Madras: 1127 1924; K.M. Matthew, Fl. Palni Hills 2: 982. 1999; Suddee & Paton in Kew Bull. 64: 250. 2009. **(Plate No. 60)**

Erect, undershrub, 30–90 cm high including spikes; stems silvery or tawny tomentose. Leaves oblanceolate or obovate, 1–2 × 0.5–1 cm, sessile, whorled, apex acute, base cuneate, entire along margins, subcoriaceous, silvery tomentose on both surfaces. Flowers in terminal, 6–10 cm long cylindrical spikes. Bracts and calyx densely silvery tomentose; fruiting calyx 3–3.5 mm long, 5-toothed. Corolla 3.5–4.5 mm long, white with pinkish-purple tinge, pubescent outside, bilipped. Stamens 4, glabrous. Nutlets 0.9–1.1 mm long, ovoid, brown.

Flowering & Fruiting: November–February.

Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Blackburn Shola, Ibex peak and Kookal. *Kabeer & Ravi Kiran 132782 & 139667.*

Notes: Grows on rocky crevices in high altitude (>1900 m) grasslands. Scattered populations seen at Blackburn Shola, Berijm, Kookal grassland and Ibex pek. Habitat loss is the major threat to this species. Wattle invasion in its habitat is another threat to the species' existence.

2. **Isodon** (Schrad. ex Benth.) Spach

Key to the species

1a. Leaves rugose; calyx teeth obtuse……...1. **I. nilgherricus**
1b. Leaves not rugose; calyx teeth acute……..2
2a. Leaf base rouded or truncate, pubescent……3. **I. wightii**
2b. Leaf base cuneate, glabrate……2. **I. rivularis**

1. **Isodon nilgherricus** (Benth.) H. Hara in J. Jap. Bot. 60: 236. 1985; K.M. Matthew, Fl. Palni Hills 2: 991.1999. *Plectranthus nilgherricus* Benth. in DC., Prodr. 12: 57. 1848; Hook.f., Fl. Brit. India 4: 619. 1885; Gamble, Fl. Madras: 1121. 1924. **(Plate No. 60)**

Herb, 0.5–1 m high including panicles; stems villous. Leaves ovate, 4–8 × 3–6 cm, apex acute, base cordate-rounded, crenate-serrate along margins, rugose, subcoriaceous, villous above, densely villous below, upper sessile; petioles 2–5 cm long, villous. Flowers in axillary and terminal thyrsoid panicles, 9–18 cm long. Calyx 1.5–2 mm long, bilipped, 5-toothed (3+2), densely villous. Corolla 5.5–7 mm long, bilipped; upper lip 4-lobed, recurved, white with pinkish-purple dots, with sessile glands and pilose outside; lower lip obovate, apex obtuse, concave, white, pilose outside. Stamens 4, glabrous. Ovary glabrous; style shortly bifid. Nutlets obovoid, 0.8–1.2 mm long.

Flowering & Fruiting: August–February.
Distribution: Kerala and Tamil Nadu. KWLS: Kookal and Poombarai. *Kabeer & Ravi Kiran 133096A*.
Notes: Frequent at Shola borders and grasslands, especially at Pommbarai and Kookal. *Ageratina adenophora* is invading the habitat and decline of this species is observed in the current study.

2. **Isodon rivularis** (Wight ex Hook.f.) H. Hara in J. Jap. Bot. 60(8): 236. 1985. *Plectranthus rivularis* Wight ex Hook.f., Fl. Brit. India 4(12): 617. 1885; Gamble, Fl. Madras: 1120. 1924. **(Plate No. 80)**

Herb, ca 1 m high including panicles, perennial; stems erect, pendulous, puberulous. Leaves elliptic-lanceolate, 2.5–8 × 1–3 cm, apex shortly acuminate, base cuneate, crenate along margins except the lower one third, membranous, glabrate, dark green, scabrous or scaberulous on both surfaces; petioles 1–3 cm long, puberulous. Flowers in axillary and terminal thyrsoid panicles, 8–22 cm long, puberulous; bracts 1.5–2 mm long, lanceolate, puberulous, persistant. Calyx 2.5–3 mm long, bilipped, 5-toothed (3+2), puberulous, in fruiting 4.5–5 mm long and deflexed. Corolla 4.5–5.5 mm long, bilipped, glabrous; upper lip 4-lobed, recurved, white with pinkish-purple dots; lower lip broadly obovate, apex rounded, white. Stamens 4, declinate; filaments glabrous. Ovary glabrous; style shortly bifid. Nutlets broadly oblong, 1–1.5 mm long, smooth, brown.

Flowering & Fruiting: February–April.
Distribution: Kerala and Tamil Nadu. KWLS: Tiger Shola. *Kabeer & Ravi Kiran 139793.*
Notes: Critically endangered (Sasidharan, 2011) species with only a few individuals were seen on the slopes of Tiger Shola at an altitude of 1750 m. May disappear very soon from the Palani Hills due to habitat loss.

3. **Isodon wightii** (Benth.) H. Hara in J. Jap. Bot. 60: 237. 1985; K.M. Matthew, Fl. Palni Hills 2: 991. 1999. *Plectranthus wightii* Benth., Labiat. Gen. Spec. 41. 1832; Hook.f., Fl. Brit. India 4: 619. 1855; Gamble, Fl. Madras: 1120. 1924. **(Plate No. 61)**

Herb, ca 1 m high including panicles; stems pubescent or glabrescent. Leaves ovate or broadly ovate, 2–12 × 1–8 cm, apex acute or shortly acuminate, base cordate-rounded or truncate, deeply crenate-serrate along margins, membranous, pubescent or glabrescent; upper subsessile; petioles 1–7 cm long, pubescent. Flowers in axillary and terminal thyrsoid panicles, 10–22 cm long, pubescent-hirtellous. Calyx 1.2–1.5 mm long, bilipped, 5-toothed (3+2), pubescent-hirtellous, glandular outside. Corolla 5–6 mm long, bilipped; upper lip 4-lobed, recurved, white with pinkish-purple dots, pilose outside; lower lip obovate or broadly obovate, apex rounded, white, pilose or glabrous outside. Stamens 4, pubescent at base. Ovary glabrous; style shortly bifid. Nutlets oblong, 0.7–1 mm long.

Flowering & Fruiting: February–April.

Distribution: Kerala and Tamil Nadu. KWLS: Kudarayar and Pambar Sholas. *Kabeer & Ravi Kiran 135490, 139696*.

Notes: Scarce at shola edges at elevation ranges from 1750 to 2300 m. Noticed few populations at Edmanakarai Shola and Kudarayar Shola and gregarious populations in Pambar Shola. Peak flowering was observed in the March of every year.

3. **Leucas** R. Br.

Key to the species

1a. Shrubs, more than 2 m high……...3. **L. lanceifolia**
1b. Undershrubs or herbs, less than 1 m high……..2
2a. Leaves whorled, glaucous, linear……1. **L. helianthemifolia**
2b. Leaves decussate, green, ovate-lanceolate……..3
3a. Corolla upper lip white bearded……2. **L. hirta**
3b. Corolla upper lip brown bearded……4. **L. vestita**

1. **Leucas helianthemifolia** Desf. in Mém. Mus. Hist. Nat.11: 2. 1824**.** Gamble, Fl. Madras: 1152. 1924; V. Singh, Monogr. Indian *Leucas* 86. 2001. *L. ternifolia* Desf. in Mém. Mus. Hist. Nat. 11: 4. 1824; K.M. Matthew, Fl. Palni Hills 2: 998. 1999. **(Plate No. 62)**

Undershrub, 35–70 cm high, much branched from base; rootstocks woody; stems and branches terete, closely appressed white or yellowish tomentose. Leaves opposite or in whorls of 3–6, linear-oblong, 1.5–3 × 0.3–1 cm, apex obtuse-subacute, base narrowed, entire and revolute along margins, coriaceous, 1-nerved, appressed white tomentose above, densely below, sessile or subsessile. Flowers in terminal whorls or 2 or 3 in upper axils; bracts linear-subulate, 3.5–5 mm long, tomentose. Calyx campanulate, 5.5–7 mm long, 10-ribbed, tomentose outside, glabrous inside, mouth truncate; teeth 10, 0.6–0.9 mm long, subulate, erect, tomentose, margins ciliate; villi longer than teeth. Corolla bilipped, white, 1–1.4 cm

long; tube exserted, tomentose; upper lip cucullate, densely bearded with white hairs; lower lip 3-lobed, pubescent outside; lateral lobes triangular-ovate; mid lobe suborbicular, apex emarginate. Stamens 4, didynamous. Ovary 4-locular; style bilobed at apex. Nutlets 4, oblong, 2.5–3 mm long, apex truncate, dark brown, smooth.

Flowering & Fruiting: August–April.
Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Kookal, Kownji, Mannavanur, Pundi and Vembadi peak. *Kabeer & Ravi Kiran 132842 & 142660*.
Notes: Scarcely distributed at elevations between 2200 and 2500 m. A few populations were found at Berijam slopes, Kookal grassland, Kownji, Pundi and Vembadi peak. Gregarious populations were noticed in the Mannavanur grassland but this area was excluded from the sanctuary.

2. **Leucas hirta** (B. Heyne ex Roth) Spreng., Syst. Veg. 2: 743. 1825; Hook.f., Fl. Brit. India 4: 687. 1885; Gamble, Fl. Madras: 1153. 1924; K.M. Matthew, Fl. Palni Hills 2: 9951999; V. Singh, Monogr. Indian *Leucas* 90. 2001. *Phlomis hirta* B. Heyne ex Roth, Nov. Pl. Sp.: 264. 1821. **(Plate No. 61)**

Erect herb, 25–50 cm long; rootstocks woody; stems and branches villous. Leaves narrow elliptic or oblanceolate, 1.5–6.5 × 1–2 cm, opposite, apex acute or subacute, base acute, ciliate and crenate-serrate along margins, scabrid, sparsely pubescent on both surfaces, densely pubescent on veins below, gland dotted below, subsessile. Flowers in terminal 2–2.5 across whorls; bracts linear-lanceolate, 8–11 mm long, pubescent, margins ciliate. Calyx tubular-campanulate, as long as bracts or slightly smaller, 10-ribbed, pubescent outside, glabrous inside, mouth truncate; teeth 10, 1.7–2 mm long, linear-subulate, pubescent, margins ciliate; villi as long as teeth. Corolla bilipped, white; tube included within calyx; upper lip cucullate, 5–5.5 mm long, densely white bearded; lower lip 3-lobed, 7.5–8 mm long, sparsely pubescent outside. Stamens 4, didynamous. Ovary 4-locular, obovoid; style bilobed at apex. Nutlets 4, obovoid, 2.5–3 mm long, brown, smooth.

Flowering & Fruiting: August–January.
Distribution: Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. KWLS: Berijam, Colonymedu, Ibex peak, Palamalai, Perumalmalai, Mannavanur, Sottimalai, Vadakownji–Pannaikkadu path and Vembadi peak. *Kabeer & Ravi Kiran 132886, 132944.*
Notes: Very frequent from mid Palanis to high altitude grasslands at altitude between 1000 and 2400 m.

3. **Leucas lanceifolia** Desf. in Mem. Mus. Hist. Nat. 11: 5. 1824; Hook.f., Fl. Brit. India 4: 685. 1885; Gamble, Fl. Madras: 1153. 1924; K.M. Matthew, Fl. Palni Hills 2: 996.1999; V. Singh, Monogr. Indian *Leucas* 102. 2001. **(Plate No. 62)**

Shrub, 1.5–4 m high, much branched; branches tetragonous, tomentose. Leaves narrow elliptic or lanceolate, 4–18 × 1–7 cm, opposite, apex obtuse-subacute, base acute or cuneate and slightly revolute, ciliate and entire or distantly crenulate along margins, subcoriaceous, scaberulous above, white tomentose beneath; petioles 0.3–4.5 cm long, white tomentose. Flowers in terminal, 2–3 cm across whorls or 2–4 whorls in upper axils; bracts linear-lanceolate, 6–12 mm long, tomentose, margins ciliate, spinulose at apex. Calyx tubular-campanulate, as long as bracts or slightly smaller, 10-ribbed, pubescent or tomentose outside, glabrous inside, mouth truncate; teeth 10, 1–1.5 mm long, subulate, erect, pubescent or tomentose, margins ciliate, spinulose at apex; villi longer or shorter than teeth. Corolla bilipped, white, 1.2–1.7 cm long; tube exserted, pubescent; upper lip cucullate, 6–8 mm long, densely bearded with white hairs; lower lip 3-lobed, 8.5–11 mm long, pubescent outside; lateral lobes triangular-ovate; mid lobe suborbicular. Stamens 4, didynamous. Ovary 4-locular, obovoid; style bilobed at apex. Nutlets 4, obovoid, 3–3.5 mm long, brown, smooth.

Flowering & Fruiting: July–November.
Distribution: Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. KWLS: Berijam. *Kabeer & Ravi Kiran 132751.*
Notes: Very scarce and grows at the edges of the shola forests. The highest individual is about 4 m among the 4 individuals, was recorded near the mosque on the Berijam road. Except these 4 individuals, no other population was seen in the sanctuary and probably it may become extinct from the Palani Hills very soon.

4. **Leucas vestita** Benth. in Wall., Pl. Asiat. Rar. 1: 61. 1830; Fyson, Fl. S. Ind. Hill. Stat. 482. t. 420. 1932; K.M. Matthew, Fl. Palni Hills 2: 998. 1999; Hook.f., Fl. Brit. India 4: 686. 1885, incl. var. *oblongifolia*; Gamble, Fl. Madras: 1153. 1924; V. Singh, Monogr. Indian *Leucas* 149. 2001.
(Plate No. 63)

Erect herb, ca 1 m high, branched from base; rootstocks woody; stems and branches covered with rusty hairs, older ones terete and younger 4-gonous. Leaves ovate-elliptic or ovate-lanceolate, 2–9 × 1–3.5 cm, apex acute, base acute or rounded, margins crenate-serrate, ciliate, subcoriaceous, scabrid, rugose, hirsute on both surfaces or older sparsely hirsute on upper surface. Flowers in terminal whorls or 2 or 3 in upper axils; bracts linear-lanceolate, 8–12 mm long, hirsute. Calyx campanulate, 7–10 mm long, 10-ribbed, hirsute outside, glabrous inside, mouth truncate; teeth 10, 2.5–4.5 mm long, linear-subulate, erect, hirsute, margins

ciliate; villi densely arranged, shorter than teeth, rusty brown. Corolla bilipped, white, 1.3–1.7 cm long; tube included within calyx, pubescent in upper part; upper lip cucullate, densely bearded with rusty brown hairs; lower lip 3-lobed, pubescent outside; lateral lobes triangular-ovate; mid lobe suborbicular. Stamens 4, didynamous. Ovary 4-locular; style bilobed at apex. Nutlets 4, obovoid, 2.7–3.4 mm long, dark brown, smooth.

Flowering & Fruiting: August–February.

Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Mannavanu and Poombarai. *Kabeer & Ravi Kiran 142661*.

Notes: Very frequent from Poombarai to Kookal road, growing at grassland edges and Shola forest borders at elevations between 1900 and 2500 m. October is the peak flowering time and pollinator is Swift Butterfly.

4. **Plectranthus** L'Hér., nom. cons.

Key to the species

1a. Decumbent undershrubs; leaves succulent……1. **P. bourneae**

1b. Erect shrubs; leaves membranous……....2. **P. deccanicus**

1. **Plectranthus bourneae** Gamble, Fl. Madras: 1122. 1924 & in Bull. Misc. Inform. Kew 1924: 264. 1924; Fyson, Fl. S. Ind. Hill. Stat. 467. t. 405. 1932; K.M. Matthew, Fl. Palni Hills 2: 1005. 1999. **(Plate No. 63)**

Ascending perennial undershrub, much branched, 30–70 cm high. Leaves suborbicular-orbicular or broadly ovate, 2–4 × 1.7–3.6 cm, apex subacute-obtuse, base rounded or truncate, crenate along margins except the basal part, fleshy, whitish pubescent on both surfaces; lateral veins 4–7; petioles 0.7–2 cm long, whitish pubescent, fleshy. Flowers in terminal thyrsoid panicles, 10–25 cm long, purplish; bracts caducous, suborbicular-orbicular or broadly ovate, 3.5–5 mm long, margins ciliate, pubescent below; pedicels 2.5–4.5 mm long, pubescent. Calyx campanulate, 2.5–3.5 mm long, elongated in fruits, dark purple, pubescent and with sessile glands outside, 5-toothed; teeth subequal. Corolla bilipped, 12–16 mm long, mauve to purple, pubescent outside, glabrous inside; tube 6–7 mm long; upper lip 4-lobed, pubescent outside, glabrous inside; lower lip boat-shaped, pubescent outside. Stamens 4, didynamous, free, attached near the mouth of the corolla tube, glabrous; anthers bilobed, dorsifixed, dehiscing longitudinally. Disk 0.8–1.1 mm long, enlarged in front side, larger than ovary; style glabrous; stigma bifid. Nutlets ellipsoid, 1–1.2 mm long, dark brown, smooth.

Flowering & Fruiting: March–May.

Distribution: Tamil Nadu (Nilgiris & Palni Hills). KWLS: Berijam, Poombarai and Vadakownji–Pannaikkadu grasslands. *Kabeer & Ravi Kiran 135584.*

Notes: Restricted to high altitude grasslands and very scarce in the sanctuary with a few individuals on the Berijam slopes, Poombarai and Vadakownji–Pannaikkadu grasslands. Facing extreme threat due to habitat loss and Gaur (Indian Bison) are consuming this species.

2. **Plectranthus deccanicus** Briq. in Annuaire Conserv. Jard. Bot. Genève 2: 234 1898; K.M. Matthew, Fl. Palni Hills 2: 1006. 1999. *Coleus fruticosus* Wight ex Benth. in DC., Prodr. 12: 78. 1848. *Plectranthus fruticosus* (Wight ex Benth.) Hook.f., Fl. Brit. India 4: 623. 1885, non L 'Hér. 1788; Gamble, Fl. Madras: 1122. 1924. **(Plate No. 64)**

Shrub, 1.5–3 m high, bushy, much branched; young branches pubescent. Leaves broadly ovate or orbicular, 5–20 cm long, apex acute, base rounded or subcordate, double crenate along margins, puberulous or pubescent on upper surface, densely pubescent below; petioles 2–12 cm long, fleshy, pubescent. Flowers in terminal thyrsoid panicles, 15–30 cm long, purplish, sometimes branched from base; bracts caducous, ovate, 4–5 mm long, apex acuminate, pubescent; pedicels 2.5–3.5 mm long, pubescent. Calyx campanulate, 2.5–3 mm long, elongated in fruits, dark purple, pubescent and with sessile glands outside, 5-toothed; teeth subequal. Corolla bilipped, 15–18 mm long, purple, pubescent outside, glabrous inside; tube 7–8.5 mm long; upper lip 4-lobed, pubescent outside, glabrous inside; lower lip boat-shaped, pubescent outside. Stamens 4, didynamous, free, attached near the mouth of the corolla tube, glabrous; anthers bilobed, dorsifixed, dehiscing longitudinally. Disk 0.9–1 mm long, enlarged in front side, larger than ovary; style glabrous; stigma bifid. Nutlets ellipsoid, 1.4–1.5 mm long, dark brown, rough.

Flowering & Fruiting: January–July.

Distribution: Kerala and Tamil Nadu. KWLS: Kownji, Pannaikkadu and Poombarai. *Kabeer & Ravi Kiran 132867.*

Notes: Frequently noticed at Kownji and Pannaikkadu at elevations between 1400 and 2400 m. Local inhabitants are using this plant as hedge for their coffee estates.

5. **Pogostemon** Desf.

Key to the species

1a. Leaves subsucculent; petioles less than 1 cm long.....1. **P. mollis**
1b. Leaves chartaceous; petioles more than 3 cm long.....2. **P. wightii**

1. **Pogostemon mollis** Benth., Labiat. Gen. Spec. 155. 1833; Hook.f., Fl. Brit. India 4: 635. 1885; Gamble, Fl. Madras: 1134. 1924; K.M. Matthew, Fl. Palni Hills 2: 1007. 1999. **(Plate No. 64)**

Ascending undershrub, much branched; stems and branches pubescent or tomentose. Leaves broadly ovate or orbicular, 1.5–3.5 cm long, subsucculent, apex acute or obtuse or rounded, base rounded, margins crenate, pubescent or tomentose on both surfaces; petioles 3–7 mm long, pubescent or tomentose. Flowers in terminal, dense, 7–15 cm long, interrupted or uninterrupted elongated spikes, sessile; bracts and bracteoles linear or narrowly lanceolate, tomentose or villous. Calyx campanulate, 4–5 mm long, 5-lobed, tomentose or villous, green or with purple tinge; lobes subulate. Corolla white, bilipped; tube slightly exserted from calyx, 4.5–5.5 mm long, pubescent outside; lips 5–6 mm long, sparsely pubescent outside, apex obtuse; upper lip 3-lobed; lower unlobed. Stamens 4, exserted, free; filaments white or with light purplish tinge in upper part, bearded in middle part with white hairs, 3 longer and 1 shorter. Ovary 4-locular; style light purple, bilobed at apex in 2 equal lobes. Nutlets 4, obovoid, 0.9–1.2 mm across, dark brown.

Flowering & Fruiting: November–May.
Distribution: Karnataka, Kerala, Maharastra and Tamil Nadu. KWLS: Dolphin Nose and Prakshapuram. *Kabeer & Ravi Kiran 140918 & 142613.*
Notes: Restricted to shola borders of the sanctuary at elevations ranging from 2000 to 2400 m. Grows on rocky crevices in shola grasslands.

2. **Pogostemon wightii** Benth., Labiat. Gen. Spec. 156. 1833; Hook.f., Fl. Brit. India 4: 635. 1885; Gamble, Fl. Madras: 1134. 1924; K.M. Matthew, Fl. Palni Hills 2: 1011. 1999. **(Plate No. 65)**

Erect herbs or undershrub, 0.4–1 m high; branches quadrangular, with purplish tinge, hirsute. Leaves ovate, 3–7 × 2–4 cm, chartaceous, apex acute, base broadly cuneate or obtuse or rounded, irregular crenate along margins, sparsely hispid on both surfaces; petioles 1.5–5.5 cm long, hispid. Flowers in terminal, dense, 5–10 cm long, interrupted or uninterrupted, elongated, branched from base or unbranched spikes; bracts and bracteoles linear-oblong, hispid. Calyx campanulate, 3.5–4.5 mm long, 5-lobed, green or with purple tinge; tube glabrous or sparsely hispid; lobes narrow ovate-triangular, hispid along margins. Corolla white, bilipped, 4.5–5.5 mm long; tube included within calyx, pubescent outside; lips 5–6 mm long, apex obtuse; upper lip 3-lobed, midlobe of upper lip hispid outside and two later lobes pubescent outside; lower unlobed, pubescent outside. Stamens 4, exserted, free; filaments light purplish, bearded with light purple hairs in middle part, 3 longer and one shorter. Ovary 4-locular; style light purple, bilobed at apex Nutlets 4, suborbicular, 0.8–1 mm across, brownish-black.

Flowering & Fruiting: August–November.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Gundar and Pambar Sholas. *Kabeer & Ravi Kiran 132719.*

Notes: This species is very occasional. Grows near streams in shola forests at elevation ranges from 2000 to 2500 m. Species of *Acacia* are invading the habitat.

6. **Scutellaria** L.

Scutellaria colebrookeana Wall. ex Benth. in Wall., Pl. Asiat. Rar. 1: 67. 1830; Gamble, Fl. Madras: 1142. 1924; K.M. Matthew, Fl. Palni Hills 2: 1016.1999. *S. violacea* B. Heyne ex Benth. var. *colebrookeana* (Wall. ex Benth.) Hook.f., Fl. Brit. India 4: 668.1885. **(Plate No. 65)**

Erect or ascending herb, much branched, 20–50 cm high; stems and branches puberulous or pubescent, branches distinctly quadrangular in upper part. Leaves deltoid or broadly ovate, 1.5–3 × 1.2–2.5 cm, apex acute, base truncate or rounded, margins crenate in middle part, entire in apex and basal part, glaucous; lateral veins 4 pairs; petioles 1–2 cm long, puberulous. Flowers opposite, in terminal, 7–15 cm long racemes; bracts foliaceous, less than 7 mm long. Calyx bilipped, 3–3.5 mm long, elongated in fruits, glandular-pubescent, red-purplish; upper lip and lower lip entire. Corolla bilipped, glandular-pubescent outside, light violet or light purple; tube 6.5–8 mm long; lower lip 3-lobed; lateral lobes jointed with galeate upper lip; mid lobe broadly ovate-trapeziform, 6–7 mm long, apex rounded. Stamens 4, didynamous, included under the upper lip of corolla. Ovary 4-locular; style unequally bilobed at apex. Nutlets ovoid, 1.4–1.5 mm long, tuberculate, dark brown.

Flowering & Fruiting: November–April.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Melpallam, Palamalai, Pannaikkadu and Oothu. *Kabeer & Ravi Kiran 138113.*

Notes: Grows in savannahs and moist evergreen forests at elevations between 800 and 1500 m. Seasonal savannah fires and exotic species are altering the species distribution. *Scutellaria wightiana* Benth. which is considered as endemic to Western Ghats area of Karnataka, Kerala and Tamil Nadu, but after study of type specimens and in field, it is found conspecific with *Scutellaria violacea* B. Heyne ex Benth.

40. **PIPERACEAE**

Piper L.

Piper wightii Miq. in London J. Bot. 5: 552. 1846; Hook.f., Fl. Brit. India 5: 94. 1886; Gamble, Fl. Madras: 1207. 1925; K.M. Matthew, Fl. Palni Hills 2: 1056. 1999. *P. canescens* J. Mathew in Ann. Bot. Fenn. 54(4–6): 267. 2017. **(Plate No. 66)**

Stout climber. Leaves simple, alternate, ovate or elliptic or orbicular, 3–12 × 2–7 cm, apex acute-acuminate, base rounded or subcordate, entire along margins, glabrous above, white glaucous and sometimes young leaves puberulous on veins beneath, 5–7-veined; petioles 1–4 cm long, glabrous. Inflorescence pendulous spikes; peduncle 2–3 cm long, glabrous; male spikes 7–16 cm long, longer than female, glabrous, pale yellow during anthesis; stamens 2, 0.4–0.5 mm long; female spikes 4–8 cm long, glabrous; bracts adnate to the spike axis, obovoid; stigmatic lobes 3 or 4. Drupes ovoid-globose, 4–6 mm across, beaked, sessile, smooth, green when young, orange when ripe.

Flowering & Fruiting: May–November.

Distribution: Tamil Nadu. KWLS: Gundar, Pambar and Vattakanal Sholas. *Kabeer & Ravi Kiran 132737, 132855, 132989, 142610 & 142659.*

Notes: Common in all shola forests of the sanctuary at elevations between 1900 and 2500 m. This species is closely allied to *Piper hookeri* Miq. and *P. hymenophyllum* Miq. After study in fields and type specimens of *P. hookeri* Miq., *P. hymenophyllum* Miq. and *P. wightii* Miq., it seems the latter two species are forms of *P. hookeri* Miq. Molecular studies are needed to resolve the taxonomic issues of these three names.

41. **LAURACEAE**

Key to the genera

1a. Dioecious trees.....2
1b. Monoecious trees.....4
2a. Leaves triplinerved; tepals bimerous (2+2); stamens 6 in 2 whorls.....6. **Neolitsea**
2b. Leaves penninerved; tepals trimerous (3+3); stamens 9–12 in 3–4 whorls.....3
3a. Leaves verticillate; involucral bracts imbricate, caducous.....1. **Actinodaphne**
3b. Leaves alternate or subopposite; involucral bracts decussate, persistent or late deciduous……5. **Litsea**
4a. Leaves triplinerved.....3. **Cinnamomum**
4b. Leaves penninerved.....5
5a. Leaves opposite; berries not enclosed or seated on persistent perianth tube or lobe.....2. **Beilschmiedia**
5b. Leaves alternate; berries enclosed by dilated perianth tube or seated on persistent perianth.....6
6a. Leaves stiffly coriaceous; anthers 2-celled; berries enclosed by dilated perianth tube.....4. **Cryptocarya**
6b. Leaves subcoriaceous; anthers 4-celled; berries seated on persistent perianth lobes.....7. **Phoebe**

1. **ACTINODAPHNE** Nees

Key to the species

1a. Inflorescence sessile, 4–8-flowered compact umbels.....1. **A. bourneae**
Ib. Inflorescence penduculate, 6–12 flowered clustered racemes…….2. **A. wightiana**

1. **Actinodaphne bourneae** Gamble in Bull. Misc. Inform. Kew 1925: 128. 1925 & Fl. Madras: 1231. 1925; K.M. Matthew, Fl. Palni Hills 2: 1065. 1999. **(Plate No. 67)**

Medium sized tree, 8–15 m high; branchlets densely rusty tomentose. Leaves verticillate, elliptic, 8–18 × 3–7.5 cm, apex acuminate, base cuneate, entire along margins, subcoriaceous, tomentose on both surfaces when young, glabrescent on upper surface except veins after maturity, glaucous and rufous tomentose on lower surface after maturity; pedicels 1.5–2.5 cm long, rufous tomentose, stout; lateral veins 7–11 pairs, basal pair opposite. Flowers in axillary, lateral and terminal, 4–8-flowered compact umbels, unisexual, trimerous (3+3), greenish-yellow; pedicels 4–5 mm long, rufous tomentose; involucral bracts imbricate, tomentose, caducous and leave distinct scars at base of umbels; male flowers 9–10 mm long; tepals in 2 whorls, broadly ovate, tomentose outside; stamens 9, in 3 whorls; filaments 3–3.5 mm long, 1st and 2nd whorls eglandular, 3rd whorls with two glands at base; anthers ovate, yellow, introrse, 4-celled; pistillode linear or absent; female flowers 10–11 mm long; tepals as in male; staminodes 9, in 3 whorls, 1st and 2nd whorls eglandular, 3rd whorls with two glands at base; ovary unilocular, 1.2–1.5 mm long, obovate; style 2.2–2.5 mm long; stigma peltate, irregularly lobed. Berries globose, 10–12 mm, green when young, dark red and glabrous when ripe, seated on cup-shaped perianth tube; perianth tube 5–6 mm long, pubescent outside, with 6 triangular-ovate perianth lobes; lobes persistent.

Flowering & Fruiting: May–September.
Distribution: Kerala and Tamil Nadu (Palani Hills). KWLS: Gundar and Pamabr Shola. *Kabeer & Ravi Kiran 133861 & 141062.*
Notes: Endangered (World Conservation Monitoring Centre, 1998). A typical shola tree restricted to few sholas at elevation ranges from 2000–2500 m. Presently recorded this species from Blackburn Shola, Bombay Shola, Gundar extension and Pambar Shola.

2. **Actinodaphne wightiana** (Kuntze) Noltie in Regnum Veg. 145: 495. 2005. *A. hirsuta* Hook.f., Fl. Brit. India 5: 152. 1886, non Blume 1851; Gamble, Fl. Madras: 1231. 1925. *Jozoste wightiana* Kuntze, Revis. Gen. Pl. 2: 570. 1891. *Actinodaphne malabarica* N.P. Balakr. in J. Bombay Nat. Hist. Soc. 63: 329. 1967; K.M. Matthew, Fl. Palni Hills 2: 1065. 1999. **(Plate No. 67)**

Medium sized tree, 12–20 m high; branchlets fulvous tomentose. Leaves verticillate, lanceolate-elliptic, 10–32 × 4–9 cm, apex acuminate, base attenuate or cuneate, entire along margins, subcoriaceous, glabrous above, rufous pubescent beneath and densely on veins; pedicels 1–2.5 cm long, rufous villous, stout; lateral veins 8–12 pairs. Flowers in axillary, lateral and terminal, 6–12-flowered clustered racemes, unisexual, trimerous (3+3), greenish-yellow; pedicels 5–10 mm long, pubescent; involucral bracts broadly ovate-orbicular, imbricate, 9–12 mm long, rufous pubescent, caducous and leave scars at base of raceme; male flowers 10–11 mm long; tepals in 2 whorls, ovate, pubescent outside; stamens 9, in 3 whorls; filaments 3.5–4 mm long, 1st and 2nd whorls eglandular, 3rd whorls with two glands at base; anthers ovate, yellow, introrse, 4-celled; pistillode linear or absent; female flowers 9–10 mm long; tepals as in male; staminodes 9, in 3 whorls, 1st and 2nd whorls eglandular, 3rd whorls with two glands at base; ovary unilocular, ovoid, 1–1.2 mm long; style 2–2.2 mm long; stigma peltate. Berries globose, 9–11 mm, green when young, red and glabrous when ripe, seated on cup-shaped perianth tube.

Flowering & Fruiting: December–March.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Blackburn Shola. *Kabeer & Ravi Kiran 142605.*

Notes: Restricted to Blackburn Shola where the population number is high. In 2018 Gaja Cyclone destroyed several matured individuals of this tree species in this shola.

2. **Beilschmiedia** Nees

Beilschmiedia wightii (Nees) Benth. ex Hook.f., Fl. Brit. India 5: 124. 1886; Gamble, Fl. Madras: 1221. 1925; K.M. Matthew, Fl. Palni Hills 2: 1067. 1999. *Haasia wightii* Nees, Syst. Laur. 676. 1836. **(Plate No. 68)**

Large evergreen tree, 20–40 m high. Leaves opposite, elliptic-ovate, 6–16 × 2.5–6 cm, apex acute-shortly acuminate, base acute or cuneate, entire along margins, glabrous on both surfaces; petioles 0.5–2 cm long, glabrous, stout. Flowers in axillary and terminal, 5–12 cm long glabrous panicles, bisexual, greenish-yellow, trimerous; pedicels 4–6 mm long, elongated in fruits; bracts caducous; tepals in 2 whorls (3+3), ovate; stamens 9, in 3 whorls; filaments 1–1.2 mm long, 1st and 2nd whorls eglandular, 3rd whorls with two stipitate glands at base; staminodes 3, 0.4–0.6 mm long, ovoid, stipitate; ovary ovoid, 1.3–1.5 mm long. Berries oblong-ovoid or ellipsoid, 2–3 cm long, smooth, glabrous, green when young, dark purplish-black when ripe.

Flowering & Fruiting: October–May.



Beilschmiedia wightii (Nees) Benth. ex Hook.f.



Cinnamomum wightii Meisn.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Berijam, Kookal Shola, Mathiketton Shola and Vattakanal. *Kabeer & Ravi Kiran 142644 & 142671.*

Notes: Shola element and very frequent in Berijam, Kookal Shola and Vattakanal Shola. Dwelling tree for Malabar Giant Squirrel and monkeys. Bats feed on its fruits.

3. **Cinnamomum** Schaeff., nom. cons.

