DIVERSITY AND ECOLOGY OF WETLAND VASCULAR PLANTS OF PALAKKAD DISTRICT, KERALA

Thesis submitted to the University of Calicut for the award

of the degree of

Doctor of Philosophy in Botany

By

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CERTIFICATE

This is to certify that the thesis titled **"Diversity and Ecology of Wetland Vascular Plants of Palakkad District, Kerala"**, submitted to the University of Calicut by **Mr. Sojan Jose**, in partial fulfillment for the award of the degree of Doctor of Philosophy in Botany is the bonafide record of the research work done under our guidance and supervision. No part of this work has been presented elsewhere for any degree or diploma.

Kozhikode -14

Prof. P V Madhusoodanan
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Dr. R. Prakashkumar
(Co-Guide)

DECLARATION

I do hereby declare that the Ph. D thesis entitled "**Diversity and Ecology of Wetland Vascular Plants of Palakkad District, Kerala**" is an independent work carried out by me and it has not been submitted anywhere else for any other degree, diploma or title.



Sojan Jose

DECLARATION

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Sojan Jose

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CONTENTS

Chapter 1 1
INTRODUCTION 1
1.1 Background of the study 1
1.2 Relevance of wetland flora 4
1.3 Need and significance of the study 4
1.4 Objectives 6
Chapter 2 7
THE STUDY AREA 7
2.1 History of Palakkad 7
2.2 Location and physiography 7
2.3 Soil types 8
2.4 Climate 8
2.5 Wetland ecosystems in Palakkad 9
Chapter 3 10
REVIEW OF LITERATURE 10
3.1 Importance of wetlands: Ecology and economics 10
3.2 Definition of wetlands 13
3.3 Wetland: Global scenario 16
3.3.1 Area and extent of wetlands 17
3.3.2 Biodiversity of wetlands 18
3.3.3 Taxonomic studies on wetland vegetation in India 19
Chapter 4 25
MATERIALS AND METHODS 25
4.1 Floristic exploration 25
4.2 Presentation of data 26
Chapter 5 28
RESULTS 28
5.1 Systematic treatment of the aquatic and wetland angiosperms of Palakkad 28
5.2 Key to the families of angiosperms 28
5.3 Enumeration and description of angiosperms 32
ACANTHACEAE Juss. 32
ACORACEAE Martinov 34
ALISMATACEAE Vent. 35
AMARANTHACEAE Juss. 35
APIACEAE Lindl. 39
APOCYNACEAE Juss. 39

ARACEAE Juss. 41
ARALIACEAE Juss. 50
ASTERACEAE Dumort. 50
BALSAMINACEAE A. Rich. 59
BORAGINACEAE Juss 60
BURMANNIACEAE Blume 64
CAMPANULACEAE Juss. 65
CANNACEAE Juss. 66
CAPPARACEAE Juss. 67
CARYOPHYLLACEAE Juss. 68
CELASTRACEAE R. Br. 69
CERATOPHYLLACEAE Gray 71
COMMELINACEAE R. Br. 72
CONVOLVULACEAE Juss. 78
CYPERACEAE Juss. 82
DROSERACEAE Salisb. 118
ELATINACEAE Dum. 120
ERIOCAULACEAE P. Beauv. Ex Desv. 123
FABACEAE Lindl. 131
GENTIANACEAE Juss. 135
GESNERIACEAE Dum. 138
HALORAGACEAE Lindl. 139
HYDROCHARITACEAE Juss 140
HYDROPHYLLACEAE R. Br. Ex Edwards 145
HYPERICACEAE Juss. 145
HYPOXIDACEAE R. Br. 146
JUNCACEAE Juss. 147
LAMIACEAE Lindl. 147
LENTIBULARIACEAE Rich. 148
LINDERNIACEAE Borsch, Kai Mull & Eb. Fisch 155
LYTHRACEAE Jaume St. - Hil. 163
MARANTACEACE Petersen 167
MELASTOMATACEAE Juss. 169
MENYANTHACEAE Dum. 171
MOLLUGINACEAE Hutch. 172
NELUMBONACEAE Dum. 176
NYMPHAEACEAE Salisb. 177
ONAGRACEAE Juss. 180
OROBANCHACEAE Vent. 185

OXALIDACEAE R. Br. 186
PANDANACEAE R. Br. 188
PHRYMACEAE Schauer 191
PLANTAGINACEAE Juss. 192
POACEAE Barnhart 199
PODOSTEMACEAE Rich.ex C.A. Agardh 220
POLYGONACEAE Juss. 226
PONTEDERIACEAE Kunth 229
POTAMOGETONACEAE Dum. 230
RUBIACEAE Juss. 231
SALICACEAE Mirb. 236
SPHENOCLEACEAE T.Baskerv. 237
TYPHACEAE L. 237
URTICACEAE Juss. 238
VERBENACEAE Jaume St. - Hill 241
XYRIDACEAE C.A. Agardh. 242
5.4 Systematic treatment of aquatic and wetland pteridophytes 242
5.5 Key to the families of aquatic and wetland pteridophytes of Palakkad district 243
5.6 Enumeration and description of taxa 243
ATHYRIACEAE Alston 243
EQUISETACEAE Michx. ex DC. 244
ISOETACEAE Dumort. 244
MARSILEACEAE Mirb. 245
OSMUNDACEAE Martinov 247
POLYPODIACEAE J. Presl & C. Presl 247
PTERIDACEAE E. D. M. Kir 248
SALVINIACEAE Martinov 249
THELYPTERIDACEAE Pic. Serm. 250
Chapter 6 253
DISCUSSION 253
6.1 Floristic analysis of angiosperms 253
6.1.1 Growth forms 253
6.1.2 Endemism 254
6.1.3 Alien invasive species 256
6.1.4 Conservation status 257
6.2 Floristic analysis of pteridophytes 262
6.3 Salient features of the wetlands of Palakkad 263
6.4 Threats and future of wetlands of Palakkad 268

6.5 Exigency of conservation of the wetlands of Palakkad 269
Chapter 7 271
SUMMARY 271
REFERENCES 273
INDEX OF TAXA 288
List of Publications 296

Chapter 1

INTRODUCTION

1.1 Background of the study

Basic information on physical environmental factors and diversity of organisms is an essential and inevitable component for the proper planning and management of any ecosystem. The taxonomic information on the plant diversity on earth is meagre and limited. As Brummitt *et al.* (2001) rightly opined, though man has surveyed galaxies and landed on moon, he has not so far come anywhere near in completing a taxonomic catalogue of higher plants that grow on earth. The status of the lower plants is still worse. Recently, the conservation of biodiversity has gained momentum due to its indispensable application in poverty alleviation, economic growth and climate change. Taxonomic and ecological studies are a key component of conservation. In tropical region, biodiversity conservation and documentation are facing severe challenges due to various factors like anthropogenic pressures, invasion of alien species, climate change, lack of natural resources due to over population, etc. Though species extinction is a natural process (Barnosky *et al.*, 2011) the rate has been more than 100 times the normal rate as evident from fossil records (Rockström *et al.*, 2009). The preliminary step for conservation is the taxonomic treatment of the living components of an ecosystem which could be accomplished only through continuous exploration, documentation, assessment and monitoring.

Amidst the various ecosystems which harbor multifarious life forms, the wetlands remain as a unique and fragile ecosystem which offers manifold services to life on earth. Wetlands are well known for their highly productive environment which supports plants, animals and microbes. Apart from this, wetlands in their original form provides

a spectrum of services to the society and the proper utilization and sustainable management can meet various functions like ground water recharge, livelihood development, poverty alleviation, viable agriculture and many more. Owing to the cleansing activity of Wetlands, they are generally labelled as "kidneys of the landscape" (Mitsch and Gosselink, 1986). Although these ecosystems are of prime importance, out of ignorance or improper understanding they were often neglected and are treated as wastelands till recently.

Wetlands vary widely throughout the world and defining wetlands has been a point of debate among researchers. Cowardin *et al.* (1979) gave an observational definition which treats wetlands as the lands that are found in the transition region between terrestrial and aquatic systems, where the land is covered with water or the water table is at or near the surface of the soil.

Watzin and Gosselink (1992) treated wetlands as a transitional region between well drained uplands and permanently flooded deep water regions that provides many biological, economic and social benefits. Ramsar convention under article 1.1 defines wetlands broadly as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters" (Ramsar-Convention-Secretariat, 2016). As per the data retrieved from Ramsar site information service (RSIS) there are 2334 wetlands all over the world which are designated as Ramsar sites due to its importance, out of which 1102 sites are in Europe; 336 sites in Asia; 394 sites in Africa; 202 sites in Latin America and Caribbean; 218 sites in North America; and 82 sites in Oceania region. Together these wetlands cover an area of 249,601,723 hectares. Cook (1996) who studied wetland plants of India in detail, considered wetlands as 'lands where inundation happens for 14 days and saturation remains for 60 consecutive days'.

He also opined that in a tropical country like India where climate vary widely, the definition though not stringent but is apt.

Kerala, one of the southern states of India is well known for wetlands, for its terrain slopes from mountainous Western Ghats in the east to the Arabian sea in the west. It is blessed with 44 rivers, of which 41 are west flowing while the other three are east flowing. These forty four rivers along with their tributaries and numerous streams and rivulets make Kerala a green and fertile land which supports wide range of life forms. Among the twenty seven designated Ramsar sites of India, three are in Kerala. They include Sasthamkotta lake (Fresh water), Ashtamudi backwaters, and Vembanad – Kole wetlands. The numerous ponds and paddy fields of Kerala add on to this treasure of wetlands.

Though many taxonomic works were carried out on the floral diversity of Kerala, the studies focusing on wetland plant diversity needs much attention as the area under wetlands in Kerala is falling down due to increasing anthropogenic pressures. The wetlands are being filled up in an alarming pace for developmental activities arising due to construction works. Climate change and shifting pattern of cultivation practices had already affected the existence and extant of wetlands.

In this background, floristic studies are a pre - requisite to assess the status of biodiversity which in turn will help to safeguard the stability of wetland ecosystem by implementing possible strategies to conserve these habitats, and the endemic and threatened species found there. This is also essential for developing an understanding on community ecology and plant distribution with respect to various climatic and edaphic factors. The primary method in determining the plant diversity of a particular region is to subject the floristic elements to a systematic taxonomic treatment.

1.2 Relevance of wetland flora

Aquatic and wetland plants play vital roles in maintaining the balance of the ecosystems irrespective of the region. Their service includes the quality maintenance of water, providing food and shelter for innumerable organisms, and controlling the temperature and humidity around the ecosystem. Under the influence of external factors, the distribution of plants in wetland systems undergoes serious changes. Certain plant species may altogether get extinct in an ecosystem or they may proliferate in such a way that they dominate the ecosystem and will become a nuisance. In many wetlands, the introduction of plant species accidentally has led to the loss many native species. In certain cases, the introduction of aquatic plants for aesthetic purpose led to the dominance of the species and has now become aggressive weeds (Cook, 1990).

The wetland plants are the base elements in many aquatic and terrestrial food chains. A significant part of their productivity goes to the detrital food chain. The wetland flora constitutes many plants which are of edible and medicinal values. Many plants including water lilies are of ornamental value and many wild species of aquatic plants are of potential aesthetic values.

1.3 Need and significance of the study

Floristic investigations and taxonomic treatments will provide dependable data and reliable information about the distribution, behavior and ecology of various plant species. The information obtained thus will work as a baseline data for developing efficient and economically viable strategies to conserve biodiversity of the particular ecosystem. Palakkad district is unique in being placed in the major gap of majestic Western Ghats which straddles the Kerala Tamil Nadu boundary in its southern part. Palakkad district is the largest district of Kerala with a total land area of 4,480 km^2 representing 11.55% of total geographical area of the state. It extends between 10^0 24' N and

11^0 14' N latitudes and 76^0 20' E and 76^0 54' E longitudes. It is bordered by Coimbatore district of Tamil Nadu on the east, Malappuram district on the north and northwest, and Thrissur district on the south. It occupies almost the center part of the state. The Palakkad district spreads over the midland plains with intermittent hillocks and paddy fields, and mountainous highlands.

The district is well known as granary of Kerala due to its contribution in the production of paddy to the state of Kerala. The paddy fields of Palakkad remain as a seasonal wetland ecosystem and supports many life forms. The fall in agriculture sector along with landfilling for developmental activities had reduced the area under paddy cultivation and it resulted in the reduction of wetlands. Palakkad is said to have a wetland area of 11892 hectares which formed around 7.41% of the wetland area of Kerala and 2.65 % of total geographical area of the district (National-Wetland-Atlas-Kerala, 2010).

The diversity of plant forms in wetland ecosystems are under continuous threat due to anthropogenic activities like constructions, land fillings, shift in cultivation, waste disposal, etc. The climate change and alien species invasion are also a major threat to the diversity of plants in these ecosystems. Consequent to climate change, the number of rainy days in Kerala has gone down with drastic change in rainfall pattern. Droughts and floods have become a routine phenomenon. The flood that occurred in the month of August 2018 stands as an obvious example which had altered the composition of wetland flora in the state. Palakkad is one among the worst hit districts of the aforesaid flood and landslides. These factors demand a thorough impact study on the floristic elements of the wetlands of Palakkad which has not been done so far though many studies have been carried out in these regions as part of many major floristic works which neither contains ecosystem specificity nor regional specificity. Considering the above said factors the present work has been carried

out to study the ecology and diversity of the wetland vascular plants of Palakkad district. The flowering plants as well as pteridophytes are being focused in the present study as there are no reports of aquatic gymnosperms from this region.

1.4 Objectives

- Collection and enumeration of the wetland vascular plants of Palakkad district.
- Prepare herbarium of the collected specimens for future reference.
- To assess the Plant form, distribution and endemism of the wetland vascular plants of the Palakkad district.

Chapter 2

THE STUDY AREA

2.1 History of Palakkad

Etymologically it is believed that Palakkad derived its name from the Malayalam words "Pala" (*Alstonia scholaris* (L.) R. Br.) and "kadu" Which means forest (Anonymous, 2011). Palakkad District became an administrative unit of Kerala State on 1st January, 1957 by the division of erstwhile Malabar district. It constituted six taluks including Ponnani, Ottappalam, Perinthalmanna, Palakkad, Alathur and Chittur. Consequent to the formation of Malappuram district in 1969, it underwent many changes and became a district with five taluks. The taluks include Palakkad, Alathur, Ottappalam, Mannarkad, and Chittur. Later in 2013, on administrative and public interest, Ottappalam taluk has been bifurcated to form Ottappalam and Pattambi taluks which ultimately led to the formation of six taluks in the district.

2.2 Location and physiography

Palakkad is situated in the middle of the state and is the largest district in Kerala. It lies between 10^0 24'N and 11^0 14'N latitudes and 76^0 20' E and 76^0 54' E longitudes. It is bounded on the east by Coimbatore district of Tamil Nadu, on north and north west by Malappuram district, and on south by Thrissur district. The district forms a part of the major Gap in Western Ghats called Palghat Gap. The district is considered as the gateway of Kerala since it is major way to move in and out of the state from its inception to the commissioning of Konkan railway. It remains as a major entrance to the state of Kerala. The total area of the district is 4,480 sq.km. The Palakkad city forms the headquarters of the district. The district is divided into two Physiographic zones; the midlands and the highlands. Pattambi and Ottappalam taluks falls under midlands while all other

four taluks (Mannarkkad, Palakkad, Chittur and Alathur) forms a combination of highlands and midlands. (Fig. 1)

2.3 Soil types

Soil type has a profound influence on the plant distribution in a region (Ansari *et al.*, 2016). The soil of the district is classified into four major types *i.e.*, Black cotton soil, Virgin forest soil, Alluvial soil and Laterite Soil. Black cotton soils are found in Chittur and Attappadi regions. There will be mud cracks in the soil and they have high water retaining capacity. Laterite soils are found in major parts of Pattambi, Ottappalam, Chittur, Palakkad and Alathur Taluks. They form the major soil type in the midland regions of the Palakkad Gap. Virgin forest soils are found in forest areas and parts of Mannarkkad. The soil here is rich in Organic matter and humus. Alluvial soils are mainly found in valley region of Bharathapuzha and its tributaries (Anonymous, 2016).

2.4 Climate

The climate of the district is humid in nature throughout the year. Being located in the Palakkad Gap the district experiences a climate different from other districts of Kerala. Seventy one percent of the rainfall is received from southwest monsoon and nearly eighteen percent during the northeast monsoon. The western region of the district around Pattambi is getting the maximum rainfall while the rain shadow region of Chittur in the eastern side reports the minimum rainfall. The maximum temperature ranges from 28.1 to 37.4^{0}C while the minimum temperature ranges from 22.2 to 25.3^{0}C. The mean annual maximum temperature is found to be 32.3^{0}C and the mean annual minimum temperature is found to be 23.4^{0}C. (Anonymous, 2016).

2.5 Wetland ecosystems in Palakkad

The district is rich with wetlands. There are river systems, ponds, tanks, and paddy fields. The district is drained by two major river systems. Bharathapuzha (Nila) flowing towards west is the major river draining the district. Kunthi puzha and Gayathripuzha along with many rivulets are the important tributaries of this river. The Attapady area is drained by Bhavani river, which flows towards east. There are eleven major dams which include Parambikulam, Peruvaripallam, Thoonakadavu, Chulliyar, Pothundi, Shiruvani, Meenkara, Walayar, Malampuzha, Kanjirapuzha and Mangalam. There are around 780 ponds / tanks of different size in the district (N W A: Kerala, 2010). The district has around 65,513 Ha. under paddy cultivation (Anonymous, 2017) which supports many wetland species.

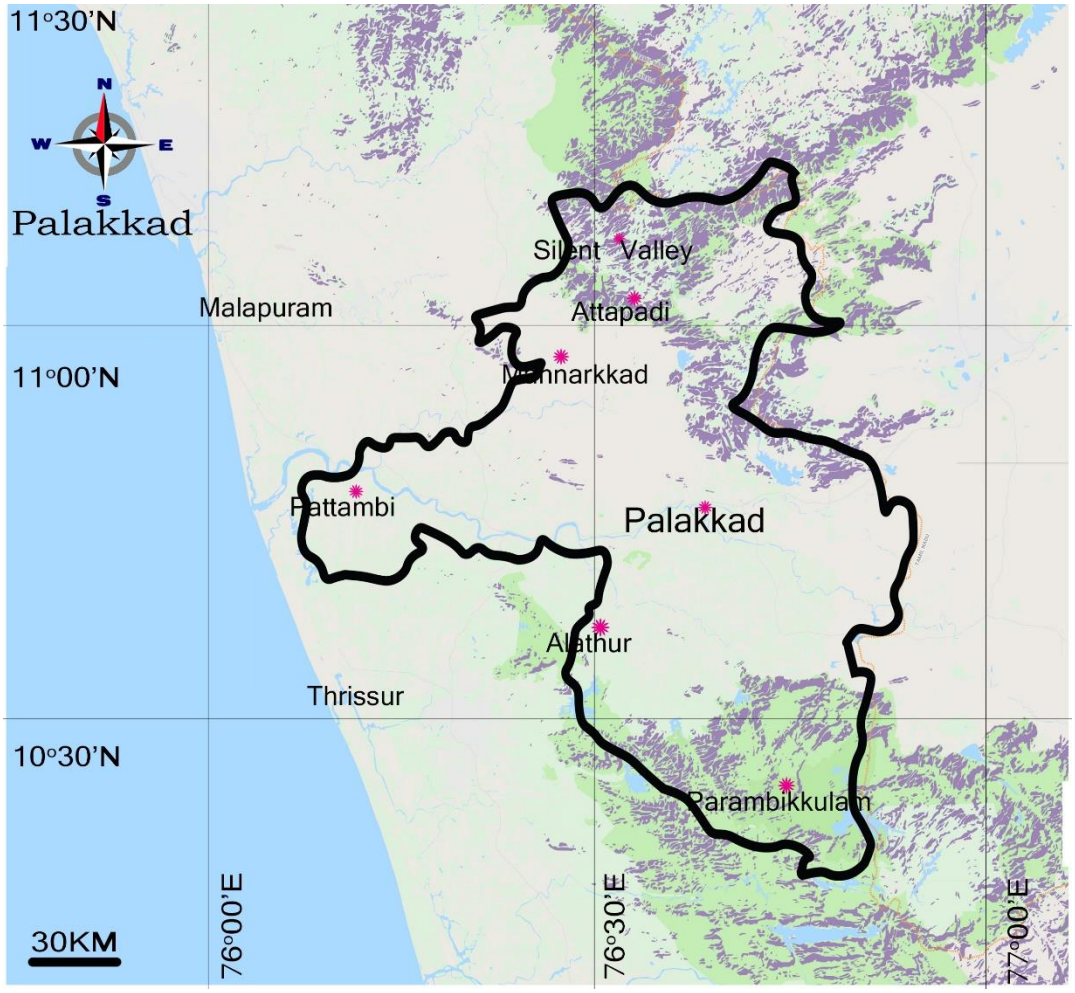


Fig.1 Map of the study area (Palakkad district, Kerala state, India)

Chapter 3

REVIEW OF LITERATURE

3.1 Importance of wetlands: Ecology and economics

Though wetlands have played a vital role in the human civilization, the attention of plant biologists to this ecosystem focused only from the beginning of twentieth century. In the beginning humans preferred to settle primarily in fertile lands adjoining the rivers due to the bonanza provided by these lands for food, water and fodder. Verhoeven and Setter (2010) assert that such floodplains in Mesopotamia were the cradle of human civilization around six thousand years ago. Wetland provides many services to mankind and life on earth. It is said that there are four ecosystem services provided by the wetlands which have global significance (Greeson *et al.*, 1979). They include improvement of water quality, carbon sequestration and management, biodiversity sustenance, and flood reduction. The estimated value of ecosystem services provided by wetlands is far above when compared with the tropical forests. It is found that the total ecosystem services of wetlands come to a monetary value of $14,785/ ha/year while the value of tropical forests is $2007/ ha/ year (Costanza *et al.*, 1997).

Wetlands are known to hold water during the dry season and supports to maintain the water table relatively high and stable. They also play a vital role during floods by mitigating the flood and trapping the suspended solids and associated nutrients. They also act as breeding and feeding ground for many wildlife species. In addition to these, they also act as a refuge and brooding site for migrating birds. These uses make them important for supporting species diversity as any other natural habitat (Prasad *et al.*, 2002).

Wetlands behave like sponges in the presence of vegetation and prevents evaporation of water during the summer season (Husain and Bhatnagar, 2013). It is estimated that a hectare of wetland stores

nearly one lakh litres of water in one centimeter depth and thus they act as an efficient tool for natural water conservation (Arya and Syriac, 2018).

Wetlands are counted among the ecosystems which are highly productive. Their primary productivity and water availability support enormous number of life forms. They remain as vital storehouse of plant genetic resources like rice which forms the staple food for more than fifty percent of the human population. The multitude of functions done by wetland ecosystems and their value to mankind have been revealed and documented in recent times which led to the restoration of many wetlands. The accelerating human population growth and climate change will have its adverse effects on wetlands and the ability of wetlands to adjust with the changing situations will be key to the survival and sustenance of humans and wildlife everywhere (Ramsar-Convention-Secretariat, 2016). The major ecosystem goods supplied by the wetlands include water supply for household uses and irrigation, fisheries, recreation, and non - wood forest products. While the prominent ecosysytem services are carbon sequestration, biodiversity conservation, flood mitigation, water table maintenance and ground water recharge, nutrient cycling and toxicity reduction (Turner *et al.*, 2000). Thus, wetlands provide several significant services to mankind (Ten Brink *et al.*, 2012). Wetlands act as carbon sinks and store carbon for long period in its sediments and for short period in the biomass and dissolved components (Wylynko, 1999). They remain as excellent carbon sinks due to its higher rate of carbon sequestration in organic matter and lower rates of decompositions (Pant *et al.*, 2003).

Wetlands deserve special mention in reducing the level of pollution. They have been proposed as a cost - effective way to reduce the pollution (Byström *et al.*, 2000). The riparian wetlands are known to reduce the nutrient load of water (Verhoeven *et al.*, 2006). In temperate areas, the nitrogen and phosphorus are removed at rate ranging from 1000 - 3000 kg/ha of land per year and 60 to 100 kg/ha

of land per year respectively (Kadlec and Reddy, 2001; Groffman and Crawford, 2003). Billore *et al.* (1999) and Kaur *et al.* (2012) experimentally pointed out the use of constructed wetlands in reducing pollution. Similar works on treatment of wastewater and restoration of aquatic systems using constructed treatment wetlands were done by Prashant *et al.* (2013) and Billore *et al.* (2001). In treatment wetlands, plant roots and its surroundings form the base of root zone technology in reducing pollutants (Vipat *et al.*, 2007). Floating plants like *Azolla, Eichhornia,* and *Lemna* and rooted emergent like *Typha, Phragmites,* etc. are a few identified wetland plants with potential to remove pollutants like heavy metals (Rai, 2008). The vegetation of wetlands is capable to remove contaminants and filter the excess nutrients from runoff water in agricultural lands before it flows into the watersheds of neighborhood (Farrell and Scheckenberger, 2003). They are also having the potential to stabilize the soil along the banks of streams and rivers (Mitsch and Gosselink, 2000).

Wetlands have a pivotal role in controlling floods. They assist in minimizing the impact of floods by reducing the velocity of the flow of water and also by absorbing the water. They very well trap the suspended solids and nutrient loads during floods (Bassi *et al.*, 2014). Due to the ability and effectiveness in reducing the flood damage, wetlands are treated as natural capital substitute for conventional flood control investments like dams (Boyd and Banzhaf, 2007). Wetlands are sources of food, fodder, fisheries and medicines. They are also a place for recreation and cultural activities (Arya and Syriac, 2018). Like other habitats of natural origin, wetlands forms abode for varied species. They support the conservation of biodiversity. It is estimated that there are more than 1200 species of aquatic plants (Prasad *et al.*, 2002). Some animals rely on wetlands for their entire life cycle while others depend on these ecosystems for a short period in certain stages of their life (Bassi *et al.*, 2014). In nutshell, on one

hand, Wetlands support large biological diversity and on the other hand they provide a wide range of ecosystem goods and services (Anonymous, 2010).

3.2 Definition of wetlands

Wetlands and wetland plants are defined by various authors in various ways, many of which are highly apt in certain regions and may not be applicable to certain other localities. Mitsch and Gosselink (1986) treated wetlands as *"lands transitional between terrestrial and aquatic ecosystems, where the water table is usually at or near the surface or the land is covered by shallow water*". Watzin and Gosselink (1992) defined wetlands as *"transitional areas between permanently flooded deep water environments and well drained uplands that contribute a wide array of biological, social and economic benefits".*

The Ramsar-Convention-Secretariat (2013) has come up with a definition which is broad enough to include almost all the wetlands. It defines wetlands as *"areas of marsh, fen or peatland, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres".*

In a recent review on wetlands by Arya and Syriac (2018), they opined that "*All wetlands are wet lands (i.e., land which is wet) but not all wet lands result in a wetland"*. They further pointed out that *"A wetland is found where the land is wet enough (i.e., saturated or flooded) for long enough to be unfavorable to most plants but are favorable to plants adapted to anaerobic soil conditions".*

Cook (1996) in his well - known book "Aquatic and Wetland Plants of India" has said that as per US legislation wetlands are *"a place where the total vegetation has eighty per cent or more wetland plants".* He also opined that this definition is potentially a threat to the conservation of wetlands and he considered wetlands as *"place where*

inundation must occur for at least 14 days and saturation for at least 60 consecutive days".