Cinnamomum wightii Meisn. in DC., Prodr. 15: 11. 1864; Hook.f., Fl. Brit. India 5: 132. 1886; Gamble, Fl. Madras: 1224. 1925; K.M. Matthew, Fl. Palni Hills 2: 1069. 1999. *C. zeylanicum* Blume var. *wightii* (Meisn.) Bedd., Fl. Sylv. S. India: t. 262. 1872. **(Plate No. 68)**

Medium sized tree, 10–30 m high. Leaves opposite or spirally arranged, ovate-elliptic or broadly elliptic, 5–10 × 2–5 cm, apex acute, base acute-obtuse or cuneate, entire along margins, coriaceous, triplinerved, glossy, glabrous on both surfaces; petioles 0.7–1.5 cm long, glabrous or puberulent; lateral veins 2, paired. Flowers in axillary and terminal, 8–15 cm long cymose panicles, rusty pubescent, bisexual, trimerous; pedicels 3–4 mm long; tepals in 2 whorls (3+3), broadly ovate, 3.5–5.5 mm long, apex obtuse-rounded, inner ones smaller than the outer, yellowish; stamens 9, in 3 whorls; filaments 0.8–1.1 mm long, 1st and 2nd whorls eglandular, 3rd whorls with two stipitate glands at base; staminodes 3, stipitate; ovary ovoid-ellipsoid, 1.5–2 mm long; stigma peltate. Berries oblong, 2–2.5 cm long, smooth, glabrous, green when young, dark bluish-black when ripe.

Flowering & Fruiting: March–September.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Kodaikanal, Kookal and Poombarai. *Kabeer & Ravi Kiran* 133724.

Notes: Endangered (Saha *et al*., 2015). Highly scarce and restricted to a few shola patches in the sanctuary at elevations between 1900 and 2500 m. Very few individuals noticed at Edmankarai Shola, Kookal Shola and Vattakanal Shola. Very old tree of more than 25 m height and about 5 m girth of this species in Kookal Shola fell over in Aug 2016, either by ageing or infection in bole.

4. **Cryptocarya** R. Br., nom. cons.

Cryptocarya stocksii Meisn. in DC., Prodr. 15: 71. 1864; Hook.f., Fl. Brit. India 5: 120. 1886; Gamble, Fl. Madras: 1219. 1925; K.M. Matthew, Fl. Palni Hills 2: 1070. 1999. *C. praetervisa* M. Gangop., Chakrab. & A.S. Chauhan in J. Econ. Taxon. Bot. 26(2): 472, f. 1. 2002. *C. neilgherrensis* Meisn. in DC., Prodr. 15: 71. 1864. **(Plate No. 69)**

Medium sized tree, 10–30 m high; branchlets rusty velutinous when young, glabrescent when old, lenticellate. Leaves alternate, elliptic-oblong or ovate or obovate or suborbicular, 5–16 ×

2.5–12 cm, apex acute-obtuse or emarginate, base subacute-obtuse or rounded, margins entire, coriaceous, glabrous above, puberulous on veins and glaucous beneath; lateral veins 5–9 pairs, raised beneath; petioles 4–1.5 cm long, glabrescent. Flowers in axillary and terminal, 5–15 cm long panicles, creamy or rusty tomentose, sparsely when mature, bisexual, trimerous; pedicels 3–6 mm long, elongated in fruits; tepals in 2 whorls (3+3), ovate-suborbicular, 1.5–2.5 mm long, apex acute or subacute; stamens 9, in 3 whorls; 1st and 2nd whorls eglandular, 3rd whorls with two stipitate glands at base; staminodes 3, stipitate; ovary ovoid, sessile, 1–1.5 mm long; stigma subcapitate. Berries oblong-ovoid, 1.5–2.8 cm long, smooth, glabrous, green when young, black when ripe.

Flowering & Fruiting: March–June.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Tiger Shola. *Kabeer & Ravi Kiran 135569.*

Notes: Vulnerable (World Conservation Monitoring Centre, 1998). A typical shola tree was collected from Tiger Shola at an elevation of 1800 m. In 2018 Gaja Cyclone destroyed the huge trees of this species at Tiger Shola but many saplings and subadult trees were noticed here.

5. **LITSEA** Lam., nom. cons.

Key to the species

1a. Leaves glabrous on both surfaces.....2
1b. Leaves pubescent or tomentose beneath.....3
2a. Leaves elliptic-lanceolate or oblanceolate, apex acute-shortly acuminate; berries ellipsoid, 1.2–1.5 cm long.....2. **L. glabrata**
2b. Leaves elliptic-oblong or obovate, apex subacute or obtuse-rounded; berries depressed globose 1.5–2.5 cm long.....4. **L. oleoides**
3a. Leaves elliptic-oblong or obovate; lateral veins 8–14 pairs; berries above 1.5 cm long.....4
3b. Leaves elliptic-obovate or elliptic-lanceolate; lateral veins 5–10 pairs; berries 1–1.5 cm long……...5. **L. wightiana**
4a. Berries 1.5–2 cm long; accrescent perianth tube smooth.....1. **L. floribunda**
4b. Berries 2.5–3 cm long; accrescent perianth tube lenticellate.....3. **L. keralana**

1. **Litsea floribunda** (Blume) Gamble, Fl. Madras: 1238. 1925; K.M. Matthew, Fl. Palni Hills 2: 1072. 1999. *Cylicodaphne floribunda* Blume, Mus. Bot. 1: 387. 1852. **(Plate No. 69)**

Medium to large tree, 10–25 m high; branchlets glabrous; branchlets rusty tomentose. Leaves alternate, obovate-oblong or elliptic-oblong, 8–25 × 4–10 cm, apex acute-obtuse, base acute-

rounded, margins entire and slightly reflexed, coriaceous, shiny above and glaucous beneath, with reddish tinge when young, glabrous above except on veins and midvein which are rusty tomentose, rusty tomentose on midvein, veins and nervules beneath; midvein slightly raised above upto 1/2 or 2/3 portion, prominent beneath; lateral veins 8–14 pairs, prominent beneath; petioles 1–3 cm long, stout, rusty tomentose, densely when young. Flowers in axillary, 3.5–7.5 cm long panicles or racemose umbels, trimerous (3+3), unisexual, tawny or rusty tomentose; involucral bracts 4–6, 7–9 mm long, broadly ovate or suborbicular, concave, glabrous inside and tomentose outside; pedicels 2–3 mm long, elongated in fruits; perianth tube 1.5–2 mm long, glabrous inside and tomentose outside; tepals in 2 whorls, 3–3.5 mm long, ovate, yellowish-green, tomentose outside. Male flowers: stamens 12 in 4 whorls, unequal; anthers 4-celled; filaments 2.5–3 mm long, bearded, 1st and 2nd whorls eglandular, 3rd and 4th whorls with two stipitate glands at base. Female flowers: staminodes 12 in 4 whorls, outer two whorls eglandular and inner two whorls glandular at base; ovary ovoid, 1.3–1.5 mm long; style 2–2.5 mm long, glabrous; stigma papillose. Berries oblong-ovoid, 1.5–2 cm long, seated on accrescent obconic perianth tube, green when unripe, black when mature.

Flowering & Fruiting: November–August.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Kookal and Mathikettan Sholas. *Kabeer & Ravi Kiran 142645.*
Notes: Shola forest element restricted to Kookal and Mathikettan Sholas. Remarkable old and huge trees (approx. 20 m high) were seen beside lake in Kookal Shola.

2. **Litsea glabrata** (Wall. ex Nees) Hook.f., Fl. Brit. India 5: 174. 1886; Gamble, Fl. Madras: 1237. 1925; K.M. Matthew, Fl. Palni Hills 2: 1072. 1999. *Tetranthera glabrata* Wall. ex Nees in Wall., Pl. Asiat. Rar. 2: 67. 1831; Meisn. in DC., Prodr. 15: 197. 1864. **(Plate No. 70)**

Small or medium sized tree, 9–20 m high; branchlets glabrous. Leaves alternate, sometimes subopposite, 6–18 × 3–6 cm, elliptic-lanceolate or elliptic-lanceolate or oblanceolate, apex acute-shortly acuminate, base acute-cuneate, margins entire, coriaceous, glabrous on both surfaces, glaucous or subglaucous beneath, with reddish tinge when young, gall frequent in mature ones; lateral veins 8–12 pairs, prominent beneath; petioles 1–2.5 cm long, stout, glabrous; Flowers in axillary and lateral, 4–8 cm long panicles or racemose umbels, trimerous (3+3), unisexual, appressed pubescent; involucral bracts usually 4, rarely 6, 5–6 mm long, broadly ovate or suborbicular, concave; pedicels 2–4 mm long, elongated in fruits; perianth tube 1–1.5 mm long; tepals in 2 whorls, 2–2.5 mm long, elliptic-obovate, subequal, yellowish-green. Male flowers: stamens 12 in 4 whorls, unequal; anthers 4-celled; filaments 1.5–2 mm long, bearded, 1st and 2nd whorls eglandular, 3rd and 4th whorls with two stipitate glands at base. Female flowers: staminodes 12 in 4 whorls, outer two whorls eglandular and inner two

whorls glandular at base; ovary ovoid, 1.4–1.7 mm long; style 1.5–2 mm long, glabrous; stigma papillose. Berries ellipsoid, 1.2–1.5 cm long, seated on accrescent, 0.8–1 cm long obconic perianth tube, green with white specks when unripe, reddish-black when mature.

Flowering & Fruiting: December–May.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Kudarayar Shola and Poombarai. *Kabeer & Ravi Kiran 132970.*
Notes: Frequently occurs in shola forests at elevations between 1500 and 2000 m. The highest number of populations were seen at Kudarayar Shola.

3. **Litsea keralana** Kosterm. in Ceylon J. Sci., Biol. Sci. 12: 138. 1977. *Litsea insignis* Gamble in Bull. Misc. Inform. Kew 1925: 130. 1925 & Fl. Madras: 1237. 1925, *nom. illeg*., non (Blume) Boerlage, 1900; K.M. Matthew, Fl. Palni Hills 2: 1073. 1999. **(Plate No. 70)**

Large dioecious tree, 15–40 m high, buttressed; branchlets rusty tomentose. Leaves alternate, broadly elliptic-oblong or obovate, 10–28 × 5–14 cm, apex subacute-obtuse or rounded, base apex subacute-obtuse or rounded or truncate, margins entire, coriaceous, glabrous above except on veins which are rusty tomentose, rusty tomentose beneath, densely on midvein, veins and nervules beneath; midvein slightly raised above upto 1/2 or 2/3 portion, prominent beneath; lateral veins 10–15 pairs, prominent beneath; petioles 1.5–3 cm long, stout, rusty tomentose, densely when young. Flowers in axillary and lateral, short racemose umbels, trimerous (3+3), unisexual, rusty tomentose; involucral bracts usually 4–5, 5–6.5 mm long, broadly ovate or suborbicular, concave, glabrous inside and tomentose outside; pedicels 2.5–3 mm long, elongated in fruits; perianth tube 1.4–1.6 mm long, glabrous inside and tomentose outside; tepals in 2 whorls, 3.5–4.5 mm long, ovate, tomentose outside. Male flowers: stamens 12 in 4 whorls, unequal; anthers 4-celled; filaments 2.5–3.5 mm long, densely bearded, 1st and 2nd whorls eglandular, 3rd and 4th whorls with two stipitate glands at base. Female flowers: staminodes 12 in 4 whorls, outer two whorls eglandular and inner two whorls glandular at base; ovary ovoid, 1.5–1.8 mm long; style 2–2.5 mm long, glabrous; stigma papillose. Berries oblong-ovoid or ellipsoid, 2.5–3 cm long, glabrous, seated on 1.3–1.5 cm across, lenticellate, accrescent obconic perianth tube, green when unripe, black when mature.

Flowering & Fruiting: August–April.
Distribution: Kerala and Tamil Nadu. KWLS: Gundar and Methiletton Shola. *Kabeer & Ravi Kiran 138158.*
Notes: Typical Shola tree and very scarce in the sanctuary at elevations between 1900 and 2300 m. Found it only in Gundar valley and this species may become extinct from Palani hills very soon. The fruit of this species is the largest in the genus *Litsea*.

4. **Litsea oleoides** (Meisn.) Hook.f., Fl. Brit. India 5: 175. 1886; Gamble, Fl. Madras: 1236. 1925; K.M. Matthew, Fl. Palni Hills 2: 1073. 1999. *Tetranthera oleoides* Meisn. in DC., Prodr. 15: 195. 1864. **(Plate No. 71)**

Small, medium or large sized tree, 9–40 m high; branchlets glabrous. Leaves alternate, upper ones usually opposite, elliptic-oblong or obovate, 7–15 × 3–6.5 cm, apex subacute or obtuse-rounded, base acute-rounded, margins entire and slightly reflexed, coriaceous, glabrous, shiny green above and glaucous beneath, with reddish tinge when young; midvein raised beneath; lateral veins 8–12 pairs; petioles 1–2.5 cm long, glabrous, stout. Flowers in axillary and terminal, 3–8 cm long racemose umbels, trimerous (3+3), unisexual, puberulent; involucral bracts 4–6, 5.5–7.5 mm long, broadly ovate or suborbicular, concave, light greenish-yellow, glabrous inside and puberulous outside; pedicels 3–4 mm long, elongated in fruits; perianth tube 2.5–3.5 mm long, glabrous inside and sparsely puberulous outside; tepals in 2 whorls, 3–4 mm long, ovate, puberulous outside. Male flowers: stamens 9–12 in 3–4 whorls, unequal; anthers 4-celled; filaments 3–5 mm long, all with 2 sessile glands at base. Female flowers: staminodes 9–12 in 3 or 4 whorls, all with 2 sessile glands at base; ovary ovoid, 1.5–2 mm long; style 1–1.5 mm long, glabrous; stigma papillose. Berries depressed globose, 1.5–2.5 cm across, glabrous, seated on accrescent obconic perianth tube, green with white specks when unripe, red when mature.

Flowering & Fruiting: August–January.
Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Gundar, Gundatttu Shola and Mathikettan Shola. *Kabeer & Ravi Kiran 133829*.
Notes: Very frequent in shola at altitude ranges from 2000 to 2500 m. A good number of individuals more than 15 m high were seen in Mathikettan Shola. Habitat is under extreme threat due to invasion of species of *Acacia.*

5. **Litsea wightiana** (Nees) Benth. & Hook.f. ex Hook.f., Fl. Brit. India 5: 177. 1886; Gamble, Fl. Madras: 1238. 1925; Fyson, Fl. S. Ind. Hill Stat. 507. t. 439. 1932; K.M. Matthew, Fl. Palni Hills 2: 1074. 1999. *Cylicodaphne wightiana* Nees in Wall., Pl. Asiat. Rar. 2: 68. 1831. **(Plate No. 71)**

Small or medium sized tree, 8–16 m high; branchlets usually rusty or tawny tomentose or pubescent when young, later become sparsely or glabrescent. Leaves alternate, elliptic-obovate or elliptic-lanceolate, 6–15 × 2.5–7.5 cm, apex acute-acuminate or obtuse, base usually acute or sometimes obtuse, margins entire and sometimes slightly reflexed, coriaceous, with reddish tinge when young, gall frequent in mature ones, glabrous above or rusty pubescent or tomentose on midvein and sparsely on lateral veins or glabrescent on

midvein and lateral veins above, glaucous and rusty tomentose or glabrescent beneath; midvein slightly raised above upto 1/2 or 2/3 portion, prominent beneath; lateral veins 5–10(12) pairs, distinctly impressed above and prominent beneath; petioles 1–3 cm long, stout, rusty tomentose or pubescent or glabrescent. Flowers in axillary and lateral, 3–10 cm long panicles or racemose umbels, unisexual, trimerous (3+3), tawny or rusty tomentose or pubescent or puberulous; involucral bracts 4, 6–8 mm long, broadly ovate or suborbicular, concave, glabrous inside and tawny or rusty tomentose or pubescent or puberulous outside; pedicels 2–2.5 mm long, tomentose or pubescent or puberulous, elongated in fruits; perianth tube 1–1.5 mm long, glabrous inside and tomentose or pubescent or puberulous outside; tepals in 2 whorls, 2.5–3 mm long, subequal, narrow elliptic-oblong, creamy, pubescent or puberulous outside. Male flowers: stamens 12 in 4 whorls, unequal; anthers 4-celled; filaments 2–2.5 mm long, bearded, 1st and 2nd whorls eglandular, 3rd and 4th whorls with two substipitate glands at base. Female flowers: staminodes 12 in 4 whorls, outer two whorls eglandular and inner two whorls glandular at base; ovary ovoid, 1–1.2 mm long; style 1–1.5 mm long, glabrous; stigma papillose. Berries ovoid, 1–1.5 cm long, glabrous, seated on accrescent obconic perianth tube, green with white specks when unripe, red when mature.

Flowering & Fruiting: August–March.

Distribution: Goa, Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Berijam, Kookal, Kudarayar, Perumalmalai, Poombarai and Tiger Shola. *Kabeer & Ravi Kiran 132713, 132715, 132824, 133093, 135560, 139791.*

Notes: Very frequent in all shola forests of the sanctuary at elevations ranges from 1700 to 2500 m. Malabar Giant Squrrel and Black Bulbuls are feeding on its fruits. Abundant at shola boarders of Berijam, Kookal, Perumalmalai, Poombarai and Tiger Shola. This species shows variation in the nature of indumentum.

6. **Neolitsea** (Benth. & Hook.f.) Merr., nom. cons.

Neolitsea fischeri Gamble in Bull. Misc. Inform. Kew 1925: 132. 1925 & Fl. Madras: 1239. 1925; K.M. Matthew, Fl. Palni Hills 2: 1075. 1999. **(Plate No. 72)**

Small or medium sized tree, 10–25 m high; branchlets tawny tomentose, lenticellate. Leaves alternate, upper ones opposite, elliptic-obovate or broadly oblanceolate or ovate, 8–30 × 3–14 cm, apex acute or obtuse or shortly acuminate, base acute or cuneate or obtuse-rounded, margins entire, coriaceous, tomentose on both surfaces when young, on maturity becomes shiny and glabrous above, remains tomentose beneath after maturity, glaucous beneath; midvein slightly raised above upto 1/2 or 2/3 portion, prominent beneath; lateral veins triplinerved, 3–5 pairs, distinctly impressed above and prominent beneath, 2 basal veins reaching towards apex upto 4/5–5/6 portion; petioles 1.5–3.5 cm long, stout, tomentose or

pubescent or puberulous. Flowers in axillary and lateral, clustered or fasciculate umbels, bimerous (2+2), unisexual; bracts 4, orbicular, 4.5–5.5 mm long, concave; pedicels 0.8–1 mm long, pubescent. Male flowers: yellowish-green; tepals in two whorls, 2.5–3.5 mm long, ovate, tomentose outside; stamens 6 in two whorls; filaments 2–3 mm long, bearded, outer whorls eglandular and inner with two orbicular, substipitate glands at base. Female flowers: colour, pedicels and tepals as in male; staminodes 6 in two whorls, outer whorls eglandular and inner with two substipitate glands at base; ovary ovoid, 1.2–1.5 mm long; stigma papillose. Berries globose, 1.2–1.8 mm, glabrous, seated on small, entire perianth tube, green when unripe, reddish-black when mature.

Flowering & Fruiting: February–May.
Distribution: Kerala and Tamil Nadu. KWLS: Kookal. *Kabeer & Ravi Kiran 135589*.
Notes: Vulnerable (World Conservation Monitoring Centre, 1998). Typical Shola tree which is restricted to Kookal Shola. Notable old tall trees and saplings were found only in Kookal Shola and it is replicating in this Shola forest by seed germination.

7. **Phoebe** Nees

Phoebe wightii Meisn. in DC., Prodr. 15: 38. 1864; Gamble, Fl. Madras: 1228. 1925; K.M. Matthew, Fl. Palni Hills 2: 1079. 1999. *Ocotea paniculata* Nees var. *minor* Nees Wall., Pl. Asiat. Rar. 2: 71. 1831. *Phoebe paniculata* (Nees) Nees var. *minor* (Nees) Nees, Syst. Laur. 105. 1836. *P. paniculata* sensu Hook.f., Fl. Brit. India 5: 142. 1886, p.p., non Nees 1836. **(Plate No. 72)**

Small tree, 4–10 m high; branchlets rusty tomentose or pubescent, lenticellate. Leaves alternate, upper ones opposite, elliptic-obovate, 7–15 × 3–7, apex subacute-acuminate, rarely obtuse, base cuneate, subcoriaceous, young leaves coppery, glabrescent above except midvein and veins which is pubescent or puberulous, rusty tomentose beneath; midvein prominent beneath; lateral veins 5–7 pairs, impressed above and prominent beneath; petioles 0.5–2 cm long, rusty pubescent when young, later glabrescent. Flowers in axillary and lateral, 3–7 cm long, lax, rusty pubescent panicles, bisexual, trimerous (3+3), yellowish-green; pedicels 4–5 mm long, rusty pubescent; tepals in two whorls, ovate, 4–5 mm long, subequal, tomentose outside; stamens 9, in 3 whorls, unequal; anthers 4-celled, 1st and 2nd whorls introrse and 3rd whorl extrorse; filaments 1.5–2 mm long, 1st and 2nd whorls eglandular and 3rd whorl with two stipitate glands at base; staminodes cordate, smaller than stamens, stipitate; ovary ca 1 mm long, globose, pubescent; style 1.7–2 mm long, glabrous; stigma capitate. Berries ovoid, 0.9–1.1 cm across, glabrous, seated on persistent perianth lobes; fruiting pedicel thickened.

Flowering & Fruiting: December–June.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Berijam Shola, Kookal Shola, Kudarayar Shola, Perumalmalai and Tiger Shola. *Kabeer & Ravi Kiran 132819, 133013.*

Notes: Frequently occurred in shola forests at elevations between 1700 and 2500 m.

42. **LORANTHACEAE**

Key to the genera

1a. Flowers actinomorphic, tetramerous……...3. **Helixanthera**

1b. Flowers zygomorphic, pentamerous ……..2

2a. Corolla lobes and stamens spirally curled when flowers open……..2. **Helicanthes**

2b. Corolla lobes reflxed and stamens straight…….....3

3a. Inflorescence recemose, flowers glabrous, petals reflexed around the corolla tube……..1. **Dendrophthoe**

3b. Inflorescence umbellate, flowers tomentose, all petals reflexed opposite side of the corolla tube split……....4. **Taxillus**

1. **Dendrophthoe** Mart.

Dendrophthoe trigona (Wight & Arn.) Danser ex Santapau, Rec. Bot. Surv. India 16(1): 263 1953; K.M. Matthew, Fl. Palni Hills 2: 1089. 1999. *Loranthus trigonus* Wight & Arn., Prodr. 386. 1834; Hook. f., Fl. Brit. India 5: 219. 1886; Gamble, Fl. Madras: 1253. 1925. **(Plate No. 72.1)**

Epiphytic parasitic undershrub; densely branched, rugose, glabrous; branchlets 3-angled. Leaves simple, alternate, ca 18 × 12 cm, ovate to obovate, obtuse at apex and base, coriaceous, glabrous; petiole ca 1–1.5 cm long, flattened to winged, pink tinged; lateral leaves 4 or 5 pairs, alternate. Inflorescence axillary racemes, ca 6 cm long; bracts ovate, chartaceous. Calyx cupuliform, truncate, glabrous, green with tinged red. Corolla 1.8–3 cm long, green or pink or yellow, tube split to the middle; lobes 5, ca 7 × 2 mm, linear, recurved around the corolla tube, sparsely pubsecent, fleshy. Stamens 5, connate to corolla tube; anthers ca 7 mm long, linear. Ovary ovate, unilocular, glabrous; style ca 3 cm long, linear; stigma rounded, reddish. Berry obovoid, 1 × 0.5 cm, crowned by cup-shaped calyx limb, red at marutiy, 1 seeded.

Flowering & Fruiting: April–December.

Distribution: Karnataka, Kerala, Maharastra and Tamil Nadu. KWLS: Colony medu, Murugamalai, Pannaikkadu and Adukkam to Thalaiyar falls.

Notes: Very common massive epiphytic parasite with greater leaf size occurs in the sanctuary at elevations between 400 and 1600 m. Flower colour varies from green to reddish at different altitudes.

2. **Helicanthes** Danser

Helicanthes elastica (Desr.) Danser in Verh. Kon. Akad. Wetensch., Afd. Natuurk., Sect. 2. 29(6): 55. 1933; K.M. Matthew, Fl. Palni Hills 2: 1090. 1999. *Loranthus elasticus* Desr. in Lam. Encycl. 3(2): 599. 1792; Gamble, Fl. Madras: 1254. 1925. **(Plate No. 73)**

Epiphytic undershrub; branches dichotomous to trichotomous, nodes prominent. Leaves opposite, decussate, obovate to elliptic-ovate, 6–12 × 3–6 cm, cuneate at base, obtuse or subacute at apex, subsucculent, sessile or subsessile. Inflorescences whorled at nodes, sunken in nodal concavities, flowers many, sessile; flower buds lanceolate, terete; flowers 2–3.5 cm long; bracts minute. Calyx cupular, ca 2 mm long, creamy. Corolla-tube 3 cm long, split equally up to middle; lobes 5, linear, spirally twisted and interlocked, white with green streaks. Stamens 5; filaments red, coiled ca 1 cm long; anthers linear, twisted, ca 4 mm long. Ovary subspherical, 2–2.5 mm long; style curved, ca 3.5 cm long; stigma papillate. Drupes spherical, ca 1.2 cm, glabrous, calyculus persistent, scarlet when ripe.

Flowering & Fruiting: Throughout the year.

Distribution: Karnataka, Kerala, Maharastra and Tamil Nadu. KWLS: Gurusaradi, Mailadamparai and Palamalai. *Kabeer & Ravi Kiran 133127.*

Notes: Epiphytic parasite and abundant in moist and wet evergreen forests at elevations between 1400 and 2000 m. The largest number of populations recorded on Law's Ghat road. Seed dispersal is by the mistletoe bird.

2. **Helixanthera** Lour.

Key to the species

1a. Racemes lax; peduncle straight.....1. **H. intermedia**
1b. Racemes dense; peduncle curved.....2. **H. obtusata**

1. Helixanthera intermedia (Wight) Danser in Bull. Jard. Bot. Buitenzorg Ser. 3, 10: 317. 1929; K.M. Matthew, Fl. Palni Hills 2: 1091. 1999. *Loranthus intermedius* Wight in Calcutta J. Nat. Hist. 6: 361. 1846; Hook.f., Fl. Brit. India 5: 205. 1886; Gamble, Fl. Madras: 1251. 1925. **(Plate No. 73)**

Epiphytic undershrub; bushy, branchlets glabrescent. Leaves opposite or subopposite, broadly ovate or elliptic, cuneate or rounded at base, obscurely decurrent, obtuse at apex, 5–8 × 3–5 cm, subsucculent; petioles ca 1.5 cm long. Inflorescence raceme, lax; peduncles ca 1.5 cm long, rachis reddish, 5–8 cm long, 1 or 2 in each axil, 12–30-flowered, sparsely hairy. Flowers tetramerous, ca1.5 cm long, reddish, glabrous; pedicels ca 5 mm long; bracts ovate, ca 2 mm. Calyx cupular, truncate, minute hairy. Corolla ca 1 cm wide; lobes 4, narrowly spathulate, ca 1 cm long, fleshy, red. Stamens 4; filaments 1.5–2 mm long, reddish; anthers 1–1.2 mm long.

Ovary subglobose, ca 2.5 mm long; stigma capitate. Drupes urceolate, ca 8 × 5 mm, rusty, red when ripe.

Flowering & Fruiting: July–September.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Kookal and Poombarai.
Notes: Very scarce in shola forests of the sanctuary at altitude ranges from 1900 to 2500 m. A few individuals located at the shola forest edges of Kookal and Poombarai.

2. **Helixanthera obtusata** (Wall.) Danser in Bull. Jard. Bot. Buitenzorg Ser. 3, 10: 317. 1929; K.M. Matthew, Fl. Palni Hills 2: 1091. 1999. *Loranthus obtusatus* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient.: 1: 381, descr. 1834; Hook.f., Fl. Brit. India 5: 205. 1886; Gamble, Fl. Madras: 1251. 1925. **(Plate No. 74)**

Epiphytic undershrub; branchlets glabrescent. Leaves opposite or subopposite, decussate, elliptic-ovate to broad elliptic, 8–12 × 5–8 cm, cuneate or obtuse or rounded at base, obtuse at apex, subsucculent; midnerve reddish in young leaves, lateral veins 4–7 pairs, obscure; petioles 1.5–2 cm long, decurrent. Inflorescence raceme, dense, axillary, solitary or in pairs; peduncle1–2 cm long, tuberculated, with 20–30 flowers; flowers 2–3 cm long; pedicel ca 8 mm long, curved, reddish; bracts ovate, carinate, 1 mm. Calyx cupular, 3 mm long; teeth obscure, reddish brown. Corolla tube 1 cm long; lobes 4, narrowly spathulate, 1 cm long, reddish brown, faintly hairy. Stamens 4; filaments 8 mm long; anthers oblong. Ovary ovoid, rugose, 3–4 mm long; style 1.5 cm long; stigma capitate. Drupes ovoid, ca 8 × 4 mm, densely tubercled, reddish brown.

Flowering & Fruiting: July–September.
Distribution: Karnataka, Kerala, Maharastra and Tamil Nadu. KWLS: Kookal. *Kabeer & Ravi Kiran 132996.*
Notes: Highly scarce epiphytic parasite and restricted to Kookal Shola at altitude between 1900 and 2100 m. Peak flowering was seen in August second week to third week of every year.

3. **Taxillus** Tiegh.

Taxillus recurvus (DC.) Tiegh. in Bull. Soc. Bot. France 42: 256. 1895; K.M. Matthew, Fl. Palni Hills 2: 1096. 1999. *Loranthus recurvus* Wall. ex DC., Prodr. 4: 299. 1830; Hook.f., Fl. Brit. India 5: 213. 1886; Gamble, Fl. Madras: 1252. 1925. **(Plate No. 74)**

Epiphytic undershrub; branchlets rusty brown, glabrescent by age. Leaves alternate, elliptic-ovate or obovate, 3–5 × 1.5–2.5 cm, cuneate or rounded at base, coriaceous, densely hairy

when young, glabrous above and densely or sparsely stellate hairy beneath; lateral veins 2–4 pairs; petioles ca1 cm long. Inflorescences axillary and ramiflorous, simple dichasial cyme, shortly peduncled; peduncles 2 or 3 in each axil, 3 (4)-flowered, 2–4 mm long; flower buds ca 2 cm long, rusty. Flowers pentamerous, 2–2.5 cm long; pedicels ca 3 mm long; bracts ovate, 3 mm long. Calyx irregularly 5-lobed, cupular, 2–3 mm long, rusty. Corolla tube ventricose at base, ca 2 cm long, split up to the half, creamor greenish yellow; lobes 5, linear-elliptic, ca 7 mm long, fleshy, reflexed, greenish, hairy outside. Stamens 5; filament, ca 1.8 cm long; anthers linear-ovate. Ovary subturbinate, 3–3.5 mm long; style ca 2.3 cm long; stigma subcapitate, bilobed. Drupes oblong, 8–5 mm loong, rusty, flesh colour; calyx crown persistant.

Flowering & Fruiting: July–February.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Berijam and Vattakanal. *Kabeer & Ravi Kiran 132795, 135477.*
Notes: Rusty epiphytic parasite on shola trees and *Acacia* tree species in sholas. Less frequent at the shola borders of Berijam and Vattakanal at elevations between 2000 and 2400m.

43. **VISCACEAE**

Viscum L.

Viscum angulatum B. Heyne ex DC., Prodr. 4: 283. 1830; Hook.f., Fl. Brit. India 5: 225. 1886; Gamble, Fl. Madras: 1259. 1925; K.M. Matthew, Fl. Palni Hills 2: 1100. 1999. **(Plate No. 75)**

Epiphytic undershrub; stems slender, 4-angular, branches compact, many, nodes prominent. Leaves scaly, ca 1 mm long, early caducous, sometimes prophylls seen at the base of the branches. Inflorescences sessile, 1 or 3-flowers at nodes, lateral; bracts 2, connate at base, central is female, laterals male. Male flowers: globose, laterally compressed and wedge-shaped towards the base, ca 1 × 1 mm; perianth lobes 4, broadly ovate, ca 0.5 mm. Stamens 4, sessile; anthers attached to the perianth lobes. Female flowers: ca 1 × 0.5 mm, perianth lobes 4, broadly ovate, ca 0.5 mm. Ovary inferior; style short; stigma subulate. Berries subglobose to globose, ca 4 mm; bracts persistent.

Flowering & Fruiting: November–February.
Distribution: Andhra Pradesh, Goa, Gujarat, Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Colony medu and Pannaikkadu. *Kabeer & Ravi Kiran 141136 & 141196.*
Notes: Ephiphytic semiparastie, which scarcely occurs in moist evergreen forests and savannahs of mid Palanis at elevations between 1300 and 1700 m. *Ligustrum perrottetii, Memecylon edule* and *Terminalia chebula* are the common hosts for this species.

44. **EUPHORBIACEAE**

Key to the genera

1a. Trees……1. **Drypetes**
1b. Shrubs or undershrubs……..2
2a. Armed shrubs……2. **Euphorbia**
2b. Unarmed undershrubs, plants with true leaves……..3. **Phyllanthus**

1. **Drypetes** Vahl

Drypetes wightii Pax & K. Hoffm. in Pflanzenr. (Engler) Euphorb.-Phyllanthoid.-Phyllanth. 273. 1922; K.M. Matthew, Fl. Palni Hills 2: 1121. 1999; N.P. Balakr. & Chakrab., Fam. Euphorbiaceae India 334. 2007; N.P. Balakr. *et al.*, Fl. India 23: 404. 2012. *Hemicyclia wightii* Hook.f., Fl. Brit. India 5: 339. 1887; Gamble, Fl. Madras: 1300. 1925. **(Plate No. 75)**

Diocious tree, 10–15 m high; bark greyish-white, branchlets terete, glabrous, pendulous. Leaves simple, alternate, elliptic-lanceolate, 5–10 × 2–4 cm, apex acuminate, base obliquely obtuse, margins entire, sparsely puberulous, subcoriaceous; stipules caducous; petioles 5–8 mm long, sparsely pubescent; lateral veins parallel, obscure, midnerve prominent. Flowers unisexual, axillary clusters or ramiflorus. Male flowers: pedicels 0.5–1 cm long, puberulous; tepals 4, fleshy, ca 4 × 3 mm, broadly elliptic hairy both side, reflexed, margins recurved. Stamens 8–10; filaments free, ca 5 mm long; anthers oblong; disk entire, densely pubescent. Female flowers: pedicels 4–5 mm long, puberulous; tepals 4, suborbicular, ca 4 × 3 mm, tomentose; disk annular; ovary ca 2 × 1 mm, ellipsoid, 1-ocular; ovules 2, sparsely puberulous, reniform. Drupes ellipsoid or obovoid, ca 2.5 × 1.7 cm; stalk ca 1.5–2 cm long.