The definition of aquatic plant is a difficult one. Many authors have described it in various ways. Regrettably there was no universally acceptable definition and it is a reality that it is impossible to have a definition in universal terms. It is mainly because of the various habitats that exists in the boundary of land and water which undergoes changes over space and time. Water is a necessary requirement for all plants and their requirement varies widely. Many of the known terrestrial plants can withstand flooding to various degree, and many of the well accepted 'truly aquatic plants' can bear some degree of dehydration (Lavania *et al.*, 1990). This might be the reason for wetland biologists like Arber (2010) to use the term 'Water plants' for all the plants that are growing in water without much categorization. Raunkiaer (1904, 1934) treated plants which have submerged vegetative shoots, leaves submerged or floating on water surface, and inflorescence above the water surface as hydrophytes. According to him plants perennate as submerged buds. This definition is not broad enogh to include true floating aquatics like *Azolla* and *Salvinia* (Lavania *et al.*, 1990). Braun-Blanquet *et al.* (1932) called annual aquatic plants surviving through seeds as 'hydrotherophytes'. Iversen (1936) went to the extent to call plants with submerged or floating vegetative parts only as aquatic. He treated the plants with aerial and aquatic leaves as 'amphiphyte'. Muenscher (1944) treated aquatic plants as *"those species which normally stand in water and must grow for at least a part of their life cycle in water, either completely submersed or emersed"*

Braun-Blanquet *et al.* (1932) classified aquatic plants into and 'radicantia', 'adnata' and 'natantia' based on rooted, attached and free floating forms respectively. Subsequent studies by Weaver *et al.* (1938) widened the definition to bring in the plants growing in water and submerged soil. Reid (1961) broadened the idea by including those

plants whose seeds will germinate either in land or water and will have a part of their vegetative phase in water. Penfound (1952) separated wetland plants from aquatic plants on the basis of water logged areas and soils under water. He classified aquatic plants in to floating, emergent and submerged categories. A comparatively broader definition was given by Den Hartog and Segal (1964). They defined hydrophytes as "*plants which are able to achieve their generative cycle when all vegetative parts are submerged or are supported by the water (floating leaves), or which occur normally submerged but are induced to reproduce sexually when their vegetative parts are dying due to emersion".*

Lavania *et al.* (1990) finds this definition unsatisfactory as many undisputed aquatic plants like *Eichhornia , Typha , Salvinia* etc. cannot be fitted in to the definition. In the words of Subramanyam (1962), it is not easy to define aquatic plants without the fear of contradiction due to the presence of numerous borderline taxa. Sculthorpe (1971) too of the opinion that it is difficult to suggest a definition for aquatic vascular plants that is universally acceptable since aquatic habitatas can not be clearly distinguished from terrestrial ones.

Hejný (1960) separated obligate water plants from facultative amphibious plants of flooded soils and separated the latter from terrestrial plants. Den Hartog and Van der Velde (1988) pointed out the limitations of the definition given by Hartog & Segal and suggested to include plant forms like helophytes and similar categories within the definition of aquatic plants. Best (1988) used the term aquatic plants to include all herbaceous plants usually found in littoral zones or marshes. Lavania *et al.* (1990) opined that all plants of the aquatic habitats cannot be designated by a single term and they used the word 'aquatic plants' to include the plants which grow in intermittently or permanently flooded habitats where the growth of such plants is promoted by waterlogging or submergence. Later on Cook (1996)

defined Aquatic vascular plants as "*all pteridophytina (fern and fern allies) and spermatophytina (seed bearing plants) whose photosynthetically active parts permanently or, at least, for several months each year partly or wholly submerged in water or which float on the surface of water*"

He had excluded those plants from the list of wetland plants which are found in areas that get flooded each year but drain quickly and make the soil free of long periods of waterlogging after the receding of floods. The national wetland atlas (National-Wetland-Atlas-Kerala, 2010) defines wetlands as *"areas of land that are either temporarily or permanently covered by water. This means that a wetland is neither truly aquatic nor terrestrial; it is possible that wetlands can be both at the same time depending on seasonal variability".*

All these definitions prove their inadequacy to demarcate aquatic and wetland plants. In the words of Gopal (2015) wetlands are found in wide range of latitudes with varied climate, that too from sea level to above 5500 m altitude and covering such an enormous diversity of dissimilar habitats within an umbrella word 'wetland" makes it impossible to define what a wetland is.

3.3 Wetland: Global scenario

Wetlands are treated as areas where the environment, and allied plant and animal life are controlled by water (Niering, 1985; Ramsar-Convention-Secretariat, 2016). They are important for survival of human beings and they constitute some of the most productive ecosystems found in the world (Millennium-Ecosystem-Assessment, 2005). They also provide many ecosystem services which ultimately leads to numerous benefits (Russi, 2013). Wetlands play a vital role as source and purifier of water. They shield us from floods, droughts and famine. They provide livelihoods to a major part of human population, they help to maintain high level biodiversity, and they store more carbon when compared with other ecosystem. But the value of wetlands has not attained the attention of decision makers and policy

holders. (Ramsar-Convention-Secretariat, 2018). To conserve the wetlands, there were a lot of initiatives and strategies organized at national as well as international level. Ramsar convention which was signed by delegates of 18 countries on 2nd February, 1972 at Ramsar in Iran is the one which was highly successful and still continues to work towards achieving the goals (Arya and Syriac, 2018). Globally there are more than 2300 wetlands designated as Ramsar sites which covers around 250 million hectares. It comes to nearly 13 - 18% of coastal and terrestrial wetlands (Davidson and Finlayson, 2018).

3.3.1 Area and extent of wetlands

Wetlands are found to occur throughout the earth, from the temperate tundra to the hot and humid tropics (Ramsar-Convention-Secretariat, 2016). Based on the available data, it is estimated that 35 % of wetlands were already lost since 1970. The rate at which wetlands are lost is much higher than the loss of global forest cover and it is estimated to be more than three hundred percent of the forest loss (Ramsar-Convention-Secretariat, 2018).

The global estimates of wetlands are really confusing, and various authors have come up with different estimates. Finlayson and Davidson (1999) estimated the areal extent of wetland ecosystems all over the world to be more than 1275 million hectares while Lehner and Döll (2004) estimated it to be around 917 million hectares. Ramsar-Convention-Secretariat (2013) estimated it to be around 570 million hectares. Due to the advancement in technology, precision of global wetland area measurement has increased. Wetlands, both inland and coastal, covers almost more than 12.1 million square kilometers. This area comes to total area occupied by Greenland. Among these wetlands, 54 % represents permanently inundated wetlands and the rest seasonal. When considering inland wetlands, it forms 93% of the total wetlands and the rest 7% is marine and coastal wetlands. Though wetlands were lost by 35 % from 1970, the man - made wetlands

including paddy fields and reservoirs has increased by roughly 100 percentage and now they form around 12 percent of the wetlands. Unfortunately, this growth in manmade wetlands could not compensate the loss happened to natural wetlands (Ramsar-Convention-Secretariat, 2018). Globally, the extent of manmade wetlands is insignificant when compared with natural wetlands. The paddy fields and reservoirs measure around 1.3 million km^2 and 0.3 million km^2 respectively (Davidson, 2014; Davidson and Finlayson, 2018). The global estimates of wetlands have increased considerably since 1980 due to the advancements in the field of remote sensing technology. It should be noted that the increase does not reflect the original status but is due to the developments in the field of remote sensing and mapping strategies. It is interesting to note that the recent evaluation of changing patterns in global area under water inundation and open water (both natural and manmade wetlands) shows both increase (Pekel *et al.*, 2016) and decrease (Prigent *et al.*, 2012; Schroeder *et al.*, 2015).

Asia has the largest share of wetlands which comes to an estimate of 32% of the total wetlands followed by North America with 27% and, Caribbean and Latin America together 16%. The remaining wetlands are shared by Europe, Africa and Oceania with approximately 13,10 and 3 percentage respectively (Davidson *et al.*, 2018). It is found that nearly 87% of the wetlands has been lost since the beginning of 18^{th} century in places where data is available. The rate of loss of wetlands has significantly gone up in the last part of 20th century (Davidson, 2014).

3.3.2 Biodiversity of wetlands

Wetlands have been recognized as ecosystems that are having significant role in the conservation of biodiversity as it outweighs the biodiversity of many other ecosystems including terrestrial ecosystems (Gopal, 2015; Ramsar-Convention-Secretariat, 2016). The richness of

plant and animal diversity may be the prime reason for giving high priority for wetland conservation throughout the world which is evident from the support received for conservation of these unique ecosystems from international agreements such as the Ramsar Convention and the International Convention of Biological Diversity (Bobbink *et al.*, 2007). The morphology of wetland basins along with the fluctuations in water level due to seasonal changes creates comparatively wide niche diversification which ultimately produce highly dynamic and varied community of plants and animals. Wetland vegetation include an array of diverse organisms starting from unicellular algae to woody angiosperms through bryophytes, mosses and ferns (Gopal, 2015). Ecologically, the high level of species diversity in the wetlands is a sign of the significance of the biodiversity concerns of the aquatic systems (Prasad *et al.*, 2002).

In the opinion of Gopal (2015) Wetland fauna is formed of two kinds of faunal elements (a) those who depend completely on wetlands for their whole life, and (b) those who utilize wetlands for particular needs or for a part of their life. Gopal and Junk (2000) identified six groups of wetland fauna. They are (1) wetland residents (2) regular migrants from terrestrial uplands (3) occasional visitors (4) regular migrants from deep - water habitats (5) regular migrants from other wetlands and (6) fauna which is indirectly reliant on wetland biota.

3.3.3 Taxonomic studies on wetland vegetation in India

'Coloquis dos Simples' by Orta (1565) is treated as the first authentic published work on Indian plants. It enlists the medicinal plants of Western Ghats. It took nearly a century for the arrival of second published work from India. The Monumental work 'Hortus Indicus Malabaricus' published by Rheede (1678), the Dutch Governor of Cochin at that period, remains as an amazing taxonomic treasure. Sunil and Sivadasan (2009) opined that this works is not only a

landmark in the plant resource studies in Asia but also in the history of plant science as it formed a reference for Linnaeus.

The British botanists contributed the major part of taxonomic studies in India. The classic works like 'Icones Plantarum Indiae orientalis' by Wight (1853) and Illustrations of Indian Botany (Wight, 1840), Prodromus Florae Peninsulae Indiae Orientalis (Wight and Arnott, 1834), Icones Plantarum Indiae Orientalis (Beddome, 1874), Flora Indica (Roxburgh and Wallich, 1820) and Flora of British India by Hooker (1872) formed the major pillars of taxonomic studies in India. Flora of British India by Hooker (1872) is still widely being used by botanist as authentic taxonomic reference for Indian plants. Later, there were many regional floristic works covering various provinces and presidencies. Flora of the presidency of Madras (Gamble and Fischer, 1915), Flora of the Upper Gangetic Plain, and of the adjacent Siwalik and sub Himalayan tracts (Duthie *et al.*, 1903), and Flora of the presidency of Bombay (Cooke, 1908) are notable works. Though these works deal extensively with the plants of India there is no special grouping of wetland plants. The wetland plant diversity has been studied broadly by Biswas and Calder (1954). The classic work 'Aquatic angiosperms' by Subramanyam (1962) gained attention of taxonomist due to its beautiful drawings and simple description. It remains as a handbook for biologists working on wetland ecology. It dealt with 117 species of aquatic plants both fresh water and marine belonging to 32 families. Later, the diversity and various aspects of aquatic and marsh vegetation were compiled by Gopal (1990).

An exhaustive work on wetland plants of India was carried out by Cook (1996). He described 644 species of plants from India. The revisionary work on aquatic and wetland plants are limited but a few are noteworthy and is being used as reference throughout India. Sivarajan and Joseph (1993) had reviewed the *Nymphoides* in India. Ansari *et al.* (2009) had extensively discussed on the waterlilies of India including the cultivation aspects of *Nymphaea* . Similarly, Ansari

et al. (1994) worked on the taxonomy and distribution of Eriocaulaceae in India. The studies of bladderworts of India by Janarthanam and Henry (1992) is another outstanding work which describes the *Utricularia* spp. found in India. Nagendran and Arekal (1981) had studied the Indian Podostemaceae.

Joseph and Sivarajan (1989) has reviewed the Genus *Rotala* in South India and there after there were series of discoveries of new species in the genus *Rotala* which shows that there is a hidden wealth of wetland plants even after revisionary studies in a particular taxon in India. *Rotala malabarica* Pradeep *et al.* (Pradeep *et al.*, 1990), *Rotala andamanensis* S. P. Mathew & P. Lakshminarasimhan (Mathew and Lakshminarasimhan, 1990), *Rotala belgaumensis* Yadav *et al.* (Yadav *et al.*, 2010), *Rotala tulunadensis* Prasad *et al.* (Prasad *et al.*, 2012), *Rotala sahyadrica* Gaikwad *et al.* (Gaikwad *et al.*, 2014), *Rotala kasaragodensis* Prasad & Raveendran (Prasad and Raveendran, 2013b), *Rotala meenkulamensis* K. S. Prasad & K. Ravi (Prasad and Raveendran, 2013a), *Rotala khaliliana* Sunil *et al.* (Sunil *et al.*, 2013a), *Rotala dhaneshiana* Sunil *et al.* (Ratheesh Narayanan *et al.*, 2014), *Rotala cheruchakkiensis* Anto *et al.* (Anto *et al.*, 2014) *Rotala anamika* Lemiya (Lemiya and Pradeep, 2015), *Rotala kanayensis* Rijuraj *et al.* (Rijuraj *et al.*, 2017) are a few additions after the review of *Rotala* by Joseph and Sivarajan (1989). These discoveries warrant the need of thorough exploration of the wetland plant wealth of India. The comparatively recent work on the Genus *Ludwigia* of the family Onagraceae in India by Barua (2010) is also a noteworthy work. There were other novelties to the wetland flora of India as evident from the discoveries of *Eriocaulon peninsulare* Punekar & Laksminarasimhan (Punekar and Lakshminarasimhan, 2003) *Pandanus palakkadensis* Nadaf *et al.* (Nadaf *et al.*, 2011), *Crinum malabaricum* Lekhak & S. R. Yadav (Lekhak and Yadav, 2012), *Eriocaulon baramaticum* Shimpale *et al.* (Shimpale *et al.*, 2009), *Eriocaulon pykarense* Nampy & Manudev (Nampy *et al.*, 2011), *Eriocaulon parvicephalum* A. M. Darshetkar *et al.*

(Darshetkar *et al.*, 2017), *Zeylanidium crustaceum* M. Kato (Kato *et al.*, 2015), etc.

In Kerala, the wetland plants received greater attention through the work of Joseph (1991) which dealt with floristic exploration of the aquatic angiosperms of erstwhile Malabar. During the same period, Sreekumar and Nair (1991) came out with their work on Poaceae of Kerala, which included many aquatic and wetland floristic elements. Similarly, Rejani (1991) worked on the Cyperaceae of Kerala and it remains as an authentic reference for the cyperacean plants of Kerala. Mathew and Satheesh (1997) worked on the taxonomy and distribution of Podostemaceae in Kerala. They discussed about 13 species belonging to nine genera. The digital database of the flowering plants of Kerala by Sasidharan (2013) has included 5094 flowering plants out of which 535 are aquatic and marshy plants. An exhaustive work on aquatic and wetland plants were carried out by Ansari *et al.* (2016), which describes 701 flowering plants. This is the only work which has focused on the aquatic and wetland flora of Kerala in detail. The drawings, photographs, diagnostic keys and descriptions make this work a primary handbook for wetland biologists.

Many species of *Eriocaulon* were discovered from Kerala after Janarthanam and Henry (1992). *Eriocaulon devendranii* R. Vijaya Sankar *et al.* (Sankar *et al.*, 2006), *Eriocaulon wayanadense* Vivek *et al.* (Vivek *et al.*, 2010), *Eriocaulon malabaricum* Pradeep & Nampy (Nampy *et al.*, 2011), *Eriocaulon madayiparense* Swapna *et.al.* (Swapna *et al.*, 2012), *E. cheemenianum* P. Biju *et al.* (Biju *et al.*, 2012), *Eriocaulon kannurense* Sunil *et al.* (Sunil *et al.*, 2013b), *Eriocaulon gopalakrishnanum* K. Rashmi & G. Krishnakumar (Rashmi and Krishnakumar, 2014), *Eriocaulon vandaanamense* Sunil *et al.* (Sunil *et al.*, 2015), *Eriocaulon manoharanii* Sunil & Naveen Kumar (Sunil and Naveen Kumar, 2015), *Eriocaulon biappendiculatum* Manudev *et al.* (Manudev *et al.*, 2015), *Eriocaulon periyarense* Sunil *et al.* (Naveen

Kumar *et al.*, 2017), *Eriocaulon govindiana* Sunil & Ratheesh (Sunil *et al.*, 2017), *Eriocaulon idukkianum* Manudev *et al.* (Manudev *et al.*, 2017), *Eriocaulon pradeepii* Anto & Reshma (Anto and Reshma, 2017), *Eriocaulon albotetrandra* Biju *et al.* (Biju *et al.*, 2018) are the notable discoveries in the family Eriocaulaceae. Many other Wetland species like *Blyxa kasargodensis* Biju *et al.* (Biju *et al.*, 2016a), *Nymphoides balakrishnanii* Biju *et al.* (Biju *et al.*, 2016b), *Utricularia sunilii* Naveen Kum. and K. M. P. Kumar (Naveen Kumar *et al.*, 2018) are also recently reported from Kerala.

In Palakkad, floristic collections were sporadically made by giants of Indian taxonomy like Beddome, Lawson and Wight (Vajravelu, 1990) but the taxonomic studies focusing on vegetation of Palakkad district was initiated by Subramaniyan *et al.* (1987). They have enumerated 757 species from the district. Manilal (1988) through his explorations in Silent Valley National Park reported 966 species belonging to 134 families under 559 genera. A comprehensive and thorough floristic work covering the whole district was later done by Vajravelu (1990) which came out as a publication of Botanical Survey of India. In this work 1355 species of flowering plants were recorded from the district. Sasidharan (2002) surveyed the Parambikulam Tiger Reserve and he enumerated 1434 species under 755 genera and 142 families. Anil Kumar (2015) has recently worked on the plant diversity of Attappadi Hills. He recorded 1661 species with two sub species and seven varieties under 818 genera and 160 families. Sasidharan (2013) had included 2942 species of flowering plants in Palakkad district.

Many new species were reported from Palakkad recently. *Eriocaulon devendranii* R. Vijaya Sankar *et al.* (Sankar *et al.*, 2006) *Pandanus palakkadensis* Nadaf *et al.* (Nadaf *et al.*, 2011) *Chlorophytum palghatense* K. M. P. Kumar and Adsul (Prabhukumar *et al.*, 2014) *Impatiens sahyadrica* (Hareesh *et al.*, 2015) *Oldenlandia dineshii* sojan and V. suresh (Jose *et al.*, 2015), *Oldenlandia vasudevanii* Soumya & Maya (Soumya *et al.*, 2017), *Pilea victoriae* V.

Suresh and Sojan (Jose *et al.*, 2017) *Utricularia sunilii* Naveen Kum. & K. M. P. Kumar (Naveen Kumar *et al.*, 2018) are some of the recent floristic novelties.

Chapter 4

MATERIALS AND METHODS

4.1 Floristic exploration

Extensive floristic collection trips of various duration ranging from 1 – 5 days were carried out at regular intervals in the wetlands of Palakkad district during 2015 - 2019. Various localities including paddy fields, rivers, rivulets, seasonal wet rocks, ponds, and dams were surveyed. The herbaceous specimens were collected along with soil in polythene bags to protect it from desiccation and were brought to the lab for identification and herbarium preparation. The larger specimens were collected as flowering twigs and were treated with FAA (Formalin – Acetic acid - Alcohol) in blotting papers and sealed them in polythene bags to kill and fix the material from the field itself. The flowers were collected in small bottles and preserved them in FAA for dissection purpose. The field data with respect to habit, colour of flower, habitat, fruit morphology, odour and colour of floral parts, and phenology of the collected specimen were noted in the field book. Photographs were taken from the field using Canon Power Shot SX 260 HS. The herbarium of the specimens was prepared based on the standard specification proposed by Bridson and Forman (1998). The collected specimens were brought to the lab and were subjected to dissection and analysis using stereo microscope and described. The specimens were identified using pertinent literature (Hooker, 1872; Cooke, 1908; Gamble and Fischer, 1915; Vajravelu, 1990; Manickam and Irudayaraj, 1992; Nayar and Geevarghese, 1993; Cook, 1996; Sasidharan, 2013; Madhusoodanan, 2015; Ansari *et al.*, 2016) including protologues. Wherever required, authentic herbaria of BSI Coimbatore (MH), Centre for Medicinal Plant Research, Kottakkal (CMPR), Malabar Botanical Garden and Institute for Plant Sciences (MBGH), Kerala Forest Research Institute (KFRI) and digital herbaria

of Kew Botanical Garden (K) were consulted. The processed herbarium was deposited at MBGH Calicut.

4.2 Presentation of data

The Angiosperms identified were assigned to the families following APG - IV system of classification and pteridophytes were assigned to the families following Christenhusz *et al.* (2011). Artificial diagnostic keys (Dichotomous) were prepared for the identification of the family, genera and species. The keys for identifying genera under various families and species under various genera were given in respective places. To obtain the accepted legitimate name of the specimen, the website of IPNI (International Plant Names Index, http://www.ipni.org) and digital database http://www.theplantlist.org were consulted. The families were arranged alphabetically for easy reference following Cook (1996) and Ansari *et al.* (2016). The genera under respective families and species under respective genera were also arranged alphabetically. The author citation along with citation of the original publication were provided with the binomial. Important synonyms along with citations of the plant taxa were also incorporated. Detailed description of every species was given after the nomenclatural citations. The flowering and fruiting period, plant form, distribution, habitat, collection number and locality were presented after the description.

The conservation status of the species was obtained from IUCN Website (http://www.iucnredlist.org), Sasidharan (2013) and relevant protologues. The endemic status of plants was obtained from Sasidharan (2013) and pertinent protologues. The invasive status of the species was obtained from Global Invasive Species Database (http://www.iucngisd.org), Reddy *et al.* (2008), and Sankaran *et al.* (2012).

The plant forms of aquatic and wetland species were recorded through field observations based on the classification given by Cook (1996). The plants were categorized by Cook (1996) into Ephydate

(Bottom rooted plants with floating leaves), Haptophytes (Attached to the substrate but not penetrating it), Helophyte (Terrestrial ones that tolerate submergence), Hyperhydate (Emergent aquatics), Plankton (free swimming below the surface). Pleustophyte (Free floating at the water surface), Rosulate (submerged, bottom rooted, leaves in rosette). Tenagophytes (Juvenile submerged, adult usually terrestrial) and Vittate (Submerged, bottom rooted with cauline leaves). Trees which tolerate water saturation or inundation for long periods and whose seedlings will not tolerate drought for long are also treated under helophytes in this study.

Chapter 5

RESULTS

5.1 Systematic treatment of the aquatic and wetland angiosperms of Palakkad

The plant specimens collected and identified from the wetlands of Palakkad district during the period from 2015 - 2019 were subjected to systematic taxonomic treatment. Suitable detailed taxonomic keys were prepared for the identification of the taxa. Separate Keys were prepared for Angiosperms and Pteridophytes. A brief description of the species was also prepared with notes on their flowering and fruiting period, distribution, habitat and Growth form.

5.2 Key to the families of angiosperms

1a. Plants with 3 merous flowers, embryo with one cotyledon, venation parallel 2
1b. Plants with 4 - 5 merous flowers, embryo with two cotyledons, venation reticulate..... 19
2a. Plants submerged 3
2b. Plants emergent or floating 4
3a. Leaves dimorphic ..... Potamogetonaceae
3b. Leaves monomorphic ..... Hydrocharitaceae
4a. Ovary inferior 5
4a. Ovary superior..... 8
5a. Ovule one in each cell ..... Marantaceae
5b. Ovule many in each cell 6
6a. Calyx winged ..... Burmanniaceae
6b. Calyx not winged 7
7a. Leaves radical ..... Hypoxidaceae
7b. Leaves cauline ..... Cannaceae

8a. Flowers in heads or spikelets of solitary flowers in axils of glumaceous bracts 9
8b. Flowers not as above 11
9a. Flowers in heads ..... Eriocaulaceae
9b. Flowers in spikelets 10
10a. Stem terete, anthers dorsifixed or versatile ..... Poaceae
10b. Stem triangular atleast at the tip, anthers basifixed ...Cyperaceae
11a. Flowers in spadices, spikes or racemes.....12
11b. Flowers in clusters or solitary..... Araceae
12a. Perianth absent or represented by hairs or scales 13
12b. Perianth present 15
13a. Inflorescence a spadix subtended by spathe or spathaceous bract 14
13b. Inflorescence a spike not subtended by spathe ..... Typhaceae
14a. Plants dioecious ..... Pandanaceae
14b. Plants monoecious 66
15a. Carpels free ..... Alismataceae
15b. Carpels united 16
16a. Inner perianth sepaloid ..... Juncaceae
16b. Inner perianth petaloid 17
17a. Outer perianth petaloid ..... Pontederiaceae
17b. Outer perianth Sepaloid 18
18a. Leaves always radical ..... Xyridaceae
18b. Leaves cauline ..... Commelinaceae
19a. Perianth uniseriate or absent..... 20
19b. Perianth two seriate 27
20a. Plants submerged 21
20b. Plants not submerged 22
21a. Flowers bisexual ..... Podostemaceae
21b. Flowers unisexual ..... Ceratophyllaceae
22a. Flowers bisexual 23
22b. Flowers unisexual 24
23a. Stipules sheathing ..... Polygonaceae

23b. Stipules not sheathing or absent 26
24a. Ovary one celled 25
24b. Ovary two or more celled ..... Euphorbiaceae
25a. Plants herbs ..... Urticaceae
25b. Plant trees ..... Salicaceae
26a. Flowers in globose heads ..... Amaranthaceae
26b. Flowers not as above ..... Molluginaceae
27a. Corolla united 28
27b. Corolla free 48
28a. Ovary inferior 29
28b. Ovary superior 32
29a. Stamens free from corolla 30
29b. Stamens inserted on the corolla 31
30a. Corolla zygamorphic ..... Campanulaceae
30b. Corolla actinomorphic ..... Sphenocleaceae
31a. Inflorescence head, stipules absent ..... Asteraceae
31b. Inflorescence not as above, stipules inter petiolar ..... Rubiaceae
32a. Ovary 1 – locular 33
32b. Ovary 2 – many locular 36
33a. Plants insectivorous ..... Lentibulariaceae
33b. Plants not insectivorous..... 34
34a. Leaves floating ..... Menyanthaceae
34b. Leaves not as above 35
35a. Corolla lobes 4 ..... Gentianaceae
35b. Corolla lobes 5 ..... Gesneriaceae
36a. Corolla actinomorphic 37
36b. Corolla zygamorphic 40
37a. Ovary cells with 1 - 4 ovules 38
37b. Ovary cells with many ovules..... 39
38a. Corolla lobes plicate ..... Convolvulaceae
38b. Corolla lobes not plicate ..... Boraginaceae
39a. Plants with milky latex ..... Apocynaceae
39b. Plants without milky latex ..... Hydrophyllaceae

40a. Style gynobasic ..... Lamiaceae
40b. Style terminal 41
41a. Fruit a capsule, seeds few to many 42
41b. Fruits other than capsule, seeds 1 - 4 ..... Verbenaceae
42a. Capsule opening elastically from apex, bracts prominent ..... Acanthaceae
42b. Capsule not opening elastically from apex, bracts not prominent..... 43
43a. Filaments of at least two stamens or staminodes appendaged, hooked or knee like ..... Linderniaceae
43b. Filaments of stamens or staminodes not appendaged, hooked or knee like 44
44a. Perfect stamens 2 45
44b. Perfect stamens 4 47
45a. Anthers two celled 46
45b. Anthers one celled ..... Phrymaceae
46a. Anther locule parallel ..... Plantaginaceae
46b. Anther locule divergent ..... Linderniaceae
47a. Leaves all pinnatisect if not pinnatisect then anther cells spurred ..... Orobanchaceae
47b. Leaves not pinnetisect ..... Plantaginaceae
48a. Stamens hypogynous or if perygynous then petals many..... 49
48b. Stamens epigynous or if perygynous 58
49a. Stamens more than 10..... 50
49b. Stamens 10 or fewer 53
50a. Petals 4 or 5..... 51
50b. Petals many 52
51a. Leaves simple 56
51b. Leaves trifoliate..... 57
52a. Carpels free ..... Nelumbonaceae
52b. Carpels fused ..... Nymphaeaceae
53a. Flowers trimerous ..... Elatinaceae
53b. Flowers 4 - 5 merous 54

54a. Ovary one celled ..... Caryophyllaceae
54b. Ovary 5 celled 55
55a. Flowers regular, sessile ..... Elatinaceae
55b. Flowers irregular, pedicelled ..... Balsaminaceae
56a. Leaves orbicular or reniform ..... Celastraceae
56a. Leave lanceolate - ovate ..... Hypericaceae
57a. Herbs ..... Oxalidaceae
57b. Trees ..... Capparaceae
58a. Flowers unisexual ..... Haloragaceae
58b. Flowers bisexual 59
59a. Ovary superior 60
59b. Ovary inferior or semi inferior 62
60a. Fruit a legume or lomentum ..... Fabaceae
60b. Fruit not as above 61
61a. Plants insectivorous ..... Droseraceae
61b. Plants not insectivorous ..... Lythraceae
62a. Connective with appendages ..... Melatostomataceae
62b. Connective without appendages 63
63a. Flowers in simple or compound umbels..... 65
63b. Flowers solitary 64
64a. Petioles inflated, fruit a spinose nut ..... Lythraceae
64b. Petioles not inflated, fruit a capsule ..... Onagraceae
65a. Leaf margins clearly divided as lobes; petals 5..... Araliaceae
65b. Leaf margins not divided as lobes; petals 4..... Apiaceae
66a. Floweing stem latteraly compressed..... Acoraceae
66b. Flowering stem not laterally compressed..... Araceae

5.3 Enumeration and description of angiosperms

ACANTHACEAE Juss.

HYGROPHILA R. Br.

1a. Plants armed with spines..... *H. auriculata*
1b. Plants unarmed ..... *H. ringens*

Hygrophila auriculata (K. Schum.) Heine, Kew Bull. 16: 172. 1962; Vajr., Fl. Palghat Dist. 350. 1990; *Hygrophila schulli* (Buch. - Ham.) M. R. & S. M. Almeida, Journ. Bombay Nat. Hist. Soc. 83 (Suppl.): 221. 1986; Joseph, Aquatic Angiosp. Malabar 42. 1991; Cook, Aquat. Wetland Pl. India 35.1996; Sasidh., Fl. Parambikulam WLS 229. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 58. 2016. *Asteracantha longifolia* (L.) Nees in Wall., Pl. Asiat. Rar. 3: 90. 1832; Hook. f., Fl. Brit. India 4: 408. 1884; Gamble, Fl. Pres. Madras 1015 (712). 1924. (Fig. 2 b)

Erect herbs with axillary spines. Stems about 90cm, thickened at nodes. Leaves simple, sessile, lanceolate, apex acute, base cuneate, margins wavy, 6 - 10 x 1.5 - 2 cm. Flowers in axillary cymes, surrounded by thorns. Thorns up to 3 cm. Bracts and bracteoles leafy, 1 - 2 cm long. Sepal tube unequally 4 lobed, 0.8 - 1.0 cm long. Corolla blue to purple, bi - lipped, 1.5 – 2.0 cm long. Stamens 4, didynamous. Capsule linear oblong, upto 1 cm long. Retinaculae long and curved. Seeds orbicular.

Flowering and Fruiting: September - April

Growth form: Helophyte

Distribution: India, Myanmar and Indo - China.

Habitat: Common in marshy waste lands, paddy fields and along riverbanks.

SJ 15064 (Alathur)

Hygrophila ringens (L.) Steud., Nomencl. Bot. (ed. 1) 1: 418. 1821; Joseph, Aquatic Angiosp. Malabar 40. 1991; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 57. 2016. *Hygrophila quadrivalvis* Nees in Wall., Pl. Asiat. Rar. 3: 80. 1832; Hook. f., Fl. Brit. India 4: 408. 1884; Gamble, Fl. Pres. Madras 1016(714). 1924; Cook, Aquat. Wetland Pl. India 35,1996. *Hygrophila angustifolia* R. Br., Prodr. 1: 479. 1810; Gamble, Fl. Pres. Madras 1016(713). 1924. *Hygrophila salicifolia* (Vahl) Nees in Wall., Pl. Asiat. Rar. 3: 81. 1832; Manilal & Sivar., Fl. Calicut 224. 1982; Vajr., Fl. Palghat Dist. 350. 1990. (Fig. 2 a)

Erect or creeping herbs, rooting at lower nodes; stems quadrangular, up to 1m long. Leaves, lanceolate - ovate, entire or crenate, 2 - 10 x 1 - 3.5 cm. Flowers solitary or in axillary clusters, sessile; bracts 6 - 8 mm long, scaly; bracteoles minute; calyx 12 mm long, tubular; corolla pale pink, 15 mm long, bilabiate; tube slender; Stamens 4, didynamous, 2 - 3 mm and 5 - 6 mm long. Capsule linear – oblong, 14 x 2 mm, terete, glabrous; seeds 8 - 12, globose, retinacula prominent.

Flowering and Fruiting: October - March

Growth form: Helophyte

Distribution: Indo - Malesia

Habitat: Common in marshy waste lands, paddy fields and along riverbanks.

SJ 11889 (Olavakkode)

ACORACEAE Martinov

ACORUS L.

Acorus calamus L., Sp. Pl. 324. 1753; Hook. f., Fl. Brit. India 6: 555. 1893; Gamble, Fl. Pres. Madras 1577 (1100). 1931; Joseph, Aquatic Angiosp. Malabar 283. 1991; Cook, Aquat. Wetland Pl. India 51. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 91. 2016. (Fig. 2 c)

Herbaceous perennial; rhizomes creeping and jointed, compressed, 13 - 25 mm thick. Leaves narrow, up to 0.8 m long, linear, glossy green in colour, apex acuminate; spathe leaf like, 20 - 50 cm long. The spadix is solid, cylindrical, sessile. Flowers pale yellow to green, fragrant, arranged closely. Stamens 6. Ovary 2 - 3 locular. Fruits green berries, angular, containing 1 - 3 seeds.

Flowering and Fruiting: April - July

Growth form: Hyperhydate / Helophyte

Distribution: North temperate hemisphere and tropical Asia

Habitat: Marshy areas

SJ 11897 (Nelliampathy)

ALISMATACEAE Vent.

LIMNOCHARIS Humb. & Bonpl.

Limnocharis flava (L.) Buch., Abh. Naturw. Ver. Bremen 2: 2. 1868; Mohanan, Fl. Quilon Dist. 435. 1984; Kammat. & Subram., Journ. Bombay Nat. Hist. Soc. 64: 389. 1967; Antony, Syst. Stud. Fl. Kottayam Dist. 420. 1989; Joseph, Aquatic Angiosp. Malabar 443. 1991; Cook, Aquat. Wetland Pl. India 248. 1996; Sunil & Sivadasan, Fl. Alappuzha Dist. 732. 2009; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 70. 2016. (Fig. 2 d)

Stout rhizomatous perennial herbs. Leaves radical, 8 - 30 x 5 - 15 cm, ovate to suborbicular, base rounded or subcordate; Petiole 15 - 50 cm long, triangular in cross section, spongy. Inflorescence terminal, 2 - 15 flowered umbel, Sepals 3, broadly ovate, obtuse, green. Petals pale yellow with dark base, ovate to rhomboidal, apex rounded. Stamens many, surrounded whorl of staminodes; anthers linear, basifixed. Ovary with numerous laterally flattened carpels; stigma sessile, capitate. Fruit subglobose with numerous nutlets.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte

Distribution: Tropical and subtropical America, south east Asia, Malaysia, Sri Lanka and India

Habitat: Common in marshy waste lands and paddy fields

SJ 15056 (Katampazhipuram)

AMARANTHACEAE Juss.

ALTERNANTHERA Forsk.

1. Flower heads pedunculate..... *A. philoxeroides*
1. Flower heads sessile..... 2
2. Leaves and flower heads clustered at nodes..... *A. paronychioides*
2. Leaves and flower heads paired at nodes..... 3

3. Stamens 5..... ..... *A. ficoidea*
3. Stamens 3..... *A. sessilis*

Alternanthera ficoidea (L.) Sm. Cycl. 39(2 Suppl.): n. 8. 1819. *Alternanthera tenella* Colla, Mem. Reale Acad. Sci. Torino 33: 131. 1820; Antony, Syst. Stud. Fl. Kottayam Dist. 334. 1989; Sasidh., Fl. Parambikulam WLS 255. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 78. 2016. (Fig. 2 f)

Prostrate or diffuse herbs, younger part of stem villous, white. Leaves 2.5 - 4.5 x 1.5 - 2 cm, elliptic - oblanceolate, hairy above, subsessile. Head axillary, sessile, ovoid; bracts and bracteoles small, lanceolate. Tepals 5, lanceolate, spinous tipped. Stamens 5, filaments 1.5 mm, staminodes strap shaped, toothed; ovary ovoid, style short. Seeds discoid, brown.

Flowering and Fruiting: June - December

Growth form: Helophyte

Distribution: Tropics and subtropics

Habitat: Riverbanks and marshy areas

SJ 11811 (Kalpathy)

Alternanthera paronychioides A. St. Hill, Voy. Bres. 2: 439. 1833; Sundararaj, Journ. Bombay Nat. Hist. Soc. 53: 525. 1956; Sasidh. & Sivar., Fl. Pl. Thrissur For. 369. 1996; Cook, Aquat. Wetland Pl. India 41.1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 74. 2016. (Fig.2 e)

Prostrate herbs, reddish, stem sparsely covered hairs. Leaves clustered, Subsessile or petiolate, 3 x 0.7 cm, oblanceolate to elliptical, apex acute, glabrous. Flower heads sessile, solitary, axillary, few - flowered; bracts and bracteoles similar, 1.5 mm long, hyaline. Flowers densely packed; perianth 5, all hairy; stamens 5 alternating with subulate pseudostaminodes. Ovary obovoid, compressed, stigma bilobed; seeds discoid.

Flowering and Fruiting: June to August

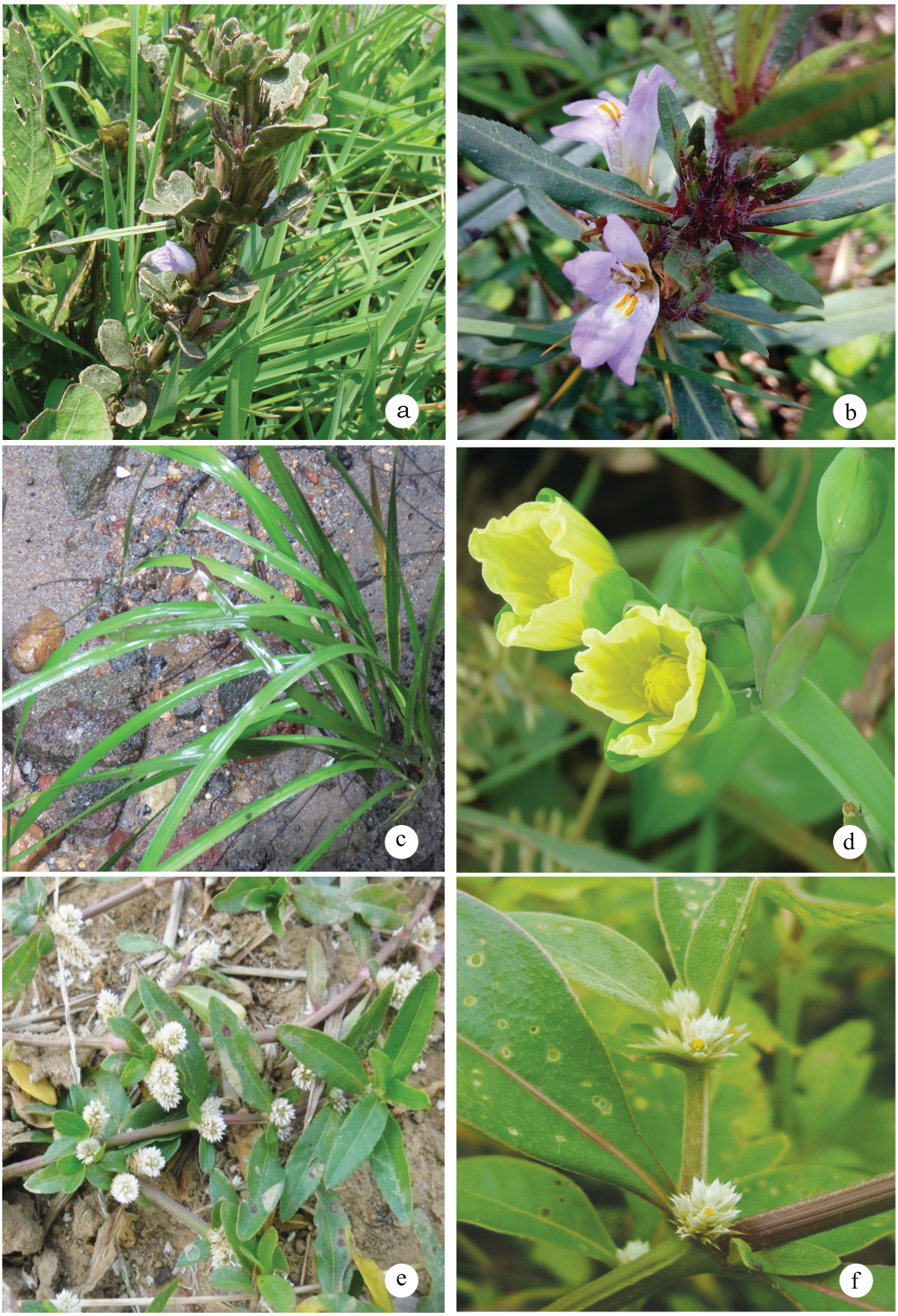


Fig. 2 a) *Hygrophila ringens* b) *Hygrophila auriculata* c) *Acorus calamus* d) *Limnocharis flava* e) *Alternanthera paronychioides* f) *Alternanthera ficoidea*

Growth form: Helophyte

Distribution: Tropical America and tropical Asia

Habitat: Common in marshy waste lands and paddy fields.

SJ 15063 (Kalpathy)

Alternanthera philoxeroides (Mart.) Grisb., Wiss. Gnett. 24: 36. 1879; Joseph, Aquatic Angiosp. Malabar 47. 1991; Madhus. & Ajit, Journ. Econ. Tax. Bot. 17: 652. 1993; Cook, Aquat. Wetland Pl. India 41. 1996; Sunil & Sivadasan, Fl. Alappuzha Dist. 590. 2009; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 75. 2016. (Fig. 3 a)

Perennial herbs with stems that becomes hollow with age, often much branched. Leaves opposite, elliptic – lanceolate, 4 - 9 x 0.5 - 2.5 cm, acute, midrib prominent. Inflorescence axillary sometimes terminal, ovoid - globose heads, 1 - 1.25 cm across, pedunculate. Tepals 5, unequal, acute, mucronate. Stamens 5 united at base. Ovary ovoid with slender style and papillose stigma. Fruit a small nut.

Flowering and Fruiting: September to March

Growth form: Helophyte

Distribution: South America, Indo - Malesia and Australia

Habitat: Riverbanks

SJ 11858 (Yakkara)

Alternanthera sessilis (L.) R. Br. ex. DC., Cat. Hort. 4: 77. 1813; Manilal & Sivar., Fl. Calicut 245. 1982; Joseph, Aquatic Angiosp. Malabar 49. 1991; Vajr., Fl. Palghat Dist. 386. 1990; Cook, Aquat. Wetland Pl. India 42,1996. Sasidh., Fl. Parambikulam WLS 254. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 75. 2016. *Alternanthera triandra* Lam., Encycl. 1: 95. 1785; Gamble, Fl. Pres. Madras 1179(825). 1925. (Fig.3 b)

Annual or perennial herbs, decumbent, stem glabrous. Leaves simple, opposite, elliptic - oblong or spathulate, 3 - 4 x 1 cm, apex obtuse. Inflorescence axillary, sessile spike, generally solitary sometimes 2 - 3 together; bracts and bracteoles similar, 1 mm long, broadly ovate,

acute, glabrous. Tepals 5, equal, 2.5 x 1.5 mm, ovate, acute. Fertile stamens 3. Utricle orbicular, 3 mm across; Achenes compressed, brown, discoid.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte

Distribution: Pantropical.

Habitat: Riverbanks, canals and paddy fields.

SJ 11864 (Attappadi)

APIACEAE Lindl.

CENTELLA L.

Centella asiatica (L.) Urban in Mart., Fl. Bras. 11:287. t.78. f. 1879; Gamble, Fl. Pres. Madras 556 (392). 1919; Manilal, Fl. Silent Valley 124. 1988; Vajr., Fl. Palghat Dist. 222. 1990; Cook, Aquat. Wetland Pl. India 44,1996; Sasidh., Fl. Parambikulam WLS 141. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 84. 2016. (Fig. 3 c)

Trailing herbs. Foliage orbicular to reniform, lamina 3 - 5 mm across, crenate or sub - entire and glabrescent; petiole to 10 cm long, sheathing at base. Inflorescence an umbel. Flowers light pink in colour, peduncles 1 - 20 cm long, calyx lobes minute, tube 1 mm long; petals 4, 1 mm long, oblong, pink; stamens 5, filaments style erect, bilobed at apex. Fruit a densely reticulated schizocarp, ovoid in shape.

Flowering and Fruiting: July - February

Growth form: Helophyte

Distribution: Tropical America and tropical Asia

Habitat: Common in marshy waste lands and paddy fields.

SJ 11816 (Kozhinjampara)

APOCYNACEAE Juss.

1a. Plants climbers.....*Oxystelma*

1b. Plants erect herbs..... *Asclepias*

ASCLEPIAS L.

Asclepias curassavica L., Sp. Pl. 215. 1753; Hook. f., Fl. Brit. India 4: 18. 1883; Gamble, Fl. Pres. Madras 833(585). 1923; Vajr., Fl. Palghat Dist. 293. 1990; Sasidh., Fl. Parambikulam WLS 192. 2002. (Fig. 3 d)

Herbs with milky latex, stem terete, glaucous. Leaves simple, opposite, glabrous, lanceolate to linear - lanceolate, up to 10 cm long and 3 cm wide with 8 - 12 pairs of nerves; petiole 1 cm long. Flowers in axillary peduncled cyme; peduncle 2 - 5 cm long, solitary, erect, dichotomous; pedicels slender, up to 2 cm long. Sepals 2.5 mm long, ovate. Corolla orange - red, tube short, lobes oblong, deflexed. Coronal lobes 7 mm long, yellow. Follicle up to 7cm long, 1 - 1.5 cm thick, terete or fusiform; seeds many, hairy.

Flowering and Fruiting: February - November

Growth form: Helophyte

Distribution: Pantropical

Habitat: Riverbanks.

SJ 11859 (Attappadi)

OXYSTELMA R.Br.

Oxystelma esculentum (L. f.) R.Br. ex Schultes in L., Syst. Veg. 6: 89, 1820; Hook. f., Fl. Brit. India 4: 17. 1883; Gamble, Fl. Pres. Madras 2: 833 (586). 1923; Cook, Aquat. Wetland Pl. India 66.1996. (Fig. 3 e)

Herbaceous climber growing up to 4 m with milky latex. Stem terete. Leaves opposite, petiolate, 4.5 - 9 x 0.6 - 3 cm, linear or linear - lanceolate, apex acute, base rounded, glabrous or nearly so. Inflorescence longer than leaves, sub - umbellate cymes, 1 - or 2 - 4 flowered. Corolla white with purple veins, 2 - 3 cm across, broadly rotate, lobed halfway down. Lobes triangular, 1 - 1.5 cm, densly ciliate. Corona lobes attached to gynostegium and exceed anthers. Pollinia up

to 1.5 mm. Ovaries glabrous with numerous ovules. Fruits 3.5 to 6 cm long follicular mericarps. Seeds small, ovoid, winged on the margins.

Flowering and Fruiting: September - April

Growth form: Helophyte

Distribution: West Asia to Malesia

Habitat: Riverbanks.

SJ 15095 (Pallam, Muthalamada)

ARACEAE Juss.

1a. Plant a free floating aquatic..... 4

1b. Plant never a free floating aquatic, rooted in soil..... 2

2a. Spathe twisted; usually brown and black in colour..... 3

2b. Spathe not twisted; usually yellow in colour..... *Colocasia*

3a. Pistillate flowers at one whorl at base..... *Cryptocoryne*

3b. Pistillate flowers spirally arranged ..... *Lagenandra*

4a. Plants with roots.....5

4b. Plants rootless..... *Wolffia*

5a. Roots 2 or more..... *6*

5b. Roots solitary..... *Lemna*

6a. Leaves above 2 cm ..... *Pistia*

6b. Leaves below 1.5 cm ..... *Spirodela*

COLOCASIA Scott.

Colocasia esculenta (L.) Schott in Schott & Endl., Melet. Bot. 1: 18. 1832; Joseph, Aquatic Angiosp. Malabar 294. 1991; Vajr., Fl. Palghat Dist. 533. 1990; Cook, Aquat. Wetland Pl. India 51,1996; Sivad. in Manoharan *et al.,* Silent Valley - Whispers Reason 242. 1999; Sasidh., Fl. Parambikulam WLS 367. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 92. 2016. *Colocasia antiquorum* Schott in Schott & Endl., Melet. Bot. 1: 18. 1832; Hook. f., Fl. Brit. India 6: 523. 1893; Gamble, Fl. Pres. Madras 1580(1102). 1931. (Fig. 3 f)



Fig. 3 a) *Alternanthera philoxeroides* b) *Alternanthera sessilis* c) *Centella asiatica* d) *Asclepias curassavica* e) *Oxystelma esculentum* f) *Colocasia esculenta*

Stoloniferous rhizomatous herb. Lamina peltate, cordate to sagittate at base, glabrous; petiole 30 - 45 cm long. Peduncle single or few together, 10 - 20 cm long, spathe to 20 cm long, yellow, constricted above the base; limb tapering towards tip. Spadix 10 cm long, cylindrical, appendages obtuse, terete. Male flowers above, stamens 6; ovary 1 - celled. Neuters many between the female and male flowers. Berries globose in shape

Flowering and Fruiting: April - July

Growth form: Helophyte / Hyperhydate

Distribution: Pantropical**Habitat:** Marshy areas, Waterlogged ditches and streamside.

SJ 11881 (Olavakkode)

CRYPTOCORYNE Fisch. ex Wydl.

Cryptocoryne retrospiralis (Roxb.) Kunth, Enum. Pl. 3: 12. 1841; Hook. f., Fl. Brit. India 6: 493. 1893; Gamble, Fl. Pres. Madras 1575 (1098). 1931; Vajr., Fl. Palghat Dist. 533. 1990; Joseph, Aquatic Angiosp. Malabar 278. 1991; Cook, Aquat. Wetland Pl. India 57,1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 94. 2016. (Fig. 4 a)

Marshy herbs. Rhizomes up to 1 cm in diameter. Leaves linear - lanceolate, many, to 160 x 8 mm, glabrescent. Peduncle 20 - 30 mm long, solitary; spathe 100 - 120 mm long, spirally twisted; spadix 14 mm long, included in the chamber. Pistillate flowers 4 or 5, one - whorled at the base; ovaries connate, 1 - celled, ovules many, on parietal placentas; style short, curved; stigmas circular, to an extent funnel shaped. Neuters a few, Staminate flowers many.

Flowering and Fruiting: November - March

Growth form: Rosulate/ Tenagophyte

Distribution: Endemic to south and north east India

Habitat: Riverbank

SJ 11863 (Agali)

LAGENANDRA Dalzell

1a. Plants relatively large; leaves 30 - 40 cm long..... 2
1b. Plants relatively small, leaves 3.5 - 15 cm long.....3
2a. Stigma borne on protruded style..... *L. ovata*
2b. Stigma sessile..... *L. toxicaria*
3a. Pistillate flowers arranged in whorls on the spadix... *L. keralensis*
3b. Pistillate flowers arranged spirally on the spadix..... *L. meeboldii*

Lagenandra keralensis Sivad. & Jaleel, Bot. Bull. Acad. Sin. 42: 153. 2001; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 99. 2016.

Herbs. Leaves 35 - 140 mm long, ovate - acute at apex, auricled at base; petiole 20 - 70 mm long, tomentose. Inflorescence 45 - 90 mm long, basal tube slightly boarder than the limb, light purplish to pink outside, limb 10 - 15 x 4 - 6 mm, spadix up to 10 mm long; pistillate portion at base, the sterile portion 3 - 4 mm long; staminate portion 2 mm long, appendix 1 mm long. Female flowers 6 - 8 in one whorled; stigma obcordate; ovary unilocular with numeral placental trichomes. Male flowers 80 - 100, twisted.
Flowering and Fruiting: March - July
Growth form: Hyperhydate/ Tenagophyte
Distribution: Endemic to Kerala
Habitat: Shady stream banks.

SJ 15025 (Brookeland)

Lagenandra meeboldii (Engl.) C.E.C. Fisch. in Gamble, Fl. Pres. Madras 1576(1099). 1931; Manilal, Fl. Silent Valley 333. 1988; Vajr., Fl. Palghat Dist. 534. 1990; Joseph, Aquatic Angiosp. Malabar 289. 1991; Aquat. Wetland Pl. India 62,1996; Sivad. in Manoharan *et al.,* Silent Valley - Whispers Reason 243. 1999; Sasidh., Fl. Parambikulam WLS 367. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 100. 2016.

Creeping rhizomatous herb. Leaves clustered, ovate, apex acute, base rounded, both surfaces glabrous; petiole 5 - 10 cm long. Peduncle to 12 cm long, spathe to 10 x 1.5 cm, ellipsoidal, long - acuminate at apex, not twisted, smooth, grey to purple, tail part 5 - 10 cm. Spadix 2 cm long, produced above into a cusp. Pistillate flowers in a cluster of 5 mm across; staminate flowers in a globose clusters of 3 mm across; stamens 1 or 2.