Flowering & Fruiting: July–December.
Distribution: Kerala and Tamil Nadu. KWLS: Poolatur piruvi. *Kabeer & Ravi Kiran 141142.*
Notes: Highly resctricted near streams of mid Palnis at elevations ranges from 800 to 1300 m. Trees are very showy during new foliage time by having creamy tender leaves on pendulous branches. A few populations are gregariously growing along with *Arenga wightii* at Thalaiyar Falls path from Palamalai and Poolatur piruvi streams.

2. **Euphorbia** L.

Euphorbia vajravelui Binojk. & N.P.Balakr., Cact. Succ. J. 63(5): 229**.** 1991. var. **theniensis** B. DeJong & R.W. Stewart, Euphorbia World 15(2): 8. 2019. **(Plate No. 75.1)**

Shrub to small tree 4–10 m high, multiple asymmetric parasol-like crowns; trunk and main branches with increasingly foreshortened central segments, each giving rise to a whorl of longer secondary branches; lower branches usually persistent, at times sagging downwards

before turning upwards again. Trunk 3–6-winged, terete by age; bark silvery grey. Spine-shields dark brown to nearly black, obovate, , 3–6 × 2–5 mm, 1.5–2.5 mm high. Spines pairs, dark brown, persistent, 3–5 mm long. Leaves sub-orbicular to obovate, 3–4 × 3–4 mm, obtuse to sub-truncate at apex, fleshy, margin entire, petiole ca 0.75–1 mm, early caducous. Inflorescence single (rarely 2) cymes per flowering eye, simple dichasium with central cyathium staminate and lateral cyathia bisexual; towards apices of branches; peduncle 1.5–4 mm, rachis 4–8 mm; involucral bracts broadly ovate, ca 3 × 2–3 mm, obtuse at the apex, greenish white; involucre shallow cupular, 7–11 × 3–5 mm; glands 5 or 6. Male flowers: 5–7 in fascicles, each fascicle enclosed by bracteoles, ca 1–2 × 2.5–2.7 mm, deeply lacerate; filaments cream, ca 1 mm long; anthers paired, oblong, flattened, ca 0.5 mm, peach to red. Female flower: pedicel 2 mm; ovary 3-lobed, 3–4 mm wide; styles 3, connate up to middle, bifid obscurely, stigmas papillose. Capsule ca 4-5 mm, subglobose, shallowly 3-lobed, 5–6 × 8–9 mm, greenish yellow, often red-tinged to red above. Seeds subglobose, 3 – 3.2 × 2.8-2.9 mm, grey to black, with white enveloping the raphe.

Flowering & Fruiting: December–April.
Distribution: Kerala and Tamil Nadu. KWLS: Palani–Kodaikanal ghat road.
Notes: Frequent at Balasamudram East to Sourikkadu on Palani–Kodaikanal ghat road at elevaton ranges from 400 to 1000 m. Easily distinguishable from *Euphorbia antiquorum* by its morphology.

3. **Phyllanthus** L.

Key to the species

1a. Branches obscurely flat, winged, leaf base truncate or subcordate or coradate……....2
1b. Branches round, unwinged, leaf base oblique……1. **P. chandrabosei**
2a. Plants more than 1 m height, stragglers, leaves more than 2 cm long…….2. **P. macraei**
2b. Plants less than 1 m height, prostarte, leaves 2 cm long…….3. **P. narayanswamii**

1. Phyllanthus chandrabosei Govaerts & Radcl.-Sm. in Kew Bull. 51: 176. 1996; N.P. Balakr. & Chakrab., Fam. Euphorbiaceae India 372. 2007; K.M. Matthew, Fl. Palni Hills 2: 1137. 1999; N.P. Balakr. *et al*., Fl. India 23: 449. 2012. *Reidia stipulacea* Gamble in Bull. Misc. Inform. Kew 1925: 332. 1925 & Fl. Madras: 1293. 1925. *Phyllanthus stipulacea* (Gamble) Kumari & Chandrab. in A.N. Henry *et al*., Fl. Tamil Nadu 2: 239. 1987, non Boj. 1837. **(Plate No. 76)**

Straggling undershrub; branchlets radiating with persistant stipules. Leaves apically crowded, subsessile, disctichous, obliquely ovate, ca 1 × 0.5 cm, apiculate or shortly acuminate at apex, membranous, hispid beneath; lateral veins obscure; stipules lanceolate, stiff, 3–6 mm long, brown. Inflorescences axillary, male flowers solitary at the proximal axils; female flowers

towards the tips; bracts many, imbricate, linear-lanceolate, ca 2 mm long. Male flowers: pedicels ca 1 cm long, filiform, glabrescent; Calyx 4 or 5, broadly ovate to deltoidsuborbicular, ca 2 × 2 mm, entire, ciliate at margin; disk glands 4 or 5, obcordate, flesh coloured; stamens 2 or 3, subsessile, horizontal. Female flowers: pedicels ca 1.5 cm long; calyx 6, ovate, ca 2 × 1.8 mm, pinkish with dark red spots, sciliate; disk glands 6, suborbicular. Ovary depressed-globose, trilocular, ca 0.8 mm across, villous; styles 3, ca 1 mm long, 2-fid. Capsules subglobose, ca 4 × 6 mm, 3-partite, depressed, densely soft hairy.

Flowering & Fruiting: Throughout the year.
Distribution: Tamil Nadu (Nilgiries & Palni Hills). KWLS: Pambar Shola. *Kabeer & Ravi Kiran 133867.*
Notes: Highly scarce and restricted only to Pambar Shola. Growing in deep shady areas as under storey vegetation of Pambar Shola (Left side of the Pambar Falls). Being a narrowly distributed species and with shrinking habitat due to *Acacia* sp. invasion, it may beome extinct from the Palani hills.

2. **Phyllanthus macraei** Müll.Arg. in Linnaea 32: 29. 1863.

Scandent undershrub, ca 2 m high; branchlets glabrous, compressed, obscurely winged. Leaves broadly elliptic to oblong or ovate-elliptic, 2–4 × 1.5–2.5 cm, truncate or cordate at base, obtuse, subacute or apiculate at apex, obscurely ciliate-hairy along margins, subcoriaceous to chartaceous, faintly glaucous beneath; lateral veins 5–7 pairs; petioles ca 2 mm long; stipules broadly orbicular. Inflorescences axillary, male fascicles towards tip and female at middle of the branch; bracts peltate. Male flowers: pedicels ca 1.2 cm long; tepals 6, campanulate, white; disk glands 6, flat, green; stamens 3, free; filaments ca 1 mm long. Female flowers: pedicels 1–1.8 cm long; tepals 6; disk 6-lobulate. Ovary trilocular, hirtellous; style short; stigmas 3, deeply 2-fid. Capsules subglobose, ca 3 × 4 mm, 3-lobed, pitted.

Key to the varieties

1a. Branchlets glabrous……2.1. var. **macraei**
1b. Branchlets hispid……2.2. var. **hispidus**

2.1. var. **macraei**; Hook.f., Fl. Brit. India 5: 269. 1887; Gamble, Fl. Madras: 1290. 1925; N.P. Balakr. & Chakrab., Fam. Euphorbiaceae India 378. 2007; N.P. Balakr. *et al.*, Fl. India 23: 469. 2012. **(Plate No. 76)**

Flowering & Fruiting: Throughout the year.
Distribution: Kerala and Tamil Nadu. KWLS: Berijam, Gundar, Kookal, Kownji, Mannavanur and Poombarai.

Notes: Very frequent at swamps and streams in grasslands and shola forests between 1700 and 2500 m altitude. A few populations are associated with *Lonicera ligustrina* and *Hypericum patulum* in the streams of shola forests. *Kabeer & Ravi Kiran 133103, 138180.*

2.2. var. **hispidus** Gamble, Fl. Madras: 1290. 1925l; N.P. Balakr. & Chakrab., Fam. Euphorbiaceae India. 378. 2007; N.P. Balakr. *et al.*, Fl. India 23: 469. 2012. **(Plate No. 77)**

Scandent undershrub, 1–1.5 m high; branchlets hispid, reddish, obscurely flattened. Leaves oblong, 2–3 × 1–1.5 cm, cordate at base, obtuse or acute, apiculate at apex, subcoriaceous, green with red tinged above, light pinkish below; midvein reddish, lateral veins 5–7 pairs, obscure; petioles ca 1 mm long; stipules peltate. Fascicles unisexual, axillary, solitary; male flowers at the tip; tepals 6, white to cream; disk glands 6; stamens 3. Female flowers towards middle of the branch; tepals 6. Capsule subglobose, ca 2 × 3 mm, pitted; fruiting pedicels ca 2 cm long.

Flowering & Fruiting: Throughout the year.
Distribution: Kerala and Tamil Nadu. KWLS: Vadakownji–Pannaikkadu grasslands. *Kabeer & Ravi Kiran 141030.*
Notes: Very scarce among the streams of shola forests and in the grasslands at elevation between 1800 and 2300 m altitude. Found only at Vadakownji–Pannaikkadu grasslands of Perupallam Range.

3. **Phyllanthus narayanswamii** Gamble in Bull. Misc. Inform. Kew 1925: 329. 1925 & Fl. Madras: 1289. 1925; N.P. Balakr. & Chakrab., Fam. Euphorbiaceae India 379. 2007; N.P. Balakr. *et al.*, Fl. India 23: 470. 2012. **(Plate No. 77)**

Herb or undershrub, 20–50 cm high; rootstock woody, glabrescent, branchlets obscurely winged, sometimes pinkish. Leaves alternate, elliptic-oblong, elliptic-ovate, ca 1.5 × 1 cm, subtruncate or cordate at base, margins pinkish, thickened, mucronate at apex, coriaceous; petioles 0.5–1 mm long; stipules triangular to deltoid, peltate. Inflorescences axillary, male fascicles bracts deltoid-acuminate, ca 1 mm long. Male flowers: pedicels 3–6 mm long. Tepals 6, oblong or orbicular, ca 3 × 2 mm, margins obscurely sinuate, white or lilac or pinkish or brick red; disk glands 6, rounded, yellowish; stamens 3, free; filaments ca 1mm long; anthers subglobose. Female flowers: pedicels 0.5–1 cm long, pulvinate at apex; tepals 6, ovate-elliptic, ovate-lanceolate, ca 1 × 0.6 mm, pink with red streaks; disk annular. Ovary subglobose, ca 1.8 mm across, glandular-verrucose; styles 3, free, bifid, recurved. Capsules subglobose, ca 3 × 3 mm, shallowly 3–6-lobed, verrucose; fruiting pedicels ca 1.3 cm long.

Flowering & Fruiting: August–April.

Distribution: Andhra Pradesh and Tamil Nadu. KWLS: Perumalmalai and Vattakanal. *Kabeer & Ravi Kiran 139782, 141085 & 142670.*

Notes: Endangered (Nayar & Sastry, 1990). Less frequent in the grasslands at elevations between 1800 and 2400 m. Populations were seen in Vattakanal grasslands, and rarely occurs on Perumalamalai. It is an addition to the Flora of Palni Hills. Habitats are under extreme threat due to invasion species of *Acacia* and *Eucalyptus*.

45. **MORACEAE**

Ficus L.

Key to the species

1a. Scandent climbers……2
1b. Trees……....3
2a. Leaves glabrous or puberulous below; style of female flowers glabrous; figs without the ooze of resin at maturity……..1. **F. amplocarpa**
2b. Leaves densely to thinly brown tomentose or pubescent below; style of female flowers with tuft of hairs at apex, figs with ooze of resin at maturity……..5. **F. guttata**
3a. Receptacles ellipsoid or ovoid, glabrous, woody with prominent vertical ridges when dry; basal bracts 5–8 mm long……3. **F. beddomei**
3b. Receptacles oblong, obovoid, globose to subglobose or turbinate, white puberulous or pubescent, not woody; basal bracts 2–4 mm long……....4
4a. Waxy glands two, in the axils of basal lateral veins beneath of leaves, aerial roots usually absent, receptacles oblong or obovoid; tepals of male flower united……...2. **F. anamalayana**
4b. Waxy gland one, at the base of midvein beneath of leaves; aerial roots present, numerous, receptacles globose to subglobose, turbinate; tepals of male flower free…….4. **F. dalhousiae**

1. **Ficus amplocarpa** Govind. & Masil. in Proc. Indian Acad. Sci. Pl. Sci. 91: 117. 1982; Chithra in A.N. Henry *et al*., Fl. Tamil Nadu 2: 251. 1987. *F. macrocarpa* (Miq.)Wight ex King, Sp. Ficus 1: 166, t. 208.1888 & in Hook.f., Fl. Brit. India 5: 534. 1888 non Blume, 1825; C.E.C. Fisch. in Gamble, Fl. Madras: 1365. 1928. *F. laevis* Blume var. m*acrocarpa* (Miq.) Corner, K.M. Matthew, Fl. Palni Hills 2: 1181. 1999. **(Plate No. 80)**

Liana; branchlets glabrescent; latex milky; bark reddish or grey. Leaves alternate, broadly ovate, ovate to elliptic, 10–20 × 6–10 cm, base rounded or subcordate, margins entire, apex gradually acuminate or caudate, acumen 1–1.5 cm long; subcoriaceous, sparsely puberulous above, glabrous beneath, glaucous beneath; basal veins 3–5 (2 obscure); midvein prominent beneath, lateral veins 3 or 4 pairs, prominent beneath; petioles 2–6 cm long, 1.5–2 mm thick, dark brown, puberulous to glabrous. Stipules in pairs, ovate–lanceolate, 1–1.5 cm long,

glabrous or puberulous, caducous. Receptacles cauliflorus to ramiflorus, in clusters of fascicles on tubercles of stem, pedunculate, dioecious, subglobose to globose or obovoid, 2–7cm in across, greenish with tinged white, glabrescent, fig wall ca 5 mm thick; peduncle ca 1 cm long, pubescent bracteoles at base, ovate–triangular, ca 1.5 mm long, glabrous; basal bracts reduced, glabrous, caducous; ostiole raised, ca 1.8 mm long, opened; ostiolar bracts 3, triangular, 2–3 mm long, glabrous, sparsely hairy at margins, internal ostiolar bracts many, broadly triangular, subulate, glabrous, internal hairs many, between flowers, linear, ca.1.7 mm long, white. Male flowers: on distinct receptacles, 4–5 rows, ca 3 mm long, pedicellate. Pseudohermaphrodite flowers: few, pistillode, ca 2 mm long, subsessile; tepals 4, free, ca 1 mm long. Gall flowers: along with male flowers, numerous, 3–8 mm long, pedicellate. Female flowers: on distinct receptacles, 2–3 mm long, sessile or subsessile. Neuter flowers: tepals, ca 3 mm long. Achenes ovoid, ca 2 mm across, brownish, tuberculate.

Flowering & Fruiting: September–July.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Blackburn and Tiger Sholas. *Kabeer & Ravi Kiran 142694.*
Notes: Restricted to sholas and collected only from Blackburn Shola of the sanctuary.

2. **Ficus anamalayana** Sudhakar & G.V.S. Murthy in Rheedea 25(1): 1–8. 2015. *F. albipila* sensu Rani in J. Bombay Nat. Hist. Soc. 82: 235. 1985, non (Miq.) King 1888; Chithra in A.N. Henry *et al.*, Fl. Tamil Nadu 2: 251. 1987. **(Plate No. 78)**

Tree, 10–15 m high; aerial roots thin, small roots, caducous, branchlets pubescent. Leaves simple, alternate, ovate, ovate to oblong, 20–30 × 10–15 cm, base cordate to rounded, margins entire or faintly undulate, apex acuminate to subacute, acumen ca 1 cm, subcoriaceous, sparsely puberulous, pubescent beneath, basal veins 5–9; lateral veins 10–12 pairs, veins prominent beneath; petioles 5–10 cm long, stout, silvery puberulous. Stipules terminal, in pairs, lanceolate or ovate-lanceolate, 3–5 cm long, subglabrous, caducous. Receptacles axillary, below the leaves, paired, pedunculate, monoecious, obovoid or oblong, ca 1.5 cm across, green with white dots, silky puberulous, slightly ribbed when dry; peduncle ca 1 cm long, puberulous; basal bracts 3, basally connate forming small cupule, ca 2.5 mm long, puberulous; ostiole prominent, ca 1.5 across, ostiolar bracts 3, ovate, ca 1 mm long, internal ostiolar bracts, ovate or deltoid, ca 1.5 mm long, glabrous, interfloral bracts present. Male flowers: few, near ostiole; pedicellate, ca 2 mm long. Gall flowers: ca 3.5 mm long, pedicellate; pedicel ca 1.5 mm long. Female flowers: sessile, ca 3.5 mm long. Achenes ovoid, 1– 1.5 mm across.
Flowering & Fruiting: June–December.
Distribution: Kerala and Tamil Nadu. KWLS: Kumbakkarai–Vellagavi path and Palani–Kodaikanal ghat road. *Kabeer & Ravi Kiran 135542.*

Notes: Abundant in dry deciduous forests and semi-evergreen forests at elevations between 500 and 1000 m. Frequenlty occurs in drydeciduous forests of Devadanapatty and Palani Ranges.

3. **Ficus beddomei** King in Ann. Roy. Bot. Gard. (Calcutta) 1: 26. 1888, t. 24. & in Hook.f., Fl. Brit. India 5: 502. 1888; C.E.C. Fisch. in Gamble, Fl. Madras: 1364. 1928; Chithra in A.N. Henry *et al.*, Fl. Tamil Nadu 2: 252. 1987; K.M. Matthew, Fl. Palni Hills 2: 1179. 1999. **(Plate No. 78)**

Deciduous tree, ca 25 m high; branchlets glabrous, annular stipular scars prominent, latex white, bark pale-brown, smooth. Leaves alternate, ovate, broadly ovate or elliptic to lanceolate, 15–30 × 8–15 cm, base cuneate to rounded or truncate, margins entire, apex acute to abruptly acuminate, coriaceous, glabrous; basal veins 3, midvein prominent beneath; lateral veins 10–16 pairs; petioles 2.5–12 cm long, stout, 2–4mm thick, glabrous, slightly grooved above, glandular at apex beneath, reddish brown when dry, not articulate. Stipules terminal, opposite, lanceolate, 5–12 cm long, glabrous, golden yellow, caducous. Receptacles: axillary, in pairs, pedunculate, clustered together towards upper axils, monoecious, ellipsoid or ovoid, ca 2.5 cm across, green with yellow or white dots when ripe, black or brownish when dry, glabrous, woody, fig wall thick, pedunculate, 1.5–2.5 cm long, glabrous; basal bracts 3, at apex of peduncle, broadly triangular or ovate-acute, ca 5 × 2 mm, coriaceous, glabrous, persistent, ostiole prominent when dry; ostiolar bracts 2, ovate–orbicular, glabrous; internal ostiolar bracts many, arranged horizontal and descending, ovate or broadly ovate to lanceolate, ca 3 mm long, glabrous; interfloral bracts linear, 2–3 mm long, glabrous. Male flowers: many, scattered, 2–4 mm long, pedicellate. Gall flowers: scattered, 2–3 mm long, pedicellate. Female flowers: throughout fig, sessile to subsessile, 4–5 mm long; Achenes ovoid, ca 2 mm across.

Flowering & Fruiting: September–March.
Distribution: Karnataka, Kerala, Madhya Pradesh, Maharashtra and Tamil Nadu. KWLS: Kumbakkarai–Vellagavi old bridge path.
Notes: Very scarce in dry deciduous forests of the sanctuary at elevations ranging from 400 to 600 m. Seen at Kumbakkarai falls, Devadanapatty range and at first glance, looks very similar to the *F.anamalayana* but differs by having short peduncled figs and smaller leaves.

4. **Ficus dalhousiae** (Miq.) Miq. in Ann. Mus. Bot. Lugduno-Batavi 3: 285. 1867; King, Sp. Ficus 1: 16, t. 11, 81a.1887 & in Hook.f., Fl. Brit. India 5: 499. 1888; C.E.C. Fisch. in Gamble, Fl. Madras: 1364. 1928; Chithra in A.N. Henry *et al.*, Fl. Tamil Nadu 2: 253. 1987. *Urostigma dalhousiae* Miq. in London J. Bot. 6: 571. 1847. **(Plate No. 79)**

Evergreen tree, ca 15 m high; aerial roots present, branchlets pubescent to glabrous, latex milky, bark brown. Leaves alternate, ovateto elliptic, broadly ovate to oblong, 15–30 × 7–18 cm, base cordate to rounded, margins entire, apex acute or acuminate, coriaceous to subcoriaceous, glabraous or puberulous above, dotted, softly white pubescent beneath, younger foliage dark red or pink beneath; basal veins 5–7, midvein prominent beneath, gland at base of midvein beneath; lateral veins 10–15 pairs, prominent beneath; petioles 6–12 cm long, ca 3 mm thick, pubescent or puberulous. Stipules terminal, ovate–lanceolate, ca 5 cm long, glabrous or puberulous, caducous, leaving annular scars. Receptacles axillary or from leaf scars, in pairs or clusters, pedunculate, monoecious, globose to subglobose, obovoid, turbinate, ca 1.5 cm across, greenish yellow, pubescent, obscurely ridged; peduncle ca 1 × 0.2 cm, pubescent; basal bracts 3, ovate, broadly triangular, pubescent or puberulous, ostiole ca 2 mm; osiolar bracts 3, ovate-obtuse, deltoid, ca 3 × 3.5 mm, puberulous; internal ostiolar bracts ovate, deltoid, ca 2 × 1.5 mm, white, glabrous, interfloral bracts ovate–lanceolate, ca 1 × 0.5 mm, white, glabrous. Male flowers: subsessile, ca 2 mm long. Gall flowers: scattered, pedicellate. Female flowers: scattered, sessile, ca 2 mm long. Achenes oblongoid, ca 1.5 mm long, brown.

Flowering & Fruiting: January–July.
Distribution: Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. KWLS: Kumbakkarai falls. *Kabeer & Ravi Kiran 147313.*
Notes: Frequently occurs in the dry and moist deciduous forests of the sanctuary at elevations ranging from 400 to 1200 m. Grows in rocky crevices along stream banks.

5. **Ficus guttata** (Wight) King, Sp. Ficus 1: 167, t. 209. 1888 & in Hook.f., Fl. Brit. India 5: 534. 1888; C.E.C. Fisch. in Gamble, Fl. Madras: 1365. 1928; Fyson, Fl. S. Ind. Hill Stat. 1: 542. 1932; Chithra in A.N. Henry *et al.*, Fl. Tamil Nadu 2: 254. 1987. *Covellia guttata* Wight, Icon. Pl. Ind. Orient 6: t. 1966. 1853. **(Plate No. 79)**

Liana; aerial roots at nodes and internodes, branchlets glabrescent, latex milky. Leaves alternate, cordiform or rotund to ovate, 8–15 × 5–12 cm, base cordate to subcordate, rounded, margins entire, apex acuminate, coriaceous or subcoriaceous, obscurely puberulous above, brown tomentose beneath, glabrescent by age; basal veins 3, midvein prominent beneath; lateral veins 3 or 4 pairs, prominent beneath; petioles 5–8 cm long, rusty tomentose. Stipules terminal, ovate-lanceolate, 1–2 cm long, rusty pubescent, caducous. Receptacles cauliflorus to ramiflorus, clusters on stem, pedunculate, dioecious, ellipsoid, ca 5 cm across, purple with tinged white, rusty tomentose, fig wall 1 mm thick, resin pale white; peduncle ca 1 cm long, ca 3 mm thick, pubescent; basal bracts 3, at apex of peduncle, basally connate, triangular, ca 2 mm long, pubescent, caducous; ostiole prominently raised, ca 2 mm long,

umbonate, opened; ostiolar bracts 3, triangular, ca 3 mm long, obscurely hairy; internal ostiolar bracts many, deltoid, subulate, ca 4 × 3 mm, white with brown tinge; interfloral bracts absent, internal hairs numerous, between flowers, linear, ca 1.5 mm long, white. Male flowers: in distinct receptacles, near ostiole, in 2 rows, sessile or shortly pedicellate, ca 3 mm long. Hermaphrodite flowers: sessile, 1.5–2 mm long, with pistillode. Gall flowers: along with male flowers, subsessile or pedicellate, ca 1cm long. Female flowers: in distinct receptacles, sessile or pedicellate, 3–4 mm long; pedicel ca 0.8 mm long, white, glabrous. Neuter flowers: ca 2 mm long. Achenes ovoid or ellipsoid, ca 2 mm across, brownish, tuberculate.

Flowering & Fruiting: July–January.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Perumalamalai and Tiger Shola.
Notes: Frequent in shola forests and semi-evergreen forests at elevations ranging from 1700 to 2400 m. Abundant in Perumalamali Shola forests and common in Tiger Shola.

46. **ORCHIDACEAE**

Key to the genera

1a. Plants terrestrial.....2
1b. Plants epiphytic or lithophytic.....4
2a. Leaves plicate; flowers non-resupinate…….....6. **Malaxis**
2b. Leaves not plicate; flowers resupinate……3
3a. Floral bracts leafy; spur lesstahn 2 mm long, conical……2. **Brachycorythis**
3b. Floral bracts not leafy; spur more than 1 cm long long…….....5. **Habenaria**
4a. Plants with pseudobulbs……..5
4b. Plants without pseudobulbs…….....6
5a. Pollinia 4 in two-pairs……3. **Coelogyne**
5b. Pollinia 8…….....4. **Conchidium**
6a. Pollinia 4…….....7. **Oberonia**
6b. Pollinia 2…….....1. **Aerides**

1. **Aerides** Lour.

Aerides crispa Lindl., Gen. Sp. Orchid. Pl. 239. 1833; Hook.f., Fl. Brit. India 6: 45. 1890; C.E.C. Fisch. in Gamble, Fl. Madras: 1442. 1928; A. Abraham & Vatsala, Intr. Orchids: 446. 1981; K.M. Matthew, Fl. Palni Hills 3: 1264. 1999. **(Plate No. 81)**

Epiphytic or lithophytic herb, ca 60 cm high. Roots thick, long, robust. Stem 15–40 × 1–1.5 cm, covered with persistent sheaths of petioles. Leaves linear-oblong, 10–25 × 2–4 cm, unequally 2-lobed at tip, sheathing at base, keeled along midvein. Inflorescence raceme or panicle; peduncles 10–25 cm long. Floral bracts minute, scaly, caducous. Flowers pink, 1.5–2

cm across; pedicel ca 1.5 cm long. Sepals and petals ca 1 × 0.5 cm. Lip 3-lobed, 1.5–2 cm long; lateral lobes ca 0.8 cm long, midlobe ovate-crenulate. Spur ca 6 mm long, projecting forward. Ovary ca 1 cm long. Capsules pyriform, 3–4 cm long, angled, winged; seeds many.

Flowering & Fruiting: July–December.

Distribution: Goa, Karnataka, Kerala, Maharastra and Tamil Nadu. KWLS: Vadakownji–Pannaikkadu grasslands. *Kabeer & Ravi Kiran 139758.*

Notes: Very scarce in the sanctuary and found in Perupallam range at an elevation of 1860 m. This habitat is shrinking due to invasion of *Acacia* and *Eucalyptus* species. Seasonal grassland fires are also restricting its expansion and the number of individuals. K.M. Matthew (1999) stated that over-collecting is also a reason for its decline.

2. **Brachycorythis** Lindl.

Key to the species

1a. Petals free from dorsal sepal……....3. **B. wightii**
1b. Petals adnate to dorsal sepal……...2
2a. Lower bracts longer than the flowers; epichile of lip 0.5–1.2 cm long……1. **B. iantha**
2b. Lower bracts shortr than the flowers; epichile of lip 1.5–3 cm long……2. **B. splendida**

1. **Brachycorythis iantha** (Wight) Summerh. in Kew Bull. 10: 238. 1955; A. Abraham & Vatsala, Intr. Orchids: 254. 1981; K.M. Matthew, Fl. Palni Hills 3: 1209. 1999. *Platanthera iantha* Wight, Icon. Pl. Ind. Orient. 5(1): 11, t. 1692. 1851. *Habenaria galeandra* (Rchb.f.) Benth. Hook.f., Fl. Brit. India 6: 163. 1890. *Phyllomphax obcordata* (D. Don) Schltr., Feddes Repert. 4: 119. 1919; C.E.C. Fisch. in Gamble, Fl. Madras: 1476. 1928. **(Plate No. 81)**

Herb, 15–35 cm high. Tubers oblong-ovoid, 2–3 × 1–2 cm. Stem 4 or 5-sheathed at base. Leaves 5–10, towards apex, ovate-lanceolate, ovate-oblong or ovate-elliptic, 3–6 × 1.5–2 cm, sheathing at base, margins entire, acute or attenuate, 5-veined, inner 3 prominent than lateral 2. Floral bracts foliaceous, ovate, acute; lower bracts longer than flowers; pedicel ca 1.5 cm long. Dorsal sepal ovate, acute, ca 6 × 3 mm, papillose, 3-veined, adnate to lateral sepals and petals. Lateral sepals obliquely lanceolate, ca 8 × 3 mm, blunt-acute-acumen, papillose, 3-nerved with lateral 2 incomplete. Petals, obliquely ovate-lanceolate, ca 7 × 3 mm, 4-nerved, margins obscurely crenate. Lip flabellate, broadly obcordate, ca 5.5 × 12 mm, clawed. Spur ca 5 × 2 mm, puberulous, shallowly notched. Column ca 3 mm long, flap at apex. Ovary oblong-ellipsoid, ca 10 × 2 mm, twisted, ridged, papillose. Pod 1–1.5 cm long, angled.

Flowering & Fruiting: July–September.

Distribution: Karnataka, Kerala and Tamil Nadu. Kookal grassland. *Kabeer & Ravi Kiran 138172.*

Notes: Restrcted to Shola grasslands at elevation between 1900 and 2500 m. Collected only from Kookal grassland slopes and now this area has been merged under the Anamalai Tiger Reserve. Synchronised flowering within local populations was noticed in August and it completes its life cycle within 3 months.

2. **Brachycorythis splendida** Summerh. in Kew Bull. 10: 240 1955; Rathakr., Bull. Bot. Surv. India 13: 2. 1971; A. Abraham & Vatsala, Intr. Orchids: 256. 1981; K.M. Matthew, Fl. Palni Hills 3: 1210. 1999. *Habenaria iantha* Hook.f., Fl. Brit. India 6: 164. 1890, descr. tantum. partim exclu. synon. *Phyllomphax obcordata* (D. Don) Schltr. var. *iantha* (Hook.f.) C.E.C. Fisch. in Gamble, Fl. Madras 1031. 1928. **(Plate No. 81.1)**

Herb, 15–45 cm high. Tubers oblong-ovoid, 2–4 × 1.2–2.3 cm. Stem pinkish brown, sulcate, sheathed with leaves; flowering stem clearly defined from the vegetative part. Leaves 3–3.5 × 1.5–2.2 cm, ovate-lanceolate, acute at apex, margin entire and pink tinged; veins prominent below and pinkinsh. Flowers in the axils of foliaceous bracts, raceme terminally crowded; bracts 1.5–2 × 1–1.2 cm, ovate, acuminate; pedicel ca 2 cm long. Dorsal sepal ca 8 × 5 mm, ovate, acute, 3-veined. Lateral sepals 10 × 4.5 mm, obliquely ovate-lanceolate, acute, 4-veined, pinkish brown. Petals 8 × 2.5 mm, linear, oblique, acuminate at apex, 3-veined; lip ca 3 × 1.8 cm, obcordate, irregulary crenate. Spur ca 6 × 4 mm, notched, pink to purple. Column ca 4 mm long, flap at apex. Ovary oblong-ellipsoid, ca 10 × 3.2 mm, ridged, papillose. Pod 1–1.7 cm long, angled.

Flowering & Fruiting: September–Decemebr.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Kookal grassland. *Kabeer & Ravi Kiran 142674.*

Notes: Restrcted to Zeronium grasslands at elevation between 1900 and 2400 m. and collected only here in 2019.

3. **Brachycorythis wightii** Summerh., Kew Bull. 10(2): 242. 1955; Rathakr., Bull. Bot. Surv. India 13: 2. 1971. *Phyllomphax wightii* (Summerh.) Szlach., Richardiana 6(2): 78. 2006. **(Plate No. 81.2)**

Terrestrail herb, erect, 15–35 cm long. Tubers ovoid, ca 2 cm long, ca 1–2 cm. in dia. Stem densely foliose, erect, leaves 10–15, lanceolate, , 4–6 × 2.2–5 cm, sheathing at base, acuminate at apex, margin entire. Inflorescence, densely or sub-loosely 6–20-flowered, ca 18 × 3–5 cm, rachis smooth, glabrous; bracts foliaceous, lanceolate, ca 4 × 2 cm. Flowers pinkish, often white; pedicel with ovary-curved, 1.5–2 cm long, short papillate. Dorsal sepals lanceolate,

erect, acuminate, 12–13.5 × 3–3.5 mm, trinerved, not adnate to petals. Lateral sepals obliquely lanceolate, acuminate, 14–15 × 3–4 mm, quadrinerved. Petals obliquely lanceolate, ca 12.5 × 2–3 mm, acute. Lip flabellate ca 2.5 cm long; epichile obovate-orbicular-cordate-reniform, apiculo-triangular at apex, 1–20 × 1–1.3 cm; hypochile 3–4 × 5–7 mm, conical, spurred; spur slightly curved, ca 5 mm long. Column erect, thick, 3–5 mm long, lobed-marginate. Ovary oblong-ellipsoid, ca 12 × 2 mm, twisted, papillose. Pod 1.2–1.8 cm long, angled.

Flowering & Fruiting: May–October.
Distribution: Kerala and Tamil Nadu. KWLS: Villpatti and Vattakanal grasslands.
Notes: Restrcted to Perumalmalai and Vattakanal grasslands at elevation between 1900 and 2300 m. Kothareddy Prasad recorded it in July, 2016 at Villpatti and Ana & Preetham recorded it in July, 2021 at Vattakanal grassland.

3. **Coelogyne** Lindl.

Coelogyne nervosa A. Rich. in Ann. Sci. Nat. Bot. Ser. 2, 15: 16. 1841; C.E.C. Fisch. in Gamble, Fl. Madras: 1430. 1928; A. Abraham & Vatsala, Intr. Orchids: 285. 1981; K.M. Matthew, Fl. Palni Hills 3: 1233. 1999. *C. corrugata* Wight, Icon. Pl. Ind. Orient. 5(1): 5, t. 1639. 1851; Hook.f., Fl. Brit. India 5: 835. 1890. **(Plate No. 82)**

Epiphytic or lithophytic herb, ca 15 cm high. Pseudobulbs broadly oblong-ovoid, 3–5 × 2–3 cm, 2-leaved. Leaves elliptic, 8–20 × 1.5–3.5 cm, narrowed into a keeled petiole, acute at apex, punctate. Inflorescence arise from the developing shoot, racemes ca 20 cm long, 3–6-flowered. Floral bracts oblong or lanceolate, ca 1.5 × 3 cm, scarious. Flowers 4–6 cm wide, dorsal sepal elliptic-oblong, acute, ca 2.2–3.1 × 0.6–1 cm, many-veined. Lateral sepals elliptic, oblique at base, acute, ca 2.5 × 0.8 cm, many-veined. Petals elliptic, 2.5–3.3 × 0.9–1.2 cm, acute, 3-veined. Lip 3-lobed, 1.8–3 cm long; lateral lobes oblong, yellowish inside; midlobe lanceolate, obscurely crenulate. Column curved, ca 1.5 cm long. Capsules ellipsoid, ca 3 × 2 cm, 6-angular.