Flowering and Fruiting: January - March

Growth form: Hyperhydate/ Tenagophyte

Distribution: Endemic to Western Ghats

Habitat: Marshy river side.

SJ 15026 (Mukkali)

Lagenandra ovata (L.) Thw., Enum. Pl. Zeyl. 334. 1864; Gamble, Fl. Pres. Madras 1576(1099). 1931; Vajr., Fl. Palghat Dist. 534. 1990; Joseph, Aquatic Angiosp. Malabar 291. 1991; Aquat. Wetland Pl. India 63,1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 103. 2016. *Lagenandra insignis* Trimen, J. Bot. 23: 269. 1885; Hook. f., Fl. Brit. India 6: 496. 1893. (Fig. 4 b)

Creeping herb. Rhizomes up to 8 cm thick. Leaves entire, up to 400 x 130 mm, ovate - oblong, acute, margins entire, glabrous on both sides. Petiole up to 45 cm long. Peduncle 15 - 20 cm long; spathe up to 20 cm long and 9 cm wide, broadly ellipsoid, closed, coarsely warted on both surface, deep brown, twisted and acuminate at apex; spadix 3 - 5 cm long, included in the chamber. Male flowers many; stamens 1or 2; female flowers many, basal, subglobose; ovary obovoid; ovule 1. Fruitlets obovoid.

Flowering and Fruiting: August - February

Growth form: Hyperhydate/ Tenagophyte

Distribution: India and Sri Lanka

Habitat: Marshy river side.

SJ 15087 (Attappadi)

Lagenandra toxicaria Dalz. in Hook.'s J. Bot. Kew. Gard. Misc. 4:289.1852 & 5: t. 4.1853; Hook. f., Fl. Brit. India 6:495.1893; Gamble, Fl. Pres. Madras 1889 (1307). 1936; Joseph, Aquatic Angiosp. Malabar 292. 1991; Aquat. Wetland Pl. India 64,1996; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 34. 1996; Sivad. in Manoharan *et al.,* Silent Valley - Whispers Reason 244. 1999; Sasidh., Fl. Parambikulam WLS 367. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 103. 2016. (Fig. 4 c)

Erect evergreen herbs. Foliage 30 - 40 x 10 - 15 cm. Rhizomes around 3 cm thick. Inflorescence with a short peduncle, 20 mm long. Spathe up to 18 cm long, having a basal tubular portion, broad limb, and a terminal caudate portion; light greenish pink or pinkish cream in colour, outer surface smooth. Pistillate flowers about 70 - 80 in number. Ovary unilocular; stigma sessile, hexagonal with slightly raised central portion. Staminate portion more or less conoid spherical and with around 200 sessile staminate flowers. Fruit a fleshy capsule; dehiscence by longitudinal splits.

Flowering and Fruiting: Throughout the year

Growth form: Hyperhydate/ Tenagophyte

Distribution: Endemic to southern Western Ghats

Habitat: Marshy river side.

SJ 15058 (Pothundi)

LEMNA L.

Lemna perpusilla Torrey, Fl. New York 2: 245. 1843; Ansari, Fl. Kasaragod Div. 405. 1985; Vajr., Fl. Palghat Dist. 537. 1990; Joseph, Aquatic Angiosp. Malabar 435. 1991. *Lemna paucicostata* Hegelm., Lemnac. 139, t.8. 1868; Hook. f., Fl. Brit. India 6: 556. 1893; Gamble, Fl. Pres. Madras 1593 (1111). 1931. (Fig. 4 d)

Floating herbs found in stagnant waters. Fronds two or sometimes one, green, minutely asymmetric, 1.5 - 3.5 x 1 - 2.5 mm, ovate to obovate or oblong, entire, apex obtuse or rounded, base obtuse or

sometimes emarginate; upper side convex or flat with or without an apical papilla, lower side flat; root solitary on each frond up to 4mm. Flowering cavity lateral; spathe open. Staminate flowers 2; anthers bithecous. Pistillate flower 1; pistil nearly 0.5 mm long; style concave. Fruit small, 0.5 mm long, single seeded. Seeds minute.

Flowering and Fruiting: September - January

Growth form: Pleustophyte

Distribution: Cosmopolitan

Habitat: Ponds, tanks and lentic regions of flowing rivers

SJ 11802 (Chulliar Dam)

PISTIA L.

Pistia stratiotes L., Sp. Pl. 963. 1753; Hook. f., Fl. Brit. India 6: 497. 1893; Gamble, Fl. Pres. Madras 1573 (1097). 1931; Vajr., Fl. Palghat Dist. 535. 1990; Joseph, Aquatic Angiosp. Malabar 285. 1991; Aquat. Wetland Pl. India 65.1996; Ansari *et al.*, Aquat. Wetland Fl. Kerala. Fl. Pl. 109. 2016. (Fig. 4 e, f)

Floating herbs. Leaves sessile, tufted, in rosettes, obovate, up to 10 cm long and 3 cm wide, veins prominent, white soft hairs present. Spathe small, up to 10 mm long, basal portion constricted, upper portion expanded, pale yellow in colour; pistillate portion adnate to the spathe; one female flower below and 2 - 8 male flowers above. Male flowers with 2 united stamens. Ovary flask shaped, unilocular forming a synandrium; fruit small berry, many seeded.

Flowering and Fruiting: October - March

Growth form: Pleustophyte

Distribution: Tropics and subtropics

Habitat: Ponds and stagnant part of rivers.

SJ 11801 (Koduvayur)



Fig. 4 a) *Cryptocoryne retrospiralis* b) *Lagenandra ovata* c) *Lagenandra toxicaria* d) *Lemna perpusilla* e) *Pistia stratiotes* f) *P. stratiotes* spadix

SPIRODELA Schleidn

Spirodela polyrhiza (L.) Schleid., Linnaea 13: 392. 1839; Vajr., Fl. Palghat Dist. 538. 1990; Joseph, Aquatic Angiosp. Malabar 439. 1991; Cook, Aquat. Wetland Pl. India 229.1996. *Lemna polyrhiza* L., Sp. Pl. 970. 1753; Hook. f., Fl. Brit. India 6: 557. 1893; Gamble, Fl. Pres. Madras 1593 (1111). 1931. (Fig. 5 a)

Floating herbs found in stagnant waters. Fronds green, solitary or in groups of 2 - 5, 3 - 9 x 2.5 - 8 mm, 5 - 8 nerved, orbicular - ovate, base obtuse, apex obtuse or rounded, flat, lower portion red - purple. Roots 5 - 15, arising from the thickened part of the frond. Flowers in small membranous spathes located in a slit - pouch with 1 - pistillate flower and 2 staminate flowers. Stamens single. Ovary with 1 or 2 ovules. Fruit with 1 - 2 smooth seeds.

Flowering and Fruiting: October - December

Growth form: Pleustophyte

Distribution: Moist temperate and tropical regions

Habitat: Ponds, tanks and lentic regions of flowing rivers

SJ 11804 (Kalpathy river)

WOLFFIA Horkel ex Schleid.

Wolffia globosa (Roxb.) Hartog & Plas, Blumea 18: 367. 1970; Joseph, Aquatic Angiosp. Malabar 441. 1991; Cook, Aquat. Wetland Pl. India 231,1996. *Wolffia arrhiza* sensu Hook.f., Fl. Brit. India 6: 557. 1893,p.p. non Wimm. 1832; Gamble, Fl. Pres. Madras 1593 (1111). 1931. (Fig. 5 b)

Minute plants with solitary fronds, green, 0.5 - 0.9 x 0.3 - 0.5 mm, elliptic to oblong, base and apex obtuse, entire, upper side flat and convex near the base, lower side highly convex. Roots absent. Inflorescence in a notch on the frond with one staminate and one pistillate flower. Stamens one. Ovary green. Fruit globose.

Flowering and Fruiting: August - October

Growth form: Pleustophyte

Distribution: Cosmopolitan

Habitat: Ponds, tanks and lentic regions of flowing rivers

SJ 11803 (Chulliar Dam)

ARALIACEAE Juss.

HYDROCOTYLE L.

Hydrocotyle javanica Thunb., Diss. Hydroc. n. 17. t. 2. 1798; Gamble, Fl. Pres. Madras 556 (392). 1919; Manilal, Fl. Silent Valley 125. 1988; Vajr., Fl. Palghat Dist. 222. 1990; Cook, Aquat. Wetland Pl. India 45. 1996; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 21, 29; 139. 1997; Swarup. *et al.,* Shola For. Kerala 35. 1998; Sasidh., Fl. Parambikulam WLS 141. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 87. 2016. (Fig. 5 c)

Creeping perennial herb. Foliage on slender petioles, alternate, 15 - 30 x 20 - 50 mm, orbicular, 7 - 9 lobed, sparsely hairy on both sides, serrulate. Flowers in capitate clusters, umbelled, peduncle 10 - 50 mm long; pedicels 5 - 18 mm long. Calyx tube 5 mm long. Petals 5, narrow with pointed tips. Stamens 5. Ovary 0.5 - 1 mm long, 2 - celled, styles 2; Fruit laterally compressed. Ribs well developed.

Flowering and Fruiting: October - May

Growth form: Helophyte

Distribution: Tropical Asia

Habitat: Along stream banks in evergreen forests.

SJ 11851 (Nelliampathy)

ASTERACEAE Dumort

1a. Leaves alternate..... 2

1b. Leaves opposite 4

2a. Inflorescence homogamous..... *Struchium*

2b. Inflorescence heterogamous..... 3

3a. Stems with wings..... *Sphaeranthus*

3b. Stems without wings.....*Grangea*

4a. Involucral bracts 4; leafy ..... *Enydra*
4b. Involucral bracts more than 4; Scale like 5
5a. Receptacle convex or conical 6
5b. Receptacle flat.....7
6a. Inflorescence homogamous..... *Acmella*
6b. Inflorescence heteroogamous .....*Spilanthes*
7a. Plants climbers..... *Mikania*
7b. Plants non climbing herbs.....8
8a. Flower heads white, leaves not lobed..... *Eclipta*
8b. Flower heads yellow, leaves trilobed..... *Sphagneticola*

ACMELLA Rich. Ex Pers.

1a. Inflorescence yellow..... *A. calva*
1b. Inflorescence white..... *A. radicans*

Acmella calva (DC.) R.K. Jansen, Syst. Bot. Monogr. 8: 41. 1985. *Spilanthes calva* DC. in Wight, Contrib. 19. 1834; Manilal, Fl. Silent Valley 158. 1988; Vajr., Fl. Palghat Dist. 256. 1990; Swarup. *et al.,* Shola For. Kerala 41. 1998; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 126. 2016. *Spilanthes acmella* sensu Hook. f., Fl. Brit. India 3: 307. 1881, non (L.) Murr. 1844; Gamble, Fl. Pres. Madras 708(498. 1921. (Fig. 5 d)

Ascending scabrid herbs, up to 40 cm, leaves ovate, base truncate, apex acute, sparsely pubescent, up to 4 cm long and 2.5 cm wide; margins undulate - serrate. Heads 10 x 7 mm, solitary, conical, homogamous. Flowers bisexual; corolla yellow, 2.5 mm long, tubular, 5 lobed at apex; lobes 0.5 mm long, ovate, acute, glabrous. Stamens 5, exerted. Achenes 2 x 1 mm, dark brown, narrowly obovate.
Flowering and Fruiting: October - March
Growth form: Helophyte
Distribution: Indo - Malesia and China
Habitat: Marshy areas.

SJ 16908 (Seetharkund)

Acmella radicans (Jacq.) R.K. Jansen, Syst. Bot. Monogr. 8: 69 - 70, f.18.1985. *Spilanthes radicans* Jacq., Collect. Bot. Chen. Hist. Nat. 11: 1714. 1804; Manilal, Fl. Silent Valley 158. 1988; Babu, Fl. Malappuram Dist. 382. 1990; Sasidh. & Sivar., Fl. Pl. Thrissur For. 254. 1996; Sivar. & Mathew, Fl. Nilambur 379. 1997. (Fig. 5 e)

Erect herbs, up to 70 cm high; stem glabrous. Leaves simple, opposite, up to 7 cm long and 4 cm wide, ovate, acute, glabrous; petiole 1 - 2 cm long. Heads 1.2 x 0.8 cm, solitary or 2 - 3 together; peduncles up to 5 cm long, puberulous; bracts 4 x 1 mm, glabrous. Inflorascence homogamous; corolla 2 mm long, 3 - lobed. Achenes 2 types, marginal ones 3 - angled, central achenes laterally compressed, obovate, truncate, ciliate along the edges, cilia longer at the apex.

Flowering and Fruiting: October - March

Growth form: Helophyte

Distribution: Tropical America and Asia

Habitat: Paddy fields.

SJ 16917 (Chittur)

ECLIPTA L.

Eclipta prostrata (L.) L., Mant. Pl. 2: 286. 1771; Sasidh., Fl. Parambikulam WLS 169. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 118. 2016. *Eclipta alba* (L.) Hassk., Pl. Jav. Rar. 528. 1848; Hook. f., Fl. Brit. India 3: 304. 1881; Gamble, Fl. Pres. Madras 705 (496). 1921; Vajr., Fl. Palghat Dist. 252. 1990; Cook, Aquat. Wetland Pl. India 69.1996. (Fig. 5 f)

Herbs covered with white bristle like hairs, up to 30 cm tall; stems terete. Leaves simple, opposite, 3x 5 cm, oblong - elliptic, acute at apex, cuneate at base, entire, sessile or subsessile. Heads up to 5 mm across; Involucral bracts in 2 rows; outer bracts 5, ovate - elliptic, sub acuminate at apex, cuneate at base, strigose outside, glabrous inside.

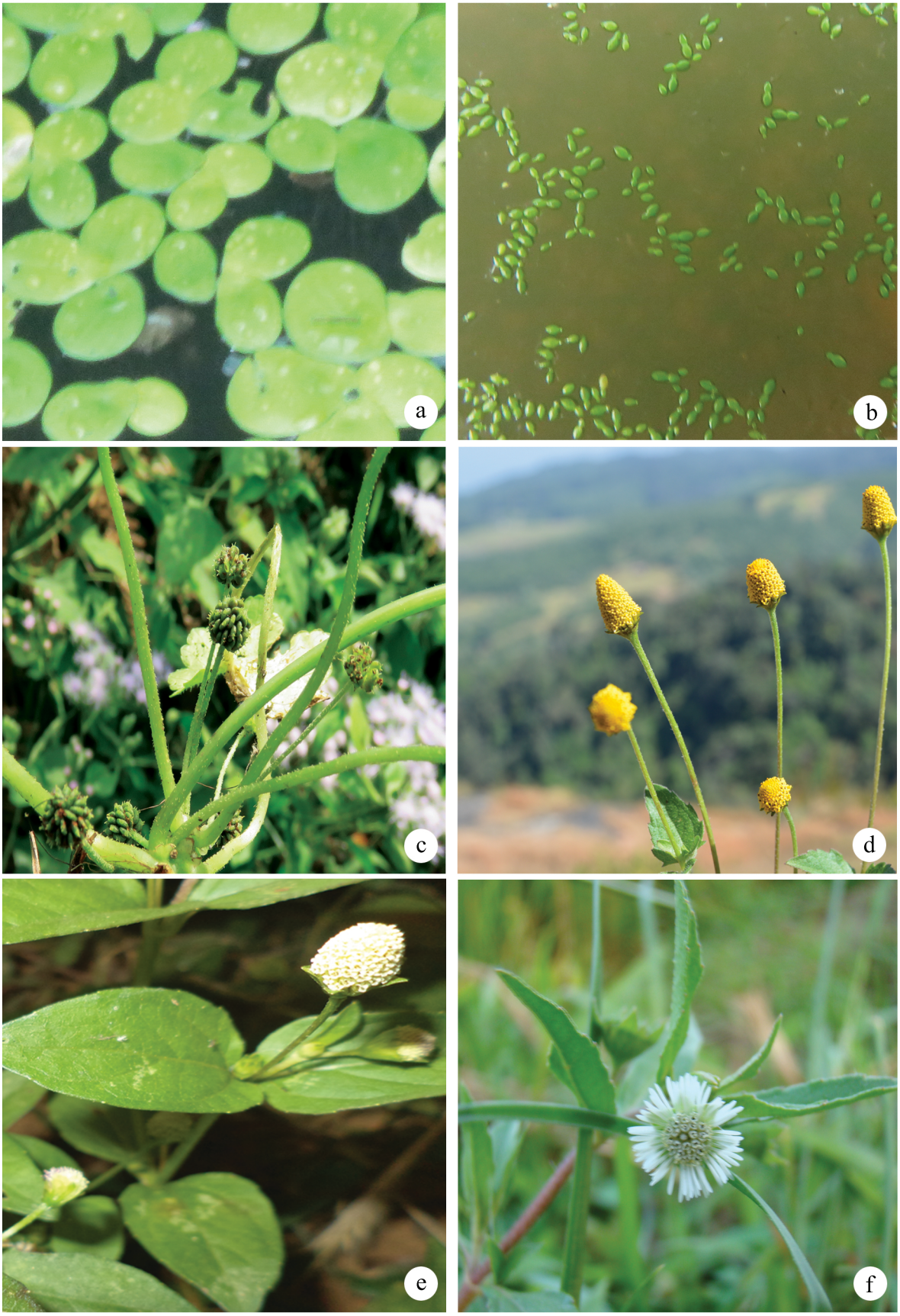


Fig. 5 a) *Spirodela polyrhiza* b) *Wolffia globosa* c) *Hydrocotyle javanica* d) *Acmella calva* e) *Acmella radicans* f) *Eclipta prostrata*

Ray florets up to 3 seriate. Sepals minute, membranous. Corolla up to 2.5 mm long. Disk florets numerous, 2.5 - 3 mm long. Corolla campanulate, lobes 4, ovate, ciliate on margin. Stamens 4. Ovary 1.1 - 1.2 mm long, hairy at apex. Achenes brown. Pappus of reduced to minute united scales.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte / hyperhydate

Distribution: Pantropical

Habitat: Marshy areas

SJ 11831 (Pulappatta)

ENYDRA Lour.

Enydra fluctuans Lour., Fl. Cochinch. 510. 1790; Cook, Aquat. Wetland Pl. India 69.1996. *Enhydra fluctuans* Lour, Hook.f. Fl. Brit. Ind. 3: 304. 1892; Lack. Willdenowia 10: 3. 1980; *Hingtsha repens* Roxb., Hort. Beng. 62. 1814, Fl. Ind. iii. 448. 1832; *Tetraotis paludosa* Reinw. Syll. Pl. Nov. 2: 8. 1825. (Fig. 6 a)

Glabrous marsh herb. Stems elongate, simple or divaricately branched, rooting at the nodes. Leaves opposite, linear–oblong, acute or obtuse, base narrowed or truncate, variable in breadth, sessile, glandular. Inflorescence a sessile head, both axillary and terminal. Involucral bracts foliaceous, four in number, in opposite pairs, outer pair larger than the inner; ray florets female, many - seriate, fertile; disk florets with a 5 - fid campanulate limb. Cypsela oblong; pappus absent.

Note: New report to Kerala

Flowering and Fruiting: November - May

Growth form: Helophyte / Hyperhydate

Distribution: South and south east Asia

Habitat: Rivers.

SJ 16918 (Shokanashini river)

GRANGEA Adans.

Grangea maderaspatana (L.) Poir. in Lam, Encycl. Suppl. 2: 825. 1812; Hook. f., Fl. Brit. India 3: 247. 1881; Gamble, Fl. Pres. Madras 680 (478). 1921; Cook, Aquat. Wetland Pl. India 70. 1996. Sasidh., Fl. Parambikulam WLS 170. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 122. 2016. (Fig. 6 b)

Prostrate annual herbs, branches spreading from the center, densely hispid. Leaves alternate, oblanceolate, irregularly pinnate - lobed, coarsely serrate - dentate along margins, base auricled, sessile, pubescent on both surfaces. Heads 8 mm across, globose, axillary, solitary, pedunculate, heterogamous. Outer few rows of florets female; corolla 2 mm long, slender, tubular, yellow. Inner florets bisexual; corolla 2 mm long, campanulate, 5 - lobed; anthers obtuse at base. Achenes obovate, compressed.

Flowering and Fruiting: March - July

Growth form: Helophyte

Distribution: Indo - Malesia and Africa

Habitat: Riverbanks and paddy fields.

SJ 11875 (Meenkara)

MIKANIA Willd.

Mikania micrantha Kunth in HBK, Nov. Gen. Sp. 4: 134. 1820; Sasidh., Fl. Parambikulam WLS 171. 2002. *Mikania scandens* Clarke, Comp. Ind. 34. 1876, non L.; Hook. f., Fl. Brit. India 3: 144. 1881. *Mikania cordata* (Burm. f.) Robins., Contrib. Gray Herb. 104:65. 1934; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 9. 1996. (Fig. 6 c)

Fast growing climbers with high ecological amplitude, stem hairy. Leaves simple, opposite, ovate, cordate at base, apex acute, glabrous; margins undulate to crenate. Petiole up to 5 cm long. Heads up to 6 mm long, in axillary panicles; bracts biseriate, outer 2 smaller, inner ones large up to 4 mm long and 1.5 mm wide, ovate, obtuse. Flowers

up to 5, homogamous, bisexual; corolla white, glandular, 3 mm long, tubular, lobes 5. Stamens 5, anthers united. Achenes 2 mm long, black; pappus many, 3 - 4 mm long.

Flowering and Fruiting: February - April
Growth form: Helophyte/ Hyperhydate
Distribution: Pantropical.
Habitat: Forests, riverbanks and agriculture lands

SJ 16981 (Attappadi)

SPHAERANTHUS L.

Sphaeranthus indicus L., Sp. Pl. 927. 1753; Hook. f., Fl. Brit. India 3: 275. 1881, p. p; Gamble, Fl. Pres. Madras 692 (487). 1921; Vajr., Fl. Palghat Dist. 255. 1990; Cook, Aquat. Wetland Pl. India 72. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 125. 2016. (Fig. 6 f)

Erect aromatic herbs; stems with wings; wings dentate. Leaves alternate, elliptic – oblanceolate, up to 4 cm long and 2 cm wide, obtuse at apex, amplexicaul, hirsute. Heads in globose spikes, numerous, densely packed; spikes to 1 cm across, peduncles winged; heterogamous, outer female, inner bisexual, all tubular; corolla 5 - lobed, pink; lobes acute; anthers tailed at base. Achenes angular, glabrous or villous; pappus absent.
Flowering and Fruiting: January - April
Growth form: Helophyte
Distribution: Indo - Malesia, Australia and Africa
Habitat: Riverbanks and paddy fields.

SJ 11890 (Puthunagaram)

SPILANTHES Jacq.

Spilanthes ciliata HBK, Nov. Gen. & Sp. Pl. 4: 621. 1836; Joseph, Aquatic Angiosp. Malabar 52. 1991; Cook, Aquat. Wetland Pl. India

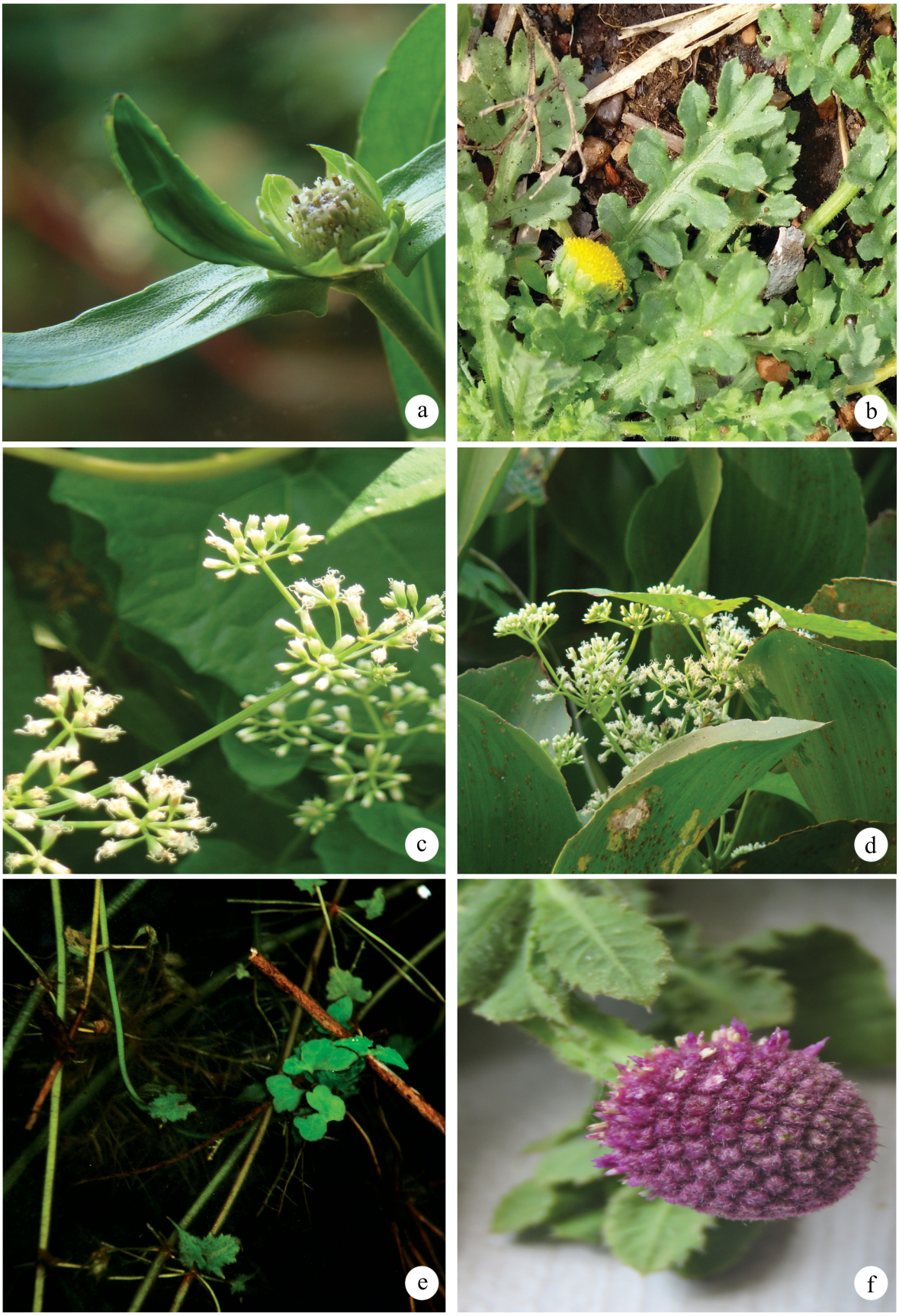


Fig. 6 a) *Enydra fluctuans* b) *Grangea maderaspatana* c) *Mikania micrantha* d) *M. micrantha* growing over *Eichhornia* e) *M. micrantha* rooting under water f) *Sphaeranthus indicus*

74. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 127. 2016. (Fig. 7 a)

Diffuse herbs stem terete; rooting at lower nodes. Leaves simple, opposite, margins serrate, 7 x 4 cm, ovate, apex acute; petiole up to 2.5 cm long. Heads rayed, heterogamous, axillary, usually solitary, rarely 2 - 3 in each axil, 8 - 10 mm across, subglobose, turning conical, yellow; peduncle up to 8 cm long. Involucral bracts 2 - seriate. Ray florets 8 - 12, female, ligulate; achenes trigonous, black, ciliate along the margins. Disc florets many, bisexual; achenes oblong, truncate at apex, laterally compressed, black, ciliate along the margins.

Flowering and Fruiting: August - December

Growth form: Helophyte

Distribution: Neotropics of the world; now naturalised in western peninsular India

Habitat: Riverbanks and paddy fields.

SJ 16919 (Chittur)

STRUCHIUM P.Browne

Struchium sparganophorum (L.) O. Ktze., Rev. Gen. Pl. 1: 366. 1891; Joseph, Aquatic Angiosp. Malabar 54. 1991; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 130. 2016. (Fig. 7 b)

Branched herbs, erect; stem green, minutely puberulous. Rooting from the nodes. Leaves alternate, elliptic - lanceolate, base attenuate and decurrent on the petiole at base, margins serrulate - denticulate, apex acute or acuminate; petiole to 2.5 cm long. Heads homogamous, axillary, sessile, white, in cluster of 4 - 5, up to 5 mm across, globose. Receptacle convex, pitted. Florets all tubular, bisexual. Corolla 2 - 3 mm long, white, tube narrow, lobes 5, spreading glandular. Stamens 3; filaments filiform, white. Ovary up to 1.5 mm long; stigma bifid, purple. Achenes up to 1.5 mm long, triangular, glabrous, black.

Flowering and Fruiting: August - February

Growth form: Helophyte / Hyperhydate

Distribution: Native of tropical America; now in all warmer countries

Habitat: Riverbanks

SJ 15037 (Mannarkkad)

SPHAGNETICOLA O. Hoffm.

Sphagneticola trilobata (L.) Pruski, Mem. New York Bot. Gard. 78: 114. 1996.*Wedelia trilobata* (L.) A. S. Hitchc., Rep. Missouri Bot. Gard. 4: 99. 1898; Sivar. & Pradeep, Indian J. For. 11: 161. 1988; Cook, Aquat. Wetland Pl. India 74. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 127. 2016. (Fig. 7 c)

Perennial diffuse herbs, rooting at nodes; stems slightly pubescent. Leaves up to 7 x 4.5 cm, elliptic - obovate, usually with 3 angular lobes with toothed margins, acute at apex, sparingly pubescent; petiole short, up to 5 mm. Heads heterogamous, up to 2.5 cm across, solitary on ebracteate 4 - 10 cm long peduncles. Involucre green; bracts lanceolate. Ray florets 5 - 8; corolla bright yellow, up to 20 mm long and 7 mm wide, 3 - 4 denticulate. Ovary trigonous; stigma bilobed. Pappus connate into a spathiform, fimbriate cup at the apex. Disc florets many; corolla yellow; tube 5 - 8 mm long, 5 - lobed. Stamens 5, filaments yellow. Anthers black, syngenecious. Style branches flattened and marginally pubescent. Achenes black, warty, crowned by the persistent pappus.

Flowering and Fruiting: June - November

Growth form: Helophyte / Hyperhydate

Distribution: Native of tropical America now naturalized in Asia.

Habitat: Riverbanks marshy areas.

SJ 15051 (Olavakkode)

BALSAMINACEAE A. Rich.

IMPATIENS L.

Impatiens scapiflora Heyne ex Roxb., Fl. Ind. 2: 464. 1824; Hook. f., Fl. Brit. India 1: 443. 1874; Gamble, Fl. Pres. Madras 138 (98). 1915;

Manilal, Fl. Silent Valley 41. 1988; Vajr., Fl. Palghat Dist. 101. 1990; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 9. 21; Sasidh., Fl. Parambikulam WLS 45. 2002. (Fig. 7 d)

Herbs. Leaves glabrous, up to 13 cm long 7.5 cm wide, ovate, apex obtuse, base cordate; petiole up to 18 cm long. Scape up to 35 cm long. Flowers 3.5 cm across, limited to the apex; bracts 5 - 8 mm long, ovate with acute ; pedicels 4 - 5 cm long; lip ovate, obtuse, spur up to 4 cm long, glabrous; sepals up to 4 mm long and 2.5 mm wide, ovate, acute; petals pink, standard concave at base, obtuse at apex; wing lobes subequal, oblong, obtuse. Capsule up to 1.25 cm long, ellipsoid; seeds glandular - hairy.

Flowering and Fruiting: July - December

Growth form: Helophyte

Distribution: Endemic to Western Ghats

Habitat: Wet rocks.

SJ 11840 (Meenvani)

BORAGINACEAE Juss

1a. Plants woody shrubs ..... *Rotula*

1b. Plants herbs 2

2a. Inflorescence terminal Scorpiod cyme.....*Heliotropium*

2b. Inflorescence axillary cyme or solitary..... *Coldenia*

COLDENIA L.

Coldenia procumbens L., Sp. Pl. 125. 1753; Hook. f., Fl. Brit. India 4: 144. 1883; Gamble, Fl. Pres. Madras 892 (627). 1923; Vajr., Fl. Palghat Dist. 302. 1990; Sasidh., Fl. Parambikulam WLS 201. 2002; Cook, Aquat. Wetland Pl. India 75.1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 151. 2016. (Fig. 7 e)

Prostrate herbs, stem and leaves white villous. Leaves alternate, obovate – oblong, oblique, subpinnatifid, rounded at apex, base cuneate, margin irregularly serrate. Inflorescence extra axillary, white,

few - flowered sessile cymes or sometimes solitary. Calyx 4 - lobed, ciliate. Corolla white, 2 mm long, lobes 4, imbricate in buds. Stamens 4, included. Ovary 4 - lobed, style terminal, bifid. Drupe of 4 subconnate pyrenes, 1.5 - 2 mm across.

Flowering and Fruiting: March - May

Growth form: Helophyte

Distribution: Pantropical

Habitat: Riverbanks, shores of ponds

SJ 11894 (Dhoni)

HELIOTROPIUM L.

1a. Corolla tube bearing bulbous based, bristle like hairs..... *H. keralense*

1b. Corolla tube devoid of hairs and if present minute and soft..... 2

2a. Leaf blades more than 5 cm long..... *H. indicum*

2b. Leaf blades less than 5 cm long..... *H. ovalifolium*

Heliotropium indicum L., Sp. Pl. 130. 1753; Hook. f., Fl. Brit. India 4: 152. 1883; Gamble, Fl. Pres. Madras 896(630). 1923; Vajr., Fl. Palghat Dist. 303. 1990; Cook, Aquat. Wetland Pl. India 76.1996; Sasidh., Fl. Parambikulam WLS 203. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 152. 2016. (Fig. 7 f)

Branched herbs; stems up to 45 cm tall. Leaves ovate, acuminate, pubescent. Flowers pale violet - white in scorpioid cymes. Sepals divided to the base, green, up to 3 mm long. Corolla tube, pale violet - white, much exceeding the calyx, sparsely hairy. Petal lobes ovate. Stamens 5, sub sessile, free. Ovary four lobed, style up to 0.7 mm. Nutlets united in pairs, 2 - 3mm long.

Flowering and Fruiting: September - March

Growth form: Helophyte

Distribution: Pantropical

Habitat: Riverbanks, shores of ponds, and paddy fields

SJ 15094 (Olavakkode)

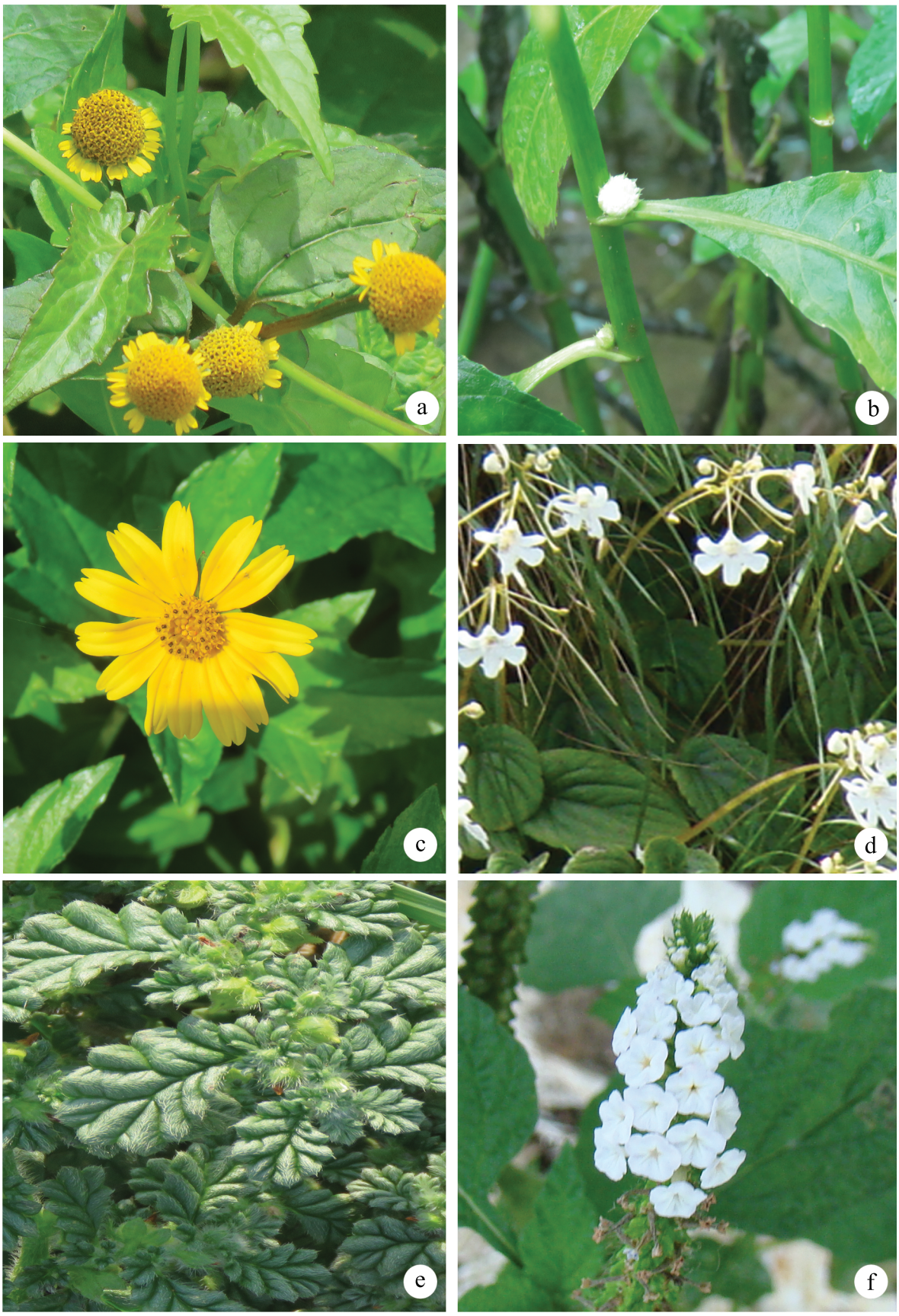


Fig. 7 a) *Spilanthes ciliata* b) *Struchium sparganophorum* c) *Sphagneticola trilobata* d) *Impatiens scapiflora* e) *Coldenia procumbens* f) *Heliotropium indicum*

Heliotropium keralense Sivar. & Manilal, J. Indian Bot. Soc. 51: 348. 1972; Cook, Aquat. Wetland Pl. India 77.1996; Sasidh., Fl. Parambikulam WLS 203. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 153. 2016.

Pubescent erect herbs, up to 30 cm height. Leaves, ovate, obtuse or acute at apex, flexuous along margins, sparsely strigose beneath on veins, glabrous above; petiole to 7.5 cm long. Flowers white in long, terminal, scorpioid cymes up to 7 cm long. Calyx up to 2.5 mm long, 5 - lobed, subequal, persistant, ornamented with bulbous - based bristle like hairs. Corolla 3 - 4 mm long, villous; 5 - lobed, triangular. Stamens 5, included. Ovary 4 - lobed, 4 - loculed; ovules one per locule; stigma lobed, hemispheric. Fruit separating into 4 pyrenes.

Flowering and Fruiting: March - may

Growth form: Helophyte

Distribution: Endemic to south India

Habitat: Marshy areas

SJ 11891 (Olavakkode)

Heliotropium ovalifolium Forssk., Fl. Aegypt. Arab. 38. 1775; Hook. f., Fl. Brit. India 4: 150. 1883; Gamble, Fl. Pres. Madras 896(629).1923. Cook, Aquat. Wetland Pl. India 77.1996. (Fig. 8 a)

Decumbent perennial or annual herbs, hispid, grey, up to 40 cm high, branching from the base; stem and branches densely clothed with long silky hairs. Leaves alternate, 1.5 - 2.5 cm x 5 - 13 mm, obovate - elliptic, obtuse and usually mucronate at the apex, rounded at the base, closely pubescent with long silky hair on both surfaces, margins slightly revolute. Flowers white, on scorpioid cymes. Calyx 1 - 2.5 mm long, persistent. Corolla 3 mm long; white. Petals ovate - oblong. Ovary pubescent; stigma sessile. Mericarps exceeding 1 mm long, hairy with silky white hairs.

Flowering and Fruiting: March - July

Growth form: Helophyte

Distribution: Tropical Asia and Africa

Habitat: Marshy areas.

SJ 11879 (Walayar dam)

ROTULA Lour.

Rotula aquatica Lour., Fl. Cochinch. 121. 1790; Gamble, Fl. Pres. Madras 893(627). 1923; Manilal, Fl. Silent Valley 185. 1988; Vajr., Fl. Palghat Dist. 304. 1990; Cook, Aquat. Wetland Pl. India 78.1996; Sasidh., Fl. Parambikulam WLS 203. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 153. 2016. *Rhabdia lycioides* Mart. & Zucc., Nov. Gen. Sp. 2:136.1827; Hook. f., Fl. Brit. India 4:145. 1883.

Woody branching shrubs; stem glabrous, up to 60 cm tall. Leaves simple, alternate or fascicled, sessile up to 2 cm long and 5 mm wide, oblong - oblanceolate, obtuse, glabrous above. Flowers in axillary cymes. Calyx 3.5 mm long 5 - lobed, lanceolate. Corolla pink, 5 mm long, campanulate, 5 - lobed. Stamens 5, anthers sagittate at base. Ovary ovoid, 4 - chambered, style terminal, stigma capitate. Drupe with 4 seeds. Orange when ripe, smooth.

Flowering and Fruiting: November - March

Growth form: Helophyte

Distribution: Pantropical

Habitat: Riverbanks

SJ 11888 (Thootha)

BURMANNIACEAE Blume

BURMANNIA L.

Burmannia coelestis D. Don, Prodr. Fl. Nepal. 44. 1825; Hook. f., Fl. Brit. India 5: 665. 1888; Gamble, Fl. Pres. Madras 1399(979). 1928; Manilal, Fl. Silent Valley 267. 1988; Vajr., Fl. Palghat Dist. 462. 1990; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 13,19. 1996; Sasidh., Fl. Parambikulam WLS 315. 2002; *Burmannia pusilla* (Wall. ex Miers)

Thw., Encycl. 325. 1864; Manilal & Sivar., Fl. Calicut 282. 1982. (Fig. 8 b)

Small herbs without leaves. Stem highly reduced. Flowers bright pink – purple, regular, terminal, 1 - 3 together, on long terminal peduncle; calyx tube 3 - winged, 0.8 - 1 cm long, retuse at apex; petals absent; stamens 3, anthers sessile, ovate, erect; ovary 3 chambered, inferior, winged, ovules numerous, style 3 - lobed. Fruit a dehiscent capsule, winged; seeds minute, numerous, reticulate.

Flowering and Fruiting: September - December

Growth form: Helophyte

Distribution: Indo – Malesia

Habitat: Wet rocks

SJ 11815 (Nottamala)

CAMPANULACEAE Juss.

LOBELIA L.

1a. Sepal lobes entire, All anthers hairy.....*L. alsinoides*

1b. Sepal lobes minutely toothed, only 2 anthers hairy... *L. heyneana*

Lobelia alsinoides Lam., Encycl. 3: 588. 1792; Gamble, Fl. Pres. Madras 736(518). 1923; Vajr., Fl. Palghat Dist. 260. 1990; Joseph, Aquatic Angiosp. Malabar 98. 1991; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 11,17. 1996; Sasidh., Fl. Parambikulam WLS 203. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 161. 2016. (Fig. 8 c)

Annual decumbent herbs, rooting from lower nodes, stem 3 - winged. Leaves simple, alternate,1 - 2 x 1 - 1.5 cm, ovate or elliptical, apex obtuse, serrate, petiolate, glabrous on both sides. Flowers in solitary, blue. Sepals 5 mm long, lanceolate. Corolla blue, up to 9 mm long, upper 3 lobes obovate, lower 2 lobes narrower. Stamens 5; Capsule obovoid – hemispherical, up to 2.5 mm long, glabrous; seeds brown.

Flowering and Fruiting: August - October

Growth form: Helophyte

Distribution: Indo - Malesia

Habitat: Riverbanks and wet localities

SJ 11882 (Kadukkamkunnam)

Lobelia heyneana Schult. in Roem. & Schult., Syst. Veg. 5: 50. 1819; Haridasan & Mukh. in Nayar *et al.,* Fasc. Fl. Ind. 19: 51. 1988; Manilal, Fl. Silent Valley 162. 1988; Swarup. *et al.,* Shola For. Kerala 57. 1998; Sasidh., Fl. Parambikulam WLS 175. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 162. 2016. *Lobelia trialata* Buch. - Ham. ex D. Don, Prodr. Fl. Nepal. 157.1825; Hook. f., Fl. Brit. India 3: 425. 1881; Gamble, Fl. Pres. Madras 736(518). 1921.

Diffuse annual herbs, stem 3 - winged, up to 60 cm tall, glabrous. Leaves simple, alternate, 2.5 x 1.5 cm, obovate, apex obtuse or acute, crenate - serrate; upper leaves sessile. Flowers solitary, axillary. Sepal tube obovoid, up to 2mm long lanceolate, minutely toothed. Corolla blue, 5 mm long, pale blue - pinkish. Stamens 5, Anthers 2.5 mm long, 2 anterior anthers with tuft of hairs at apex. Style stout curved; stigma with a ring of hairs below. Capsule up to 3 mm long and 2.5 mm wide. Seeds ellipsoid, biconvex.

Flowering and Fruiting: August - November

Growth form: Helophyte

Distribution: Indo - Malesia, China and Africa

Habitat: Riverbanks and wet localities

SJ 15043 (Parambikulam)

CANNACEAE Juss.

CANNA L.

Canna indica L., Sp. Pl. 1. 1753; Hook. f., Fl. Brit. India 6: 260. 1890; Manilal & Sivar., Fl. Calicut 288. 1982; Mohanan, Fl. Quilon Dist. 409. 1984; Antony, Syst. Stud. Fl. Kottayam Dist. 394. 1989; Babu, Fl. Malappuram Dist. 801. 1990; Subram., Fl. Thenmala Div. 383. 1995; Sunil & Sivadasan, Fl. Alappuzha Dist. 685. 2009. *Canna orientalis*

Rosc., Monadr. Pl. t. 12. 1828; Gamble, Fl. Pres. Madras 1496 (1045). 1928. *Canna indica* L. var. *orientalis* (Rosc.) Baker in Hook.f., Fl. Brit. India 6: 260. 1892. (Fig. 8 d)

Plants with creeping rhizomes, aerial stem glabrous, erect. Leaves ovate – oblong, acuminate, 18 - 40 x 10 - 14 cm. Inflorescence a raceme, many - flowered, up to 18 cm long. Bracts narrowly linear up to 7 cm long; bracteoles to 1 cm, orbicular. Sepals 3, 0.5 - 1.5 cm long, lanceolate. Petals 3, orange - red, basally united, 4 - 7 cm, staminodes petaloid, bright - red; Ovary 3 - celled; ovules numerous; placentation axile; style flattened. Capsule 1.2 - 3 x 1 - 1.5 cm with warty projections on surface.

Flowering and Fruiting: January - July

Growth form: Helophyte

Distribution: Indo - Malesia

Habitat: Riverbanks, small streams, also cultivated

SJ 15065 (Palakkayam)

CAPPARACEAE Juss.

CRATAEVA L.

Crataeva magna (Lour.) DC., Prodr. 1: 243. 1824; Vajr., Fl. Palghat Dist. 58. 1990; Sasidh., Fl. Parambikulam WLS 14. 2002. *Capparis magna* Lour., Fl. Cochinch. 330. 1790. *Crataeva nurvala* Buch. - Ham., Trans. Linn. Soc. London 15: 121. 1827; Manilal & Sivar., Fl. Calicut 32. 1982. *Crataeva religiosa* var. nurvala (Buch. - Ham.) Hook. f. & Thoms. in Hook.f., Fl. Brit. India 1: 172. 1872. (Fig. 8 e)

Medium sized deciduous trees up to 10 m high, surface grey, smooth. Branches terete. Leaves alternate, digitately trifoliate; leaflets unequal, ovate, ovate - lanceolate or broadly elliptic, base acute, or subacute, apex acute or acuminate, margin entire, glabrous, coriaceous. Inflorescence a terminal corymb. Flowers bisexual, fragrant, creamy white. Sepals 4, free, 3 mm long, oblong. Petals 4, creamy white, often

tinged with purple, long - clawed, obovate, up to 2 cm long. Disc nectariferous. Stamens many, free, longer than the petals, inserted at the base of gynophore. Gynophore 4 - 5 cm long at anthesis, slender; ovary superior, ellipsoid, ovules many; stigma sessile, capitate. Fruit a berry, ovoid, yellowish - grey.

Flowering and Fruiting: March - April

Growth form: Helophyte

Distribution: Indo - Malesia and China

Habitat: Dams and riverbanks

SJ 11892 (Malampuzha)

CARYOPHYLLACEAE Juss.

1a. Leaves cordate at base..... *Drymaria*

1b. Leaves not cordate at base..... *Polycarpon*

DRYMARIA Schult.

Drymaria cordata (L.) Willd. ex Roem. & Schult. ssp***. diandra*** (Blume) Duke, Ann. Miss. Bot. Gard. 48: 253. 1961; Manilal, Fl. Silent Valley 17. 1988; Vajr., Fl. Palghat Dist. 67. 1990; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 166. 2016. *Drymaria diandra* Blume, Bijdr. 62. 1825; N. C. Majumdar in B.D. Sharma & N.P. Balakr., Fl. India 2: 533.1993; P. Daniel in P. Daniel, Fl. Kerala 1: 311. 2005. *Drymaria cordata* Edgew. & Hook.f. in Hook.f., Fl. Brit. India 1:244.1874; Gamble, Fl. Pres. Madras 63 (46). 1915; Sasidh., Fl. Parambikulam WLS 19. 2002. (Fig. 8 f)

Prostrate or ascending herbs, rooting at the nodes. Branches slender, arising from the base, rooting at the nodes. Leaves to 1.5 x 1 cm, rounded or ovate, base cordate. Petiole up to 3 mm. Cymes axillary or terminal, up to 3.5 cm; Sepals 5, up to 2.5 mm, lanceolate, green, 3 - nerved. Petals 2mm, bifid at apex, white; stamens 2 - 3, filaments 1.5 mm; ovary globose, 1 mm across, style 3 fid. Capsule 2.5 mm, oblong, 3 valved. Seeds reniform.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte

Distribution: Paleotropics

Habitat: Riverbanks, small streams, paddy field bunds

SJ 15052 (Seetharkund)

POLYCARPON L.

Polycarpon prostratum (Forssk.) Asch. & Schweinf., Osterr. Bot. Z. 39: 128. 1889; Vajr., Fl. Palghat Dist. 67. 1990; Babu, Fl. Malappuram Dist. 38. 1990; N. C. Majumdar in B.D. Sharma & N.P. Balakr., Fl. India 2: 553. 1993; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 166. 2016. *Polycarpon loeflingiae* (Wall. ex Wight & Arn.) Benth. ex Edgew. & Hook. f., Fl. Brit. India 1: 245. 1874; Gamble, Fl. Pres. Madras 64(46). 1915. (Fig. 9 a)

Prostrate or decumbent annual herbs, pubescent, branches to 20 cm long. Leaves subsessile; linear - oblong or spathulate, base attenuate, apex subacute or obtuse, up to 18 mm long and 5 mm wide. Flowers in terminal dichasial paniculate cymes, flowers around 3 mm across. Sepals 5, linear - oblong or ovate, subequal, up to 5mm long. Petals linear lanceolate, truncate, smaller than sepals, notched at apex. Stamens 3 - 5. Ovary 1 - celled; style trifid. Capsules ovoid, 1.5 - 2 mm long. Seeds many, subcylindrical, pale brown, minutely tuberculate.

Flowering and Fruiting: January - April

Growth form: Helophyte

Distribution: Paleotropics

Habitat: Wet areas in dam shore

SJ 16940 (Malampuzha)

CELASTRACEAE R. Br.

PARNASSIA L.