Flowering & Fruiting: September–December.
Distribution: Kerala and Tamil Nadu. KWLS: Vadakownji–Pannaikkadu grasslands. *Kabeer & Ravi Kiran 142643 & 142685.*
Notes: Frequent on rocky slopes of grasslands with abundant populations in the Vadakownji – Pannikkadu grasslands. Habitat is under extreme threat due to invasion of *Acacia* sp., *Eucalyptus* sp. and *Pteridium* sp. Live plants in vegetative stage observed at Vattakanal shola and Vembadi peak are smaller in size and have glabrous pesudobulbs when compared with *C. nervosa*. These match well with *C. mossiae*.

4. **Conchidium** Griff.

Conchidium nanum (A. Rich.) Brieger in Orchideen (Schlechter) 1(11–12): 751. 1981. *Eria nana* A. Rich. in Ann. Sci. Nat. Bot. Ser. 2, 11: 19.1842; Hook.f., Fl. Brit. India 5: 789. 1890; C.E.C. Fisch. in Gamble, Fl. Madras: 1425. 1928; A. Abraham & Vatsala, Intr. Orchids: 377. 1981; K.M. Matthew, Fl. Palni Hills 3: 1246. 1999. **(Plate No. 82)**

Small epiphytic herb, 5–8 cm long. Pseudobulbs flat, slightly concave above, crowded. Leaves 2 or 3, oblong, 2–3 × 1–1.2 cm, narrowed at base, obtusely acute and cuspidate. Inflorescence raceme, terminal, ca 5 cm long. Flowers 5–8, secund or subsecund. Floral bracts cymbiform, acuminate, 3.5–4.8 × 1–2.5 mm. Dorsal sepal lanceolate, acuminate, 8–9.4 × 1.5–2 mm, green. Lateral sepals broader, as long as dorsal sepal, falcate-lanceolate, acuminate. Petals lanceolate, acuminate, 7–8.5 × 1–1.5 mm, green or creamy. Lip narrowly lanceolate, abruptly shortly clawed, ca 5 × 1.4 mm, sparsely gland-dotted, papillose, green. Capsules pyriform, ca 5.5 mm long.

Flowering & Fruiting: August–April.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Kookal, Perumalamali, Tiger Shola and Vattakanal. *Kabeer & Ravi Kiran 142666.*

Notes: Frequently occurs in sholas at elevations between 1900 and 2400 m. A good number of populations growing on *Turpinia nepalensis* were found in Perumalmalai and Tiger Shola.

5. **Habenaria** Willd.

Key to the species

1a. Petals entire……2
1b. Petals 2-partite……3. **H. rariflora**
2a. Scape with 1–5-flowered; lip longer than lateral sepals……..2. **H. longicornu**
2b. Scape with 20 or more flowered; lip shorter than lateral sepals……1. **H. elliptica**

1. **Habenaria elliptica** Wight, Icon. Pl. Ind. Orient. 5(1): 13, t. 1706. 1851; Hook.f., Fl. Brit. India 6: 147. 1890; C.E.C. Fisch. in Gamble, Fl. Madras: 1471. 1928; A. Abraham & Vatsala, Intr. Orchids: 233. 1981; K.M. Matthew, Fl. Palni Hills 3: 1221. 1999. **(Plate No. 83)**

Terrestrial herb, 20–35 cm high. Tubers oblong-ovoid, ca 2.5 × 1.5 cm. Stem sheathed at base. Leaves 4 or 5, oblong-lanceolate or elliptic-lanceolate, 5–8 × 1–2 cm, margins entire, pointedly acute; midvein prominent, lateral veins 4. Inflorescence raceme, dense, many flowered, scape 10–15 cm long. Floral bracts lanceolate, minutely crenulate, acuminate, 1– 1.5 × ca 0.2 cm; sterile bracts 1.5–2.5 cm long; pedicel 1–1.7 cm, grooved. Dorsal sepal ovate, obtuse, ca 5 × 3 mm, 5-veined; lateral sepals elliptic-ovate, acute, 5–6 × 2.5–3 mm, pubescent

inside, 3-nerved. Petals elliptic-ovate, acute, ca 3 × 2.5 mm. Lip deflexed, ca 6 mm long, 3-lobed at middle, clawed for 2.5–3 mm, white; lobes equal, subulate-lanceolate, obtusely acute, ca 2 × 0.9 mm, pubescent below lobes. Spur 1–1.8 cm long, clavate at apex, as long as ovary. Capsules linear-oblong, ca 1.2 cm long, grooved.

Flowering & Fruiting: October–November.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Vattakanal. *Kabeer & Ravi Kiran 141093.*
Notes: Typical Shola grassland element and extremely scarce in the sanctuary between 2200 and 2300 m elevation in Vattakanal grassland and this habitat is shrinking due to *Acacia* sp. and *Eucalyptus* sp. invasion.

2. **Habenaria longicornu** Lindl., Gen. Sp. Orchid. Pl. 322. 1835; Hook.f., Fl. Brit. India 6. 139. 1890; C.E.C. Fisch. in Gamble, Fl. Madras: 1470. 1928; A. Abraham & Vatsala, Intr. Orchids: 229. 1981; K.M. Matthew, Fl. Palni Hills 3: 1219. 1999. **(Plate No. 83)**

Terrestrial herb, 10–35 cm high; tuber 4.5 × 2.5 cm across, roots 3– 5 mm thick, rising at nodes on the scape, above the tuber. Leaves 4–6, linear-oblong or lanceolate, ca 10 × 2.5 cm, imbricate on the stem above tuber, acute or acuminate. Scape ca 30 cm high, noded above the tuber. Flowers 4–6, 2–2.5 cm across; bracts linear, ca 2.5 cm long; pedicel ca 5 cm long, grooved; sepals ovate, acute, ca 1.2 × 0.8 cm across, green outside; dorsal sepal ca 8 × 7 mm. Petals linear-oblong, ca 1 × 0.5 cm across; lip 3-partite, midlobe linear, shorter; side lobes ca 1.8 × 1 cm, cuneate, apex obliquely truncate, fimbriate; spur ca 12 cm long, apex clavate. Stamens 2. Ovary 1.5–2 cm long. Pod linear, angled, ca 2 cm long.

Flowering & Fruiting: October–November.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Melpallam. *Kabeer & Ravi Kiran 141061.*
Notes: Very scarce and grows on rocky slopes of grasslands from 1500 to 2500 m. at Palani view on the Melpallam to Kodaikanal ghat road. The entire grassland habitat was invaded by *Eucalyptus* sp. and *Lantana camara*.

3. **Habenaria rariflora** A. Rich. in Ann. Sci. Nat. Bot. Ser. 2, 15: 70. 1841; Hook.f., Fl. Brit. India 6: 136. 1890; C.E.C. Fisch. in Gamble, Fl. Madras: 1469. 1928; A. Abraham & Vatsala, Intr. Orchids: 216. 1981; K.M. Matthew, Fl. Palni Hills 3: 1219. 1999. **(Plate No. 84)**

Terrestrial herb, ca 15 cm high; tuber round, ca 1 cm across; roots ca 0.5 cm thick. Leaves at base of the scape, linear, 2.5–4.5 × ca 1.2 cm, acute at apex. Flowers in terminal raceme;

scape 6–10 cm long; bracts ovate or lanceolate, hyaline; bracteole linear. Flowers white, 1–3, ca 2 cm across. Dorsal sepal ca 6 × 5 mm, broadly ovate, obtuse, 5-veined; lateral sepals ca 7 × 3 mm, obliquely elliptic-oblong, subacute, 5-veined. Petals unequally biparted, larger lobe ca 6 × 3 mm, ovate, acute; smaller lobe ca 12 × 0.5 mm, linear acute. Lip ca 15 × 3 mm, 3-lobed; lateral lobes ca 12 × 0.7 mm, linear, acute; mid lobe shorter than lateral linear lobes, ca 7 × 2 mm, oblong, obtuse; spur 6–8 cm long, cylindric, obtuse, green. Overy with pedicel ca 4 cm, linear, grooved.

Flowering & Fruiting: August–September.

Distribution: Andhra Pradesh, Karnataka, Kerala, Maharastra and Tamil Nadu. KWLS: Pallangi–Palamputtur grasslands, Vadakownji–Pannaikkadu grasslands and Vattakanal grassland. *Kabeer & Ravi Kiran 138199.*

Notes: Frequent in grasslands at elevations ranging from 1700 to 2400 m. All grassland habitats are under threat due to invasion by the speciesof *Acacia*, *Eucalyptus* and *Ptreridium*.

6. **Malaxis** Sol. ex Sw.

Malaxis intermedia (A. Rich.) Seidenf. in Bot. Tidsskr. 73: 99. 1978. *Liparis intermedia* A.Rich., Ann. Sci. Nat. Bot. Ser. 2, 15: 17. 1841. *Seidenfia* intermedia (A. Rich.) Szlach. Fragm. Florist. Geobot. Supp. 3: 122 .1995; K.M. Matthew, Fl. Palni Hills 3: 1240. 1999; Sathish & Manilal, Orchid Memories 221. 2004. *Microstylis stocksii* Hook.f., Fl. Brit. India 5: 691. 1890; C.E.C. Fisch. in Gamble, Fl. Madras: 1408. 1928. **(Plate No. 85)**

Terrestrial herb, 15–25 cm high; pseudobulbs obscure or absent sometimes. Leaves usaually 4 rarely 5, broadly ovate-lanceolate, 5–12 × 2–6 cm, acuminate at apex, sheathing at base, 6-ribbed, oblique at base, margins wavy. Inflorescence terminal racemes, 10–15 cm long, scape reddish brown. Floral bracts ca 6 mm long, lanceolate. Flowers crowded at apex on the scape, 0.6–1 cm across, flesh coloured. Sepals and petals 0.5–0.8 cm long, lanceolate, deflexed. Lip broader than long, ca 4 × 8 mm, laciniate teeth 10 or more on each side of the median line. Pedicel with ovary ca 5 mm long. Capsules oblong, ca 8 mm long, ribbed.

Flowering & Fruiting: August–September.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Blackburn and Pambar Sholas.

Notes: Very scarce understorey herb in shola forests at elevations between 1900 and 2400m.

7. **Oberonia** Lindl., nom. cons.

Oberonia balakrishnanii R. Ansari in R. Ansari & N.P. Blakr., Orchid Monogr. 4: 16. t.10. 1990; K.M. Matthew, Fl. Palni Hills 3: 1244. 1999. **(Plate No. 84)**

Epiphytic herb. Leaves articulate at base, ca 12, oblong-ensiform, ca 10 × 1.8 cm, acute or subacuminate, glabrous. Scape ca 8 cm long, flat; spike ca 10 cm long, arcuate, with a distinct sterile tip 1–2 cm long. Flowers pedicelled, ca 3.5 × 2 mm; bracts equalling the ovary and pedicel, ovate, ca 1.5 mm, subacuminate, lacerate along margins, gland-dotted. Sepals and petals sparsely gland-dotted, glabrous, reflexed; sepals 2, ca 1 mm; dorsal sepal oblong, obtuse, entire; lateral sepals oblong, obtuse, entire, minutely keeled. Petals 2, oblong, ca 0.8 × 0.6 mm, rounded at apex, crenate along margins. Lip 3-lobed, ca 2.5 mm long; lateral lobes ca 3 mm across, midlobe ca 2 mm across, gland-dotted; lateral lobes obliquely cuneate, auricled, subentire, curved; midlobe 2-lobuled; lobules orbicular, margins crenate or subentire, diverging; sinus broad; disk indistinct. Ovary & pedicel ca 2 mm long. Column ca 1 mm long, ca 0.5 mm thick, clavate. Pod obovoid, ca 8 × 6 mm across.

Flowering & Fruiting: August–November.
Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Palamalai and Sottimalai.
Notes: Very scarce and distributed in the savannahs and moist evergreen forests of the sanctuary at an elevtion ranges from 1100 to 1600 m. Collected from Colonymedu, Chennai Saragam where a few individuals are growing on *Terminalia chebula* trees.

47. **ASPARAGACEAE**

Asparagus L.

Asparagus fysonii J.F. Macbr. in Contr. Gray Herb. 56: 17. 1918; C.E.C. Fisch. in Gamble, Fl. Madras: 1517. 1928; K.M. Matthew, Fl. Palni Hills 3: 1295. 1999. *Protasparagus fysonii* (J.F. Macbr.) Kamble in J. Econ. Taxon. Bot. 15(3): 709. 1992. **(Plate No. 85)**

Scandent armed shrub; stem glabrous, branchlets grooved, spines rigid, straight, ca 2 cm long. Leaves reduced to cladodes, 5–15 at node, subulate, 1–1.8 cm long, pointed at apex, triquetrous, scales brown, triangular, ca 1 mm. Flowers 1or 2 together at node, solitary; pedicels ca 2 mm long, jointed above the middle. Perianth petaloid, campanulate, 6-partite, oblanceolate, white, pink tinged, glabrous. Stamens 6, at bases of perianth segments; filaments free, ca 2.5 mm long; anthers oblong, brown. Ovary trilocular, trigonous; ovules 2 or more in each locule; style ca 1.5 mm; stigmas 3-capitate. Berries globose, ca 0.6 cm, red when ripe; seeds 1–6, testa black, brittle.

Flowering & Fruiting: February–July.
Distribution: Kerala and Tamil Nadu. KWLS: Edmankarai, Kookal lake and Kudarayar Sholas. *Kabeer & Ravi Kiran 140912.*

Notes: Very scarce at shola forest borders between 2000 and 2500 m elevations. Noticed very limited distribution of this species with less number of individuals. Cattle grazing in the habitat is the major threat to this species .

48. **COMMELINACEAE**

Murdannia Royle, nom. cons.

Murdannia dimorpha G. Brückn. in Engler & Prantl, Nat. Pflanzenfam., ed. 2. 15a: 173. 1930; K.M. Matthew, Fl. Palni Hills 3: 1348. 1999. *Aneilema dimorphum* Dalzell in Hook.'s J. Bot. Kew Gard. Misc. 3: 138. 1851; Hook.f., Fl. Brit. India 6: 377. 1892; C.E.C. Fisch. in Gamble, Fl. Madras: 1545. 1931. **(Plate No. 86)**

Herb, ca 40 cm high; stem brached from the base, branchlets sparsely pubescent. Leaves linear-lanceolate, ca 8 × 1 cm, acute at apex, base amplexicaul, sheathing at base, glabrous on both surfaces, finely ciliate at margins; sheath open, minutely hairy, pink. Flowers in terminal and axillary thyrses, composed of 2–4 alternate cincinni, flowers 5–10; peduncle 4–6 cm long. Flowers 0.8–1 cm across; pedicel ca 7 mm long, slender; sepals ca 5 × 4 mm, ovate, acute, dark brown, glabrous; petals ca 7 × 6 mm, obovate, glabrous. Stamens 3; anthers ellipsoid, pale white, margins lilac; staminodes 3-lobed; filaments ca 5 mm long, densely woolly at the base, glabrous towards anthers. Ovary void to ellipsoid, green; style lilac or vinaceous; stigma capitate, white or lilac. Capsules oblong–ellipsoid, 3–4 × ca 2 mm, trilocular, glabrous; seeds uniseriate, 3 or 4 per locule.

Flowering & Fruiting: July–September.

Distribution: Goa, Karnataka, Kerala, Tamil Nadu. KWLS: Berijam, Jamindar Shola, Katrika odae. *Kabeer & Ravi Kiran* 132779 & 132828.

Notes: Very frequent at shola forest borders, grassland slopes and near streams of the wet evergreen forests from 1200 to 2500 m elevation.

49. **ARECACEAE**

Key to the genera

1a. Leaf base auriculated……....1. **Arenga**

1b. Leaf base not auriculated……...2. **Bentinckia**

1. **Arenga** Labill., nom. cons.

Arenga wightii Griff. in Calcutta J. Nat. Hist. 5: 475.1845; Becc. & Hook.f. in Hook.f., Fl. Brit. India 6:422.1892; C.E.C. Fisch. in Gamble, Fl. Madras: 1588. 1931; K.M. Matthew, Fl. Palni Hills 3: 1357. 1999. **(Plate No. 86)**

Botanical Survey of India



Arenga wightii Griff.

Monoecious tree, trunk 10–15 m high; covered with persistent leaf sheaths. Leaves pinnatisect, ca 8 m long; leaflets ca 100 × 5 cm, linear, base auricled, faintly glaucous below; petioles ca 3 m long. Spathe 70 cm long; spadix branched, ca 1.3 m long. Male flowers: towards tip of spadices, orbicular, sessile; tepals 6, biseriate. Stamens many, free. Female flowers: towards base; tepals 6, biseriate, inner tepals bigger than outer, accrescent. Ovary trilocular, trigonous. Drupes globose, ca 5 × 4 cm across, sessile, silvery flocoose.

Flowering & Fruiting: Throughout the year.

Distribution: Goa, Karnataka, Kerala, Maharastra and Tamil Nadu. KWLS: Poolathur piruvi. *Kabeer & Ravi Kiran 138115.*

Notes: Vulnerable (Johnson, 1998). Restricted to single location in the sanctuary at an altitude of 850 m elevation near Poolathur Piruvu, Law's Ghat road. The habitat should be declared as an eco-sensitive zone where this species shares its habitat with *Drypetes wightii* and *Glyptopetalum lawsonii.* The endosperm will cause the unbearable itching if it touches bare skin and local people call it Kaatu Tengai.

2. **Bentinckia** Berry ex Roxb.

Bentinckia condapanna Berry ex Roxb. Fl. Ind. 3: 621. 1832; Becc. & Hook.f. in Hook.f., Fl. Brit. India 6:418.1892; C.E.C. Fisch. in Gamble, Fl. Madras: 1555. 1931; K.M. Matthew, Fl. Palni Hills 3: 1358. 1999. **(Plate No. 87)**

Monoecious tree, 10–15 m high; trunk ca 20 cm wide, annulate. Leaves pinnately compound; leaflets 50–80 × 3–5 cm, linear-lanceolate, sessile; petioles 30–70 cm long, sheath rounded, ca 50 × 30 cm, encircling the stem. Inflorescence spadix, arise in axil of leaves; spathe 30–50 cm across, flowers sunken in branches of spadix. Male flowers small, sunken in the spirally arranged pits towards the tips; perianth lobes 6, biseriate, outer smaller, ca 5 mm across, orbicular, inner longer; stamens 6, free. Female flowers ca 8 mm across, towards the base of the branches of spadix, lilac; ovary trilocular, 1 locule larger with an ovule. Fruit subglobose, ca 1.2 × 1 cm, 1-seeded, red.

Flowering & Fruiting: Throughout the year.

Distribution: Kerala and Tamil Nadu. KWLS: Chinnur, Periur and Vattakanal.

Notes: Vulnerable **(**Johnson, 1998). Restricted to shola grassland slopes and rocky cliffs at elevations between 1900 and 2500 m. Very few Individuals were noticed at Vattakanal–Chinnur valley, Periyur–Suicide Point valley.

Botanical Survey of India



Bentinckia condapanna Berry ex Roxb.

50. **ERIOCAULACEAE**

Eriocaulon L.

Key to the species

1a. Anthers black……...1. **E. pectinatum**
1b. Anthers white……2. **E. ritchieanum**

1. **Eriocaulon pectinatum** Ruhland in Engler, Pflanzenr. IV, 30(13): 85. 1903; C.E.C. Fisch. in Gamble, Fl. Madras: 1620. 1931; K.M. Matthew, Fl. Palni Hills 3: 1388. 1999; R. Ansari & N.P. Balakr., Eriocaul. India (Rev.) 139. 2009. *Eriocaulon geoffreyi* Fyson in Bull. Misc. Inform. Kew 1914: 330. 1914. **(Plate No. 87)**

Acaulescent herb; rootstock 1–2 cm long. Leaves rosette at base, linear, 2–5 × ca 0.3 cm, acute or acuminate, glabrous. Peduncles 1–3, ca 15 cm long; sheath 4 cm long, limb minute. Head globose to spherical, black to grey; involucral bracts obovate, acute, glabrous, reflexed; floral bracts ca 2.5 × 1 mm, chartaceous, deltoid, acute, hairy towards the apex, black. Male flowers: pedicel minute; sepals obovate, united into a split sheath, densely hoary at apex, truncate, black; petals 3, hairy, one slightly larger with a black gland; anthers 6, black. Female flower: sepals 3, free, ca 2 × 0.6 mm, densely hoary at apex, black; petals 3, oblanceolate or spathulate, hoary at apex, glandular. Ovary ovoid oesherical; style 3-fid. Seeds oblong, epidermal cells transversely elongate.

Flowering & Fruiting: August–December.
Distribution: Kerala and Tamil Nadu (Nilgiris & Palni Hills). KWLS: Perupallam. *Kabeer & Ravi Kiran 132881 & 141177.*
Notes: Vulnerable (Kumar, 2011). Tiny, ephemeral herb and restricted to swamps of shola grasslands at elevations between 1800 and 2500 m. Very scares in the sanctuary and a few populations were found at Vadakownji–Pannikkadu grasslands.

2. **Eriocaulon ritchieanum** Ruhland in Engler Pflanzenr. IV, 30: 73 1903; K.M. Matthew, Fl. Palni Hills 3: 1390. 1999; R. Ansari & N.P. Balakr., Eriocaul. India (Rev.) 161. 2009. *Eriocaulon horsley-kundae* Fyson in J. Indian Bot. 3: 13. 1922. **(Plate No. 88)**

Acaulescent herb. Leaves rosette at base, linear-ensiform, ca 5 × 0.3 cm, glabrous. Peduncles ca 20 cm long, glabrous. Sheaths 4–7 cm long, glabrous. Heads hemispherical, ca 7 mm across, grey to black. Involucral bracts oblong-obovate, obtuse, ca 1.2 × 0.7 mm, chartaceous, black. Floral bracts lanceolate, acute, hoary towards apex, black. Male flowers: pedicels ca 0.5 mm long; sepals obovate, united into a spathe of ca 1.2 × 1 mm, 3-lobed, lobes obtuse, hoary towards apex, black; petals 3, unequal, oblong, obtuse at apex, ca 5 mm long, hoary, glandular.

Anthers 6, subglobose, white. Female flowers: pedicels ca 0.3 mm long; sepals 3, free, oblong or oblanceolate, obtuse or acute at apex, ca 1.3 mm long, hyaline, sparsely hoary towards apex, black; petals 3, free, spathulate, obtuse, ca 1.28 mm long, hyaline, hoary towards apex, gland black. Ovary globose; style 3-fid. Seeds oblong-ellipsoid, acute or obtuse, ca 0.4 × 0.3 mm; epidermal cells vertical, transversely elongated.

Flowering & Fruiting: September–April.
Distribution: Andhra Pradesh, Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Ibex peak and Kookal. *Kabeer & Ravi Kiran 140917.*
Notes: Very frequent in the swamps and moist places in the grasslands at elevations between 1500 and 2500 m. The largest population of this species was observed at the Berijam slopes and Ibex peak grassland.

51. **CYPERACEAE**

Fimbristylis Vahl, nom. cons.

Key to the species

1a. Spikelets solitary; glumes imbricate……1. **F. kingii**
1b. Spikelets 3–10 in an umbel; glumes spiral……..2. **F. ulignosa**

1. **Fimbristylis kingii** Gamle ex Boeckeler, Beitr. Cyper. 2: 40. 1890; C.B. Clarke in Hook.f., Fl. Brit. India 6: 633. 1893; C.E.C. Fisch. in Gamble, Fl. Madras: 1658. 1931; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1421. 1999. **(Plate No. 88)**

Tufted, short rhizomatous, perennial. Culms obtusely angled, 10–35 cm, glabrescent. Leaves shorter to as long as culms, ca 1 mm thick, flat, acute at apex, densely hairy; ligule absent; sheaths membranous. Inflorescence a terminal spikelet. Involucral bracts 2, ca 4 × 0.8 mm, glumes like, short, keeled, hyaline at margins. Spikelet solitary, ovoid, 0.4–1 × 0.3–0.5 cm, acute at apex, many-flowered. Glumes imbricate, ovate, ca 4 × 2 mm, membranous, obtuse–acute at apex, mucronate, keeled, 3–5-nerved, reddish brown, margins hyaline. Stamens 3, elongate, ca 4 mm long; anthers oblong, ca 2 mm long. Style apically ciliate; stigmas 3, ciliate. Nutlet trigonous, obovoid, ca 1.2 × 1 mm, short stipitate, stramineous, greyish.

Flowering & Fruiting: July–December.
Distribution: Karnataka, Kerala, Maharastra and Tamil Nadu. KWLS: Pappaliamman kovil. *Kabeer & Ravi Kiran 138179.*
Notes: Highly scarce and restricted to high altitude grasslands. A few populations were noticed in the Kookal hilltop at 2400 m elevation.

2. **Fimbristylis uliginosa** Hochst. ex Steud., Syn. Pl. Glum. 2: 109. 1855; C.B. Clarke in Hook.f., Fl. Brit. India 6: 648. 1891; C.E.C. Fisch. in Gamble, Fl. Madras: 1660. 1931; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1423. 1999. **(Plate No. 89)**

Erect, tufted, rhizomatous perennial; rhizome covered with old brownish sheaths. Culms triangular, 30–40 cm long, thickened at base. Leaves many, clustered, basal, filiform, 5–20 cm long, ca 1.5 mm wide, narrowed from a broad base, scabrid, acute at apex; ligule absent; sheaths ca 4 cm long, hyaline margins, brownish coloured. Inflorescence simple umbel, with 3–10 spikelets. Involucral bracts 2 or 3, lower bract exceeding the inflorescence, linear, ca 3.5 cm long. Spikelets ovoid to obovoid, 6–8 × ca 3 mm, sessile, dark brown. Glumes spiral, ovate, ca 6 × 3 mm, boat shaped, keeled, 3-nerved, mucronate, lineolate with dark reddish brown. Stamens 3; anthers oblong, ca 2 mm long; filaments flat. Style ca 3 mm long, dilated at base; stigmas 3, as long as style, ciliate. Nutlet obovoid, ca 1.5 × 1 mm, trigonous, tuberculate, dark brown, stipitate.

Flowering & Fruiting: November–May.

Distribution: Andhra Pradesh, Kerala and Tamil Nadu. KWLS: Vadkownji–Pannikkadu grasslands. *Kabeer & Ravi Kiran 141188*.

Notes: Very scarce in the grassland slopes and marshy areas in the grasslands. A few poplations located in Vadkownji–Pannikkadu grasslands at an elevation of 1860 m. Habitat is under invasion by *Eucalyptus* sp. and Wattle.

52. **POACEAE**

Key to the genera

1a. Spikelet with a definite awn……..2
1b. Spikelet unawned……...11
2a. Leaf sheath margins connate and tubular; lemma awn twisted and entangled ……10. **Streblochaete**
2b. Leaf sheath margins free and open; lemma awns not coiled as above…….....3
3a. Spikelet with one floret……4
3b. Spikelet with two or more florets……...6
4a. Awn of lemma arising from above base……...1. **Agrostis**
4b. Awn of lemma arising from apex……..5
5a. Decumbent annual herb; glumes with a definite awn….....9. **Polypogon**
5b. Robust perennial herb; glumes unawned…… 6. **Garnotia**
6a. Sessile spikelets subtended by involucral homogamous spikelets…….....11. **Themeda**
6b. Sessile spikelets not subtended by any other means……7
7a. Spikelets with many fertile florets……...12. **Tripogon**
7b. Spikelets with one fertile and other male or barren floret……...8

8a. Inflorescence a solitary raceme…….....7. **Heteropogon**
8b. Inflorescence a panicle……9
9a. Awn of lemma more than 3 cm long…….....4. **Chrysopogon**
9b. Awn of lemma from ca 0.5 mm to almost 1 cm long…….....10
10a. Florets 3 per spikelet; lower male, middle one barren and upper most floret bisexual …….....2. **Anthoxanthum**
10b. Florets 2 per spikelet; lower male and upper bisexual……...3. **Arundinella**
11a. Number of florets per spikelet many…….....5. **Eragrostis**
11b. Number of florets per spikelet always two……8. **Isachne**

1. **Agrostis** L., nom. cons.

Agrostis peninsularis Hook.f., Fl. Brit. India 7: 255. 1896; C.E.C. Fisch. in Gamble, Fl. Madras: 1810.1934; Bor, Grass. Burma Ceylon India Pakistan 389. 1960; B.D. Sharma *et al.* in Biol. Mem. 2 (1 & 2): 158.1977; V.J. Nair in A.N. Henry *et. al*., Fl. Tamil Nadu Anal. 3: 87. 1989; Bhattacharya (Sunanda Moulik), Grasses Bamboos India 2: 374. t. 80. 1997; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1468. 1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 69. 2009. **(Plate No. 89)**

Tufted annuals or perennial. Culms erect to geniculate, 30–75 cm high. Leaf blade linear-lanceolate, 8–20 cm long, acuminate, truncate to round at base, scabrid dorsally; ligule ca 2.5 mm, membranous, lacerate; leaf sheath ca 8 cm long. Panicle effuse, 10–20 × 5–8 cm; peduncle ca 30 cm long. Racemes 2–6 per node, 6–8 cm long; rachis terete, scabrid, bare at base. Spikelet oblong-lanceolate, 3.4–3.7 × ca 1 mm, acuminate, greenish yellow to purplish, divergent at maturity; pedicel filiform to terete, scabrellate. Glumes oblong-lanceolate, acuminate, chartaceous. Lower glume ca 3.5 × 0.7 mm, 1-nerved, keeled, scabrid along keel and dorsally above; upper glume ca 3 × 0.5 mm, 3–nerved, 1–keeled, scabrid. Floret 1, bisexual; callus bearded, hairs 0.2–0.5 mm; disarticulating above persistent glumes. Lemma ovate-lanceolate, boat shaped, 2–2.3 × ca 0.8 mm, acuminate and 2-lobed or lobes bipartite, awned from slightly above base, chartaceous, 3–5-nerved, scabrellate dorsally; awn geniculate, 3–4 mm long, barbellate. Palea lanceolate, ca 2 × 0.5 mm, acuminate, membranous, 2-nerved, keeled, margins infolded. Stamens 3. Ovary oblong, ca 0.6 mm; style short; stigma plumose. Caryopsis oblong, brownish.

Flowering & Fruiting: November–January.

Distribution: Kerala and Tamil Nadu. KWLS: Ibex Peak, Perumalmalai, Pulavichiar and Vembadi Peak. *Kabeer & Ravi Kiran 139725 & 142681*.

Notes: Occurs occasionally on higher peaks at elevations between 1900 and 2500 m. Shrinking tropical montane grasslands is the biggest threat to this species.

2. **Anthoxanthum** L.

Anthoxanthum borii S.K. Jain & D. C. Pal in J. Bombay Nat. Hist. Soc. 72: 90. 1975; V.J. Nair in A.N. Henry *et al*., Fl. Tamil Nadu Anal. 3: 88. 1989; Bhattacharya (Sunanda Moulik), Grasses Bamboos India 2: 436. 1997; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1465. 1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 74. 2009. **(Plate No. 90)**

Tufted, rhizomatous perennial. Culms ca 1 m high. Leaf blade linear-lanceolate, 10–20 cm long, shallowly cordate at base, sparsely hairy; ligule ca 3 mm, membranous, fimbriate; leaf sheath glabrous to sparsely tuberculate. Panicle contracted, oblong-lanceolate, ca 12 cm long. Spikelets solitary, oblong-lanceolate, ca 7 mm, golden yellow; pedicels ca 2 mm long, ciliolate. Glumes ovate-lanceolate, chartaceous, persistent, dissimilar. Lower glume ca 5 mm, acute, 1-nerved, keeled. Upper glume ca 7 mm, acute to acuminate, yellowish, 1–3-nerved, 1-keeled, scabrid. Florets 3, basal 2 sterile, upper 1 fertile; lower male, middle barren and upper bisexual; disarticulating above glumes. Lower lemma linear-oblong, ca 6 mm, bifid at apex, awned from sinus, membranous, brownish, ciliate, 5-nerved; awn ca 6 mm long. Lower palea linear-lanceolate, ca 5 mm, membranous, 2-nerved, keeled. Stamens 2 or 3. Second lemma oblong, deeply bifid, chartaceous, faintly 5-nerved, villous, awn dorsal, ca 1 cm long. Fertile lemma ovate-oblong, ca 3 mm, obtuse at apex, faintly 5-nerved, shortly aristate. Palea lanceolate, ca 2 mm long, membranous, 2-nerved, keeled. Stamens 2 or 3; anthers 2–4 mm. Ovary oblong, ca 0.5 mm; stigma golden yellowish.

Flowering & Fruiting: July–December

Distribution: Kerala and Tamil Nadu. KWLS: Konalar marsh and Mannavanur. *Kabeer & Ravi Kiran 132844 & 132969.*

Notes: Occasionally occurs in marshy meadows and swampy areas in shola grasslands from 2000 to 2400 m elevation. High number of individuals noticed at Konalar marsh, Berijam range. The habitat is shrinking due to invasion of species of *Pinus*.

3. **Arundinella** Raddi

Key to the species

1a. Upper lemma with one awn and two lateral bristles……..2
1b. Upper lemma with one awn; lateral bristles absent……3. **A. vaginata**
2a. Glumes with tuberculate hairs along veins…….....1. **A. mesophylla**
2b. Glumes with ciliate hairs along veins or glabrous; tuberculate hairs absent…2. **A. nervosa**

1. **Arundinella mesophylla** Nees ex Steud., Syn. Pl. Glumac. 1: 115. 1854; Hook.f., Fl. Brit. India 7: 69.1896; C.E.C. Fisch. in Gamble, Fl. Madras: 1801. 1934; V.J. Nair in A.N. Henry *et al*., Fl. Tamil Nadu Anal. 3: 92. 1989; Bhattacharya (Sunanda Moulik), Grasses Bamboos India 1:

58.1997; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1558. 1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 338. 2009. **(Plate No. 90)**

Tufted annual. Culms geniculate, 20–60 cm high; nodes brownish. Leaves distichous; leaf blade linear-lanceolate, 3–10 cm, acuminate, rounded at base, glabrous to tuberculate, basal margins hairy; ligule membranous, fimbriate; leaf sheath tuberculate hairy, margins ciliate. Panicle with racemes alternate, 1–4 cm; spikelets, rachis and pedicels tuberculate; peduncle 7–18 cm, sparsely tuberculate hairy. Spikelets elliptic to ovate-lanceolate, 4–5 × ca 0.8 mm, acuminate, awned with 2 lateral setae, tuberculate dorsally, purple to greenish; pedicels serrulate. Lower glume 3–5 mm, chartaceous, 3 or 4-nerved, tuberculate hairy, margins ciliate. Upper glume 4–5 mm, caudate to acuminate, at times 2-lobed, 5-nerved, tuberculate hairy along veins. Florets 2; lower male, upper bisexual; callus villous. Lower lemma ovate-lanceolate, 1.5–2.5 mm, acuminate, chartaceous, 3-nerved. Lower palea lanceolate, 1.5–2.5 mm, acuminate, chartaceous, 2-nerved, keeled. Upper lemma elliptic-lanceolate, 0.8–1.7 mm, acute, subcoriaceous, granulate at maturity, 3–5-nerved, brown when mature; awn geniculate, 5–6.5 mm; setae 2, one on each side of awn, 1–2 mm long. Upper palea lanceolate, 1.2–1.5 mm, acuminate, membranous, 2-nerved, keeled. Lodicules 2, membranous. Stamens 3; anthers 0.8–1.2 mm. Ovary elliptic; style capillary; stigma plumose, purplish. Caryopsis oblong to elliptic, greenish.

Flowering & Fruiting: May–March.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Jamindar Shola, Kookal and Pulavichiar. *Kabeer & Ravi Kiran 132827, 132904 & 138166.*

Notes: Very frequent in all grasslands at elevations ranging from 1900 to 2500 m. Grows on rocky grassland slopes. At times grass appears purple in colour including the inflorescence. The largest number of populations were recorded at Kishan Kovil Saragam, Poombarai and Jamindar shola slopes.

2. **Arundinella nervosa** (Roxb.) Nees ex Hook. & Arn., Bot. Beechey Voy.: 237. 1837; Hook.f., Fl. Brit. India 7: 70. 1896; Bor in Kew Bull. 1955: 395. 1955 & Grass. Burma, Ceylon, India, Pakistan 424. 1960; V.J. Nair in A.N. Henry *et al.*, Fl. Tamil Nadu Anal. 3: 92. 1989; Bhattacharya (Sunanda Moulik), Grasses Bamboos India 1: 59. 1997; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1558.1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 340. 2009. *Holcus nervosus* Roxb., Hort. Bengal: 82. 1814. **(Plate No. 91)**

Culms solitary to tufted annual, 50–80 cm high; lower nodes rooting. Leaf blade 10–17 cm long, acuminate, tuberculate-ciliate to glabrous; ligule membranous; leaf sheath glabrous to pubescent. Panicle open, ca 20 cm long, branches scabrid. Spikelets paired, lanceolate, ca 6

mm long, pedicelled; pedicels hairy at apex. Glumes persistent; dissimilar, gaping. Lower glume ovate, ca 3 mm, acuminate to aristate at apex, membranous, 3-nerved, at times 1-keeled, scabrellate. Upper glume elliptic, ca 5 mm, acute to caudate at apex, 5-nerved, 1-keeled, scabrid and bristly or at times glabrous. Florets 2; lower male or barren, upper bisexual; disarticulating below florets at maturity; callus obtuse, pubescent. Lower lemma elliptic, ca 3 mm, rounded dorsally, obtuse, membranous, 3-nerved, 1-keeled. Lower palea ca 3 mm long. Upper lemma oblong-elliptic, ca 2 mm, awned with 2 lateral setae, subcoriaceous, scabrid on upper half, margins incurved; awn geniculate, ca 8 mm long; column ca 4 mm long; setae ca 2 mm long. Upper palea subcoriaceous, 2-nerved, keeled, margins infolded. Lodicules 2, membranous. Stamens 3; anthers 1–1.4 mm long. Stigmas 2.

Flowering & Fruiting: June–December

Distribution: Goa, Karnataka, Kerala, Maharashtra, Meghalaya and Tamil Nadu. KWLS: Law's Ghat road. *Kabeer & Ravi Kiran 132959.*

Notes: Commonly occurs in glassland slopes and evergreen forest edges at 1100–1800 m elevation. Frequently noticed from Perumalmalai to Damdam Parai.

3. **Arundinella vaginata** Bor in J. Indian Bot. Soc. 27: 66. 1948 & Grass. Burma, Ceylon, India, Pakistan 425. 1960; V.J. Nair in A.N. Henry *et al.*, Fl. Tamil Nadu Anal. 3: 93. 1989; Bhattacharya (Sunanda Moulik), Grasses Bamboos India 1:61. 1997; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1560. 1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 344. 2009. *A. villosa* var. *heynei* Hook.f., Fl. Brit. India 7: 73. 1896. **(Plate No. 91)**

Tufted perennial. Culms 50–80 cm high; villous throughout below panicle; nodes hairy. Leaf blade linear-lanceolate, involute, 15–30 cm, acuminate, tuberculate hairy to glabrescent; ligule membranous; leaf sheath tuberculate hairy. Panicle compact, spiciform, interrupted, ca 12 cm long; central axis villous, densely spiculate; peduncle hairy towards apex. Racemes ca 2.5 cm long; rachis villous. Spikelets elliptic-lanceolate, ca 7 mm long, paired; pedicels unequal. Lower glume oblong-lanceolate to elliptic, ca 6 mm, as long as lower lemma, chartaceous, aristate, 3–5-nerved, veins tuberculate hairy with dense glassy bristles. Upper glume ovate-lanceolate, ca 7 mm, acute to acuminate at apex, chartaceous, 5-nerved, veins tuberculate hairy. Florets 2; lower male, upper bisexual; disarticulating above persistent glumes; callus bearded. Lower lemma elliptic to oblong-lanceolate, ca 6 mm, acute, chartaceous, 5-nerved, scabrid on keel and apex. Lower palea elliptic-lanceolate, ca 4 mm, membranous, 2-nerved, keeled. Stamens 3. Upper lemma elliptic-oblong, ca 3 mm, acute to 2-lobed at apex, awned, subcoriaceous, 5-nerved; awn geniculate, ca 5 mm long. Upper palea oblong-lanceolate, ca 3 mm, hyaline, 2-nerved, keeled. Lodicules obovate. Stamens 3; anthers 1.5–2 mm long. Ovary elliptic; stigma 1.5–2 mm long.

Flowering & Fruiting: June–September.

Distribution: Kerala, Tamil Nadu. KWLS: Berijam slopes, Konalar and Vembadi peak. *Kabeer & Ravi Kiran 133878 & 139719.*

Notes: Typical shola grassland element and dominant grass on Ibex peak at 2000–2550 m. Seventy per cent of Ibex peak has been invaded by *Acacia* sp. Few grass clumps were found at Berijam slopes and Konalar marsh path from Escape route. This is the most favourite grass for elephants in the sanctuary.

4. **Chrysopogon** Trin., nom. cons.

Chrysopogon asper B. Heyne ex Blatt. & McCann in J. Bombay Nat. Hist. Soc. 32(3): 412. 1928 & Bombay Grasses 68. 1935; C.E.C. Fisch. in Gamble, Fl. Madras: 1738. 1934; Bor, Grass. Burma, Ceylon, India, Pakistan 116.1960; V.J. Nair in A.N. Henry *et al.*, Fl. Tamil Nadu Anal. 3: 100. 1989; Bhattacharya (Sunanda Moulik), Grasses Bamboos India 1: 240. 1997; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1577.1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 381. 2009. **(Plate No. 92)**

Tufted perennial. Culms straight to geniculate, ca 1.5 m high. Leaf blade fastigiate below, distichous, linear-lanceolate, 5–10 cm long, sparsely hairy; ligule membranous, fimbriate at apex; leaf sheath keeled near base. Panicle 8–13 cm long; racemes ca 2.7 cm long, ca 10 per node, yellow; peduncle smooth. Spikelets 3 together, one sessile, two pedicelled, dissimilar; disarticulation from tip of raceme; callus oblique, rufous hairy. Sessile spikelet oblong-lanceolate, 5–6 mm, awned. Lower glume boat shaped, ca 4 mm, aristate, subcoriaceous, 5-nerved, keeled towards apex, pectinate near keel and above middle; arista ca 1 mm, ciliate. Upper glume 4–6 mm, awned, 3-nerved, ciliate to hispid dorsally; awn 1–1.5 cm long, ciliolate. Florets 2, epaleate; lower male or barren, upper bisexual. Lower lemma oblong, 3–4 mm, membranous. Upper lemma oblong, 2–4 mm, membranous, 1–3-nerved; awn geniculate, column 2–3 cm, rufous hairy; bristle 3–3.5 cm, barbellate. Stamens 3. Ovary oblong; style hyaline; stigma plumose. Pedicelled spikelet oblong-lanceolate, 8–10 mm long, acuminate, awned, hairy dorsally; pedicels 4–5 mm, rufous hairy along margins. Lower glume 8–10 mm, acuminate, chartaceous, awned, 5–7–nerved, 2-keeled near margins, sparsely ciliate on keel, greenish yellow; awns straight or curved, 7–10 mm long, ciliate towards base. Upper glume narrowly lanceolate, 8–9 mm, acuminate with ca 3 mm long arista at apex, membranous, 3-nerved. Florets 2, epaleate; lower empty, upper male. Lower lemma oblong-lanceolate, ca 6.5 mm, acute, membranous, 2-nerved. Upper lemma elliptic-lanceolate, 3.5–4 mm, acute, membranous, 1-nerved. Stamens 3; anthers ca 4 mm.

Flowering & Fruiting: July–January.


Nilgiri Pipit

Distribution: Andhra Pradesh, Karnataka, Kerala, Maharashtra, Tamil Nadu. KWLS: Palamputtur, Perumalmalai and Vadakownji–Pannaikkadu grasslands. *Kabeer & Ravi Kiran* 138195.

Notes: Frequently occurs on slopes at elevations between 1400 and 1800 m. and one of the dominants in Palamputtur and Vadakownji–Pannaikkadu grasslands. *Acacia* spp., *Eucalyptus* spp. and *Pteriduim* sp are altering its habitat and resctricting this species expansion.

5. **Eragrostis** Wolf

Eragrostis collinensis Vivek, G.V. S. Murthy & V.J. Nair in Ind. J. Forestry. 36 (3): 401. 2013. **(Plate No. 92)**

Tufted annual, ca 35 cm high. Leaf blades linear-lanceolate, acute to acuminate, margins eglandular, sparsely ciliate towards base; ligule membranous, fimbriate at apex; leaf sheath mouth bearded. Panicle ovate, 5–10 cm, branches alternate, angled, eglandular; peduncle eglandular. Spikelets ovate to elliptic, ca 10 mm, purplish; pedicels ca 3 mm long, eglandular, angled. Glumes deciduous, unequal, lanceolate, 1-nerved, keeled. Lower glume 1–1.5 mm; upper glume 1.7–2 mm long. Florets ca 40, disarticulating from below upwards; rachilla zigzag, internode ca 1 mm long. Lemma lanceolate to elliptic, 1.5–2 mm, chartaceous, 3-nerved, 1-keeled, keel scabrid towards apex. Palea elliptic to lanceolate, 1.5–1.9 mm, 2-nerved, keeled. Lodicules 2, truncate. Stamens 3; anthers 0.5–0.8 mm long. Ovary ovoid; stigma cream coloured. Caryopsis narrowly elliptic, reddish brown.

Flowering & Fruiting: Throughout the year.

Distribution: Kerala, Maharashtra, Tamil Nadu. KWLS: Berijam, Colonymedu, Konalar marsh and Palamalai. Kabeer & Ravi Kiran 132708.

Notes: Very frequent in low altitude grasslands, svannahs and swampy patches in moist evergreen forests of the sanctuary at elevations ranging from 900 to 2100 m.

6. **Garnotia** Brongn.

Garnotia elata (Arn. ex Miq.) Janowski in Repert. Spec. Nov. Regni Veg. 17: 86. 1921; Bor, Grass. Burma, Ceylon, India, Pakistan 567. 1960; Ved Prakash & S.K. Jain, Fasc. Fl. India 3: 8. tt. 1, 2. 1979; V.J. Nair in A.N. Henry *et al.*, Fl. Tamil Nadu Anal. 3: 118. 1989; Bhattacharya (Sunanda Moulik), Grasses Bamboos India 1: 351. 1997; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1562. 1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 348. 2009. *Berghausia elata* Arn. ex Miq. in Anal. Bot. Ind. 2: 32. 1851. **(Plate No. 93)**

Robust, tufted perennial. Culms ca 1.5 m high. Leaf blade linear, 35–95 cm, canaliculate, inrolled towards apex, margins serrulate, scabrid; ligule a dense row of hairs; leaf sheath more

of less keeled towards apex, disarticulation zone not very distinct; collar ciliate. Panicle ca 60 cm long; racemes 10–15 cm long. Spikelets paired, similar, lanceolate, 2–3 × 0.6–0.8 mm, acute, greenish-yellow, awned; pedicels 1.5–4 mm; entire spikelet disarticulating from pedicel tip; callus bearded, hairs whitish. Lower glume ovate-lanceolate, 2–3 × ca 0.5 mm, acuminate, aristate, chartaceous, 3-nerved; arista barbellate. Upper glume ovate-lanceolate, 2–3.3 mm, at times bicuspidate, chartaceous, 3-nerved. Floret 1, bisexual. Lemma ovate-lanceolate, 2–2.5 mm, acuminate, 2-lobed, awned from sinus, chartaceous, 3-nerved; awn 3–4.5 mm, column usually twisted, faintly geniculate. Palea lanceolate, 1.8–2 mm, acute, membranous, 2-nerved, margins at times ciliate towards apex. Lodicules 2, obovate, membranous. Stamens 3; anthers ca 1 mm. Ovary oblanceolate, brown; style hyaline; stigma purplish. Caryopsis oblong.

Flowering & Fruiting: August–February.

Distribution: Andaman & Nicobar Islands, Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Utter Pradesh. KWLS: Law's Ghat road, Palamalai–Sottimalai, Pallangi grasslands. *Kabeer & Ravi Kiran 133035, 135502 & 139601.*

Notes: Frequently occurs on bare slopes and rocky crevices at elevations ranging from 1100 to 1900 m. Massive clumps were seen on Palamalai–Sottimalai. Local inhabitants are collecting the inflorescence to prepare brooms.

7. **Heteropogon** Pers.

Heteropogon fischerianus Bor in Kew Bull. 1951: 170. 1951 & Grass. Burma, Ceylon, India, Pakistan 165. 1960; V.J. Nair in A.N. Henry *et al.*, Fl. Tamil Nadu Anal. 3: 120. 1989; Bhattacharya (Sunanda Moulik), Grasses Bamboos India 1: 227. 1997; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3:1597. 1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 429. 2009. *H. contortus* P. Beauv. ex Roem. & Schult. var. *distichus* C.E.C. Fisch. in Gamble, Fl. Madras: 1743. 1934. **(Plate No. 93)**

Tufted perennial. Culms 15–100 cm high. Leaf blade linear, 3–10 cm, distichous, margins cartilaginous, scabrid towards apex; ligule ca 1 mm, densely ciliate; leaf sheath strongly compressed, ca 2.5 cm, keeled, distichous. Raceme solitary, terminal, 3–6 cm long, glabrous; lower 4–6 pairs of spikelets male or barren, unawned; upper pairs bisexual; joints thickened at apex, scabrous. Sessile and pedicelled spikelets more or less similar except broadly winged margins of lower glume of pedicelled spikelets. Lower glume lanceolate, ca 6 × 2 mm, acute, 2-keeled, keels narrowly winged, margins infolded. Upper glume elliptic, ca 5 mm, acute, 8-nerved, margins ciliate towards apex. Lower lemma elliptic, ca 5 mm, hyaline, margins ciliate. Upper lemma lanceolate, ca 4 mm long, hyaline. Stamens 3; anthers ca 2.5 mm long. Heterogamous sessile spikelets ca 1 cm long; callus ca 2.5 mm, dark brownish with reddish brown hairs, pointed. Lower glume oblong, ca 6.5 mm, truncate, grooved dorsally,

puberulous, brownish. Upper glume linear-oblong, ca 1 cm, ciliolate, 3-nerved, grooved dorsally, margins hyaline. Lower lemma linear-lanceolate, ca 6 mm, hyaline. Upper lemma hyaline, reduced to base of awn; awn ca 4 cm long. Palea oblong, ca 4 mm, membranous. Stigma purplish. Pedicelled spikelet ca 1 cm long, more or less similar to sessile homogamous spikelet.

Flowering & Fruiting: July–November.

Distribution: Southern India. KWLS: Damdam Parai, Kumbakkarai falls, Manjalar and Palamalai. *Kabeer & Ravi Kiran 139607.*

Notes: Scarce in scrublands and dry deciduous forests of the sanctuary from 400 to 1000 m. Gregarious colonies occurs at Kumbakkarai falls in October to November. Disctichous nature occurs obscurely in the indviduals growing at lower altitudes and shades. The grass sizes also varies from higher elevations to the lower elevations.

8. **Isachne** Benth.

Key to the species

1a. Florets vary in size and texture; lower bisexual, upper female……1. **I. bourneorum**
1b. Florets both similar in size, texture and sex……...2. **I. deccanensis**

1. Isachne bourneorum C.E.C. Fisch. in Bull. Misc. Inform. Kew 1932: 323. 1932 & in Gamble, Fl. Madras: 1796. 1934; Bor, Grass. Burma, Ceylon, India, Pakistan 579. 1960; B.D. Sharma *et al.* in Biol. Mem. 2(1 & 2): 166. 1977; Ved Prakash & S.K. Jain, Fasc. Fl. India 14: 15. 1984; V.J. Nair in A.N. Henry *et al.*, Fl. Tamil Nadu Anal. 3: 122. 1989; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1553. 1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 326. 2009. **(Plate No. 94)**

Tufted perennial. Culms decumbent, 25–30 cm high; nodes glabrous to white hairs, lower ones rooting. Leaf blade oblong-lanceolate, ca 4 × 0.4 cm, acuminate, semiamplexicaul at base, margins cartilaginous, scabrid with few tuberculate hairs; ligule a rim of white hairs; leaf sheath 1–2 cm, margins ciliate to tuberculate on one side. Panicle ca 4.5 × 2 cm; racemes 5–8, 1.5–4 cm long; rachis triquetrous. Spikelets paired below, solitary at above, elliptic-lanceolate, 2.8–3.5 × ca 1.2 mm, acuminate, greenish yellow to purple; pedicels scabrid. Glumes slightly subequal, longer than florets, acuminate to caudate at apex, chartaceous, divergent. Lower glume ovate-lanceolate, 2.5–3.5 mm, 5–7-nerved, veins tuberculate hairy. Upper glume ovate to elliptic-lanceolate, 2.7–3.5 mm, 7-nerved, veins tuberculate hairy, hairs falling at maturity. Florets 2, unequal in size and texture; lower bisexual; upper female, ca half or slightly more of lower floret. Lower lemma ovate-lanceolate, 2–3 mm, acute, chartaceous, greenish, 5–7-nerved. Lower palea oblong, ca 2 mm, acute, chartaceous, greenish, 2-nerved, margins incurved. Stamens 3. Rachilla extension ca 0.3 mm long between florets. Upper lemma

obovate, 1.5–2 mm, acute, subcoriaceous, white to yellow, 7-nerved, hispidulous, margins incurved. Upper palea elliptic, ca 1.2 mm, acute, subcoriaceous, 2-nerved, margins incurved. Lodicules 2, hyaline. Ovary oblong; stigma plumose.

Flowering & Fruiting: July–December.

Distribution: Karnataka, Kerala and Tamil Nadu. KWLS: Tiger Shola and Vadakownji–Pannikkadu grasslands. *Kabeer & Ravi Kiran 133018.*

Notes: Very scarce on shola floors, rocky crevices and bare hill slopes at elevations between 1800 and 2000 m. A good number of populations were seen at Vadakownji–Pannikkadu grasslands. The fern *Pteridium aquilinum* is altering the habitat and becoming a major threat.

2. **Isachne deccanensis** Bor in Kew Bull. 1949: 95. 1949 & Grass. Burma, Ceylon, India, Pakistan 579. 1960; B.D. Sharma *et al.* in Biol. Mem. 2 (1 & 2): 166. 1977; Ved Prakash & S.K. Jain, Fasc. Fl. India 14: 18. 1984; V.J. Nair in A.N. Henry *et al.*, Fl. Tamil Nadu Anal. 3: 122. 1989; Bhattacharya (Sunanda Moulik), Grasses Bamboos India 2: 544. 1997; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1554.1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 327. 2009. **(Plate No. 94)**

Tufted annual or perennial. Culms decumbent, ca 1 m high; lower nodes rooting. Leaf blade lanceolate, 5–12 × 0.3–0.5 cm, acuminate, scabrellate with ciliate to appressed soft hairs below; ligule a rim of hairs; leaf sheath 1.5–3.5 cm, margins ciliate, brownish. Panicle 6–13 cm, compact to lax at maturity; peduncle ca 15 cm long. Racemes 3–5 cm, flexuous; rachis smooth to serrulate towards apex; pedicels 0.3–1.2 cm, glandular bands in between. Spikelets elliptic to obovate, 1.7–3 × 1–1.2 mm, acute, purplish yellow. Glumes as long as spikelets, acute to obtuse, chartaceous, 7–9-nerved, margins hairy towards apex. Florets 2, both similar in texture, size and gender; rachilla ca 0.2 mm long between florets, yellowish. Lemma oblong-elliptic, 1–2 mm, obtuse, subcoriaceous, faintly 5-nerved, pubescent, margins incurved. Palea elliptic, 0.8–1.5 mm, subacute, chartaceous to subcoriaceous, 2-nerved. Stamens 3; anthers brownish.

Flowering & Fruiting: August–September.

Distribution: Tamil Nadu. KWLS: Konalar marsh and Mannavanur streams. *Kabeer & Ravi Kiran 132960*.

Notes: Highly scarce in the swampy areas at shola forest borders and grasslands at altitude from 2000 to 2500 m. During the survey this species was also collected from Mannavanur grassland which is excluded from the sanctuary area.

9. **Polypogon** Desf.

Polypogon nilgiricus Kabeer & V.J. Nair in Nordic. J. Bot. 25: 9. 2008 (2007); Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 86. 2009. **(Plate No. 95)**

Stoloniferous perennial. Culms decumbent, 40–75 cm high. Leaf blade linear-lanceolate, ca 30 cm l0ng, acuminate, rounded at base, scabrellate dorsally; ligule lanceolate, ca 1.2 cm long, acute, lacerate at maturity; leaf sheath terete, margins hyaline, glabrous. Panicle 6–12 × ca 5 cm; peduncle terete, ca 30 cm long; rachis scabrellate. Racemes many, 1.5–3 cm, whorled, at times lower ones branching, spreading at maturity. Spikelets solitary, pedicelled, oblong, 1.5–2 mm, laterally compressed, deciduous with pedicels; pedicels terete, scabrid. Glumes similar, exceeding floret, divergent when mature, oblong, 1.5–2 mm, acute to emarginate with awn at apex, chartaceous, greenish, 1-nerved, keeled, margins hispidulous; awn 2–3 mm long, straight to curved, barbellate. Floret 1, bisexual, usually ca ½ of glumes; callus glabrous. Lemma oblong, ca 1 mm, acute to 4-fid with excurrent veins at apices, chartaceous, faintly 5-nerved, margins incurved; awn from sinus, 1–1.3 mm, barbellate. Palea as long as lemma, membranous, faintly 2-nerved, 2 -keeled. Lodicules 2, membranous. Stamens 3; anthers yellowish. Ovary obovate, yellowish; style short; stigma plumose.

Flowering & Fruiting: March–April.

Distribution: Tamil Nadu. KWLS: Berijam, Konalar and Kookal. *Kabeer & Ravi Kiran 133734.*

Notes: Scarce in shola grasslands and streams of shola forests at altitude ranges from 1900 to 2500 m. A good number of individuals located at Gundar, Kookal and Konalar marshes. Habitat is shrinking due to invasion of species of *Pinus* and *Acacia*.

10. **Streblochaete** Hochst. ex A. Rich.

Streblochaete sanjappae Kabeer & V.J. Nair in Bull. Bot. Surv. India 47(1–4): 137. 2006; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 66. 2009; Kabeer *et al.* in Indian Forester, 143 (4): 387, 2017. *Koordersiochloa sanjappae* (Kabeer & V.J. Nair) Veldkamp, Reinwardtia 13(3): 302. 2012. **(Plate No. 95)**

Stoloniferous perennial; culms geniculate, ca 50 cm high. Leaf-blade linear-lanceolate, 10–13 cm, acuminate, sparsely hairy; ligule ca 3 mm long, membranous; leaf sheath tubular, margins connate, scaberulous, mouth auricles adnate to ligule. Panicle contracted, ca 10 × 2 cm; pedicels 1–1.5 cm long. Spikelets 4–8 per raceme, paired, laterally compressed, 1.5–2 cm long. Glumes 2, subequal, usually shorter than spikelets, divergent, persistent. Lower glume lanceolate, ca 8 mm, acuminate to shortly aristate, chartaceous, greenish, 3-nerved, keeled. Upper glume similar to lower one in shape and texture, ca 12 mm, 5–6-nerved, keeled. Florets 3–6, loosely imbricate, lower 2–4 usually bisexual, others male or reduced lemmas



Gaur




Nilgiri Tahr

often represented as cluster at tip; rachilla ca 2 mm long, slender, oblique, disarticulation above glumes and between florets; callus ca 2 mm long, linear, pungent with short stiff whitish bristles. Lemma oblong-lanceolate, ca 1 cm, acuminate, with two 3–4 mm long apical lobes, 7–9-nerved, awned from just below the sinus of lobes; awn 3–3.5 cm long, barbellate, twisted and entangled with awns of other florets. Palea oblong-lanceolate, ca 7 mm, acute, chartaceous, 2-nerved, keeled. Lodicules 2, truncate. Stamens 3; anthers 1–2 mm. Ovary oblong; stigma plumose. Caryopsis linear, shallowly long furrowed, brownish.

Flowering & Fruiting: March–April.
Distribution: Tamil Nadu. (Nilgiris & Palani Hills) KWLS: Edmankarai and Poombarai. *Kabeer & Ravi Kiran 133736.*
Notes: Gregarious on slopes of shola forests and grasslands. Indian Bison are feeding on this grass which is the dominant grass on the slopes of Poombarai and Kookal. Dry spikes will stick to animal bodies, human dresses, allowing seeds to translocate. The habitats of this species such as Poombarai-Kookal grassland slopes are under extreme threat by invasion of *Acacia* spp., *Ageratina adenophora* and *Eucalyptus* spp.

11. **Themeda** Forssk.

Themeda sabarimalayana Sreek. & V.J. Nair in Bull. Bot. Surv. India 29: 127. 1987; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1599. 1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 482. 2009. **(Plate No. 96)**

Tufted perennial. Culms ca 1.5 m high. Leaf blade linear, ca 50 cm long, acuminate, margins scabrid; ligule membranous, fimbriate at apex; leaf sheath keeled. Panicle lax, drooping, ca 75 cm long. Racemes dense, terminal and axillary, subtended by spatheole. Racemes single, cuneate, bearing 4 involucral and 1 or 2 pairs of sessile and pedicelled spikelets; rachis fragile. Involucral spikelet in 2 pairs, lanceolate, inserted at same level, subsessile, ca 7 mm long. Lower glume ovate-lanceolate, ca 7 mm, acuminate, muticous, 9–13-nerved, keeled, keel faintly winged, pilose dorsally. Upper glume lanceolate, ca 6 mm, chartaceous, 3–5-nerved, margins ciliate above middle. Florets 2, epaleate. Lower lemma elliptic-lanceolate, ca 6 mm, acute, hyaline. Upper lemma ca 1.8 mm long. Stamens 3; anthers 2–3 mm long. Sessile spikelets ovate-lanceolate, ca 5 mm long, brownish. Glumes dissimilar, exceeding apex of florets. Lower glume oblong-lanceolate, ca 5 mm, emarginate to dentate, subcoriaceous, 9–11-nerved, hairy dorsally. Upper glume oblong-lanceolate, 5–5.5 mm, acute, chartaceous, 3–5-nerved, 2-keeled, pubescent. Florets 2; lower barren, epaleate, upper bisexual; callus rufous brown hairy, pungent. Lower lemma ovate-lanceolate, ca 4 mm, hyaline, 3–5-nerved. Upper lemma linear, ca 2 mm, stipitate hyaline base of awn; awn ca 2.5 cm, geniculate. Upper palea ovate, acute, chartaceous. Stamens 3; anthers 2–3 mm long. Ovary ca 0.5 mm; stigma

plumose. Pedicelled spikelets lanceolate, ca 5 mm; pedicels ca 2 mm long; glumes and florets more or less similar to sessile spikelet.

Flowering & Fruiting: August–January.
Distribution: Kerala and Tamil Nadu. KWLS: Dolphin Nose and Colonymedu. *Kabeer & Ravi Kiran 139618.*
Notes: Frequent at grassland slopes and shola forest edges between 1700 and 2400 m elevations. Noticed gregarious clumps on Dolpin's Nose to Vellgavi village path, Perumalmalai to Adukkam road. These slopes were completely invaded by species of *Eucalyptus*. Local inhabitants are using this grass as thatch.

12. **Tripogon** Roem. & Schult.

Key to the species

1a. Leaf blade pungent at apex…….....2. **T. pungens**
1b. Leaf blade not pungent at apex……1. **T. narayanae**

1. **Tripogon narayanae** Sreek.,V.J. Nair & N.C. Nair in J. Bombay Nat. Hist. Soc. 80: 196. 1983; K.M. Matthew, Ill. Fl. Palni Hills t. 879. 1996; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1499. 1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 181. 2009. **(Plate No. 97)**

Tufted perennial. Culms erect, ca 20 cm high. Leaf blade linear, flat to convolute, 4–12 cm long, densely hairy on both surfaces; ligule membranous with ciliolate rim of hairs; leaf sheath hirsute, basal sheaths fibrous, persistent. Raceme contracted, 4–10 cm long; rachis triquetrous. Spikelets 2-rowed, sessile, solitary, oblong to obovate, ca 6 mm long, greenish yellow, breaking up at maturity. Glumes more or less similar, shorter than spikelets, persistent. Lower glume ovate-lanceolate, 2–2.5 mm, shallowly notched on one side, membranous, 1-nerved, keeled. Upper glume lanceolate, 3–4 mm, emarginate to 2-dentate at apex, mucronulate, membranous, 1-nerved, keeled. Florets 4–7; callus bearded. Lemma ovate-lanceolate to oblong, 2.5–3.5 mm, dentate to 4 -fid at apex, central lobes acute, outer lobes longer, ends with arista or awn, subcoriaceous, greenish to yellow; median awn ca 3 mm, lateral arista or awns ca 1.5 mm long, shorter than middle. Palea elliptic, ca 3 mm long, 2-nerved, keeled, keels ciliolate in upper half. Upper florets similar to lower one. Lodicules 2. Stamens 3; anthers purplish brown. Ovary obovate; stigma plumose.

Flowering & Fruiting: August–November.
Distribution: Kerala and Tamil Nadu. KWLS: Pallangi, Palamali and Vadakownji–Pannikkadu. *Kabeer & Ravi Kiran 138171.*

Notes: Very frequent in the savannahs of mid Palanis and high altitude grasslands (1300–2400 m). One of the best grasses for herbivores as fodder. Abundant in open grasslands and rocky slopes of Pallangi and Palamali.

2. **Tripogon pungens** C.E.C. Fisch. in Bull. Misc. Inform. Kew 1934: 170. 1934 & in Gamble, Fl. Madras: 1834. 1934; Bor, Grass. Burma, Ceylon, India, Pakistan 522. 1960; V.J. Nair in A.N. Henry *et al.*, Fl. Tamil Nadu Anal. 3: 145. 1989; Bhattacharya (Sunanda Moulik), Grasses Bamboos India 2: 623. 1997; K.T. Mathew in K.M. Matthew, Fl. Palni Hills 3: 1499. 1999; Kabeer & V.J. Nair, Fl. Tamil Nadu: Grasses 181. 2009. **(Plate No. 97)**

Tufted perennial, with rhizomatous base. Culms filiform, erect, ca 10 cm long, 2 or 3 noded. Leaf blade aciculate, convolute, 1–2.5 cm long, pungent at apex, coriaceous, stiff, at times sparsely pilose; ligule membranous; leaf sheath compressed, basal ones at times degenerated. Raceme single, flexuous, unilateral, ca 5 cm long; rachis angular. Spikelets ascending, sessile, solitary, 2-rowed, distant or imbricate, oblong, 2–3.5 mm long. Glumes persistent, more or less similar. Lower glume narrowly oblong, 1–1.2 mm long, ½ of upper glume, acute, membranous, 1-nerved, keeled. Upper glume oblong, 2–2.5 mm long, acute, membranous, 1-nerved, narrowly furrowed along nerve, keeled. Florets 5–7, similar, bisexual, disarticulating between florets; callus pilose. Lemma elliptic, 1–1.5 mm long, obtuse to 2-fid at apex, awned, membranous, 3-nerved; awn 0.2–0.5 mm long. Palea as long as lemma, obtuse, 2-nerved, keeled, keels narrowly winged, scabrellate. Stamens 3; anthers minute. Caryopsis cylindrical.

Flowering & Fruiting: June–November.
Distribution: Karnataka, Maharashtra and Tamil Nadu. KWLS: Palamputtur, Poombarai and Vadakownji–Pannaikkadu grasslands. *Kabeer & Ravi Kiran 138196 & 133042.*
Notes: Very abundant on rocky slopes at Mid-Palanis and a few patches were also seen at shola grasslands. Dominant grass in Palamputtur grasslands and spreading entire hill slopes and tops. Aslo a dominant grass in Vadakownji–Pannaikkadu grasslands, but scarce in shola grasslands at Poombarai.

53. **CYCADACEAE**

Cycas L.

Cycas circinalis L. Sp. Pl. 2: 1188. 1753; Hook. f., Fl. Brit. India 5: 656. 1888; Gamble, Fl. Madras 1394. 1928; K.M. Matthew, Fl. Palni Hills 3: 1635. 1999. (**Plate No. 98**)

Shrub to small trees, ca 7 m tall; bark thick and corky, cataphylls and leaf bases persistent. Leaves whorled, crowned at the shoot apex, 120–280 cm long, flat, with 50–110 leaflets, dark green; tender leaves covered with wax; petiole 20–80 cm long glabrous, spinescent for 30–

100% of length; Median leaflets simple, 2–6 × 1–1.5 cm wide; acuminate at apex; midrib raised above margins flat, base attenuate; cataphylls narrowly triangular, 5 cm long. Male cones ovoid to conical, dark orangish to brown, 20–50 × 10–25 cm diam.; sterile microsporophylls 4–6 × 2–3 cm; fertile microsporophyll 4–8 cm long. Megasporophylls 20–30 cm long, green with brown tomentose; ovules 4–15, glabrous; lamina lanceolate, 3–5 × 3–4 cm, dentate, with 10–30 lateral spines, apical spine distinct from lateral spines, 1.5–4 cm × 3–6 mm. Seeds globular to elongated, 3–4 cm across; sarcotesta orangish.