Parnassia mysorensis Heyne ex Wight & Arn., Prodr. 35. 1834; Hook. f., Fl. Brit. India 2: 402. 1878; Gamble, Fl. Pres. Madras 448

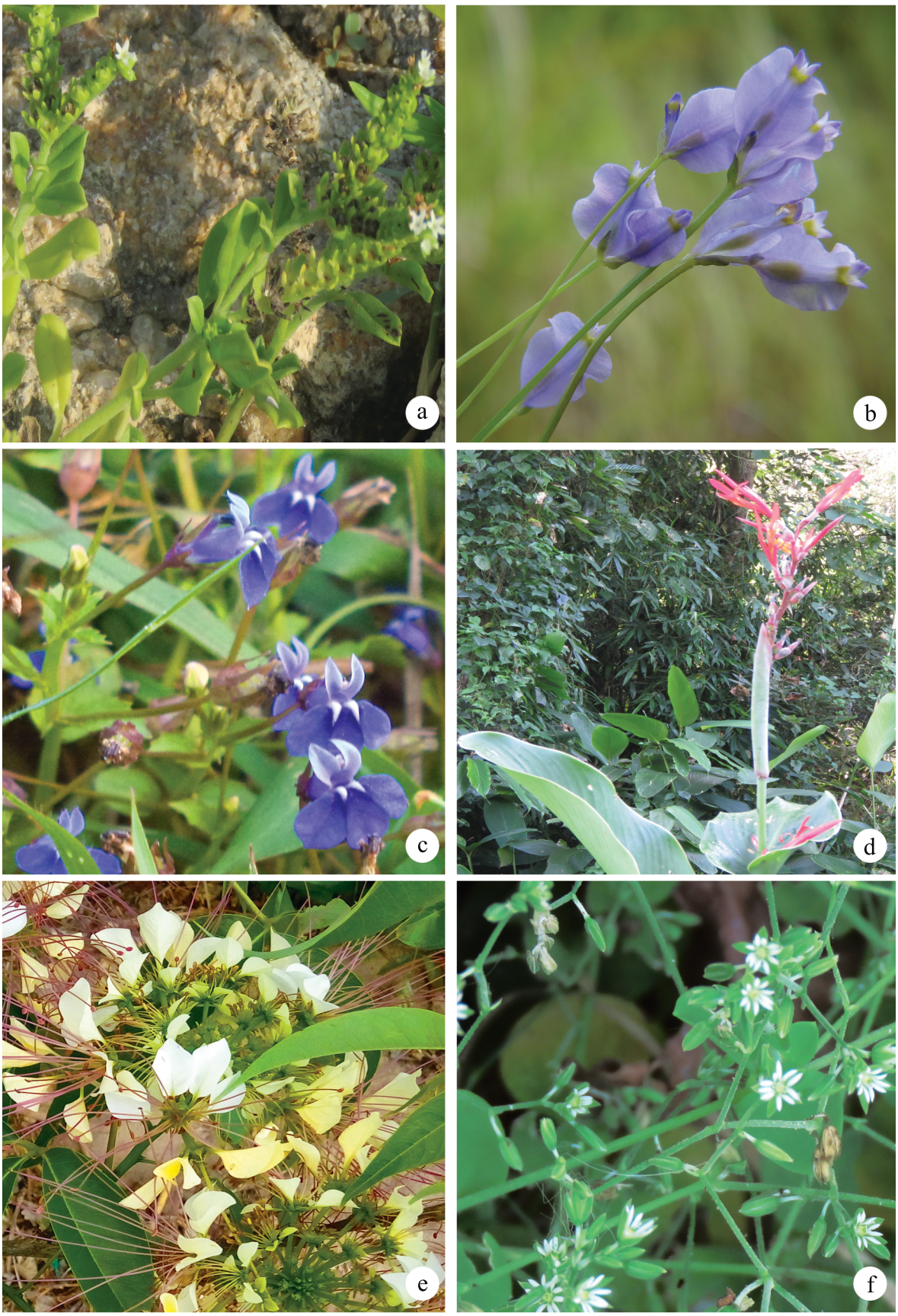


Fig. 8 a) *Heliotropium ovalifolium* b) *Burmannia coelestis* c) *Lobelia alsinoides* d) *Canna indica* e) *Crataeva magna* f) *Drymaria cordata*

(317). 1919; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 38. 1996; Swarup. *et al.,* Shola For. Kerala 70. 1998. Small ephemeral herbs. Leaves simple, radical, orbicular to reniform, base cordate, nearly 1.5 cm across. Petioles up to 4.5 cm long. Flowers solitary on scape, 6 - 12 cm long. Scape with a leafy bract at middle. Calyx broadly campanulate, 3.5 mm long, lobes 5, broadly ovate. Petals 5, white, broadly ovate; stamens and staminodes 5, alternating with each other. Ovary 4mm long, ovoid, unilocular; ovules many; style short; stigma 3. Capsules ovoid, 3 - 4 valved; seeds many, minute.

Flowering and Fruiting: September - January

Growth form: Helophyte

Distribution: Peninsular India and eastern Himalayas.

Habitat: Wet areas in grass lands

SJ 11839 (Meenvani)

CERATOPHYLLACEAE Gray

CERATOPHYLLUM L.

Ceratophyllum demersum L., Sp. Pl. 992. 1753; Hook. f., Fl. Brit. India 5: 639. 1888; Gamble, Fl. Pres. Madras 1391(973). 1928; Joseph, Aquatic Angiosp. Malabar 58. 1991; Cook, Aquat. Wetland Pl. India 84,1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 169. 2016. (Fig. 9 b)

Rootless herbs, submerged, 15 - 90 cm long. Leaves whorled, 1.5 - 3 cm long; denticulate along the margin often terminated by 1 or 2 sharp bristles. Flowers minute, sessile, solitary, unisexual. In male flowers perianth segments 10 - 15, connate at the base. Stamens 10 - 20, anthers erect, 2 - lobed. Female flowers with 10 - 15 perianth segments and sessile carpel; ovary 1 - celled, globose, style simple, stigma oblique. Fruit ovoid or ellipsoid with one terminal and two sub basal spines. Seeds globose.

Flowering and Fruiting: October - January

Growth form: Plankton

Distribution: Cosmopolitan

Habitat: Rivers and ponds

SJ 16937 (Thirunellayi)

COMMELINACEAE R. Br.

1a. Petals united into a tube ..... *Cyanotis*
1b. Petals free 2
2a. Bracts spathaceous ..... *Commelina*
2b. Bracts scale like..... 3
3a. Stamens 6..... *Floscopa*
3b. Stamens 3 ..... *Murdannia*

COMMELINA L.

1a. Flowers yellow..... *C. wightii*
1b. Flowers blue.....2
2a. Spathe with margins united below.....*C. benghalensis*
2b. Spathe with margins free..... *C. diffusa*

Commelina benghalensis L., Sp. Pl. 41. 1753; Hook. f., Fl. Brit. India 6: 370. 1892; Gamble, Fl. Pres. Madras 1539(1075). 1931; Vajr., Fl. Palghat Dist. 516. 1990; Cook, Aquat. Wetland Pl. India 86,1996; Sasidh., Fl. Parambikulam WLS 356. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 173. 2016. (Fig. 9 c)

Herbs with ascending stems, up to 50 cm long, internodes with purple lines, rooting at lower nodes; rootstock with cleistogamous flowers. Leaves ovate to lanceolate 3 - 6 x 2 - 4 cm, base rounded or subtruncate, apex obtuse or acute, pubescent, margin ciliate; petiole to up to 1 cm. Spathe, funnel - shaped, pubescent. Flowers bisexual, petals blue, broadly ovate. Stamens 3, 2.5 - 3.5 mm; staminodes 3, violet. Ovary pale green. Capsule 6 x 5 mm long, ellipsoid; seeds ovoid.

Flowering and Fruiting: July - November

Growth form: Helophyte

Distribution: Africa, India, China, Japan and Malesia

Habitat: Riverbanks, moist areas and paddy fields

SJ 15066 (Kollengode)

Commelina diffusa Burm. f., Fl. Ind. 18.1768; Vajr., Fl. Palghat Dist. 516. 1990; Subram., Fl. Thenmala Div. 394. 1995; Sasidh. & Sivar., Fl. Pl. Thrissur For. 474. 1996; Sasidh., Fl. Periyar Tiger Reserve 460. 1998; Aquat. Wetland Pl. India 86,1996; Sasidh., Fl. Parambikulam WLS 356. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 176. 2016. (Fig. 9 d)

Diffuse herbs. Stem erect at first and later decumbent, up to 90 cm height, rooting at lower nodes. Leaves 2 - 5x 1 - 2 cm, lanceolate, acute or acuminate, entire. Inflorescence subterminal; bracts erect, ovate – lanceolate; flowers 1cm across; sepals 3, 2 - 3 mm long; petals 3, blue, 4 - 5 mm long. Fertile stamens 3. Ovary globose, stigma capitate. Capsule to 8 mm long, oblong; Seeds up to 2 x1 mm, reticulate, dark brown.

Flowering and Fruiting: July – November

Growth form: Helophyte

Distribution: Pantropical

Habitat: Marshy waste lands and paddy fields

SJ 15067 (Olavakkode)

Commelina wightii Raiz., Indian For. 84: 479. 1958; Vajr., Fl. Palghat Dist. 517. 1990; Sasidh., Fl. Parambikulam WLS 357. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 180. 2016. *Commelina glabra* (Wight) Clarke in A. & C. DC., Monogr. Phan 3:163.1881, nom. illeg.; Hook. f., Fl. Brit. India 6: 371. 1892; Gamble, Fl. Pres. Madras 1539 (1074). 1931; Babu, Fl. Malappuram Dist. 820. 1990. (Fig. 9 e)

Erect or decumbent annual herbs, glabrous. Leaves 1 - 4.5 x 1 - 1.5 cm, sessile; lamina linear - oblong, acute, obtuse at base, entire, pubescent. Spathe terminal or axillary, cordate at base, ciliate along margins; flowers yellow, bisexual; sepals 3, ovate, obtuse; petals 3, yellow, paired ones large, reniform; odd one boat - shaped; stamens 3,

filaments yellow, lobes brown. Staminodes 3, ovary globose, style slender, stigma capitate. Capsule globose; seeds spherical.

Flowering and Fruiting: July – November

Growth form: Helophyte

Distribution: Pantropical

Habitat: Marshy waste lands and wet rocks

SJ 11832 (Malampuzha)

CYANOTIS D. Don

Cyanotis axillaris (L.) D. Don, Prodr. Fl. Nepal. 46.1825; Hook. f., Fl. Brit. India 6:388.1892; Gamble, Fl. Pres. Madras 1550 (1082). 1931; Aquat. Wetland Pl. India 87,1996; Sasidh., Fl. Parambikulam WLS 358. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 182. 2016. *Tonningia axillaris* (L.) O. Ktze., Rev. Gen. Pl. 2: 722. 1891; Vajr., Fl. Palghat Dist. 524. 1990; Joseph, Aquatic Angiosp. Malabar 299. 1991. (Fig. 9 f)

Stem creeping or ascending, fleshy, up to 40 cm long, internodes 2 - 8 cm long, rooting at lower nodes, often purple coloured. Leaves 3 - 7.5 x 0.5 - 0.8 cm, linear, apex acute; sheath up to 1 cm long. Inflorescence in axillary cymes, enclosed within the leaf sheath. Flowers 7.5 mm across. Calyx connate, tube up to 4 mm long. Corolla blue; tube to 9 mm, lobes to 4 mm, ovate. Stamens 6, up to 1.8 cm, filaments pink with purple pilose hairs. Ovary 1.5 – 2 mm, 3 locular; ovules 2 per cell with axile placentation; style 1.5 mm long, stigma simple. Capsule 3 x 7 mm long, oblong, apex beaked, yellowish green; seeds sub cylindrical, grey, 2mm long.

Flowering and Fruiting: August – December

Growth form: Helophyte

Distribution: Indo - Malesia

Habitat: Marshy waste lands and wet rocks

SJ 15096 (Chittur)

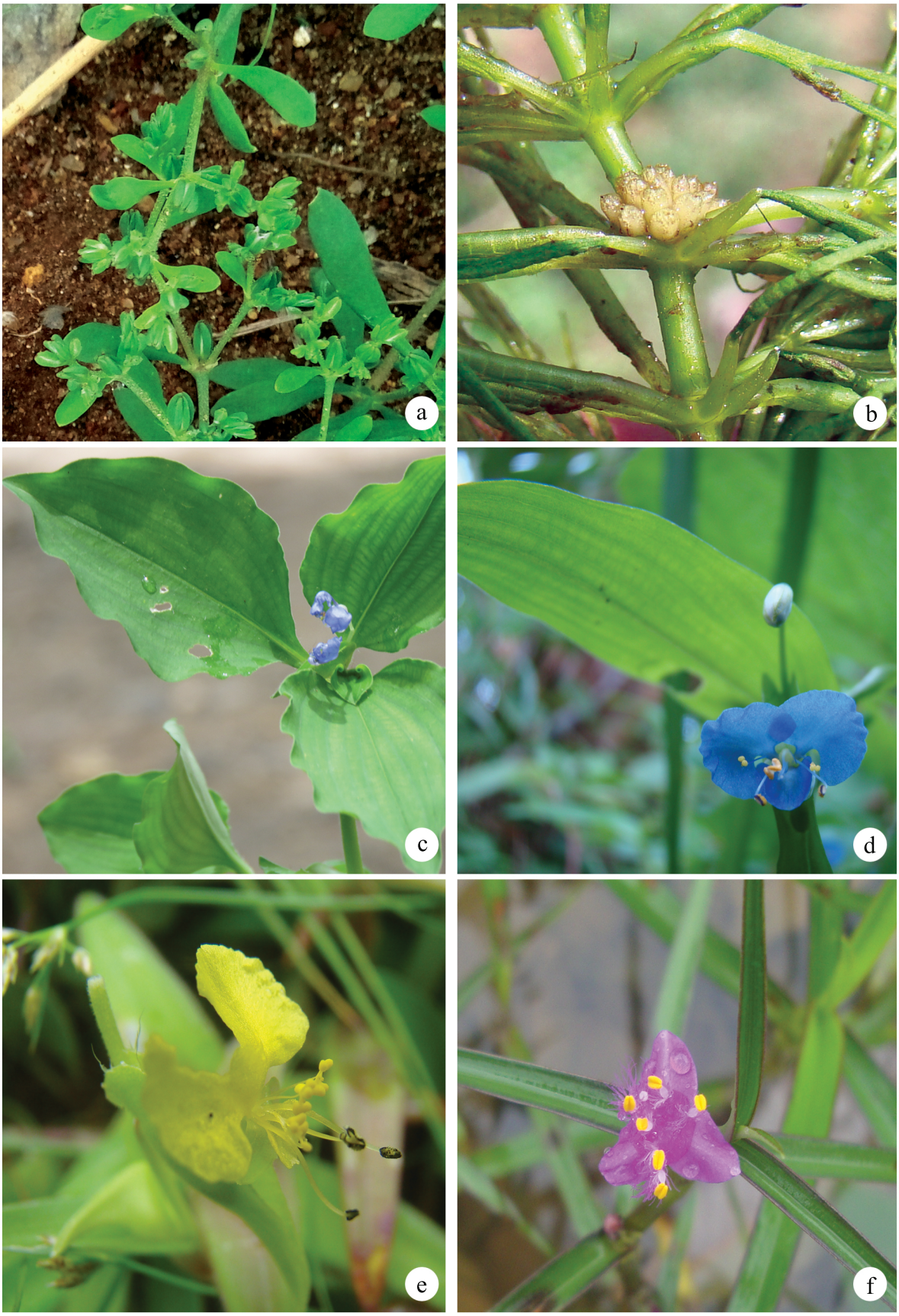


Fig. 9 a) *Polycarpon prostratum* b) *Ceratophyllum demersum* c) *Commelina benghalensis* d) *Commelina diffusa* e) *Commelina wightii* f) *Cyanotis axillaris*

FLOSCOPA Lour.

Floscopa scandens Lour., Fl. Cochinch. 193. 1790; Hook. f., Fl. Brit. India 6: 390. 1892; Gamble, Fl. Pres. Madras 1522(1083). 1931; Vajr., Fl. Palghat Dist. 521. 1990; Aquat. Wetland Pl. India 88. 1996; Sasidh., Fl. Parambikulam WLS 359. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 193. 2016. (Fig. 10 a)

Ascending or creeping perennial herbs. Stem terete, rooting at nodes; internodes up to 8 cm long with line of cilia. Leaves spiral with greenish purple sheath, elliptic - lanceolate, acuminate, acute at base, glabrous; 3 - 8 x 1.5 - 2.5 cm, midrib and veins prominent. Inflorescence axillary or terminal. Panicle 3 - 6 cm long. Flowers many, 3 - 5 mm across, bisexual; sepals 3, pale purple; petals 3, free, pale violet. Fertile stamens 6, filaments free, glabrous; anthers small, obtuse, with broad connective, anther lobes yellow. Ovary bilocular with one ovule per locule. Capsule broadly ovoid with globose - elliptic seeds.

Flowering and Fruiting: January – April

Growth form: Helophyte

Distribution: Indo - Malesia

Habitat: Marshy waste lands and along streams

SJ 16948 (Nelliampathy)

MURDANNIA Royle

1a. Leaf blade folded, not more than 2 mm wide..... *M. semiteres*

1b. Leaf blades flat, more than 3 mm wide 2

2a. Inflorescence terminal panicle, flowers blue..... *M. japonica*

2b. Inflorescence terminal or axillary cyme, flowers brick red.....*M. pauciflora*

Murdannia japonica (Thunb.) Faden, Taxon 26: 142. 1977; Vajr., Fl. Palghat Dist. 522. 1990; Sasidh., Fl. Parambikulam WLS 360. 2002; Mohanan & Sivad., Fl. Agasthyamala 739. 2002; Anil Kumar *et al.,* Fl.

Pathanamthitta 516. 2005; Ratheesh Narayanan, Fl. Stud. Wayanad Dist. 892. 2009.

Erect herbs, up to 1m; stem terete, smooth; roots tuberous. Leaves up to 15 x 7 cm, basal and cauline, ovate, acute at apex, cordate at base, glabrous, sessile. Panicle 10 – 12 cm long, terminal; flowers 10 mm across, solitary or in group of 2 or 3, pedicelled. Sepals, oblong - obtuse. Petals obovate, obtuse, pale blue or white. Stamens 3, filaments hairy. Capsule globose; seeds brown, three sided.

Flowering and Fruiting: July – September

Growth form: Helophyte

Distribution: Indo - Malesia

Habitat: Marshy waste lands and near streams

SJ 15068 (Karappara)

Murdannia pauciflora (Wight) Brueck. in Engl. & Prantl, Naturl. Pflanzenfam. (ed. 2) 15a: 173. 1930; Vajr., Fl. Palghat Dist. 523. 1990; Sasidh., Fl. Parambikulam WLS 360. 2002; Ansari et al., Aquat. Wetland Fl. Kerala. Fl. Pl. 200. 2016. *Aneilema pauciflorum* Wight, Ic. t. 2077. 1853; Hook. f., Fl. Brit. India 6: 378. 1892; Gamble, Fl. Pres. Madras 1545 (1078). 1931. (Fig. 10 b)

Spreading herbs. Leaves, ovate, cordate at base, apex acute, 1 - 3 x 0.5 - 1.5 cm, pubescent; sheath 5 mm long, hairy. Cymes axillary and terminal with 1 - 4 bisexual flowers, 4 - 5 mm across; pedicels 0.5 - 1 cm long, deflexed in fruits. Sepals 3, oblong, 1 x 3 mm, acute. Petals brick red, oblong, acute. Fertile stamens 3, filaments bearded; staminodes 3. Capsule 4 - 5 mm long, ellipsoid, pale green, glabrous; style purple; seeds 4 - 6 in each cell, black, suborbiculoid.

Flowering and Fruiting: September - November

Growth form: Helophyte

Distribution: Indo - Malesia

Habitat: Marshy waste lands and wet rocks

SJ 15041 (Parambikulam)

Murdannia semiteres (Dalz.) Sant., Poona Agri. Coll. Mag. 41(4): 15. 1951; Manilal, Fl. Silent Valley 327. 1988; Vajr., Fl. Palghat Dist. 523. 1990; Cook, Aquat. Wetland Pl. India 90,1996; Sasidh., Fl. Parambikulam WLS 360. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 203. 2016. *Aneilema semiteres* Dalz. in Hook.'s, J. Bot. Kew Gard. Misc. 3: 138. 1851. *Aneilema paniculatum* Wall. ex Clarke in A. & C. DC., Monogr. Phan. 3: 215. 1881; Gamble, Fl. Pres. Madras 1546 (1079). 1931. *Dichaespermum paniculatum* (Wall. ex Clarke) Hook. f. & Thoms. in Hook.f., Fl. Brit. India 6: 381. 1892. (Fig. 10 c)

Tufted slender herbs, erect, purplish green, rooting at base. Leaves 4 - 13 x 0.1 - 0.2 cm, linear, filiform, semi terete, apex acuminate. Panicles terminal, lax, longer than leaves, peduncles reddish, up to 18 cm long. Flowers blue; pedicels up to 5 mm long. Sepals 3, obovate, acute. Petals 3, blue, 2 - 4 mm long, obovate, apex acuminate. Fertile stamens 3; filaments naked. Ovary globose, glabrous, light green; stigma papillose. Fruit elliptic, brown. Seeds dark brown.

Flowering and Fruiting: October to December
Growth form: Helophyte
Distribution: Endemic to peninsular India
Habitat: Wet rocks

SJ 16920 (Vengappara)

CONVOLVULACEAE Juss.

1a. Pollen grains spinulose ..... *Ipomoea*
1b. Pollen grains smooth ..... *Merremia*

IPOMOEA L.

1a. Plants erect shrubs ..... *I. fistulosa*
1b. Plants creeping or floating ..... *I. aquatica*

Ipomoea aquatica Forssk., Fl. Aeg. - Arab. 44. 1775; Hook. f., Fl. Brit. India 4: 210. 1883; Vajr., Fl. Palghat Dist. 309. 1990; Joseph,

Aquatic Angiosp. Malabar 63. 1991; Cook, Aquat. Wetland Pl. India 92,1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 209. 2016. *Ipomoea reptans* Poir. in Lam., Encycl. Suppl. 3: 460. 1814; Gamble, Fl. Pres. Madras 916(643). 1923. (Fig. 10 e)

Perennial creeping or floating aquatic herbs, stems hollow, rooting at the nodes. Leaves simple; petioles up to 10 cm long, oblong - sagittate or hastate. Flowers solitary or in 2 - 3 flowered cymes, pedicellate, purplish - white. Calyx lobes subequal, ovate, acute, 6 - 8 mm long, glabrous. Corolla funnel - shaped, up to 5 cm long, pale purple to nearly white, tube up to 2 cm long. Stamens unequal, villous at the base; anthers 4mm long. Ovary glabrous. Capsule subglobose. Seeds 4 or 2, minutely pubescent.

Flowering and Fruiting: November - March

Growth form: Ephydate/ Hyperhydate/ Tenagophyte

Distribution: Pantropical

Habitat: Ponds and streams

SJ 11809 (Kalpathy)

Ipomoea fistulosa Mart. ex Choisy in DC., Prodr. 9: 349. 1845; Manilal & Sivar., Fl. Calicut 181. 1982; Antony, Syst. Stud. Fl. Kottayam Dist. 263. 1989; Cook, Aquat. Wetland Pl. India 93. 1996: Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 210. 2016. *Ipomoea carnea* Jack. ssp. *fistulosa* (Mart. ex Choisy) Austin, Taxon 26: 237. 1977; Joseph, Aquatic Angiosp. Malabar 64. 1991. (Fig. 10 d)

Perennial erect to subscandent shrubs; up to 3.5 m tall. Stems fistulose at maturity, swollen when in water. Leaves ovate - deltate, cordate, apex acuminate, 8 - 15 cm long and 4 - 7 cm wide, lateral veins 8 - 10 pairs, prominent. Flowers in axillary or subterminal cymes; peduncle up to 10 cm long; calyx lobes 5, subequal; corolla pale pink, funnel shaped, up to 9 cm across. Filaments of stamen villous at base. Capsule subglobose. Seeds pubescent with brownish hairs.

Flowering and Fruiting: Throughout the year

Growth form: Hyperhydate/ Tenagophyte/ Helophyte

Distribution: Pantropical

Habitat: Ponds and streams

SJ 11806 (Chittur)

MERREMIA Dennst.ex Endl.

Merremia gangetica (L.) Cufod., Bull. Jard. Bot. Etab. Brux. Suppl. 31: 743. 1961; Manilal & Sivar., Fl. Calicut 185. 1982. Cook, Aquat. Wetland Pl. India 94. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 213. 2016. *Merremia emarginata* (Burm.) Hall.f. in Engl., Bot. Jahrb. Syst. 16: 552. 1893; Gamble, Fl. Pres. Madras 928 (652). 1923. *Ipomoea reniformis* Choisy, Mem. Soc. Phys. Geneve 6: 446. 1883; Hook. f., Fl. Brit. India 4: 206. 1883. (Fig. 10 f)

Creeping herbs, rooting at the nodes; perennial, sparsely pubescent, glabrescent. Leaves alternate, reniform to ovate, up to 3 cm long, often slightly wider, cordate at the base, obtuse at the apex. Inflorescence axillary, solitary or in 2 - 3 - flowered cymes. Flowers with very short peduncles. Calyx lobes unequal. Corolla yellow with a paler tube, campanulate, 5 - 9 mm long and around 7mm in diameter. Stamens 5, filaments up to 4 mm long. Fruits subglobose, embraced by persistent sepals, 5 - 6 mm long. Seeds grayish - brown, glabrous, subglobose.

Note: New report to Palakkad

Flowering and Fruiting: December - April

Growth form: Helophyte

Distribution: Indo - Malesia and tropical Africa

Habitat: Ponds and streams

SJ 16941 (Nattukal)

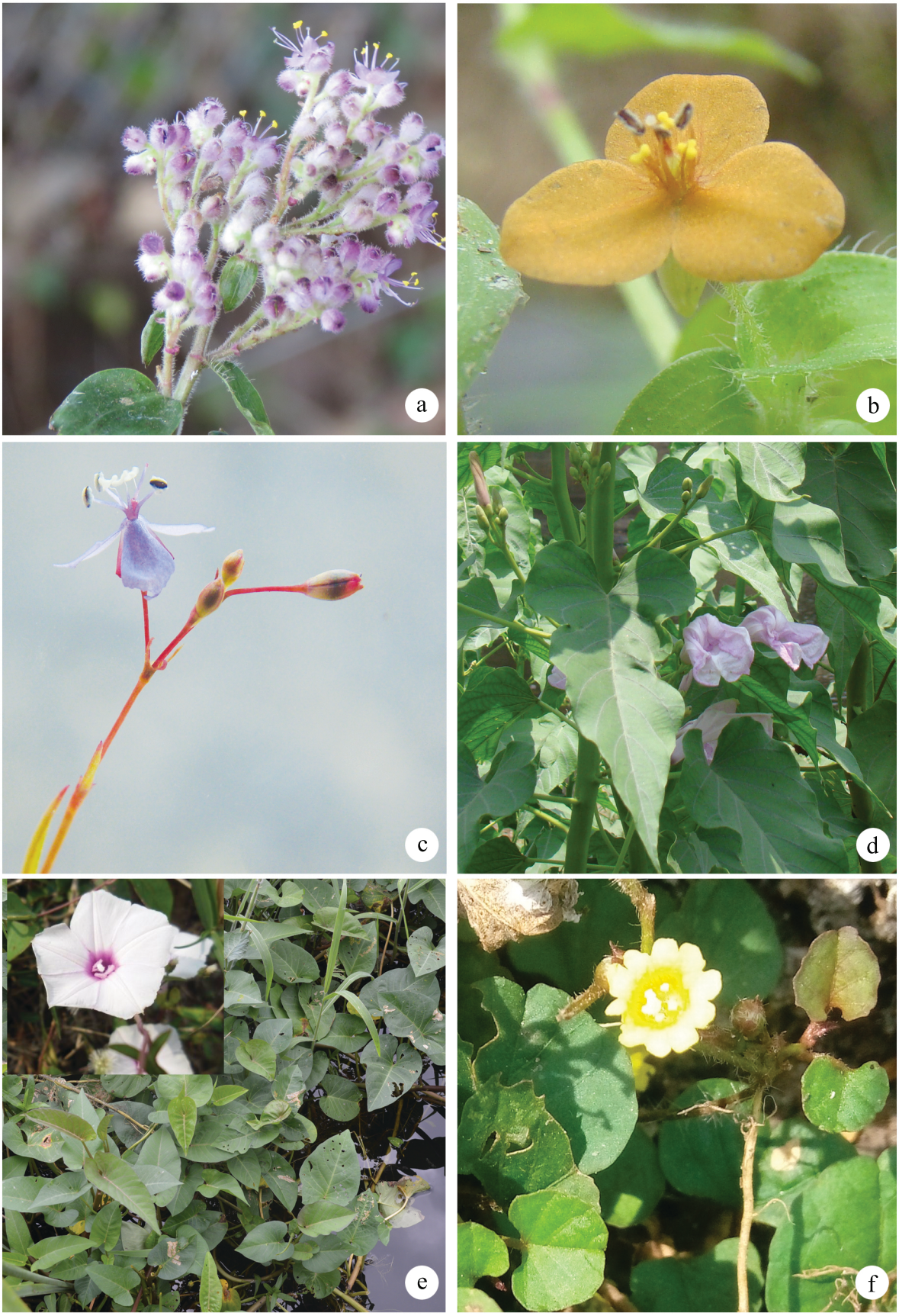


Fig. 10 a) *Floscopa scandens* b) *Murdannia pauciflora* c) *Murdannia semiteres* d) *Ipomoea fistulosa* e) *Ipomoea aquatica* f) *Merremia gangetica*

CYPERACEAE Juss.