Flowering & Fruiting: June–November.

Distribution: Andra Pradesh, Karnataka, Kerala, Maharashtra and Tamil Nadu. KWLS: Adukkam, Andipatty, Palani and Periakulam-Periur path.

Notes: Endangered. Scarse at the foot hills of the Deavadanapatty and Palani forest ranges. Local tribes uses this plant to make the brooms.







1. A,B,C : *Magnolia nilagirica* (Zenker) Figlar







2. A,B,C: *Corynandra felina* (L.f.) Cochrane & Iltis



A,B,C,D,E,F : *Hydnocarpus pentandrus* (Buch.-Ham.) Oken

Plate No: 1.1







1. A,B,C : *Pittosporum neelgherrense* Wight & Arn.

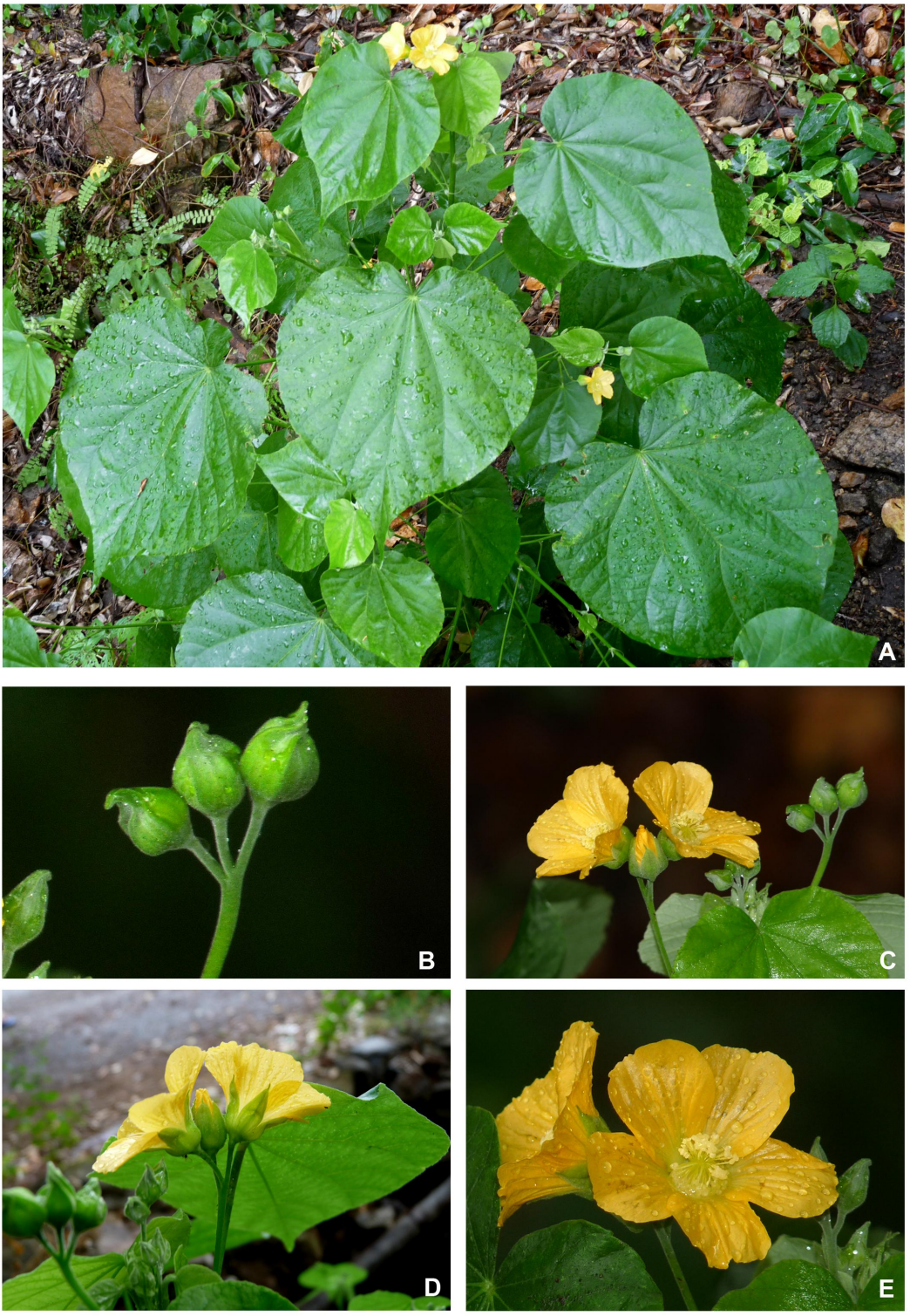






2. A,B,C : *Mesua ferrea* L. var. *coromandeliana* (Wight) N.P. Singh

Plate No: 02



A,B,C,D,E: *Abutilon neelgherrense* Munro

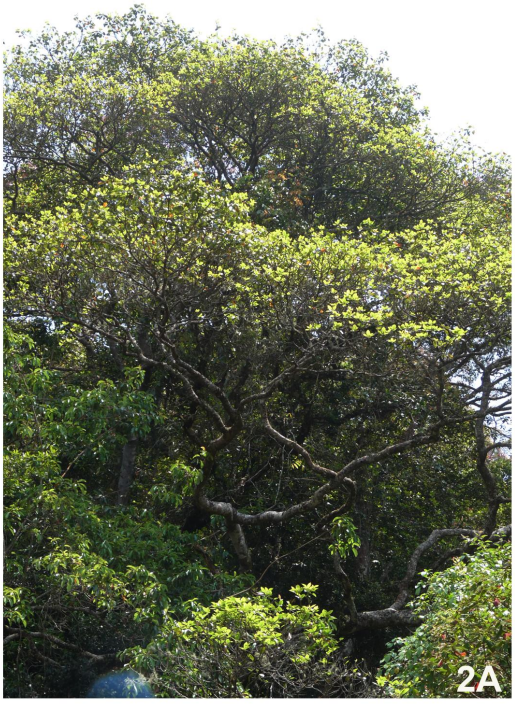
Plate No: 2.1







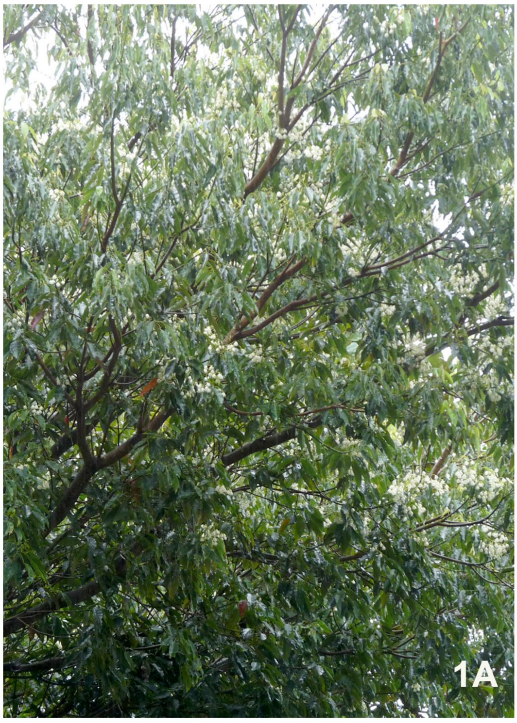
1. A,B,C : *Gordonia obtusa* Wall. ex Wight & Arn.







2. A,B,C : *Elaeocarpus blascoi* Weibel







1. A,B,C: *Elaeocarpus munroii* (Wight) Mast.







2. A,B,C: *Elaeocarpus recurvatus* Corner



1. A,B,C : *Elaeocarpus variabilis* Zmarzty



2. A,B,C : *Impatiens fasciculata* Lam.



1. A,B,C: *Impatiens campanulata* Wight



2. A,B,C: *Impatiens dasysperma* Wight



1. A,B,C: *Impatiens goughii* Wight



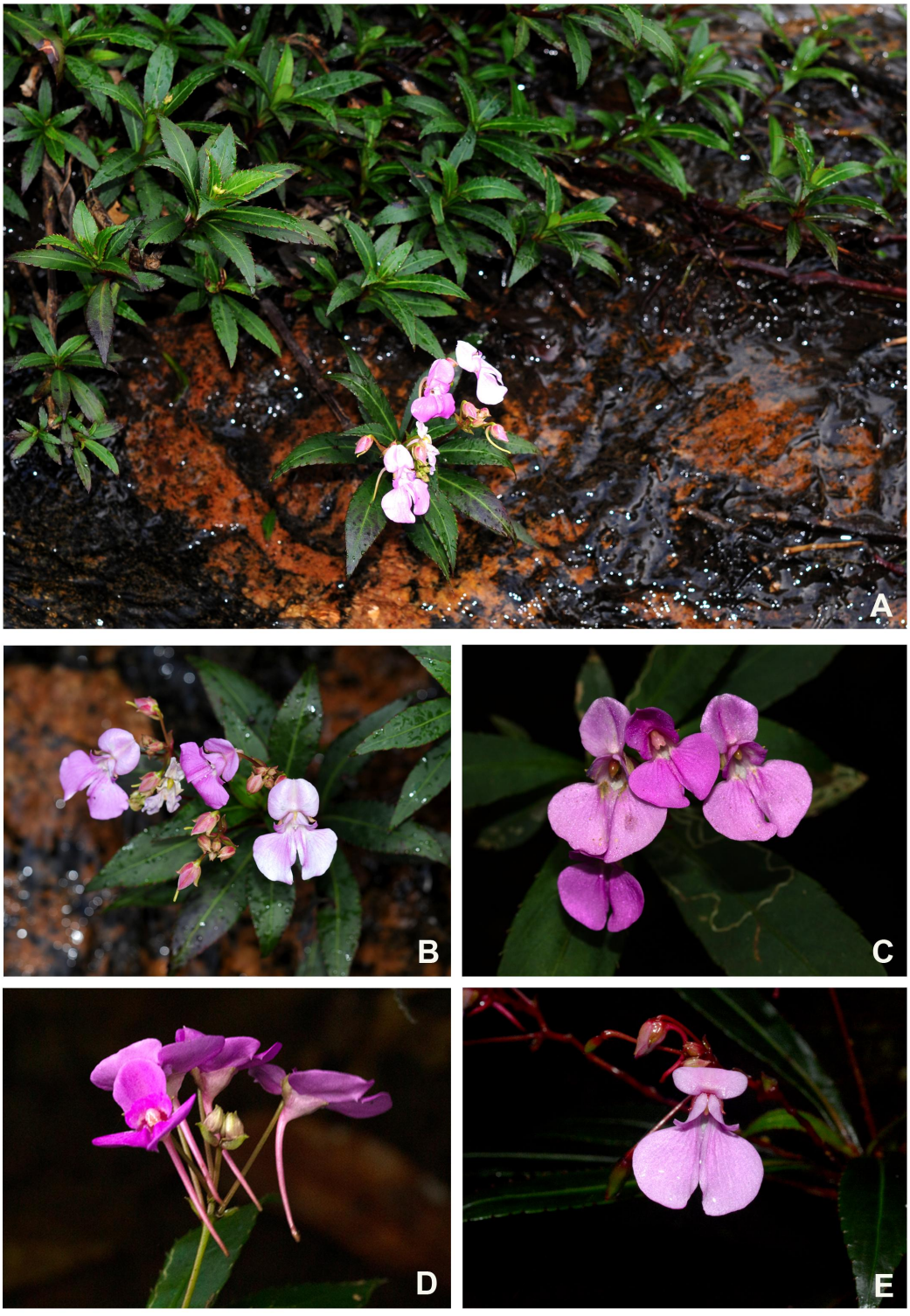
2. A,B,C: *Impatiens lechenaultii* (DC.) Wall. ex Wight & Arn.



1. A,B,C: *Impatiens phoenicea* Bedd.



2. A,B,C: *Impatiens tanyae* R.Kr. Singh, Arigela & Kabeer



A,B,C,D,E: *Impatiens tangachee* Bedd.

Plate No: 8.1







1. A,B,C: *Impatiens tomentosa* B.Heyne ex Wight & Arn.







2. A,B,C: *Impatiens viscida* Wight



1. A,B,C: *Atalantia wightii* Yu.Tanaka



2. A,B,C: *Clausena austroindica* B.C. Stone & K. Narayan







A,B,C: *Boswellia serrata* Roxb. ex Colebr.

Plate No: 10.1







1. A,B,C: *Commiphora caudata* var. *pubescens* (Wight & Arn.) K.M. Matthew







2. A,B,C: *Celastrus paniculatus* Willd. subsp. *aggregatus* K.M. Matthew







1. A,B,C: *Euonymus crenulatus* Wall. ex Wight & Arn.







2. A,B,C: *Glyptopetalum lawsonii* Gamble



1. A,B,C: *Gymnosporia heyneana* M.A. Lawson



2. A,B,C: *Tetrastigma sulcatum* (M.A. Lawson) Gamble







A,B,C: *Allophylus concanicus* Radlk.

Plate No: 13.1



1. A,B,C: *Allophylus serratus* (Roxb.) Kurz



2. A,B,C: *Crotalaria beddomeana* Thoth. & A.A. Ansari







1. A,B,C: *Crotalaria fysonii* Dunn var. *fysonii*







2. A,B,C: *Crotalaria fysonii* Dunn var. *glabra* Gamble







1. A,B,C: *Crotalaria longipes* Wight & Arn.







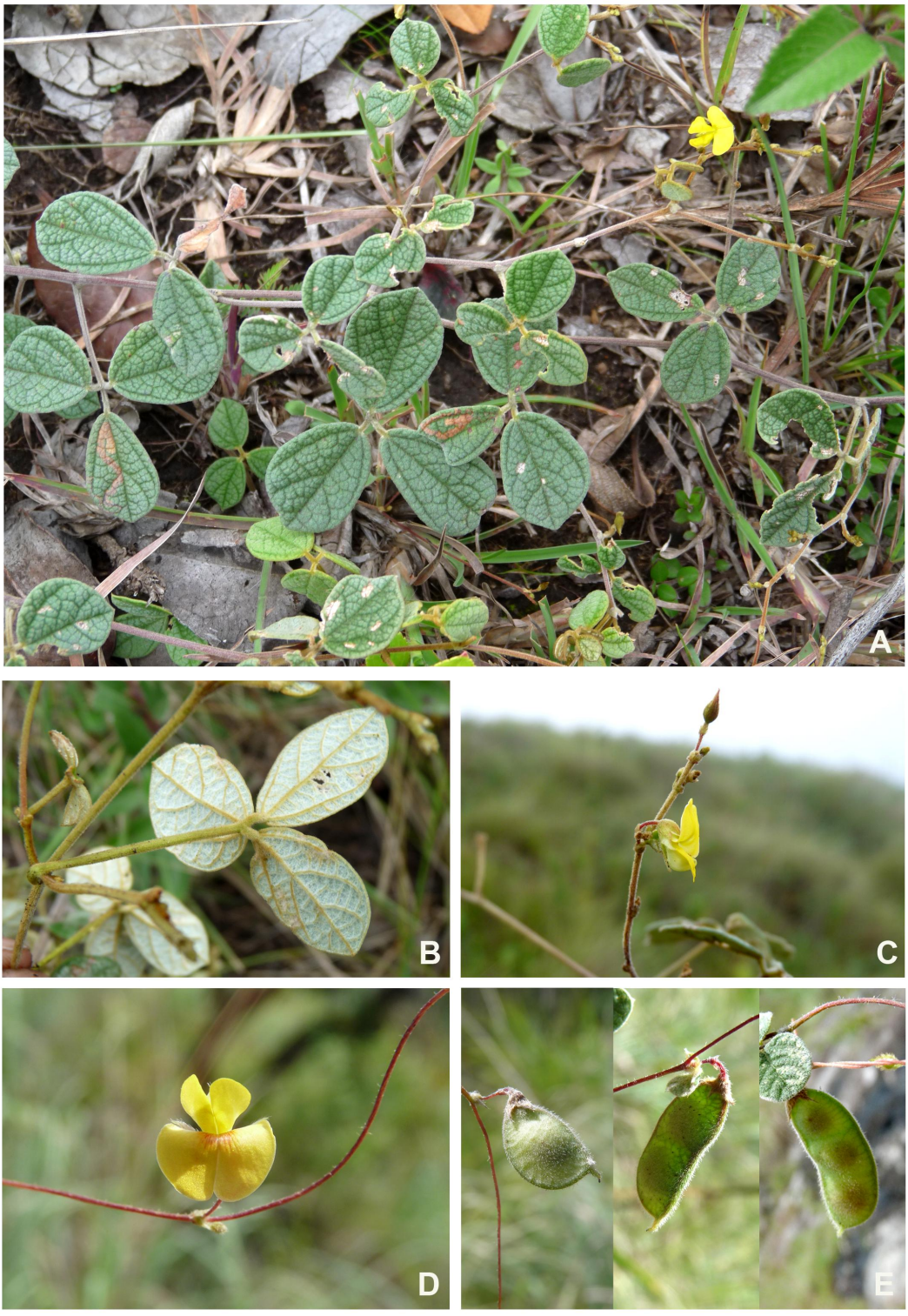
2. A,B,C: *Derris brevipes* (Benth.) Baker



1. A,B,C: *Derris heyneana* (Wight & Arn.) Benth.



2. A,B,C: *Indigofera prostrata* Willd.



A,B,C,D,E: *Rhynchosia filipes* Benth.

Plate No: 18









A,B,C,D: *Smithia hirsuta* Dalzell

Plate No: 18.1







1. A,B,C: *Smithia gracilis* Benth.







2. A,B,C: *Cotoneaster buxifolius* Wall. ex Lindl.











A,B,C,D,E: *Albizia lathamii* Hole

Plate No: 19.1







1. A,B,C: *Rosa leschenaultiana* (Thory) Wight & Arn.







2. A,B,C: *Syzygium densiflorum* Wall. ex Wight & Arn.



A,B,C,D,E: *Kalanchoe bhidei* T.Cooke

Plate No: 20.1



A,B,C,D,E: *Kalanchoe grandiflora* Wight & Arn.

Plate No: 20.2







1. A,B,C: *Osbeckia gracilis* Bedd.







2. A,B,C: *Osbeckia leschnaultiana* DC.







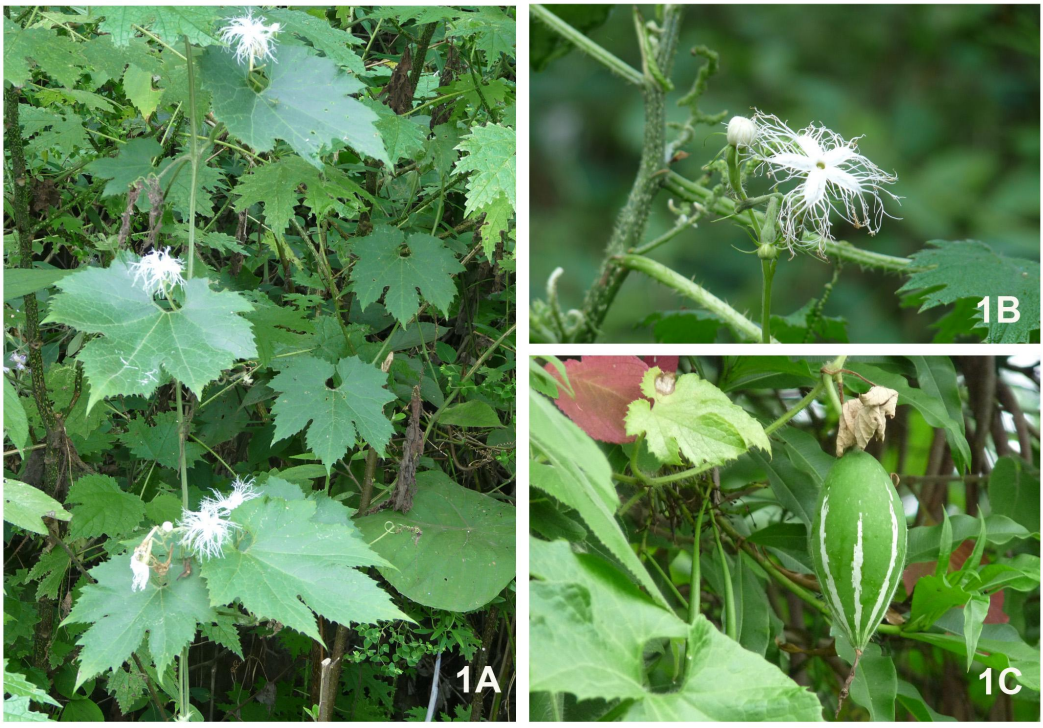
1. A,B,C: *Osbeckia reticulata* Bedd.







2. A,B,C: *Sonerila pulneyensis* Gamble



1. A,B,C: *Trichosanthes lobata* Roxb.



2. A,B,C: *Bupleurum distichophyllum* Wight & Arn.



1. A,B,C: *Zehneria hookeriana* (Wight & Arn.) Arn.



2. A,B,C: *Zehneria maysorensis* (Wight & Arn.) Arn.

Plate No: 24.1



1. A,B,C: *Heracleum candolleanum* (Wight & Arn.) Gamble



2. A,B,C: *Heracleum rigens* Wall. ex DC.







1. A,B,C: *Heracleum sprengelianum* Wight & Arn.







2. A,B,C: *Hydrocotyle conferta* Wight

Plate No: 26







1. A,B,C: *Vanasushava pedata* (Wight) P.K. Mukh. & Constance







2. A,B,C: *Lonicera leschenaultii* Wall.



1. A,B,C: *Canthium neilgherrense* Wight var. *chartacea* (Gamble) Swamin.



2. A,B,C: *Gardenia gummifera* L.f.







1. A,B,C: *Hedyotis articularis* R. Br. ex Wight & Arn.







2. A,B,C: *Hedyotis leschenaultiana* DC.



1. A,B,C: *Hedyotis swertioides* Hook.f.



2. A,B,C: *Ixora notoniana* Wall. ex G.Don







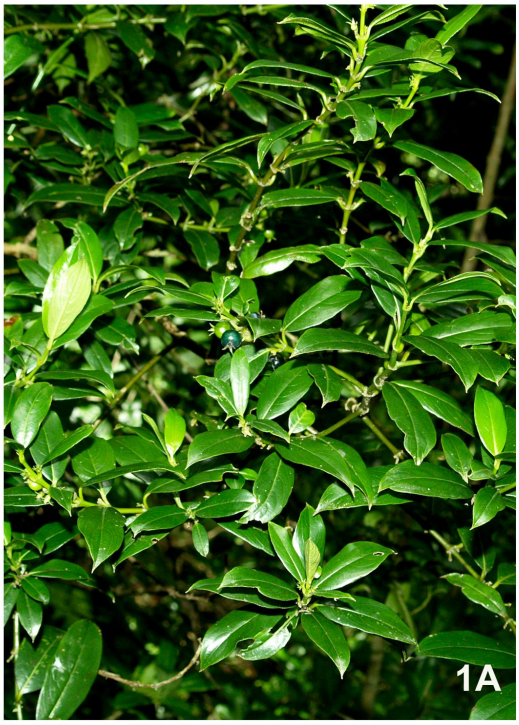
1. A,B,C: *Lasianthus acuminatus* Wight







2. A,B,C: *Lasianthus parvifolius* Wight







1. A,B,C: *Lasianthus venulosus* (Wight & Arn.) Wight







2. A,B,C: *Mussaenda hursutissima* (Hook.f.) Hutch. ex Gamble







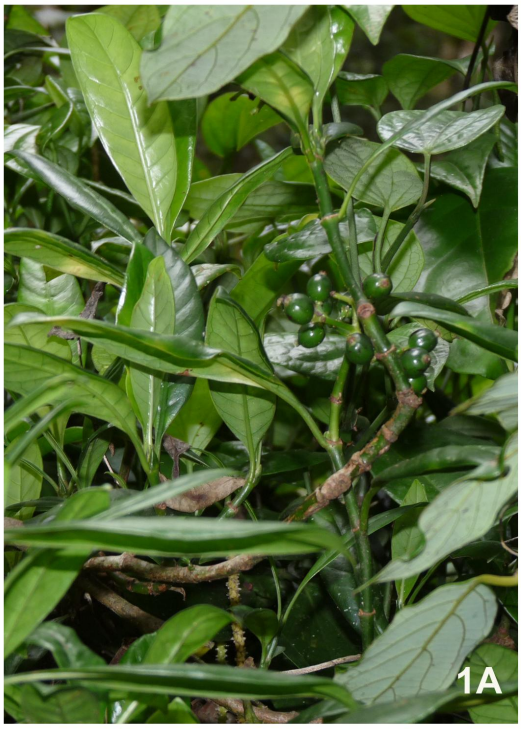
1. A,B,C: *Neanotis longiflora* W.H. Lewis







2. A,B,C: *Ophiorrhiza roxburghiana* Wight



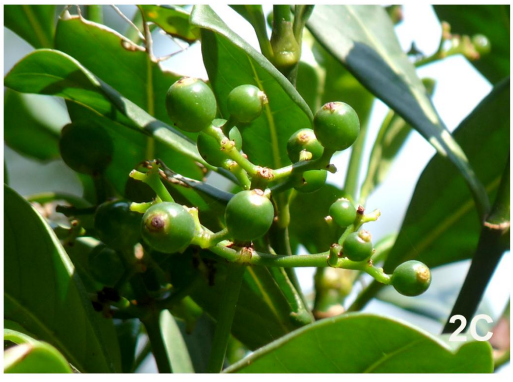




1. A,B,C: *Psychotria nilgiriensis* Deb & M. Gangop. var. *nilgiriensis*







2. A,B,C: *Psychotria nilgiriensis* var. *astephana* Deb & M. Gangop.



1. A,B,C: *Psychotria subintegra* (Wight & Arn.) Hook.f.



2. A,B,C: *Psydrax ficiformis* (Hook.f.) Bridson







1. A,B,C: *Anaphalis aristata* DC.







2. A,B,C: *Anaphalis beddomei* Hook.f.



1. A,B,C: *Anaphalis bournei* Fyson



2. A,B,C: *Anaphalis meeboldii* W.W. Sm.







1. A,B,C: *Anaphalis travancorica* W.W. Sm.







2. A,B,C: *Anaphalis wightiana* (Wall ex DC.) DC.







1. A,B,C: *Gynura nitida* DC.







2. A,B,C: *Gynura travancorica* W.W. Sm.

Plate No: 39







1. A,B,C: *Senecio lavendulaefolius* DC.







2. A,B,C: *Vernonia bourneana* W.W. Sm.







1. A,B,C: *Vernonia fysonii* Calder







2. A,B,C: *Vernonia peninsularis* (C.B. Clarke) C.B. Clarke ex Hook.f.







1. A,B,C: *Rhododendron nilagiricum* Zenker







2. A,B,C: *Vaccinium neilgherrense* Wight







1. A,B,C: *Ardisia rhomboidea* Wight







2. A,B,C: *Isonandra perrottetiana* A. DC.



1. A,B,C: *Diospyros foliolosa* Wall. ex A. DC.



2. A,B,C: *Symplocos anamallayana* Bedd.







1. A,B,C: *Symplocos foliosa* Wight







2. A,B,C: *Chionanthus mala-elengi* P.S. Green subsp. *mala-elengi*

Plate No: 45



1. A,B,C: *Jasminum brevilobum* DC.



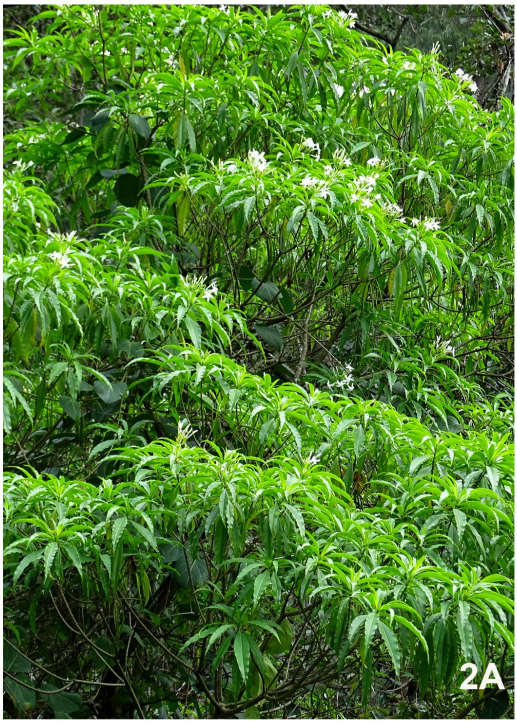
2. A,B,C: *Jasminum calophyllum* Wall. ex G. Don







1. A,B,C: *Ligustrum perrottetii* A. DC.







2. A,B,C: *Alstonia venetata* R. Br.

Plate No: 47







1. A,B,C: *Ceropegia intermedia* Wight







2. A,B,C: *Hoya wightii* Hook.f. subsp. *palniensis* K.T. Mathew







1. A,B,C: *Cryptolepis grandiflora* Wight







2. A,B,C: *Decalepis hamiltonii* Wight & Arn.

Plate No: 48.1



A,B,C,D,E: *Utleria salicifolia* Bedd. ex Hook.f.

Plate No: 48.2







1. A,B,C: *Exacum wightianum* Arn.







2. A,B,C: *Argyreia cuneata* (Willd.) Ker Gawl.

Plate No: 49







1. A,B,C: *Solanum multiflorum* Roth

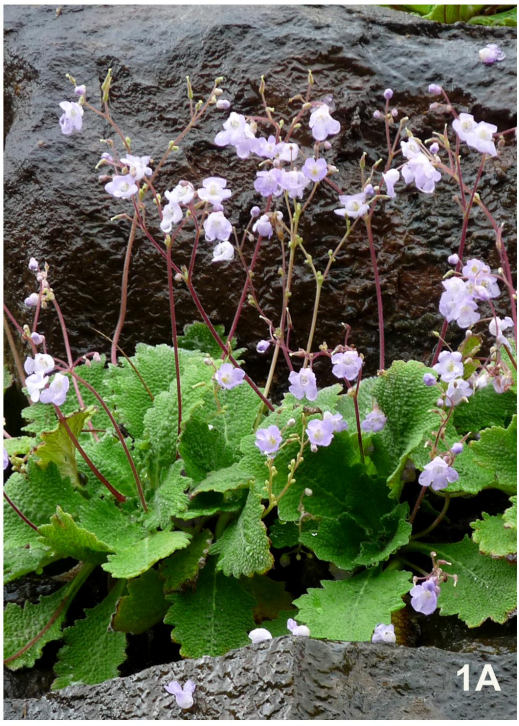






2. A,B,C: *Aeschynanthus perrottetii* A. DC.

Plate No: 50







1. A,B,C: *Henckelia incana* (Vahl) Spreng.







2. A,B,C: *Andrographis affinis* Nees







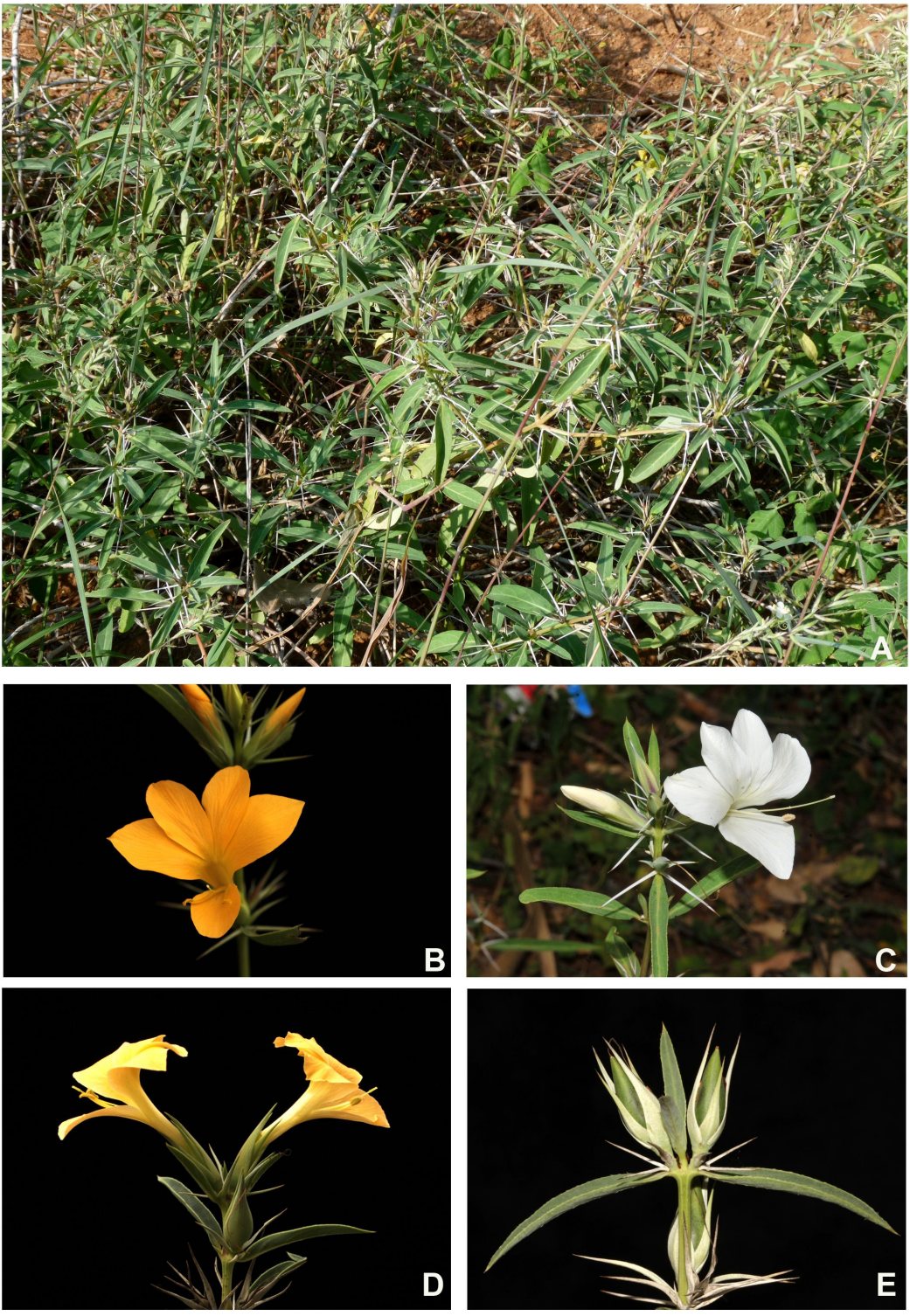
1. A,B,C: *Andrographis neesiana* Wight







2. A,B,C: *Barleria acuminata* Wight ex Nees



A,B,C,D,E: *Barleria cuspidata* B. Heyne ex Nees

Plate No: 53







1. A,B,C: *Justicia glauca* Rottl.







2. A,B,C: *Rungia laeta* C.B. Clarke



1. A,B,C: *Strobilanthes consanguinea* (Nees) T. Anderson



2. A,B,C: *Strobilanthes foliosa* (Wight) T. Anderson







1. A,B, C: *Strobilanthes gracilis* Bedd.







2. A,B, C: *Strobilanthes heteromalla* T. Anderson ex C.B. Clarke

Plate No: 56







1. A,B,C: *Strobilanthes kunthiana* (Nees) T. Anderson ex Benth.







2. A,B,C: *Strobilanthes lanata* Nees

Plate No: 57

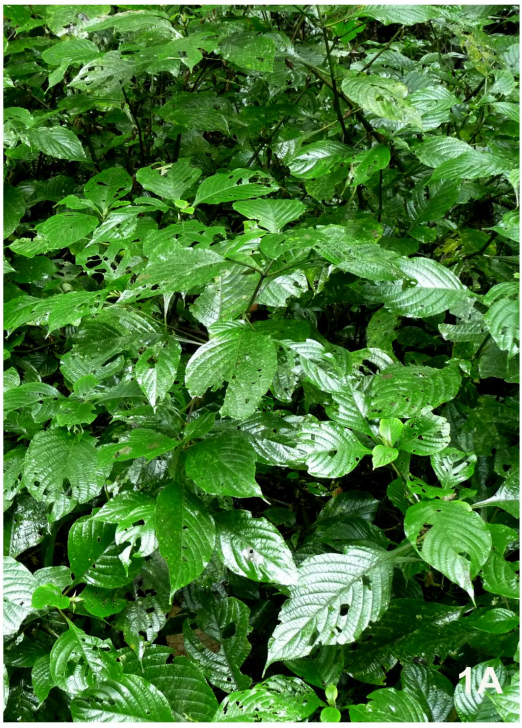






A,B,C: *Strobilanthes lurida* Wight

Plate No: 57.1







1. A,B,C: *Strobilanthes micrantha* Wight







2. A,B,C: *Strobilanthes pulneyensis* C.B. Clarke

Plate No: 58







1. A,B,C: *Strobilanthes urceolaris* Gamble



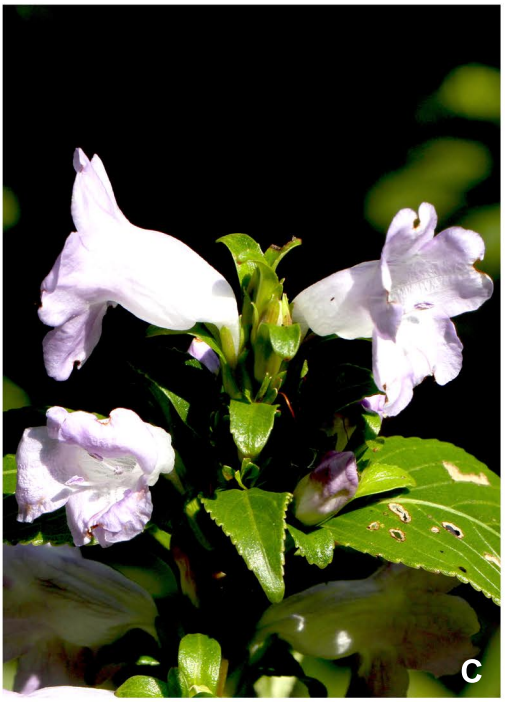




2. A,B,C: *Thunbergia tomentosa* Wall. ex Nees







A,B,C: *Strobilanthes zenkeriana* (Nees) T. Anderson © E. Kunhikrishnan

Plate No: 59.1







1. A,B,C: *Anisochilus argenteus* Gamble





2. A,B: *Isodon nilgherricus* (Benth.) H. Hara







1. A,B,C: *Isodon wightii* (Benth.) H. Hara





2. A,B: *Leucas hirta* (B. Heyne ex Roth) Spreng.







1. A,B,C: *Leucas helianthemifolia* Desf.







2. A,B,C: *Leucas lanceifolia* Desf.







1. A,B,C: *Leucas vestita* Benth.







2. A,B,C: *Plectranthus bourneae* Gamble

Plate No: 63







1. A,B,C: *Plectranthus deccanicus* Briq.







2. A,B,C: *Pogostemon mollis* Benth.

Plate No: 64







1. A,B,C: *Pogostemon wightii* Benth.







2. A,B,C: *Scutellaria colebrookiana* Wall.







1. A,B,C: *Knoxia wightiana* Wall. ex Wight & Arn.







2. A,B,C: *Piper wightii* Miq.

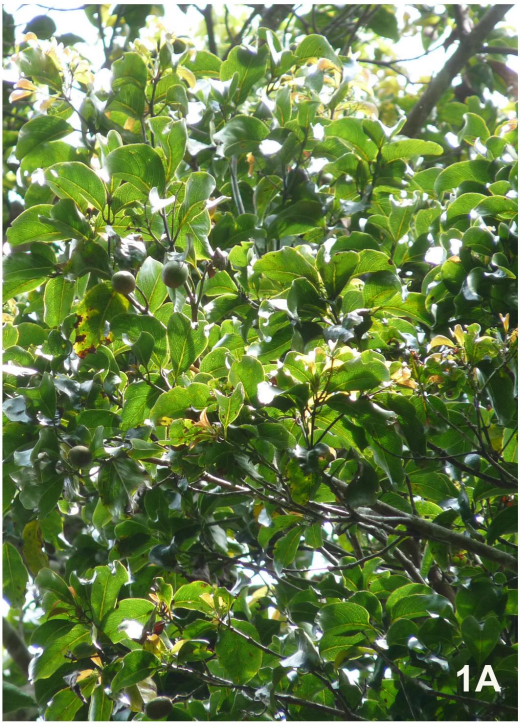
Plate No: 66



1. A,B,C: *Actinodaphne bourneae* Gamble



2. A,B,C: *Actinodaphne wightiana* (Kuntze) Noltie







1. A,B,C: *Beilschmiedia wightii* Benth. & Hook.f.







2. A,B,C: *Cinnamomum wightii* Meisn.







1. A,B,C: *Cryptocarya stocksii* Meisn.







2. A,B,C: *Litsea floribunda* Gamble



1. A,B,C: *Litsea glabrata* Hook.f.



2. A,B,C: *Litsea keralana* Kosterm.







1. A,B,C: *Litsea oleoides* (Meisn.) Hook.f.







2. A,B,C: *Litsea wightiana* (Nees) Hook.f.







1. A,B,C: *Neolitsea fischeri* Gamble







2. A,B,C: *Phoebe wightii* Meisn.



A,B,C,D,E: *Dendrophthoe trigona* (Wight & Arn.) Danser ex Santapau

Plate No: 72.1







1. A,B,C: *Helicanthes elastica* (Desr.) Danser







2. A,B,C: *Helixanthera intermedia* Wight







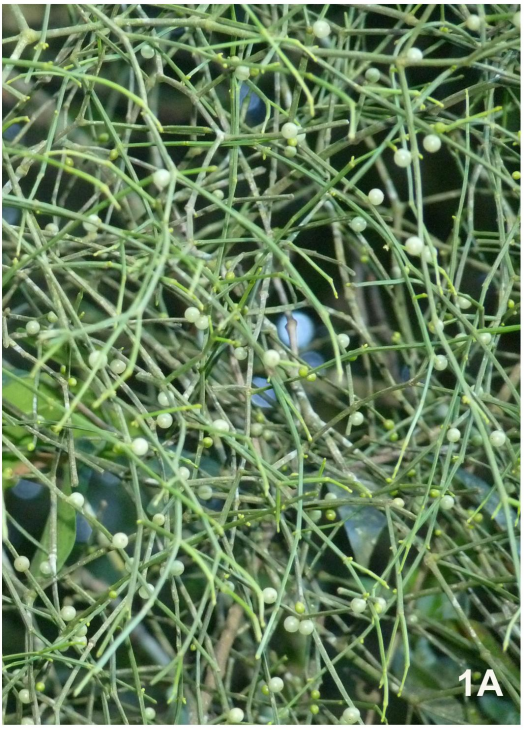
1. A,B,C: *Helixanthera obtusata* (Wall.) Danser







2. A,B,C: *Taxillus recurvus* (DC.) Tiegh.







1. A,B,C: *Viscum angulatum* Heyne ex DC.







2. A,B,C: *Drypetes wightii* (Hook.f.) Pax & K. Hoffm.









A,B,C: *Euphorbia vajravelui* var. *theniensis* B. DeJong & R.W. Stewart

Plate No: 75.1







1. A,B,C: *Phyllanthus chandrabosei* Govaerts & Radcl.-Sm.







2. A,B,C: *Phyllanthus macraei* Müll.Arg. var. macraei

Plate No: 76







1. A,B,C: *Phyllanthus macraei* Müll.Arg. var. *hispidus* Gamble







2. A,B,C: *Phyllanthus narayanswamii* Gamble

Plate No: 77







1. A,B,C: *Ficus anamalayana* Sudhakar & G.V.S. Murthy







2. A,B,C: *Ficus beddomei* King







1. A,B,C: *Ficus dalhousiae* Miq.







2. A,B,C: *Ficus guttata* (Wight) King



1. A,B,C: *Ficus amplocarpa* Govind. & Masil.



2. A,B,C: *Isodon rivularis* (Wight ex Hook.f.) H. Hara







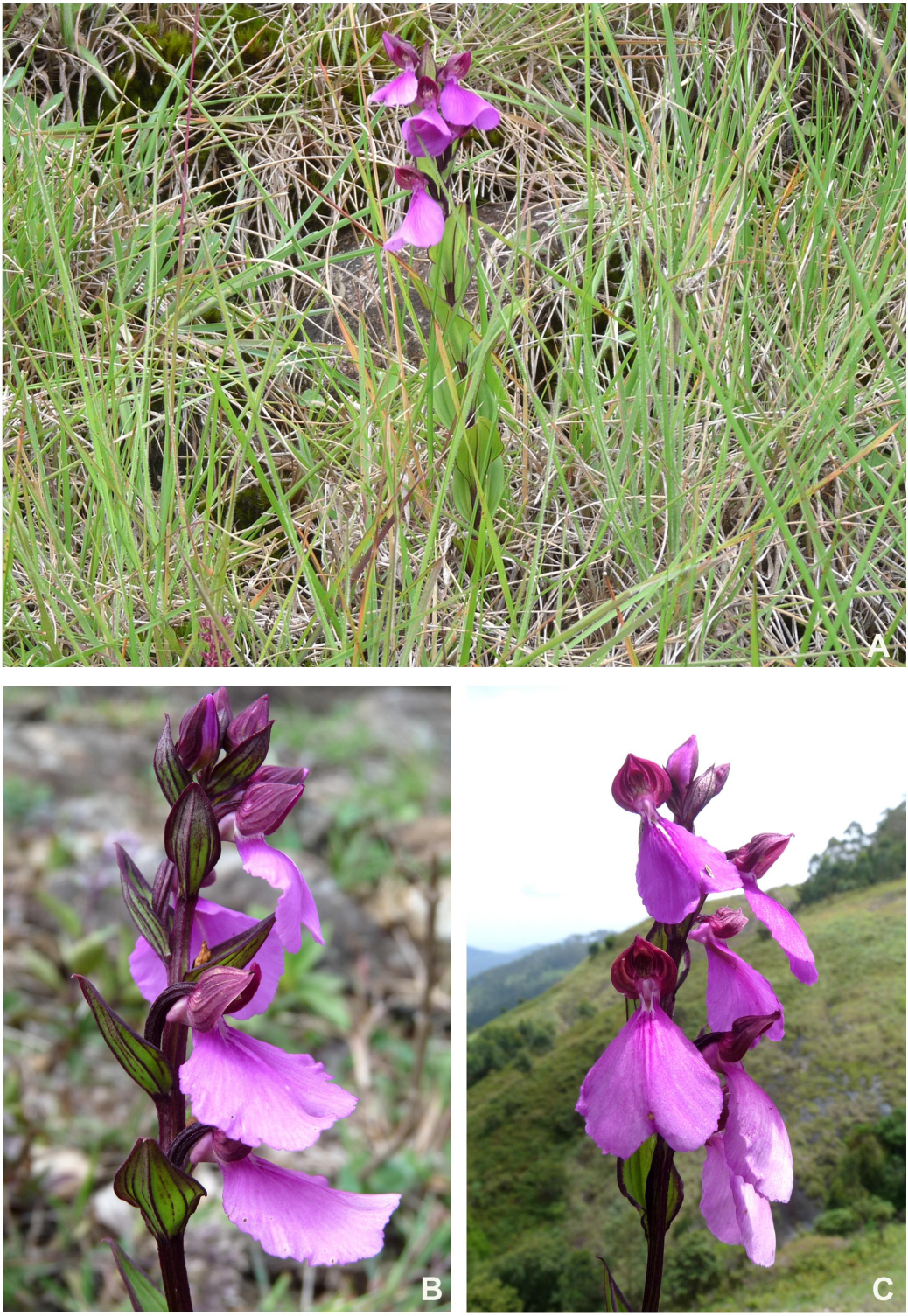
1. A,B,C: *Aerides crispa* Lindl.







2. A,B,C: *Brachycorythis iantha* (Wight) Summerh.



A,B,C: *Brachycorythis splendida* Summerh.

Plate No: 81.1







A,B,C: *Brachycorythis wightii* Summerh.

Plate No: 81.2







1. A,B,C: *Coelogyne nervosa* A. Rich.







2. A,B,C: *Conchidium nanum* (A. Rich.) Brieger







1. A,B,C: *Habenaria elliptica* Wight







2. A,B,C: *Habenaria longicornu* Lindl.



1. A,B,C: *Habenaria rariflora* A. Rich.



2. A,B,C: *Oberonia balakrishnanii* R. Ansari © tspkumar



© Jeevith

1. A,B,C: *Malaxis intermedia* (A. Rich.) Seidenf.



2. A,B,C: *Asparagus fysonii* J.F. Macbr.







1. A,B,C: *Murdannia dimorpha* (Dalzell) G. Brückn.

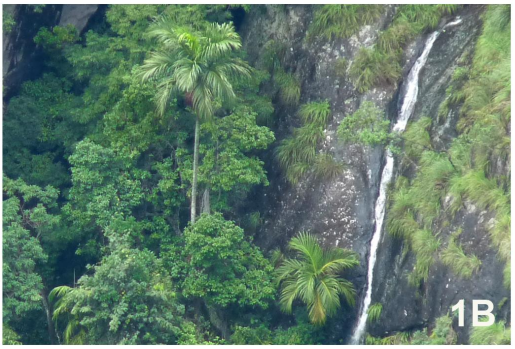






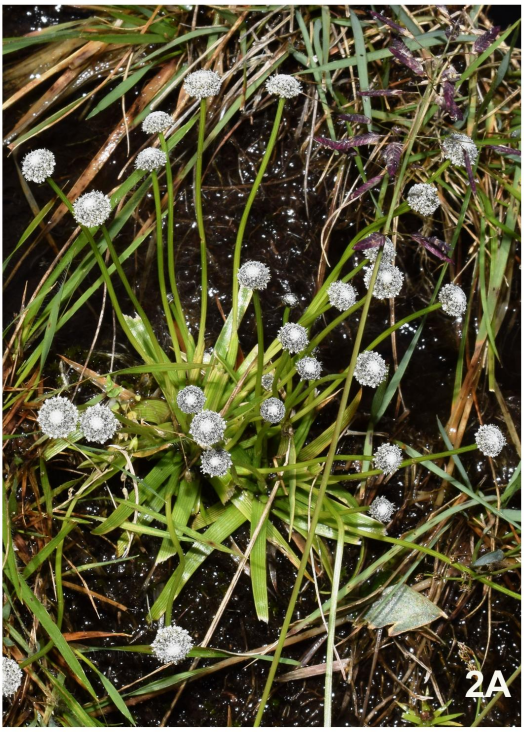
2. A,B,C: *Arenga wightii* Griff.



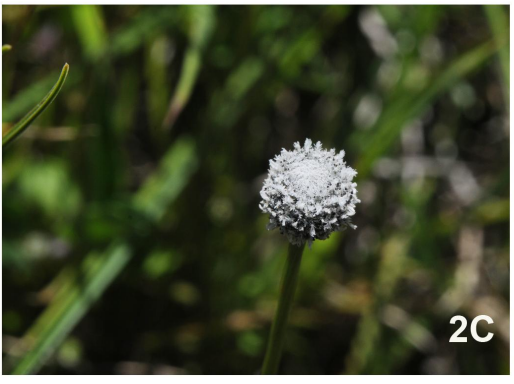




1. A,B,C: *Bentinckia condapanna* A. Berry







2. A,B,C: *Eriocaulon pectinatum* Ruhland







1. A,B,C: *Eriocaulon ritchieanum* Ruhland







2. A,B,C: *Fimbristylis kingii* Gamble ex Boeckeler



1. A,B,C: *Fimbristylis uliginosa* Steud.



2. A,B,C: *Agrostis peninsularis* Hook.f.







1. A,B,C: *Anthoxanthum borii* S.K. Jain & D.C. Pal







2. A,B,C: *Arundinella mesophylla* Nees ex Steud.







1. A,B,C: *Arundinella nervosa* (Roxb.) Nees ex Hook. & Arn.







2. A,B,C: *Arundinella vaginata* Bor

Plate No: 91







1. A,B,C: *Chrysopogon asper* B. Heyne ex Blatt. & McCann







2. A,B,C: *Eragrostis collinensis* Vivek, G.V.S. Murthy & V.J. Nair



1. A,B,C: *Garnotia elata* (Miq.) Janowski



2. A,B,C: *Heteropogon fischerianus* Bor



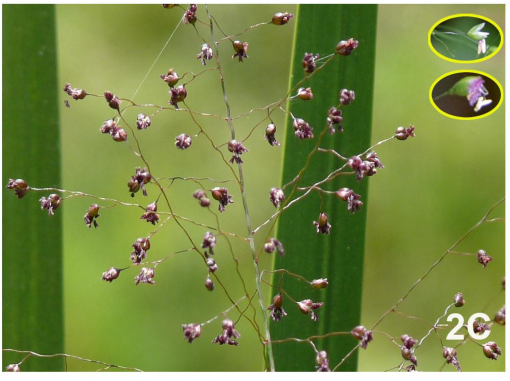




1. A,B,C: *Isachne bourneorum* C.E.C. Fisch.







2. A,B,C: *Isachne deccanensis* Bor



1. A,B,C: *Polypogon nilgiricus* Kabeer & V.J. Nair



2. A,B,C: *Streblochaete sanjappae* Kabeer & V.J. Nair



A,B,C,D,E: *Themeda sabarimalayana* Sreek. & V.J. Nair

Plate No: 96



1. A,B,C: *Tripogon narayanae* Sreek., V.J. Nair & N.C. Nair



2. A,B,C: *Tripogon pungens* C.E.C. Fisch.











A,B,C,D,E: *Cycas circinalis* L.

Plate No: 98

REFERENCES

Ahmedullah, M. & Nayar, M.P. (1986) *Endemic plants of Indian Region*. Botanical Survey of India, Calcutta.

Agarwal, S.G. (1961a) Grassland communities of moist tropical forests. *Indian Forester* 87: 94–99.

Agarwal, S.G. (1961b) Grassland communities of moist tropical forests. *Indian Forester* 87: 119–123.

Agarwal, S.G. (1961c) Grassland communities of dry tropical forests. *Indian Forester* 87: 309–315.

Aiton, W. (1789) *Hortus Kewensis*. 3 Vols. George Nicol, London.

Ajit, P.J. & Singh, N.P. (2011) *Biodiversity of the Western Ghats of Maharashtra – Current Knowledge*. Dehradun.

Almeida, M.R. (1996) *Flora of Maharashtra*. Vo1. 1. Orient Press, Mumbai.

Anand Kumar & Srivastava, R.C. (1988) Rare and less known flowering Plants of Madhya Pradesh – A Checklist. *J. Econ. Taxon. Bot.*12: 293–303.

Anand Kumar, Khanna, K. K. & Ramesh Kumar (2000) Rare and Less known Flowering Plants of Madhya Pradesh–A Check list II. *J. Econ. Taxon. Bot.* 24: 589–610.

Anderson, J.G. (1966) The genus *Andropogon* in southern Africa. *Bothalia* 9: 5–30.

Anitha, K. (2011) *Hydrocotyle conferta*. *The IUCN Red List of Threatened Species* 2011.

Ansari, A.A. (2008) *Crotalaria in India*. Bishen Singh Mahendra Pal Singh. Dehradun.

Ansari, R. & Balakrishnan, N.P. (1990) A revision of the Indian species *Oberonia* (Orchidaceae). *Orchid Monogr.* 4: 1–82.

Ansari, R. and Balakrishnan, N.P. (2009) (Rev. ed.) *The Family Eriocaulaceae in India*. Bishen Singh Mahendra Pal Singh, Dehradun.

Arasumani, M., Khan, D., Das, A., Lockwood, I., Stewart, R., Kiran, R.A., Muthukumar, M., Milind Bunyan & Robin, V. V. (2018) Not seeing the grass for the trees: Timber plantations and agriculture shrink tropical montane grassland by two-thirds over four decades in the Palani Hills, a Western Ghats Sky Island. *PLoS ONE* 13(1): e0190003.

Aravind, N.A., Tambat, B., Ravikanth, G., Ganeshaiah, K.N. & Uma Shaanker, R. (2007) Patterns of species discovery in the Western Ghats, a megadiversity hot spot in India. *J. Biosci.*32 781–790.

Arigela R.K. & Kabeer, K.A.A. (2018) *Cotoneaster buxifolius* Wall. ex Lindl., a vulnerable shrub species in Kodaikanal Wildlife Sanctuary, Tamil Nadu, India. *Cur. Sci.* 115(9): 1622.

Arigela R.K., Singh, R.K., Kabeer, K.A.A., Murthy, G.V.S. & Robin, V.V. (2019) Phytodiversity Inventorisation and Mapping of Shola grasslands of Kodaikanal Wildlife Sanctuary, Western Ghats, India. *Indian Forester* 145(3): 214–226.

Arigela R.K., Singh, R.K. (2019) Lectotypification and a new synonym for *Strobilanthes pulneyensis* C.B. Clarke (Acanthaceae). *Phytotaxa* 408 (2): 123–128.

Arigela. R.K., Singh, R.K. & Kabeer, K.A.A. (2019) *Impatiens tanyae* (Balsaminaceae), a new species from Western Ghats, India. *Kew Bulletin* 74:1–7. DOI 10.1007/s12225-019-9831-4.

Arigela, R.K. & Singh, R.K. (2020) Rediscovery of endangered tree *Psydrax ficiformis*, lectotypication of two names and a new combination in the genus *Psydrax* (Rubiaceae). *Indian Forester* (146) 2: 108–112.

Arigela, R.K. & Kabeer, K.A.A. (2022) New synonyms in three southern Indian endemic species of *Impatiens* (Balsaminaceae). *Ann. Bot. Fennici* 59: 261–271.

Arigela R.K., Singh R.K. & Rajasekar C. (2023) Taxonomy and typification of Indian endemic *Impatiens goughii* (Balsaminaceae). *Ann. Bot. Fennici* 60: 43–59.

Bailey, F.M. (1897) Order Urticaceae, *Ficus* Linn. *Queensl. Agr.* J. 1: 231.

Balakrishnan, N.P. (1964) New plant records from South India. *Bull. Bot. Surv. India* 6: 81–92.

Beddome, R.H. (1858) Flora of the Punley hills, as observed in September and October, 1857. *Madras J. Lit. Sci.* 19: 169–202.

Beddome, R.H. (1868–1874) *Icones Plantarum Indiae Orientalis*. Gantz Brothers, Madras.

Beddome, R. H. (1869–1874) *The Flora Sylvatica for South India*. Gantz Brothers, Madras.

Bentham, G. & Hooker, J.D. (1862–1883) *Genera Plantarum*. 3 vols. A. Black, London.

Bhaskar, V. (1981) The genus *Impatiens* L. in South India: Endemism and Affinities. *Indian Forester* 107(6): 368–378.

Bhaskar, V. (2012) *Taxonomic monograph on Impatiens L. (Balsaminaceae) of Western Ghats, South India, The Key Genus for Endemism*. Centre for Plant Taxonomic Studies, Bangalore.

Bhuinya, T., Singh, P. & Mukherjee, K.S. (2010) An Account of the Species of *Litsea* Lam. (Lauraceae) Endemic to India. *Bangladesh J. Pl. Taxon.* 17(2): 183–191.

Blume, C.L. (1825) *Bijdragen tot de Flora van Nederlandsch Indië*. Batavia.

Bond, W.J. & Parr, C.L. (2010) Beyond the forest edge: ecology, diversity and conservation of the grassy biomes. *Biol. Conservation* 143(10): 2395–2404.

Bor, N.L. (1938) The vegetation of the Nilgiris. *Indian Forester* 93: 164–168.

Bor, N.L. (1960) *The Grasses of Burma, Ceylon, India and Pakistan (excluding Bambuseae).* Pergamon Press, London.

Brandis, D. (1882) The forests of South India. *Indian Forester* 7: 363–369.

Brummit, R.K. & Powell, C.E. (1992) *Authors of Plants Names*. Royal Botanic Garden. Kew.

Brummitt, R.K. (2001) *Vascular Plant Families and Genera*. Royal Botanical Gardens, Kew.

Burkill, I. H. (1965) *Chapters on the History of Botany in India*. Govt. of India Press, Delhi.

Burman, N.L. (1768) *Flora Indica*. Lieden (Cornelius Haak), Amsterdam.

Candolle, A.P. de. (1823–1873) *Prodromus Systematis Naturalis Regni Vegetabilis*. 17 vols. Paris (Treuttel et Wurtz), Strasbourg, London.

Carine, A.M., Alexander, M.J. & Scotland, W.R. (2004) A Revision of the *Strobilanthes kunthiana* – Group (*Phlebophyllum* sensu Bremekamp) (Acanthaceae) *Kew Bull.* 59(1): 1–25.

Champion, H.G. & Seth, S.K. (1968) *A Revised Survey of the Forest Types of India*. Govt. of India Publications, New Delhi.

Chandrashekaran, U.M. & Ramakrishnan, P.S. (1994) Vegetation and gap dynamics of a tropical wet evergreen forest in the Western Ghats of Kerala, India. *J. Trop. Ecol.* 10: 337–354.

Chaudhary, L.B., Sudhakar, J.V., Kumar, A., Bajpai, O., Tiwari, R., & Murthy, G.V.S. (2012) Synopsis of the Genus *Ficus* L. (Moraceae) in India. *Taiwania* 57(2): 193–216.

Chithra, V. (1987) Moraceae. In: Henry, A.N., Kumari, G.R & Chithra, V. *Flora of Tamil Nadu* Series I: Analysis. Vol. 2. Botanical Survey of India, Calcutta.

Cilek, V., Livchits, V.N. and Tokarev, V.V. (2009) *Earth system: History and natural variability*. Vol. 3. Eolss Publishers, Oxford.

Cincotta R.P., Engelman, R. (2000) Nature's place: human population and the future of biologicaldiversity. Population Action International, Washington, D C.

Cincotta, R.P., Wisnewski, J. & Engelman, R. (2000) Human population in the biodiversity hotspots. *Nature* 404: 990–992.

Clarke, C.B. (1884) *Strobilanthes* Blume. In: Hooker, J.D. (Ed.) *Flora of British India*, Vol. 4. L. Reeve & Co., London.

Collins, N.M., Sayer, J.A. & Whitmore, T.C. (1991) *The Conservation Atlas of Tropical Forests: Asia and the Pacific*. Macmillan, London.

Cooke, T. (1901–1908) *The Flora of the Presidency of Bombay*. 2 vols. Taylor & Francis, London.

Corner, E.J.H. (1958) An Introduction to the distribution of *Ficus*. *Reinwardtia*. 4(3): 325–355.

Corner, E.J.H. (1972) *Ficus* (Moraceae) from India, Burma, Thailand, Indochina, Korea, Japan Ryu Kyu, Formosa and Hainan. *Ident. Lists Mal. Specim*. 43: 735–784.

Cronquist, A. (1986) *Evolution and Classification of Flowering Plants*. Nelson, New York.

Don, D. (1825) *Prodromus Florae Nepalensis*. J. Gale, London.

Deepu, S., Geethakumary, M.P. & Pandurangan, A.G. (2017) Typification of five names of *Cinnamomum* (Lauraceae). *Bot. Lett.* DOI: 10.1080/23818107.2017.1310057.

Dickoré, W.B. & Kasperek, G. (2010) Species of *Cotoneaster* (Rosaceae, Maloideae) indigenous to naturalising or commonly cultivated in Central Europe. *Willdenowia 40(1)*: 13–45.

Duckworth, J.W., Sankar, K., Williams, A.C., Samba Kumar, N. & Timmins, R.J. (2016) *Bos gaurus*. The IUCN Red List of Threatened Species 2016: e.T2891A46363646. http://dx.doi.org/10.2305/IUCN.UK.2016-2.RLTS.T2891A46363646.en

Dutta, R. & Deb, D.B. (2004) *Taxonomic Revision of Hedyotis L. (Rubiaceae) in Indian sub-continent*. Botanical Survey of India, Kolkata.

Dutta, K., Reddy, C.S., Sharma, S., & Jha, C.S. (2016) Quantification and monitoring of forest cover changes in Agasthyamalai Biosphere Reserve, Western Ghats, India (1920–2012). *Cur. Sci.* 110(4): 508–520.

Dwivedi, M.D., Barfield, S., Pandey, A.K. & Schaefer, H. (2018) Phylogeny of *Zehneria* (Cucurbitaceae) with special focus on Asia. *TAXON* 67 (1): 55–65.

Ewers, R.M., Kapos, V., Coomes, D.A., Lafortezza, R., & Didham, R.K. (2009) Mapping community change in modified landscapes. *Biol. Conservation* 142(12): 2872−2880.

Fernando, S.S. & Ormerod, P. (2008) An Annotated checklist of the Orchids of Sri Lanka. *Rheedea* 18: 1–28.

Fischer, C.E.C. (1921) A Survey of the Flora of the Anamalai hills in the Coimbatore District, Madras Presidency. *Rec. Bot. Surv. India* 9(1): 1–218.

FSI. (2017) State of Forest Report 2017. Forest Survey of India, Dehradun.

Fyson, P.F. (1915) *Flora of the Nilgiri and Pulney Hills–Tops*. 3 Vols. Govt Press, Madras.

Fyson, P.F. (1932) *Flora of the South Indian Hill Stations*. 2 Vols. Govt Press, Madras.

Gadgil, M. & Meher-Homji, V.M. (1985) Land Use and Productive Potential of Indian Savannas. In: Tothill, J.C., & Mott, J.J. (eds.) *Ecology and Management of the World's Savannas*. Australian Academy of Science, Canberra. pp. 107–113.

Gadgil, M. & Meher-Homji, V.M. (1986) Role of Protected Areas in conservation. In: Chopra, V.L. & Khoshoo, T.N. (eds.), *Conservation for Productive Agriculture*. Indian Council of Agricultural Research, New Delhi. pp. 143–159.

Gadgil, M. & Meher-Homji, V.M. (1990) Ecological diversity. In Daniel, J. C. & Serrao, J. S. (eds.), *Conservation in Developing Countries: Problems and Prospects.* Oxford University Press, Bombay, India. pp. 175–198.

Gamble, J.S. (1915–1936) *The Flora of the Presidency of Madras*. Adlard and Son Ltd., London.

Ganesaiah, K.N., Ganesan, R., Vasudeva, R, Kushalappa, C.G., Menon, A. R.R., Patwardhan, A., Yadav, S.R. & Umashaanker, R. (2012) *Plants of Western Ghats*. Vol. 1. School of Ecology and Conservation, University of Agricultural Sciences, Bangalore.

Giriraj, A., Murthy, M.S.R., & Ramesh, B.R. (2008). Vegetation composition, structure and patterns of diversity: A case study from the tropical wet evergreen forests of the Western Ghats, India. *Edinburgh J. Bot.* 65(03): 447–468.

Green, P.S. (2003) Synopsis of the Oleaceae from the Indian Sub-Continent. *Kew Bull.* 58: 257–295.

Hansen, M.C., Defries, R.S., Townshend, J.R.G. & Sohlberg, R. (2000) Global land cover classification at 1 km spatial resolution using a classification tree approach. *Int. J. Rem. Sens*. 21: 1331–1364.

Haridasan, K., Ved, D., Saha, D. & Ravikumar, K. (2015) *Magnolia nilagirica*. *The IUCN Red List of Threatened Species* 2015: e.T15114888A15114897.

Hasmadi, M., Zaki, M.H., Adnan, A.M.I., Pakhriazad, H.Z. & Fadlli, A.Y.M. (2010) Determining and Mapping of Vegetation using GIS and Phytosociological Approach in Mount Tahan, Malaysia. *J. Agric. Sci.* 2(2): 80–89.

Helmer, E.H. (2000) The landscape ecology of secondary forest in montane Costa Rica. *Ecosystems* 3: 98–114.

Henry, A.N., Vivekanathan, K. & Nair, N.C. (1978) Rare and Threatened Flowering Plants of South India. *J. Bombay Nat. Hist. Soc*. 75: 684–697.

Heyne, B. (1814) *Tracts, Historical and Statistical on India; with journals of several tours through various parts of the peninsula*. East India Company, London.

Hooker, J.D. & Thomson, T. (1855) *Flora Indica*, vol. 1. W. Pamplin, London.

Hooker, J.D. (1872–1897) *The Flora of British India*. 7 vols. L. Reeve & Co., London.

Hooker, J.D. (1904) *A Sketch of the Flora of British India*. Eyre and Spottiswoode, London

Hutchinson, J. (1973) *The Families of Flowering Plants*. Oxford University Press, Oxford.

IIRS. (2002) *Biodiversity characterization at Landscape level in North East, western Himalayas, Western Ghats using satellite remote sensing and geographic information system*. Indian Institute of remote Sensing (IIRS-NRSA), Dehradun,

Jain, S.K. & Rao, R.R. (1983) *An Assessment of Threatened Plants of India*. Botanical Survey of India, Howrah.

Jalal, J.S. & Jayanthi, J. (2012) Endemic orchids of peninsular India: a review. *J. Threat. Taxa* 4(15): 3415–3425.

Jain, S.K. (1966) Notes on Indian grasses. II: The identity and distribution of certain species. *Indian Forester* 92: 362–367.

Jha, C.S., Dutt, C.B.S. & Bawa, K.S. (2000) Deforestation and land use changes in Western Ghats, India. *Cur. Sci.* 79(2): 231–238.

Johnson, D. (1998) *Arenga wightii. The IUCN Red List of Threatened Species* 1998.

Johnson, D. (1998) *Bentinckia condapanna*. *The IUCN Red List of Threatened Species* 1998.