1a. Glumes arranged in two rows on the rachilla; spikelets flattened...2
1b. Glumes (at least the upper ones) arranged spirally on the rachilla; spikelets not flattened.....6
2a. Rachilla articulated; spikelets falling at entirely at maturity.....3
2b. Rachilla not articulated; spikelets remains attached to rachilla when nuts are shed..... 4
3a. Stigmas 2..... *Kyllinga*
3b. Stigmas 3 ..... *Cyperus*
4a. Style constricted and swollen at base..... *Fimbristylis*
4b. Style neither constricted nor swollen at base.....5
5a. Nuts with the angle facing rachilla, stigmas 2..... *Pycreus*
5b. Nuts with flat side facing the rachilla, stigmas usually 3 if 2 leaves inverted W shaped..... *Cyperus*
6a. Style base constricted and swollen or articulated above the ovary..... 7
6b. Style base not swollen, continuous with the ovary.....8
7a. Hypogynous bristles present..... *Rhynchospora*
7b. Hypogynous bristles absent 9
8a. Leaf blades absent or highly reduced..... *Schoenoplectiella*
8b. Leaf blades present..... 10
9a. Style base persistent if falls, no tumors are left on nut...*Fimbristylis*
9b. Style base falls off leaving a button like scar or tumor ... *Bulbostylis*
10a. Leaf sheath and blades glabrous..... *Lipocarpha*
10b. Leaf sheath and blades hairy..... *Fuirena*

BULBOSTYLIS Kunth.

1a. Nuts smooth; Inflorescence capitate..... *B. barbata*
1b. Nuts transversely wrinkled; Inflorescence sub – umbellate .....
..... *B. puberula*

Bulbostylis barbata (Rottb.) Kunth ex Clarke in Hook. f., Fl. Brit. India 6: 651. 1893; Gamble, Fl. Pres. Madras 1662 (1153). 1931; Vajr.,

Fl. Palghat Dist. 540. 1990; Rejani, Cyperac. Kerala 80. 1991; Sasidh., Fl. Parambikulam WLS 372. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 216. 2016. (Fig. 11 a)

Rhizomes lacking. Culms densely tufted, slender to filiform, up to 15 cm tall, angular, smooth. Leaves basal, lower ones reduced to sheaths, membranous, 7 mm long, yellowish brown, upper one blade, up to 3 cm long, blade filiform, shorter than stem, glabrous. Ligule of 1 – 2 mm long, white hairs. Involucral bracts about or as long as the inflorescence. Inflorescence of capitate heads. Spikelets sessile, 4mm long, 0.6 mm wide. Glumes ovate, 2mm long, 1mm wide, sides brownish, nerves not clear, margin white, hyaline, keel green with a slightly curved mucro. Stamens 1. Style 3 - cleft, smooth, with swollen base, leaving a button like scar on the fruit. Nuts 0.6 mm long, 0.5 mm wide, golden brown, 3 - sided, sides slightly concave.

Flowering and Fruiting: August - December

Growth form: Hyperhydate/Tenagophyte/Helophyte

Distribution: Paleotropics and southern USA

Habitat: Near banks of streams, sandy and waste lands.

SJ 15005 (Veezhumala)

Bulbostylis puberula (Poir.) Clarke in Hook.f., Fl. Brit. India 6: 652. 1893; Rejani, Cyperac. Kerala 85. 1991; Sunil & Sivadasan, Fl. Alappuzha Dist. 748. 2009; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 218. 2016.

Annual. Non - rhizomatous. Culms erect, tufted, filiform, 8 - 30cm tall. Leaves basal, much shorter than the culms, 3 - 10 cm long, 0.5 mm broad, capillary, short pubescent; sheaths 5 - 8 mm long, 4 - 5 ribbed, pubescent. Ligule present as a fringe of long hairs. Involucral bracts 2 - 4, one longer than the inflorescence, others shorter, filiform. Inflorescence sub - umbellate, umbels congested. Spikelets ovate, acute densely many flowered, 4 - 8 mm long, 1 - 1.5 mm wide. Glumes ovate, acute and mucronulate, 2 mm long, 2mm wide, densely

pubescent. Style 3 - cleft, 2mm long. Nuts obovoid, 3 - sided, 0.75 mm long, 0.5 mm in diameter, transversely wrinkled.

Flowering and Fruiting: September - January

Growth form: Helophyte

Distribution: Tropical Africa, Madagascar, India and Malesia

Habitat: Sandy banks of streams

SJ 15009 (Malampuzha)

CYPERUS L.

1a. Rachilla articulated; spikelets falling entirely at maturity..... 2

1b. Rachilla not articulated; spikelets fixed to rachilla when nuts are shed 5

2a. Culms with swollen, bulb - like bases with chestnut brown sheaths; inflorescence simple 3

2b. Culms not swollen and bulb - like at the base; inflorescence compound 4

3a. Inflorescence a digitate cluster of cylindrical spikes; stolons present; spikelets with 1 nut ..... *C. clarkei*

3b. Inflorescence a single, hemi - spherical or lobed head; stolons absent; spikelets with 2 - 6 nuts ..... *C. dubius*

4a. Glumes awned and incurved; without rhizomes ..... *C. squarrosus*

4b. Glumes not awned; with rhizomes ..... *C. cyperinus*

5a. Spikelets spicately arranged on an elongated rachis.....6

5b. Spikelets digitately, stellately arranged or inflorescence capitate 5

6a. Culms without bladed leaves.....7

6b. Culms with bladed leaves, more than 3 cm 8

7a. Involucral bracts scaly, below 1.5 cm ..... *C. articulatus*

7b. Involucral bracts leaf like, more than 2 cm ..... *C. malaccensis*

8a. Plants annual with minute root system.....9

8b. Plants perennial with woody rhizome.....10

9a. Nuts much shorter than glumes..... *C. compressus*

9b. Nuts as long as glumes..... *C. iria*

10a. Styles 2 ..... *C. alopecuroides*
10b. Styles 3 11
11a. Plants with slender stolons..... *C. rotundus*
11b. Plants without stolons 12
12a. Spikelets cylindrical or subterete..... *19*
12b. Spikelet distinctly flattened..... 13
13a. Spikelet very numerous and crowded together so as to obscure the axis of spike..... *C. nutans*
13b. Spikelets not very numerous, mostly distant, axis of spike visible between them 14
14a. Spikelets not more than 1 mm wide..... *C. distans*
14b. Spikelets more than 1 mm wide..... *C. exaltatus*
15a. Inflorescence head like; without rays..... *C. cephalotes*
15b. Inflorescence not head like; with developed rays..... 16
16a. Rhizomes short (less than 10 mm) not stoloniferous but corm like or erect ..... *C. platystylis*
16b. Rhizomes either absent or elongated and stoloniferous..... 17
17a. Nuts as long as the subtending glume..... *C. difformis*
17b. Nuts much shorter than the subtending glumes.....18
18a. Fruiting spikelets with visible nuts in between them .....
... .*C. tenuispica*
18b. Fruiting spikelets with covered nuts in between them .....
.....*C. haspan*
19a. Spikelets arranged distantly on rachis ..... *C. digitatus*
19b. Spikelets arranged closely on rachis ..... *C. platyphyllus*

Cyperus alopecuroides Rottb., Desc. Nov. Pl. 38. t. 8, f. 2. 1773; Rejani, Cyperac. Kerala 122. 1991; Joseph, Aquatic Angiosp. Malabar 308. 1991. *Juncellus alopecuroides* (Rottb.) Clarke in Hook. f., Fl. Brit. India 6: 595. 1893; Gamble, Fl. Pres. Madras 1133 (1133). 1931. Cook, Aquat. Wetland Pl. India 102. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 226. 2016. (Fig. 11 b)

Rhizomatous perennial herbs, erect, up to 180 cm height; rhizome

short, woody. Culms tufted, three sided, smooth. 1 - 1.5 cm thick, Leaves 3 - 5, sheath spongy, up to 35 cm long. Blades long up to 75 cm long, 1 - 2 cm wide, inverted W shaped in cross section, involucral bracts 4 - 7, unequal, larger one up to 65 cm long. Inflorescence a compound paniculate spike; rays 5 - 10, unequal. Spikes upright, cylindrical, 1 - 4 cm long, 0.5 - 1.5 cm thick; glume - like bract 2.5 mm, acute, rachis flat, quadrangular, narrowly winged; Stamens 2; stigmas 2. Nut minute, 0.5 mm, yellowish brown, bi - convex, finely reticulate or almost smooth, shiny.

Note: New report to Palakkad

Flowering and Fruiting: February - April

Growth form: Hyperhydate/Tenagophyte/Helophyte

Distribution: North and tropical Africa, Madagascar and Indo - Malesia

Habitat: On the boundary of ponds and marshy areas.

SJ 16978 (Manapullikkavu)

Cyperus articulatus L., Sp. Pl. 44. 1753; Hook. f., Fl. Brit. India 6: 611. 1893; Gamble, Fl. Pres. Madras 1641 (1140). 1931; Rejani, Cyperac. Kerala 136. 1991; Joseph, Aquatic Angiosp. Malabar 309. 1991. Cook, Aquat. Wetland Pl. India 102. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 105. 2016. (Fig. 11 c)

Perennial, erect, herbs,1 - 1.5 m; Stolons, covered by brown or reddish - brown scales, longer than internodes. Stem 4 - 8 mm diam., terete or obtusely trigonous at the tip just below inflorescence; green, glabrous, septa formed by transversal internal tissue plates. Leaves reduced; sheaths up to 30 cm, soft, yellowish - brown or often reddish, mouth oblique; blades of uppermost sheaths up to 3 cm. Inflorescence up to 15 cm; bracts to 20 mm, upright; spikes 5 - 25 x 1 - 1.5 mm, slightly compressed; glumes acute; rachis 0.5 mm broad, winged; stamens 3, 1 - 1.2 mm long; anthers yellow. Nut 1.6 x 0.5 mm, obovoid, trigonous, sides concave, brown or silvery brown.

Flowering and Fruiting: February - April

Growth form: Hyperhydate/Tenagophyte

Distribution: Pantropics

Habitat: Marshy areas.

SJ 16950 (Pezhumkara)

Cyperus cephalotes Vahl, Enum. Pl. 2: 311. 1805; Hook. f., Fl. Brit. India 6: 597. 1893; Gamble, Fl. Pres. Madras 1639 (1139). 1931; Rejani, Cyperac. Kerala 130. 1991; Joseph, Aquatic Angiosp. Malabar 314. 1991; Cook, Aquat. Wetland Pl. India 106. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 234. 2016. (Fig. 11 d)

Rhizomatous perennial herbs, erect; rhizome short, creeping, producing slender stolons, rooting at nodes; culms solitary or few together, 12 - 38cm tall, trigonous. Leaves 2 to many, basal, 5.5 - 20 x 0.2 - 0.4 cm, narrowly linear, gradually tapering to acute apex, scabrid on margins towards apex; sheaths up to 6 cm long. Inflorescence capitate, 1 - 1.5 x 1 - 1.8 cm, ovoid or globose; leafy bracts 3 - 5, the longest up to 15 cm long. Spikelets congested, 4 - 7 x 3 - 4 mm, ovate - acute, compressed, reddish brown. Rachilla straight; glumes ovate, mucronate, brown, 3 - 5 nerved. Stamens 3; style 3 - 4 mm long; stigmas 3. Nut to 1.5 x 1 mm, ovoid, trigonous, apiculate at apex.

Flowering and Fruiting: October - February

Growth form: Hyperhydate/Pleustophyte

Distribution: Indo - Malesia and China to Australia.

Habitat: Often floating on ponds

SJ 16970 (Ponnamkode)

Cyperus clarkei Cooke, Fl. Pres. Bombay 2: 873. 1908. *Mariscus bulbosus* Clarke in Hook. f., Fl. Brit. India 6: 620. 1893, non Steud. 1855; Gamble, Fl. Pres. Madras 1644 (1142). 1931. *Mariscus clarkei* (Cooke) Koyama, J. Jap. Bot. 51:313. 1976, nom. illeg.; Rejani, Cyperac. Kerala 351. 1991; Cook, Aquat. Wetland Pl. India 162.1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 333. 2016.

Perennial herbs. Rhizome short with stolons. Culms solitary, 10 - 30 cm tall, 3mm thick, 3 - sides, smooth throughout, the base thickened and bulb - like. Leaves 5 - 7, glabrous, green, as long as the culms, 5mm wide, sheaths cylindrical, dusky brown, wider than the blade. Involucral bracts 5 - 9, spreding or reflexed, usually overtopping the inflorescence. Inflorescence congested into a digitate cluster of spikes, spikes cylindrical, 8 - 15 mm long, glaucous green, the rachis hidden by densely disposed spikelets. Spikelets spreading, lanceolate, 3 - 3.3 mm long, 1.3 - 1.5 mm wide, bearing 2 glumes and 1 flower. Glumes 2, inner glume ovate or narrowly acute, 2.5 mm long, 0.5 mm wide, outer glume lanceolate, acute, 2.5 mm long, 1 mm wide. Stamens 2. Style 3 - cleft to half way down, 2.5 mm long. Nuts oblong - ellipsoid, 3 - sided, 1.5 mm long, 0.5 mm wide, dark brown.

Note: New report to Palakkad

Flowering and Fruiting: October - December

Growth form: Tenagophyte/Helophyte

Distribution: Endemic to Sri Lanka and South India

Habitat: Marshy areas

SJ 15004 (Veezhumala)

Cyperus compressus , L., Sp. Pl. 46.1753; Hook. f., Fl. Brit. India 6: 605.1893; Gamble, Fl. Pres. Madras 1640 (1140). 1931; Vajr., Fl. Palghat Dist. 543. 1990; Rejani, Cyperac. Kerala 133. 1991; Joseph, Aquatic Angiosp. Malabar 315. 1991; Cook, Aquat. Wetland Pl. India 106. 1996; Sasidh., Fl. Parambikulam WLS 373. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 235. 2016.

Annual herbs. Rhizome absent. Culms tufted, erect, 10 - 40 cm tall, 1.5 mm thick, smooth, 3 - sided. Leaves shorter than or equal to the culms, 12 cm long, 3.5 mm wide, sheaths purple. Involucral bracts 2 - 5, unequal, lower ones exceeding the rays. Inflorescence simple, or compound, rays 3 - 8, unequal, spikes ovoid - cylindrical, 3 - 7 in clusters, digitately arranged spikelets. Spikelets linear - oblong, 5 - 20 flowered, greenish bearing golden yellow colour at maturity, 1.1 cm

long, 3 mm wide. Glumes ovate, acute, 3.5mm long, 3 mm wide, conspicuously multi - nerved with green keel, short mucro, silvery hyaline margins. Stamens 2, 1 mm long. Style 3 - cleft, 3 mm long. Nuts 3 - sided, obovoid, shining, 1.3 mm long, 1 mm wide, dark brown to blackish.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte/ Tenagophyte

Distribution: Pantropical

Habitat: Marshy areas and along riverbanks

SJ 15014 (Ottappalam)

Cyperus cyperinus (Retz.) Sur., Cyp. Mal. Arch. 154. t.6. f.10. 1898; Ansari, Fl. Kasaragod Div. 418. 1985; Ramach. & V.J. Nair, Fl. Cannanore Dist. 504. 1988; M. Mohanan & Henry, Fl. Thiruvanthapuram 507. 1994; Swarup. *et al.,* Shola For. Kerala 78. 1998; Ratheesh Narayanan, Fl. Stud. Wayanad Dist. 923. 2009. *Mariscus cyperinus* (Retz.) Vahl, Enum. Pl. 2: 377. 1805; Hook. f., Fl. Brit. India 6: 621. 1893; Gamble, Fl. Pres. Madras 1644 (1143). 1931; Rejani, Cyperac. Kerala 354. 1991; Joseph, Aquatic Angiosp. Malabar 386. 1991; Vajr., Fl. Palghat Dist. 554. 1990; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 336. 2016. (Fig. 11 e)

Perennial herbs. Rhizome short. Culms tufted, 10 - 30 cm tall, triquetrous, smooth. Leaves many, basal, linear, long - acuminate, 5 - 20 cm long, 0.2 - 0.4 cm wide, scabrid along margins. Sheaths up to 4 cm long, basal one reddish brown. Involucral bracts 4 - 7, the longest up to 15 cm long. Inflorescence simple with spicate branches, spikes nearly capitate, cylindric, sub - sessile. Spikelets linear - lanceolate, terete or sub - terete, 3 - 5 mm long, greenish - straw coloured, 1 or 2 flowered. Glumes distichous, elliptic, obtuse, rolled inward. Stamens 3. Stigmas 3. Nuts mostly 2 per spikelets, oblong, trigonous, shortly apiculate, minutely puncticulate, brown.

Flowering and Fruiting: June - August

Growth form: Helophyte

Distribution: Tropics and subtropics

Habitat: Marshy areas

SJ 15011 (Mannarkkad)

Cyperus difformis L., Cent. Pl. 2: 6. 1756; Hook. f., Fl. Brit. India 6: 599. 1893; Gamble, Fl. Pres. Madras 1640 (1139). 1931; Vajr., Fl. Palghat Dist. 544. 1990; Rejani, Cyperac. Kerala 177. 1991; Joseph, Aquatic Angiosp. Malabar 318. 1991; Cook, Aquat. Wetland Pl. India 109. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 238. 2016. (Fig. 11 f)

Culms tufted up to 50 cm tall, smooth. Leaves acuminate, folded, up to 20 cm long; margins scabrous towards the tip. Sheath yellowish brown; Involucral bracts 2 - 4, unequal; Inflorescence simple or in part compound. Spikelets in congested globose cluster. Spikelets 2 - 5 x 0.6 - 1 mm, linear, obtuse. Glumes 1 mm long, orbicular, apex rounded or emarginate, margins broadly white - hyaline, keel yellowish. Stamens 1 rarely 2. Stigmas 3. Style half as long as the nut. Nut elliptic, trigonous, apiculate, pale brown.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte/ Hyperhydate/Tenagophyte

Distribution: Tropical, Subtropical and temperate regions of the world

Habitat: Marshy areas and Paddy fields

SJ 15069 (Tattamangalam)

Cyperus digitatus Roxb., Fl. Ind. 1: 209. 1820; Hook. f., Fl. Brit. India 6: 618. 1893; Gamble, Fl. Pres. Madras 1642(1141). 1931; Rejani, Cyperac. Kerala 168. 1991; Cook, Aquat. Wetland Pl. India 109. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 241. 2016.

Erect, rhizomatous perennials; rhizomes woody, around 1 cm in diameter. Culms tufted or solitary, up to 65 cm tall, 3 sided. Leaves basal, up to 50 cm long and 1 cm wide, linear, acute, flat, scabrid on margins; sheaths upto 20 cm long, purple coloured. Inflorescence compound or decompound; leafy bracts 4 - 8, the longer ones upto 45

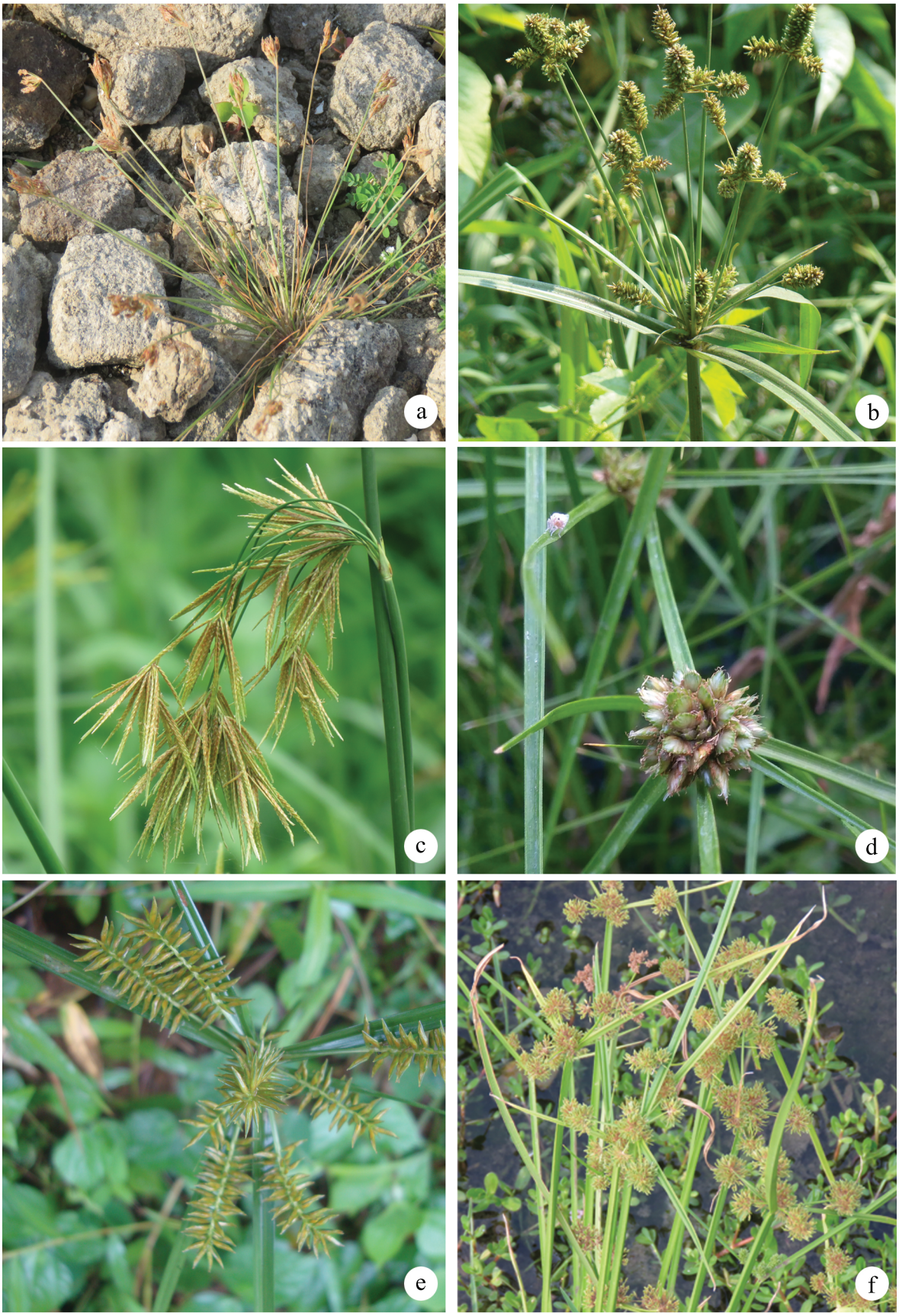


Fig. 11 a) *Bulbostylis barbata* b) *Cyperus alopecuroides* c) *Cyperus articulatus* d) *Cyperus cephalotes* e) *Cyperus cyperinus* f) *Cyperus difformis*

cm long; primary rays 4 to 10, unequal. Rachis upto 10 cm long. Spikelets 7 x 1.5 mm, linear, subterete, straw-coloured; arranged distantly on the rachis. Glumes 1.5 - 2 mm long, narrowly elliptic, keeled on back, pale straw-coloured. Stamens 3. Stigmas 3. Nut oblong-elliptic, trigonous, brownish.

Note: New report to Palakkad

Flowering and Fruiting: January - September

Growth form: Helophyte/ Hyperhydate/Tenagophyte

Distribution: Pantropical

Habitat: Marshy areas

SJ 16990 (Kadukkamkunnam)

Cyperus distans L. f., Suppl. Pl. 103. 1781; Hook. f., Fl. Brit. India 6: 607. 1894; Gamble, Fl. Pres. Madras 1640 (1140). 1931; Manilal, Fl. Silent Valley 338. 1988; Vajr., Fl. Palghat Dist. 544. 1990; Rejani, Cyperac. Kerala 161. 1991; Joseph, Aquatic Angiosp. Malabar 320. 1991; Cook, Aquat. Wetland Pl. India 110. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 244. 2016; *Cyperus nutans* sensu Clarke in Hook.f., Fl. Brit. India 6: 607. 1893, p.p., non Vahl 1805. *Cyperus distans* L.f. var. *pseudonutans* Kukenth. in Engler's Das Pflanzenr. Heft 101, 140. 1936; Manilal, Fl. Silent Valley 339. 1988; Vajr., Fl. Palghat Dist. 545. 1990.

Rhizome short, knotty, aromatic. Culms solitary, 3 - sided, sides flat, green, 45 cm tall, 5 mm wide. Leaves shorter than or about as long as the culms, channeled, midrib prominent and white, 1.25 cm wide, sheaths purplish - brown below, whitish green above. Involucral bracts 4 - 6, lower 2 0r 3 overtopping the inflorescence. Inflorescence compound, paniculate, corymbose, primary rays 5 - 12, very unequal. Spikelets linear, sub - terete, 6 - 20 flowered, 1.3 cm long, 1 mm wide, rachilla winged, zig - zag. Glumes thin, elliptical, obtuse, margins membranous, 2mm long, 1 mm wide, light or dark reddish brown, 3 - 5 nerved, keel green. Stamens 3, anther lobe 0.5 mm long. Style 3 - cleft, 1 mm long. Nuts 3 - sided, oblong - ellipsoidal, smooth with a

metallic shine, 0.8 mm long, 0.25 mm wide, yellowish, maturing dark brown.

Flowering and Fruiting: September - December

Growth form: Helophyte/ Tenagophyte

Distribution: Pantropical.

Habitat: Marshy areas and along riverbanks

SJ 15017 (Pothundi)

Cyperus dubius Rottb., Desc. Nov. Pl. 20. t. 4, f.5. 1773; Mohanan, Fl. Quilon Dist. 442. 1984; Manilal, Fl. Silent Valley 339. 1988; Mohanan & Henry, Fl. Thiruvanthapuram 507. 1994. *Mariscus dubius* (Rottb.) Kukenth. ex C.E.C. Fisch. in Gamble, Fl. Pres. Madras 1644 (1142). 1931; Vajr., Fl. Palghat Dist. 554. 1990; Rejani, Cyperac. Kerala 357. 1991; Cook, Aquat. Wetland Pl. India 164. 1996; Sasidh., Fl. Parambikulam WLS 378. 2002.

Rhizome short, without stolons. Culms tufted, 14 - 30 cm tall, 3 mm thick, 3 sided, smooth throughout, the base thickened and bulb - like. Leaves several to a culm, longer than half of the stem, 5mm wide, soft, scabrous along the upper midrib and margins, sheaths somewhat inflated towards the base. Involucral bracts 3 - 6, erect to reflexed, the lower ones much overtopping the inflorescence, longest one 14 cm long, 5 mm wide. Inflorescence a dense, hemi - spherical or lobed head, 5 - 20 mm in diameter, greenish - white to dirty white. Spikelets with 6 - 10 flowers. Glumes broadly ovate to lanceolate - elliptical, 4mm long, 2mm wide, sub - acute to acute, 14 nerved, midrib green and slightly keeled. Stamens 2. Stigmas 3, shorter than style. Style 2mm long. Nuts ellipsoid, 3 - sided, 4mm long, 2mm wide, maturing light brown.