Joseph, S., Reddy, C.S., Pattanaik, C., & Sudhakar, S. (2008) Distribution of plant communities along climatic and topographic gradients in Mudumalai Wildlife Sanctuary (Southern India)–*Biol. Lett.* 45: 29–41.

Kabeer, K.A.A., Arigela, R.K. & Benjamin, J.H.F. (2017) The status and extended distribution of *Streblochaete sanjappae* Kabeer & V.J. Nair (Poaceae). *Indian Forester* 143(4): 387.

Karthikeyan, S., Sanjappa, M. & Moorthy, S. (2009) *Flowering Plants of India–Dicotyledons (Acanthaceae–Avicenniaceae)*, Vol. 1. Botanical Survey of India, Kolkata.

King, G. (1888) *Ficus* L. In: Hooker, J.D. (ed.) *The Flora of British India*. Vol. L. Reeve & Co. London. pp. 494–537.

Kumar, B. (2011) *Anaphalis beddomei*. The IUCN Red List of Threatened Species 2011.

Kumar, B. (2011) *Anthoxanthum borii*. The IUCN Red List of Threatened Species 2011.

Kumar, B. 2011. *Eriocaulon pectinatum*. The IUCN Red List of Threatened Species 2011.

Kumar, S., Chandran, K., Arumugam, S. & Mastakar, V.K. (2020). Lectotypification of *Albizia lathamii* (Leguminosae: Mimosoideae). *Phytotaxa* 446(4): 260–264.

Lal, P. (2016) *Indica: A Deep Natural History of the Indian Subcontinent*. Penguin Random House India, Haryana.

Lewis, G., Schrire, B., Mackinder, B. & Lock, M. (2005) *Legumes of the World*. Royal Botanical Garden, Kew.

Lindstrom, A.J. & Hill, K.D. (2007) The genus *Cycas* (Cycadaceae) in India. *Telopea* 11(4): 463–488.

Linnaeus, C. (1747) *Flora Zeylanica*. Laurentius Salvius, Stockholm.

Linnaeus, C. (1753) *Species Plantarum*. Laurentius Salvius, Stockholm.

Lockwood, I. (2006) Kurinji crown. *Frontline* 23: 66–72.

Lotsch, A., Tian, Y., Friedl, M.A. & Myneni, R.B. (2003) Land cover mapping in support of LAI and FPAR retrievals from EOS-MODIS and MISR: classification methods and sensitivities to errors. *Int. J. Rem. Sens*. 24: 1997–2016.

Mabberley, D.J. (2017) *Mabberley's Plant-Book*: *A portable dictionary of plants, their classification and uses*. Fourth Edition. Cambridge University Press, Cambridge.

Madden, M. (2004) Remote Sensing and Geographic Information System Operations for Vegetation Mapping of Invasive Exotics. *Weed Technol.* 18: 1457–1463.

Manilal, K.S. (1988) *Flora of Silent ValleyTropical Rain Forests of India*. Mathrubhoomi Press, Calicut.

Mao, A.A., Agrawala, D. K., Dash, S.S., Shukla, A.N. & Sinjini Mukherjee, S. (2022) *Plant Discoveries 2021*. Botanical Survey of India, Kolkata.

Matthew K.M. (1959) The vegetation of Kodaikanal grassy slopes. *J. Bombay Nat. Hist. Soc.* 56(3): 387–422.

Matthew, K.M. (1969) The Exotic Flora of Kodaikanal, Palni Hills. *Rec. Bot. Surv. India.* 20(1): 1–241.

Matthew K.M. (1971) The flowering of the Strobilanth (Acanthaceae). *J. Bombay Nat. Hist. Soc.* 67(3): 502–506.

Matthew, K. M. (1981) *Materials for a Flora of the Tamilnadu Carnatic*.The Rapinat Herbarium, St. Joshep's College, Tiruchirappalli.

Matthew, K. M. (1982) *Illustrations on the Flora of the Tamilnadu Carnatic*.Vol. 2. The Rapinat Herbarium, St. Joshep's College, Tiruchirappalli.

Matthew, K. M. (1983) *The Flora of the Tamilnadu Carnatic*. Part 2. The Rapinat Herbarium, St. Joshep's College, Tiruchirappalli.

Matthew, K.M. (1988) *Further Illustrations to the Flora of Tamilnadu, Carnatic*. The Rapinat Herbarium, St. Joshep's College, Tiruchirappalli.

Matthew, K.M. (1991) *An Excursion Flora of Central Tamil Nadu, India*. Oxford & IBH Publishing Company, New Delhi.

Matthew, K.M. (1996) *Illustrations to the Flora of the Palni Hills*. The Rapinat Herbarium, St. Joshep's College, Tiruchirappalli.

Matthew, K.M. (1996) Precursory *Notes* on the Flora of the Palni (Pulney) Hills, South India. *J. Econ. Taxon. Bot.* 20: 1–14.

Matthew, K.M. (1998) *Supplement to Illustrations of the Flora of the Palni Hills*. The Rapinat Herbarium, St. Joshep's College, Tiruchirappalli.

Matthew, K.M. (1999) *The Flora of the Palni Hills. South India*. 3 Parts. The Rapinat Herbarium, St. Joshep's College, Tiruchirappalli.

Mohandass, D. & Davidar, P. (2009) Floristic structure and diversity of a tropical montane evergreen forest (Shola) of the Nilgiri Mountains, southern India. *Trop. Ecol.* 50: 219–229.

Myers, N. (1979) *The Sinking Ark: A new look at the problem of disappearing species*. Pergamon Press, London.

Myers, N. (1990) Climate change and Biological diversity: Policy implications. In: M. Boer Matthias & de Groot Rudolf (eds.) *Landscape – Ecological impact of climatic change*: 406–429. IOS Press, Amsterdam.

Myers, N. (1992) The Sinking Ark: Pollution and the world wide loss of biodiversity. *Biodivers. Conservation* 1: 2–18.

Myers, N., Miller, K.R., Reid, W., Mittermier, W. & Warner, T. (1990) *Conserving the World's Biological diversity*. IUCN, Washington, D.C.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. (2000) Biodiversity Hotspots for conservation priorities. *Nature* 403: 853–858.

Nandikar, M.D. & Gurav, R.V. (2015) Revision of the genus *Murdannia* (Commelinaceae) in India. *Phytodiversity* 2(1): 56–112.

Nayar, M.P. (1996) *Hotspots of endemic plants in India, Nepal and Bhutan*. Tropical Botanic Garden and Research Institute, Thiruvananthapuram.

Nayar, M.P. (1977) Changing pattern of Indian flora. *Bull. Bot. Surv. India* 19: 145–155.

Nayar, M.P. (1980). Endemism and patterns of distribution of endemic genera (angiosperms). *J. Econ. Taxon. Bot.* 1: 99–110.

Nayar, M.P. & Sastry, A.R.K. (1987, 1988, 1990) *Red Data Book on Indian Plants*. 3 Vols. Botanical Survey of India, Calcutta.

Nagendra, H & Gadgil, M. (1999) satellite images as a tool for monitoring species diversity: An assessment. *Journal of Applied Ecology* 36: 388–397.

Nayar, T.S., Rasiya Beegam, A., Mohanan, N. & Rajkumar, G. (2006) *Flowering Plants of Kerala*. A Handbook. Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Thiruvananthapuram.

Nayar, T.S., Rasiya Beegam, A. & Sibi, M. (2014) *Flowering Plants of the Western Ghats, India*. 2 Vol. Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Thiruvananthapuram.

Nees, C.G.D. (1832) *Phlebophyllum*. In: Wallich, N. (ed.) *Plantae Asiaticae Rariores: or, Descriptions and figures of a select number of unpublished East Indian plants.* Vol. 3. Treuttel & Würtz, London.

NRSA. (2007) *Biodiversity Characterisation at Landscape level in Eastern Ghats and East coast of India using satellite remote sensing and Geographic Information System*. Joint Project report of Department of Biotechnology and Department of Space, Government of India, National Remote Sensing Agency, Hyderabad.

Parthasarathy, N. (1999) Tree diversity and distribution in undisturbed and human-impacted sites of tropical wet evergreen forest in southern Western Ghats, India. *Biodiver. Conservation* 8: 1365–1381.

Pascal, J.P. & Raphael, P. (1996) Structure and floristic composition of a tropical evergreen forest in South-West, India. *J. Trop. Ecology* 12: 191–214.

Porwal, M.C. & Roy, P.S. (1992) vegetation type discrimination on landsat TM data in heterogenous forested landscape of Western Ghats – Accuracy evaluation from large scale aerial photo maps. *Journal of Indian society of Remote sensing* 20: 21–33.

Prain, D. (1903). *Bengal Plants*. 2 vols. N W & Co., Calcutta.

Raju, V.S., Reddy, C.S. & Sateesh, S. (2010) Flowering plant diversity and endemism in India: an overview. *ANU J. Nat.* Sci. 1(1), 27–39.

Ramesh, B.R. & Pascal, J.P. (1997) *Atlas of Endemics of the Western Ghats (India)*. Institut Francias de Pondicherry, Pondicherry.

Rao, C.K. (1972) Angiosperm genera endemic to Indian Floristic Region and neighbouring areas. *Indian Forester* 9: 560–566.

Rao, C.K., Geetha, B.L. & Geetha, S. (2003) '*Red List of Threatened Vascular Plant Species in India*'– Compiled from the 1997 IUCN Red List of Threatened Plants. ENVIS, Botanical Survey of India, Howrah.

Rao, M.V. & Senthil Kumar, T. (2015) *Status and distribution of threatened taxa of Kodaikanal Forest Division, Tamil Nadu*. Project Report of Tamil Nadu Biodiversity Greening Project (TBGP), Tamil Nadu Forest Department, Government of Tamil Nadu, Chennai.

Reddy, C.S., Varma, Y.N.R., Brahmam, M. and Raju, V.S. (2006) Conservation Prioritization of Endemic plants of Eastern Ghats, India. *J. Econ. Taxon. Bot.* 30(4): 755–772.

Reddy, C.S. (2008) Catalogue of Invasive Alien Flora of India. *Life Sci. J.* 5(2): 84–89.

Reddy, C.S., & Ugle, P. (2008) Survival threat to the flora of Mudumalai Wildlife Sanctuary, India: an assessment based on regeneration status. *Nat. & Sci.* 6(4): 42–54.

Reddy, C.S., Pujar, G.S., Sudhakar, S., Shilpa, B., Sudha, K., Gharai, B. & Murthy, M.S.R. (2008) Mapping the Vegetation Types of Andhra Pradesh, India using Remote Sensing. *Proc. A. P. Acad. Sci.* 12: 14–23.

Reddy, C.S., Hari Krishna, P. & Kiran A.R. (2011) Mapping the Vegetation Types of Rajasthan, India Using Remote Sensing Data. *J. Environm. Res. & Managem*. 2(1): 1–9.

Reddy, C.S., Jha, C.S., & Dadhwal, V.K. (2016) Assessment and monitoring of long-term forest cover changes (1920–2013) in Western Ghats biodiversity hotspot. *J. Earth Syst. Sci.*125(1): 103–114.

Rehel, S. (2011) *Anaphalis wightiana*. *The IUCN Red List of Threatened Species* 2011.

Rehel, S. (2011) *Gynura travancorica*. *The IUCN Red List of Threatened Species* 2011.

Raven, P.H. (1988) Biological resources and global stability. In: Reid, W.V. & Miller, K.R. (1989) *Keeping options alive*: *the scientific basis for conserving Biodiversity*. World Resources Institute, Washington, D.C.

Rehel, S. (2011) *Gynura travancorica*. The IUCN Red List of Threatened Species 2011.

Rheede tot Draakestein, H.A. von (1678–1693) *Hortus Indicus Malabaricus*. Sumptibus Johannis van Someren et Joannis van Dyck, Amsterdam.

Robinson M.E. (1935) The flowering of *Strobilanthes* in 1934. *J. Bombay Nat. Hist. Soc*. 38(1): 117–122.

Rodgers, W.A., Panwar, H.S. & Mathur, V.B. (2002). *Wildlife Protected Area Network in India: A Rieview*. Wildlife Institute of India, Dehradun.

Roxburgh, W. (1814) *Hortus Bengalensis*. Mission Press, Serampore.

Roxburgh, W. (1820 & 1824) *Flora Indica*. 2 vols. Mission Press, Serampore.

Roxburgh, W. (1832) *Flora Indica*. 3 vols. W. Thacker & Co., Calcutta.

Roy, P.S., Ranganath, B.K., Diwakar, P.G., Vohra, T.P.S., Bhan, S.K., Singh, I.J. & Pandian, V.C. (1991) Tropical forest type mapping and monitoring using remote sensing, *Int. Jour. Remote Sensing* 12(11): 2205–2225.

Russell, A., Gil, P.R., Hoffman M., Pilgrim, J., Brooks, T., Mittermer, C.G., Lamoreux, J. & Fonseca, G.A.B. da. (2004) *Hotspots revised*. Cemex, S.A de C.V. Mexico.

Saha, D., Ved, D., Ravikumar, K. & Haridasan, K. (2015) *Cinnamomum wightii*. The IUCN Red List of Threatened Species 2015.

Sampath Kumara, K.K., Sringeswara, A.N., Sadananda, K.B. & Prakash, H.S. (2013) New distribution record of the endemic and rare *Ficus dalhousiae* Miq. (Moraceae). *J. Threat. Taxa.* 5(13): 4808–4810.

Sanchez-Azofeifa, G. A., Quesada-Mateo, C., Gonzales-Quesada, P., Dayanandan, S. & Bawa, K. S. (1999) Protected areas and conservation of biodiversity in the tropics. *Conservation Biol.* 13: 407–411.

Sanjappa, M. (1992) *Legumes of India*. Bishen Singh Mahendra Pal Singh, Dehradun.

Santapau, H. & Henry, A.N. (1973) *A Dictionary of Flowering Plants of India*. Council of Scientific & Industrial Research, New Delhi.

Sasidharan, N. (2004) *Biodeversity documentation for Kerala, Part 6: Flowering Plants*. Kerala Forest Research Institute, Preechi.

Sasidharan, N. (2011) *Flowering Plants of Kerala. Ver. 2.0.* Kerala Forest Research Institute, Preechi.

Scotland, R.W. (1998) One new and one rediscovered species of *Strobilanthes* Blume (Acanthaceae). *Bot. J. Linn. Soc.* 128: 203–210.

Singh, A.P., Kumar, N., Prabhakar Rao, M.R.K., & Singh, B. (2010) Crustal configuration beneath the Palghatgap (South India) and mantle-crustconnections. *Advances Geo Sci.* 26: 117–129.

Singh, P., Karthigeyan, K., Lakshminarasimhan, P. & Dash, S.S. (2015) *Endemic vascular plants of India*. Botanical Survey of India. Kolkata.

Singh R.K. & Diwakar, P.G. (2007) Gregarious flowering of *Strobilanthes callosus* Nees in Western Ghats. *Indian J. Forest*. 30(4): 553–555.

Singh, R.K. & Rao, P.S.N. (2008) The genus *Ischaemum* L. (Poaceae) in India. *J. Econ.Taxon. Bot.* 32: 797–838.

Singh, R.K. & Diwakar, P.G. (2009) Notes on the identity and taxonomic status of some species and infraspecific taxa of Genus *Pittosporum* Banks. ex Soland. (Pittosporaceae). *J. Non-Timber Forest Products* 16: 211–214.

Singh, R.K. (2015) Lectotypification of Indian taxa of *Leucas* (Lamiaceae). *Telopea* 18: 395–424.

Singh, R.K. (2015) Typification of seven species of *Litsea* (Lauraceae) endemic to India. *Phytotaxa* 201(4): 278–286.

Singh, R.K., Garg, A. & Singh, P. (2015). Typification of ten species of *Litsea* Lam. (Lauraceae) endemic to India. *Bangladesh J. Pl. Taxon.* 22(2): 77–81.

Singh, R.K. (2016) Lectotypification of three Linnaean names in *Impatiens* (Balsaminaceae). *Phytotaxa* 321: 299–300.

Singh, R.K. (2016) Lectotypification of three Indian endemic taxa of *Pittosporum* (Pittosporaceae). *Turkish J. Bot.* 40(5): 557–560.

Singh, R.K. (2016) Typification of thirty six names of thirty five recognized taxa in *Impatiens* (Balsaminaceae), endemic to Western Ghats. *Phytotaxa* 268 (3): 167–180.

Singh, R.K. (2017) Nomenclatural novelties and lectotypifications in *Litsea* (Lauraceae). *Kew Bulletin* 72(2): 20(1–9).

Singh, R.K. & Arigela, R.K. (2019) Gregarious flowering of two endemic *Strobilanthes* species (Acanthaceae) in southern Western Ghats, India and typification of two names. *NeBIO* 10(4): 227–232.

Singh, R.Kr. & Arigela, R.K. (2020) Lectotypifications and new synonyms in Indian *Syzygium* (Myrtaceae). *Phytotaxa* 429 (3): 200–216.

Singh, S., Singh, T.P. & Srivastava, G. (2005) Vegetation cover type mapping in Mouling National Park in Arunachal Pradesh, Eastern Himalayas – An integrated geospatial approach. *Photonirvachak* 33(4): 547–563.

Singh, T.P., Singh, S., Roy, P.S. & Rao, B.S.P. (2002) Vegetation mapping and characterization in West Siang District of Arunachal Pradesh, India–a satellite remote sensing-based approach. *Curr. Sci.* 83(10): 1221–1230.

Singh, V. (2005) *Monograph on Indian Diospyros L. (Persimmon, Ebony) Ebenaceae*. Botanical Survey of India, Kolkata.

Stafleu, F.A. & Cowan, R.S. (1976–1988) *Taxonomic Literature: A Selective Guide to Botanical Publications and Collections with Dates, Commentaries and Types*. 7 vols. Bohn, Scheltema & Holkema, Utrecht.

Stafleu, F.A. & Mennega, E.A. (1992) *Taxonomic Literature: A Selective Guide to Botanical Publications and Collections with Dates, Commentaries and Types. Supplement*. Koeltz Scientific Books, Königstein.

Subramaniam, S., Pandey, A.K., & Rather, S.A. (2015) A revised circumscription of the species in *Bracteatae* complex (section *Calycinae*) in the genus *Crotalaria* L.: evidence from nuclear and chloroplast markers. *Plant Systematics and Evolution* 301(9): 2261–2290.

Sudhakar, J.V. & Murthy, G.V.S. (2012) Additions of *Ficus* L. (Moraceae) species to the South Indian States. *Indian J. Forestry* 35(3): 345–350.

Sudhakar, J.V., Reddy, N.C.M. & Murthy, G.V.S. (2017) *Figs of Eastern Ghats, India*. National Biodiversity Authority, Chennai.

Suresh, S. (2008) *Technical Report Series – District groundwater brochure, Dindigul district, Tamil Nadu*. Central Ground Water Board, Chennai.

Takhtajan, A. (1969) *Flowering Plants: Origin and Dispersal*. Oliver & Boyd Ltd., Edinburgh.

Thomas, S., Mani, B. & Britto, S.J. (2018) *Strobilanthes orbiculata* (Acanthaceae) a new species and *Notes* on *S. matthewiana* from the southern Western Ghats, India. *Phytotaxa* 369(1): 47–55.

Thothathri, K. (1982) *Fascicles of Flora of India. Fascicle 8. Leguminosae: Genus Derris*. Botanical Survey of India, Howrah.

Thothathri, K. (1987) *Taxonomic Revision of the Tribe Dalbergieae in the Indian Subcontinent*. Botanical Survey of India, Kolkata.

Turland, N.J., Wiersema, J.H., Barrie, F.R., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Kusber, W.-H., Li, D.-Z., Marhold, K., May, T.W., McNeill, J., Monro, A.M., Prado, J., Price, M.J. & Smith, G.F. (2018) International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code). *Regnum Veg. 159*. Koeltz Botanical Books, Glashütten.

Ubhaykar, R. (2016) Exploring India's Megalithic Culture, a Riddle Set in Stone. Livemint, July 3.

Ved, D., Saha, D., Ravikumar, K. & Haridasan, K. 2015. *Decalepis hamiltonii*. *The IUCN Red List of Threatened Species* 2015 2015: e.T50126587A50131330.

Ved, D., Saha, D., Ravikumar, K. & Haridasan, K. 2015. *Utleria salicifolia*. *The IUCN Red List of Threatened Species* 2015: e.T50130765A50131450.

Venu, P. (2006) *Strobilanthes Blume (Acanthaceae) in Peninsular India*. Botanical Survey of India, Kolkata.

Vivek, C.P., Murthy, G.V.S. & Nair, V.J. (2013) *Eragrostis collinensis* (Poaceae; Eragrostideae): A new species from the hills of Kerala and Tamil Nadu, India. *Indian J. Forest.* 36: 401–404.

Voigt, J.O. (1845) *Hortus suburbanus Calcuttensis*. Bishop's College Press, Calcutta.

Wallich, N. (1830–1832) *Plantae Asiaticae Rariores*. 3 Vols. Truettel & Wurtz, London.

Warner, F. (1882) *Indo-Swedish Forestry Programme II*. Backround document. Govt. of India, New Delhi.

Wight, R. (1838–1853) *Icones Plantarum Indiae Orientalis*. J.B. Pharoah, Madras.

Wight, R. (1840) *Illustrations of Indian Botany*. J.B. Pharoah, Madras.

Wight, R. & Arnott, G.A.W. (1834) *Prodromus Florae Peninsulae Indiae Orientalis*. Purbury, Allen & Co., London.

Wilson, E.O. (1988) The biodiversity crisis: A challenge to science. *Symb. Bot. Ups*. 28(3): 5–12.

Williams, J.N. (2011) Human Population and the Hotspots Revisited: A 2010 Assessment. In: Zachos, F.E. & Habel, J.C. (ed.) *Biodiversity Hotspots*. Springer-Verlag Berlin Heidelberg.

World Conservation Monitoring Centre (1998) *Actinodaphne bourneae*. The IUCN Red List of Threatened Species 1998.

World Conservation Monitoring Centre (1998) *Cryptocarya stocksii*. The IUCN Red List of Threatened Species 1998.

World Conservation Monitoring Centre 1998. *Drypetes wightii*. The IUCN Red List of Threatened Species 1998.

World Conservation Monitoring Centre (1998) *Elaeocarpus blascoi*. The IUCN Red List of Threatened Species 1998.

World Conservation Monitoring Centre (1998) *Elaeocarpus recurvatus*. The IUCN Red List of Threatened Species 1998.

World Conservation Monitoring Centre 1998. *Euphorbia vajravelui*. *The IUCN Red List of Threatened Species* 1998.

World Conservation Monitoring Centre (1998) *Glyptopetalum lawsonii*. The IUCN Red List of Threatened Species 1998.

World Conservation Monitoring Centre (1998) *Neolitsea fischeri*. The IUCN Red List of Threatened Species 1998.

World Conservation Monitoring Centre (1998) *Psychotria nilgiriensis* var. *astephana*. The IUCN Red List of Threatened Species 1998.

World Conservation Monitoring Centre (1998) *Psydrax ficiformis*. The IUCN Red List of Threatened Species1998.

World Conservation Monitoring Centre (1998) *Symplocos anamallayana*. The IUCN Red List of Threatened Species 1998.

World Conservation Monitoring Centre (1998) *Syzygium densiflorum*. The IUCN Red List of Threatened Species 1998.

Zmarzty, S. (2001) Revision of *Elaeocarpus* (Elaeocarpaceae) Section *Elaeocarpus* in Southern India and Sri Lanka. *Kew Bull.* 56(2): 405–447.

Botanical Survey of India



Common Map

INDEX TO SCIENTIFIC NAMES

Abutilon neelgherrense Munro 65
Actinodaphne bourneae Gamble 162
Actinodaphne wightiana (Kuntze) Noltie 162
Aerides crispa Lindl. 183
Aeschynanthus perrottetii A. DC. 137
Agrostis peninsularis Hook.f. 196
Albizia lathamii Hole 91
Allophylus concanicus Radlk. 83
Allophylus serratus (Roxb.) Kurz 83
Alstonia venetata R. Br. 132
Anaphalis aristata DC. 117
Anaphalis beddomei Hook.f. 117
Anaphalis bournei Fyson 118
Anaphalis meeboldii W.W. Sm. 119
Anaphalis travancorica W.W. Sm. 119
Anaphalis wightiana (Wall ex DC.) DC. 120
Andrographis affinis Nees 139
Andrographis neesiana Wight 140
Anisochilus argenteus Gamble 152
Anthoxanthum borii S.K. Jain & D.C. Pal 197
Ardisia rhomboidea Wight 126
Arenga wightii Griff. 191
Argyreia cuneata (Willd.) Ker Gawl. 136
Arundinella mesophylla Nees ex Steud. 197
Arundinella nervosa (Roxb.) Nees ex Hook. & Arn. 198
Arundinella vaginata Bor 199
Asparagus fysonii J.F. Macbr. 190
Atalantia wightii Yu.Tanaka 77
Barleria acuminata Wight ex Nees 140
Barleria cuspidata B. Heyne ex Nees 141
Beilschmiedia wightii Benth. & Hook.f. 163
Bentinckia condapanna A. Berry 192
Boswellia serrata Roxb. ex Colebr. 78
Brachycorythis iantha (Wight) Summerh. 184
Brachycorythis splendida Summerh. 185
Brachycorythis wighti Summerh. 185
Bupleurum distichophyllum Wight & Arn. 101
Canthium neilgherrense Wight 106
Celastrus paniculatus Willd. subsp. *aggregatus* K.T. Mathew ex K.M. Matthew 80
Ceropegia intermedia Wight 132
Chionanthus mala-elengi (Dennst.) P.S. Green 129
Chrysopogon asper B. Heyne ex Blatt. & McCann 200
Cinnamomum wightii Meisn. 164
Clausena austroindica B.C. Stone & K. Narayan 78
Coelogyne nervosa A. Rich. 186
Conchidium nanum (A. Rich.) Brieger 187
Commiphora caudata var. *pubescens* (Wight & Arn.) K.M. Matthew 79
Corynandra felina (L.f.) Cochrane & Spreng. 62
Cotoneaster buxifolius Wall. ex Lindl. 91
Crotalaria beddomeana Thoth. & A.A. Ansari 84
Crotalaria fysonii Dunn var. *fysonii* 85
Crotalaria fysonii Dunn var. *glabra* Gamble 86
Crotalaria longipes Wight & Arn. 86
Cryptocarya stocksii Meisn. 164
Cryptolepis grandiflora Wight 133
Cycas circinalis L. 208
Decalepis hamiltonii Wight & Arn. 134
Dendrophthoe trigona (Wight & Arn.) Danser ex Santapau 171
Derris brevipes (Benth.) Baker 87

Derris heyneana (Wight & Arn.) Benth. 88
Diospyros foliolosa Wall. ex A. DC. 127
Drypetes wightii (Hook.f.) Pax & K. Hoffm. 175
Elaeocarpus blascoi Weibel 66
Elaeocarpus munroii (Wight) Mast. 67
Elaeocarpus recurvatus Corner 68
Elaeocarpus variabilis Zmarzty 68
Eragrostis collinensis Vivek, G.V.S. Murthy & V.J. Nair 201
Eriocaulon pectinatum Ruhland 193
Eriocaulon ritchieanum Ruhland 193
Euonymus crenulatus Wall. ex Wight & Arn. 81
Euphorbia vajravelui var. *theniensis* B. DeJong & R.W. Stewart 175
Exacum wightianum Arn. 135
Ficus amplocarpa Govind. & Masil. 179
Ficus anamalayana Sudhakar & G.V.S. Murthy 180
Ficus beddomei King 181
Ficus dalhousiae Miq. 181
Ficus guttata (Wight) King 182
Fimbristylis kingii Gamble ex Boeckeler 194
Fimbristylis uliginosa Steud. 195
Gardenia gummifera L.f. 106
Garnotia elata (Miq.) Janowski 201
Glyptopetalum lawsonii Gamble 81
Gordonia obtusa Wall. ex Wight & Arn. 65
Gymnosporia heyneana M.A. Lawson 82
Gynura nitida DC. 120
Gynura travancorica W.W. Sm. 121
Habenaria elliptica Wight 187
Habenaria longicornu Lindl. 188
Habenaria rariflora A. Rich. 188
Hedyotis articularis R. Br. ex Wight & Arn. 107
Hedyotis leschenaultiana DC. 108
Hedyotis swertioides Hook.f. 108
Helicanthes elastica (Desr.) Danser 172
Helixanthera intermedia Wight 172
Helixanthera obtusata (Wall.) Danser 173
Henckelia incana (Vahl) Spreng. 138
Heracleum candolleanum (Wight & Arn.) Gamble 101
Heracleum rigens Wall. ex DC. 102
Heracleum sprengelianum Wight & Arn. 103
Heteropogon fischerianus Bor 202
Hoya wightii Hook.f. subsp. *palniensis* Mathew. 134
Hydnocarpus pentandrus (Buch.-Ham.) Oken 63
Hydrocotyle conferta Wight 103
Impatiens campanulata Wight 70
Impatiens dasysperma Wight 71
Impatiens fasciculata Lam. 71
Impatiens goughii Wight 72
Impatiens lechenaultii (DC.) Wall. ex Wight & Arn. 73
Impatiens phoenicea Bedd. 73
Impatiens tangachee Bedd. 74
Impatiens tanyae R.Kr. Singh, Arigela & Kabeer 75
Impatiens tomentosa B.Heyne ex Wight & Arn. 76
Impatiens viscida Wight 76
Indigofera prostrata Willd. 88
Isachne bourneorum C.E.C. Fisch. 203
Isachne deccanensis Bor 204
Isodon nilgherricus (Benth.) H. Hara 152
Isodon rivularis (Wight ex Hook.f.) H. Hara 153
Isodon wightii (Benth.) H. Hara 153
Isonandra perrottetiana A. DC. 126
Ixora notoniana Wall. ex G. Don 109

Jasminum brevilobum DC. 130
Jasminum calophyllum Wall. & G. Don 130
Justicia glauca Rottl. 142
Kalanchoe bhidei T.Cooke 93
Kalanchoe grandiflora Wight & Arn. 93
Knoxia wightiana Wall. ex Wight & Arn. 109
Lasianthus acuminatus Wight 110
Lasianthus parvifolius Wight 111
Lasianthus venulosus (Wight & Arn.) Wight 111
Leucas helianthemifolia Desf. 154
Leucas hirta (B. Heyne ex Roth) Spreng. 155
Leucas lanceifolia Desf. 156
Leucas vestita Benth. 156
Ligustrum perrottetii A. DC. 131
Litsea floribunda Gamble 165
Litsea glabrata Hook.f. 166
Litsea keralana Kosterm. 167
Litsea oleoides (Meisn.) Hook.f. 168
Litsea wightiana (Nees) Hook. f. 168
Lonicera leschenaultii Wall. 104
Magnolia nilagirica (Zenker) Figlar 61
Malaxis intermedia (A. Rich.) Seidenf. 189
Memecylon randerianum S.M. Almeida & M.R. Almeida 95
Mesua ferrea L. var. *coromandeliana* (Wight) N.P. Singh 64
Murdannia dimorpha (Dalzell) G. Brückn. 191
Mussaenda hursutissima (Hook.f.) Hutch. ex Gamble 112
Neanotis longiflora W.H. Lewis 112
Neolitsea fischeri Gamble 169
Oberonia balakrishnanii R. Ansari 189
Ophiorrhiza roxburghiana Wight 113
Osbeckia brachystemon Naudin 96
Osbeckia gracilis Bedd. 96
Osbeckia leschnaultiana DC. 97
Osbeckia reticulata Bedd. 97
Phoebe wightii Meisn. 170
Phyllanthus chandrabosei Govaerts & Radcl.-Sm. 176
Phyllanthus macraei Müll.Arg. var. *hispidus* Gamble 178
Phyllanthus macraei Müll.Arg. var. *macraei* 177
Phyllanthus narayanswamii Gamble 178
Piper wightii Miq. 160
Pittosporum neelgherrense Wight & Arn. 63
Plectranthus bourneae Gamble 157
Plectranthus deccanicus Briq. 158
Pogostemon mollis Benth. 158
Pogostemon wightii Benth. 159
Polypogon nilgiricus Kabeer & V.J. Nair 205
Psychotria nilgiriensis Deb & M. Gangop. *var. nilgiriensis* 114
Psychotria nilgiriensis var. *astephana* Deb & M. Gangop. 114
Psychotria subintegra (Wight & Arn.) Hook.f. 115
Psydrax ficiformis (Hook.f.) Bridson 115
Rhododendron nilagiricum Zenker 125
Rhynchosia filipes Benth. 89
Rosa leschenaultiana (Thory) Wight & Arn. 92
Rungia laeta C.B. Clarke 142
Scutellaria colebrookeana Wall. ex Benth. 160
Senecio lavendulaefolius DC. 122
Smithia gracilis Benth. 90
Smithia hirsuta Dalzell 90
Solanum multiflorum Roth 137
Sonerila pulneyensis Gamble 98
Streblochaete sanjappae Kabeer & V.J. Nair 205
Strobilanthes consanguinea (Nees) T. Anderson 143
Strobilanthes foliosa (Wight) T. Anderson 144
Strobilanthes gracilis Bedd. 145

Strobilanthes heteromalla T. Anderson ex C.B. Clarke 145
Strobilanthes kunthiana (Nees) T. Anderson ex Benth. 146
Strobilanthes lanata Nees 147
Strobilanthes lurida Wight 148
Strobilanthes micrantha Wight 148
Strobilanthes pulneyensis C.B. Clarke 149
Strobilanthes urceolaris Gamble 150
Strobilanthes zenkeriana (Nees) T. Anderson 150
Symplocos anamallayana Bedd. 128
Symplocos foliosa Wight 128
Syzygium densiflorum Wall. ex Wight & Arn. 94
Taxillus recurvus (DC.) Tiegh. 173
Tetrastigma sulcatum (M.A. Lawson) Gamble 82
Themeda sabarimalayana Sreek. & V.J. Nair 206
Thunbergia tomentosa Wall. ex Nees 151
Trichosanthes lobata Roxb. 99
Tripogon narayanae Sreek., V.J. Nair & N.C. Nair 207
Tripogon pungens C.E.C. Fisch. 208
Utleria salicifolia Bedd. ex Hook.f. 135
Vaccinium neilgherrense Wight 125
Vanasushava pedata (Wight) P.K. Mukh. & Constance 104
Vernonia bourneana W.W. Sm. 123
Vernonia fysonii Calder 123
Vernonia peninsularis (C.B. Clarke) C.B. Clarke ex Hook.f. 124
Viscum angulatum B. Heyne ex DC. 174
Zehneria hookeriana (Wight & Arn.) Arn. 99
Zehneria maysorensis (Wight & Arn.) Arn. 100



Malabar giant squirrel

Botanical Survey of India



Impatiens dasysperma Wight



Habenaria longicornu Lindl.

Botanical Survey of India



Aeschynanthus perrottetii A. DC.



Ceropegia intermedia Wight

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