Flowering and Fruiting: August - January

Growth form: Helophyte / Tenagophyte

Distribution: Tropical Africa, India, Indo - China to Malesia

Habitat: Along the banks of streams and marshy areas

SJ 15013 (Karappara)

Cyperus exaltatus Retz., Obs. Bot. 5: 11. 1789; Hook. f., Fl. Brit. India 6: 617. 1893; Gamble, Fl. Pres. Madras 1642 (1141). 1931; Vajr., Fl. Palghat Dist. 545. 1990; Rejani, Cyperac. Kerala 171. 1991; Joseph, Aquatic Angiosp. Malabar 321. 1991; Cook, Aquat. Wetland Pl. India 111. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 244. 2016

Perennial herbs. Rhizome very short, woody. Culms densely tufted, smooth, 60 - 90 cm tall, 6 - 10 mm thick, 3 - sided, smooth. Leaves nearly equaling the culm; sheaths somewhat spongy, reddish brown; blades flat, herbaceous, up to 80 cm long, 6 - 15 mm wide, 3 - nerved, scabrous margins. Involucral bracts 4 - 6, unequal, the lower ones overtopping the inflorescence, 30 - 80 cm long, 8 - 12 mm wide, erect or spreading. Inflorescence compound, of groups of sub - sessile and stalked spikes; rays 3 - 12, unequal. Spikes 2 - 4 cm long, 1.5 - 2.5 mm wide. Spikelets loose, semi - erect, linear to oblong, flattened, reddish brown, 1 cm long, 2mm wide, 12 - 20 flowered. Glumes ovate to broadly ovate, 2 mm long, 1 - 1.5 mm wide, 3 - 5 nerved, shining brown to greenish, with hyaline margins; keel green, excurrent to a short mucro. Stamens 3. Style slender, 3 - cleft, 1.5 mm long. Nuts 3 - sided, ellipsoid to obovoid - ellipsoid, 0.7 - 1.2 mm long, 0.5 mm thick, yellowish, almost smooth.

Flowering and Fruiting: August - December

Growth form: Helophyte/ Tenagophyte

Distribution: Pantropical

Habitat: Marshy areas grass lands

SJ 15100 (Pattambi)

Cyperus haspan L., Sp. Pl. 45. 1753. (*halpan* orth. mut) Hook. f., Fl. Brit. India 6: 600. 1893; Gamble, Fl. Pres. Madras 1640 (1139). 1931; Manilal & Sivar., Fl. Calicut 315. 1982; Joseph, Aquatic Angiosp. Malabar 324. 1991; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 13. 1996; Cook, Aquat. Wetland Pl. India 112. 1996; Sasidh., Fl. Parambikulam WLS 373. 2002; Mohanan & Sivad., Fl. Agasthyamala 774. 2002; Anil

Kumar *et al.,* Fl. Pathanamthitta 537. 2005; Ratheesh Narayanan, Fl. Stud. Wayanad Dist. 924. 2009; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 246. 2016

Rhizome short or absent. Culms acutely triangular, longitudinally striated, 10 - 40 cm tall. Leaves 2 - 3, as long as or shorter than the culms; sheath bladeless below, bladed or rarely bladeless above, linear, flat, acute. Inflorescence compound umbel, many rayed. Spikes with digitate cluster of 2 - 5 spikelets, stellatelt spreading. Spikelets linear, acute, flattened, with 6 - 20 flowers, 5.5 mm long, 1 mm wide. Glumes distichous, closely imbricate, 1 - 1.5 mm long, 0.5 - 0.7 mm wide, sides hyaline with a purplish brown tinge, nerve less; keel green, 3 - nerved, ending in a short straight mucro below the tip. Stamen 1. Style 3 - fid. Nut sub - globose, obtusely 3 - sided, sides convex, 0.45 mm long, o.25 mm wide, marble white to cream yellow, densely tuberculate.

Flowering and Fruiting: throughout the year

Growth form: Hyperhydate/ Tenagophyte

Distribution: Pantropical

Habitat: Along banks of streams, paddy fields and marshy areas.

SJ 15018 (Pothundi)

Cyperus iria L., Sp. Pl. 45. 1753; Hook. f., Fl. Brit. India 6: 606. 1893; Gamble, Fl. Pres. Madras 1640 (1140). 1931; Vajr., Fl. Palghat Dist. 545. 1990; Rejani, Cyperac. Kerala 195. 1991; Joseph, Aquatic Angiosp. Malabar 327. 1991; Cook, Aquat. Wetland Pl. India 112. 1996; Sasidh., Fl. Parambikulam WLS 373. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 248. 2016. (Fig. 12 a)

Annual herbs. Culms tufted, 45 cm tall, 3 mm thick, smooth, 3 - sided. Leaves 2 or 3, as long as or shorter than the culms, 5mm wide; sheaths purplish. Involucral bracts 3 - 7, unequal, the lower one overtopping the inflorescence. Inflorescence simple or compound, 1 spike sessile, the rest stalked; rays 3 - 8, unequal. Spikes 5 - 10 in clusters, bearing

5 - 20 spikelets. Spikelets linear - oblong, 5 - 20 flowered, golden yellow, 4 mm long, 1.5 mm wide. Glumes broadly ovate to sub - orbicular, obtuse, 1.5 mm long, 1.25 mm wide, keeled on back, keel 3 - 5 nerved. Stamens 2. Style 3 - cleft. Nuts trigonous, obovoid - ellipsoid, slightly concave on sides, shining, dark brown.

Flowering and Fruiting: throughout the year

Growth form: Helophyte/ Tenagophyte

Distribution: Tropical Asia and east Africa; introduced in U.S.A and West Indies

Habitat: Paddy fields and marshy areas.

SJ 15012 (Chittur)

Cyperus malaccensis Lam., Illustr. 1: 146. 1791; Hook. f., Fl. Brit. India 6: 608. 1893; Gamble, Fl. Pres. Madras 1640(1140). 1931; Vajr., Fl. Palghat Dist. 546. 1990; Rejani, Cyperac. Kerala 199. 1991; Joseph, Aquatic Angiosp. Malabar 329. 1991; Cook, Aquat. Wetland Pl. India 115. 1996. Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 251. 2016. (Fig. 12 b)

Perennial herbs; rhizomes creeping, woody, covered with brown scales. Culms up to 1.5 m tall, tufted, sharply trigonous, sides concave above. Leaves reduced; sheaths few, up to more than 20 cm, brown or reddish. Bracts 3 - 4, longer than inflorescence. Inflorescence compound; primary rays 3 – 10, unequal. Spikes 10 - 25 x 1.5 – 2 mm; rachis almost straight, quadrangular with sharp, narrowly winged angles; glumes ovate – elliptic; margins scarious, grey-yellow. Stamens 3. Stigma 3. Nut narrowly oblong, dark brown, glossy, very finely reticulate.

Flowering and Fruiting: September - January

Growth form: Tenagophyte/Helophyte

Distribution: Paleotropics

Habitat: Ponds and marshy areas.

SJ 16976 (Manapullikavu)

Cyperus nutans Vahl **ssp. *nutans*** Koyama in Dassan. & Fosb., Rev. Handb. Fl. Ceylon 5: 190. 1985; Mohanan, Fl. Quilon Dist. 444. 1984; Rejani, Cyperac. Kerala 163. 1991; Joseph, Aquatic Angiosp. Malabar 330. 1991. Cook, Aquat. Wetland Pl. India 117. 1996. Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 253. 2016. (Fig. 12 c)

Perennial herbs with short rhizomes. Culms solitary or a few, trigonous up to 1.4 m, 5 - 12 mm thick; Leaves few, flat or plicate, up to 50 cm. Sheath 15 - 30 cm long, light purple. Involucral bracts 4 - 6, unequal, longer ones over topping the inflorescence. Inflorescence compound, paniculate, lax; primary rays 6 - 10, unequal. Spikes clustered, sessile, with 10 - 20 linear oblong spikelets; Rachilla winged, Glumes closely appressed to the rachilla; oblong, mucronate. Stamens 3. Nuts 3 sided, apiculate, brown.

Note: New report to Palakkad

Flowering and Fruiting: February - April

Growth form: Helophyte / Tenagophyte

Distribution: Tropical Africa and Asia

Habitat: Along the banks of streams and rivers

SJ 16975 (Goolikkadav)

Cyperus platyphyllus Roemer & Schultes. Syst. Veg. 2:876. 1817; C.B.Cl. in Hook. f., Fl. Brit. India 6: 606. 1893; Gamble, Fl. Pres. Madras 1642. 1928; Cook, Aquat. Wetland Pl. India 120. 1996. (Fig. 12 d)

Rhizome present, short, up to 8 cm long. Culms robust, 120 cm tall, 1 - 1.25 cm thick, 3 - sided below, sharply 3 - angled with concave sides above, scabrous on the angles. Leaves up to or as long as the culms; sheath straw coloured; blades plicate, with 3 prominent nerves, deep green, scabrous along the margins. Involucral bracts 4 - 6, the two lower ones much overtopping the inflorescence, 70 cm long, 1 cm wide. Inflorescence of one sessile spike and 10 - 12 stalked spikes; rays 6 - 12, spreading, unequal, up to 17.5 cm long. Spikes linear

cylindrical, sub - sessile, forming digitate secondary corymbs, 3 - 6 cm long. Spikelets sessile, erect to sub - erect, slightly spreading, sub terete, linear, 4.5 mm long, 1.25 mm wide, 8 - 14 flowered. Glumes obovate elliptical, 1.5 mm long, 1 mm wide, subacute at mucronate apex, 3 - 5 nerved, midrib green, sides nerveless, straw coloured tinged with gold or brown. Stamens 3. Style 3 - cleft, 1mm long. Nuts 3 - sided, ellipsoid, 0.5 mm long, 0.4 mm wide, grayish brown.

Note: New report to Kerala

Flowering and Fruiting: September - March

Growth form: Helophyte

Distribution: Endemic to South India and Sri Lanka

Habitat: Rivers and canals

SJ 15022 (Mukkai, Kalpathy)

Cyperus platystylis R. Br., Prodr. 214. 1810; Hook. f., Fl. Brit. India 6: 598. 1893; Gamble, Fl. Pres. Madras 1134 (1139). 1931; Rejani, Cyperac. Kerala 207. 1991; Joseph, Aquatic Angiosp. Malabar 334. 1991; Cook, Aquat. Wetland Pl. India 120. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 258. 2016. (Fig. 12 e)

Perennial herbs. Rhizome less than 10 cm long, not stoloniferous. Culms triquetrous, 60 cm tall. Leaves as long as or longer than the culms, flat, gradually acuminate, very scabrous along margins and midrib; sheath strongly keeled, brownish to purple, lower ones bladeless. Involucral bracts 2 - 6, unequal, longer ones overtopping the inflorescence, 40 cm tall. Inflorescence of compound umbels; rays spreading. Spiklets digitately arranged in clusters of 2 - 8, ovate to linear - lanceolate, strongly compressed, densely 15 - 30 flowered, straw - coloured and stained with rusty brown; rachilla not winged. Glumes closely adpressed to the rachilla, ovate, obtuse and mucronulate, 3 - nerved, 2.5 mm long, 1.5 mm wide. Stamens 3. Style flattened, 3 - cleft, 1.5 mm long. Nuts unequally 3 - sided, dorsoventrally flattened, with spongy - thickened angles, 1.7 mm long. **Flowering and Fruiting:** September - March

Growth form: Hyperhydate/ Pleustophyte

Distribution: Indo - Malesia to Australia

Habitat: Ponds

SJ 11805 (Tattamangalam)

Cyperus rotundus L., Sp. Pl. 45. 1753; Hook. f., Fl. Brit. India 6: 614. 1893; Gamble, Fl. Pres. Madras 1641 (1140). 1931; Vajr., Fl. Palghat Dist. 548. 1990; Rejani, Cyperac. Kerala 150. 1991; Joseph, Aquatic Angiosp. Malabar 339. 1991; Cook, Aquat. Wetland Pl. India 123. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 261. 2016. (Fig. 12 f)

Stolons slender, wiry, ending in globose or ellipsoidal tubers. Culms corm –like at the base, usually solitary, 20 cm tall, 1.5 mm thick, 3 - angled, smooth. Leaves crowded at the base; sheaths green to reddish brown, soon disintegrating into parallel fibers; blades flat, gradually acuminate, usually shorter than the culm, 11cm long, 3mm wide, smooth, scabrous above and on the margins. Involucral bracts 2 - 4, very unequal, usually short, the lowest sometimes just overtopping the inflorescence but usually much shorter. Inflorescence simple or compound, of 1 sessile and 1 - 10 stalked spikes, with or without secondary spikes; rays 2 - 10, very unequal. Spikelets linear to oblong, acute at the tip, 1.75 mm long, 1 mm wide, with 8 - 40 flowers. Glumes membranous, ovate, 2.5 mm long, 2 mm wide, sub obtuse, apiculate at tip, red to deep reddish - brown; keel green, ending in or below the apex of the glume. Stamens 2. Styles 3 - cleft, 4 mm long, stigma trifurcate at 1.5 mm length. Nuts very rarely maturing, 3 - sided, oblong - obovoid to ellipsoid. Gynoecium 1 mm long, 0.5 mm wide.

Flowering and Fruiting: August - January

Growth form: Helophyte

Distribution: Pantropical

Habitat: Marshy areas and paddy fields

SJ 15015 (Ottappalam)

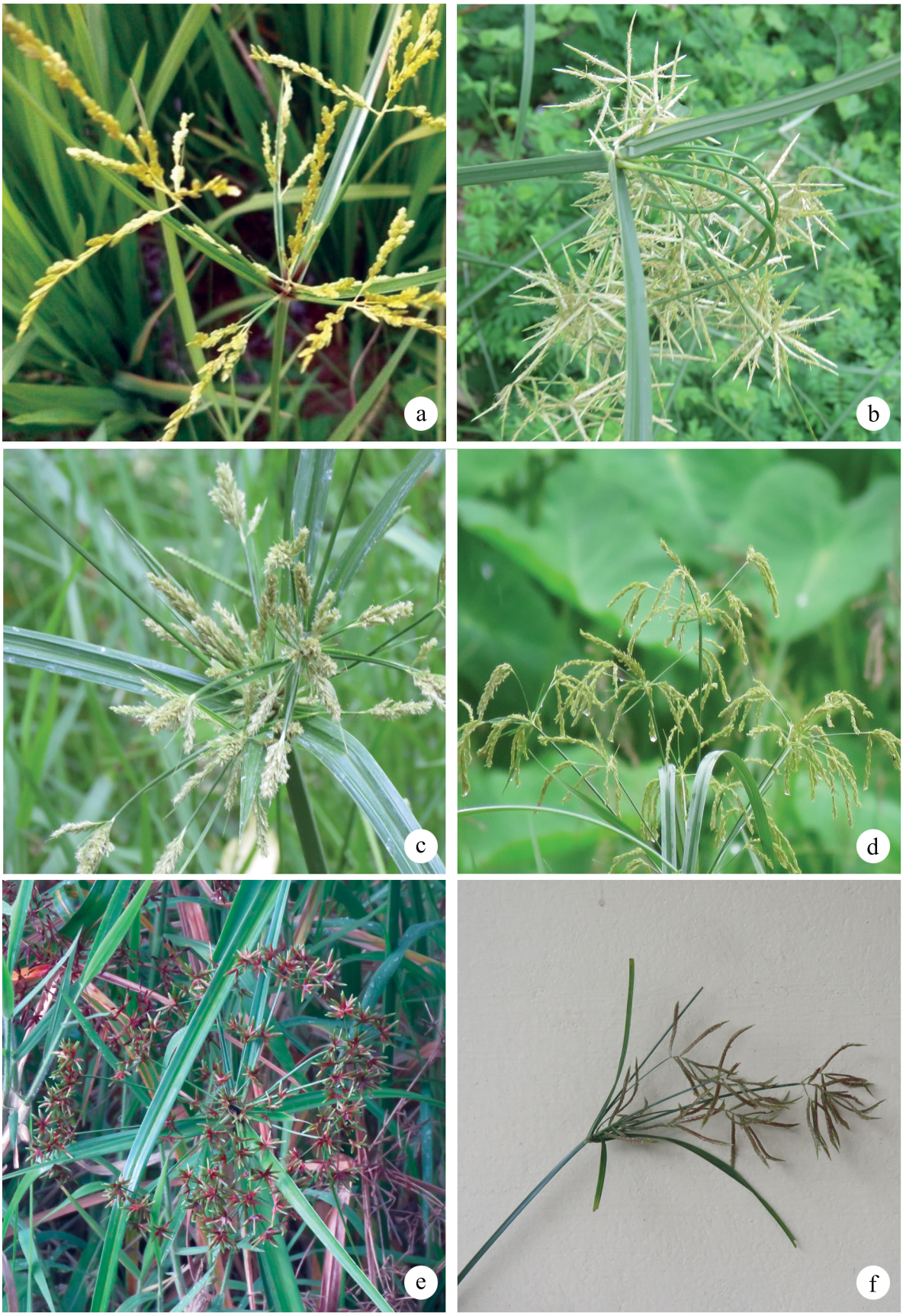


Fig. 12 a) *Cyperus iria* b) *Cyperus malaccensis* c) *Cyperus nutans* d) *Cyperus platyphyllus* e) *Cyperus platystylis* f) *Cyperus rotundus*

Cyperus squarrosus L., Cent. Pl. 2: 6.1756; Cook, Aquat. Wetland Pl. India 166.1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 340. 2016. *Mariscus squarrosus* Clarke in Hook. f., Fl. Brit. India 6: 623. 1893 quoad spec.; Gamble, Fl. Pres. Madras 1645(1143). 1931; Vajr., Fl. Palghat Dist. 555. 1990; Rejani, Cyperac. Kerala 364. 1991; Joseph, Aquatic Angiosp. Malabar 387. 1991. *Cyperus aristatus* Rottb., Desc. Nov. Pl. 22. t. 6, f. 1. 1773; Hook. f., Fl. Brit. India 6: 606. 1893; Gamble, Fl. Pres. Madras 1640(1140). 1931. (Fig. 13 b)

Annual herbs. Rhizome absent. Culms erect, solitary or tufted, up to 20 cm tall, triquetrous. Leaves few, basal, linear, gradually acuminate, shorter than or almost equal to the culms; sheaths 1 - 2.5 cm long, purple. Involucral bracts 2 - 4, the lowest up to 8 cm long. Inflorescence of one central globose spike and usually 1 - 4 stalked lateral spikes, each with 20 - 60 spikelets. Spikelets spicately arranged, oblong or linear, compressed, 4 - 5 mm long, 2 mm thick. Glumes distichous, elliptic or ovate, 2 mm long, 1 mm wide, 3 - nerved, strongly keeled, with recurved awns of length 1.75 mm, green with red streaks, basal 2 glumes empty. Stamens 1. Stigmas 3. Nuts oblong, trigonous.

Flowering and Fruiting: August - January

Growth form: Helophyte / Tenagophyte

Distribution: India, Sri Lanka and tropical Africa

Habitat: Along the banks of streams and marshy areas

SJ 15021 (Nemmara)

Cyperus tenuispica Steud., Syn. Pl. Glum. 2: 11. 1855; Gamble, Fl. Pres. Madras 1640 (1139). 1931**;** Vajr., Fl. Palghat Dist. 548. 1990; Rejani, Cyperac. Kerala 185. 1991; Joseph, Aquatic Angiosp. Malabar 340. 1991; Cook, Aquat. Wetland Pl. India 125. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 266. 2016. *Cyperus flavidus* Clarke, J. Linn. Soc. Bot. 21: 22. 1884 & in Hook. f., Fl. Brit. India 6: 600. 1893, non Retz. 1789. (Fig. 13 a)

Annual herbs. Culms solitary, slender, smooth, 40 cm tall, thickness less than 2 mm. Leaves 3 - 4, as long as or shorter than the culm, 5 mm wide; sheath scarious, yellowish to brownish or grey, the lower ones bladeless or shortly bladed; blades gradually acuminate, smooth or scabrous above. Involucral bracts 2 - 3, unequal, the lower one overtopping the inflorescence. Inflorescence compound; lax, relatively large. Spikelets digitately arranged in clusters of 3 - 9 spikelets, stellately spreading, oblong to linear, acute, flattened, 5 mm long, 2 mm wide. Glumes rather loose, exposing parts of the rachilla and nuts, ovate to ovate oblong, obtuse, 1.75 mm long, 1.5 mm wide, sides nerveless, hyaline, reddish - brown with purple stripes or spots; keel green, 3 nerved, excurrent and curved into a minute mucro just below the tip. Stamens 3, 1 mm long. Style 3 - cleft, 1.5 mm long. Nuts obtusely 3 - sided with convex sides, sub - globose to ellipsoid, 1 mm long, 0.75 mm wide.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte/Tenagophyte/ Hyperhydate

Distribution: Pantropical

Habitat: Marshy areas and paddy fields

SJ 15010 (Chittur)

FIMBRISTYLIS Vahl.

1a. Nuts oblong - cylindrical ..... *F. dipsacea*

1b. Nuts ellipsoidal - suborbicular or obovoid 2

2a. Stigma 2..... 3

2b. Stigma 3..... 6

3a. Inflorescence a single spikelet ..... *F. acuminata*

3b. Inflorescence paniculate..... 4

4a. Ligules a fringe of hairs or membranous.....*F. bisumbellata*

4b. Ligules absent 5

5a. Inflorescence head like cluster of sessile flowers.....*F. argentea*

5b. Inflorescence of numerous stalked spikelets..... *F. aestivalis*

6a. Leaves with a ligule..... *F. microcarya*

6b. Leaves without a ligule..... *F. quinquangularis*

Fimbristylis acuminata Vahl, Enum. Pl. 2: 285.1805; Hook. f., Fl. Brit. India 6:631. 1893; Gamble, Fl. Pres. Madras 1658 (1150). 1931; Vajr., Fl. Palghat Dist. 549. 1990; Rejani, Cyperac. Kerala 295. 1991; Joseph, Aquatic Angiosp. Malabar 359. 1991; Cook, Aquat. Wetland Pl. India 134. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 284. 2016. (Fig. 13 c)

Perennial herbs, densely tufted, rhizome absent or if present very small. Culms slender, up to 20 cm long and 0.5 mm thick, obtusely trigonous, smooth, base sheathed. Leaf sheaths cylindrical. Inflorescence a single terminal spikelet; bract scale - like. Spikelets erect, ovate - lanceolate, terete, 5 - 8 mm long, 2 - 2.5 mm thick, acute at apex. Lowest glumes empty, the remaining flower - bearing, spirally imbricate, broadly ovate, 2.5 x 2 mm, slightly brownish. Stamens 2; anthers 0.8 - 1 mm long Styles 2 - 3 mm long, flattened, glabrous, base dilated, 0.5 mm wide; stigmas 2, up to 1 mm long. Nut obovoid - orbicular, biconvex, 1 - 1.5 x 0.8 - 1.3 mm, rounded at apex, cream or white coloured, transversely wrinkled with ridges.

Flowering and Fruiting: October - December

Growth form: Helophyte / Tenagophyte

Distribution: Tropical Asia

Habitat: Marshy areas and paddy fields

SJ 16901 (Mannarkkad)

Fimbristylis aestivalis (Retz.) Vahl, Enum. Pl. 2: 288. 1805; Hook. f., Fl. Brit. India 6: 637. 1893; Vajr., Fl. Palghat Dist. 549. 1990; Rejani, Cyperac. Kerala 299. 1991; Cook, Aquat. Wetland Pl. India 144. 1996; Sasidh., Fl. Parambikulam WLS 374. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 286. 2016. (Fig. 13 d)

Annual herbs. Rhizome absent. Culms densely tufted, very slender, 3 - 15 cm long, 0.3 - 0.5 mm in diameter. Leaf sheath brownish, membranous, blades filiform, as long as the culm, sometimes even

longer, width 0.5 mm, soft hairy with hairy margins. Ligule absent. Involucral bract 4 - 6, up to 4 cm long, some overtopping the inflorescence, the longest leaf - like, hairy. Inflorescence a compound umbel, 6 - 12 rayed. Spikelet sessile, ovoid to elongate ovoid, 2.5 - 3.5 mm long, 1 mm in diameter. Glumes thinly membranous, 1 - 2 mm long, width 0.5 mm, pubescent, margin hyaline, cuspidate with mucro of length up to 1 mm, keel prominent and green. Stamen 1. Style 0.75 mm long, dilated at base, hairy above style base papillose without hairs, stigmas 2. Nut biconvex, elliptical, 0.5 mm long and 0.25 mm wide, yellowish smooth and shiny.

Flowering and Fruiting: February - August

Growth form: Helophyte

Distribution: Asia and Australia

Habitat: Marshy areas and paddy fields

SJ 15003 (Chithali)

Fimbristylis argentea (Rottb.) Vahl, Enum. Pl. 2: 294. 1805; Hook. f., Fl. Brit. India 6: 640. 1893; Gamble, Fl. Pres. Madras 1659 (1151). 1931; Rejani, Cyperac. Kerala 303. 1991; Cook, Aquat. Wetland Pl. India 144. 1996; Sasidh., Fl. Parambikulam WLS 375. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 137. 2016. (Fig. 13 e)

Annual herbs; rhizome absent. Culms densely tufted, slender, setaceous, 5 - 15 cm long, 0.5 mm wide. Leaf sheath straw - like, gland - dotted, leaves 1 or 2, shorter than the culm. Ligule absent. Involucral bracts 2 - 4, much over topping the inflorescence. Inflorescence a terminal globose head with 10 - 20 sessile spikelets. Spikelets oblong - ovoid to elongate - ovoid, 4 - 10 mm long, 1 mm wide; glumes membranous, ovate - obtuse, 1.5 mm long, 0.5mm wide, with or without mucro, keel green. Stamen 1. Style 1.25mm long, 2 - cleft, base swollen. Nuts biconvex, obovoid, pale yellow, slightly warty.

Flowering and Fruiting: July - October

Growth form: Helophyte/Tenagophyte

Distribution: Asia

Habitat: Marshy areas and paddy fields

SJ 15002 (Chithali)

Fimbristylis bisumbellata (Forssk.) Bubani, Dodecanthea. 30. 1850; Gamble, Fl. Pres. Madras 1898 (1151). 1931; Rejani, Cyperac. Kerala 266. 1991; Joseph, Aquatic Angiosp. Malabar 361. 1991; Cook, Aquat. Wetland Pl. India 144. 1996; Sasidh., Fl. Parambikulam WLS 375. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 290. 2016.

Herbs. Culms tufted, up to 30 cm tall, 1.75 mm in diameter, glabrous above, hairy at the base, 3 - sided. Leaves flat, sheath loose, membranous, less than or equal to half of the length of the culm, 2.5 mm wide, glabrous. Ligule present as a fringe of hairs. Involucral bracts 1 - 3, the lowest not or slightly overtopping the inflorescence. Inflorescence compound corymbs in umbellate clusters. Spikelets with more than 20 flowers, oblong - ovoid to narrowly oblong, 5 - 6 mm in length, 1 - 1.5 mm wide; rachilla elongating in fruits; glumes broadly ovate, membranous, acute at apex, 1.2 mm in length, 0.7 mm wide, white hyaline margins, cuspidate with a short mucro. Single stamen. Style flat, longer than nut, 2 - cleft, 1 - 1.5 mm long, hairy towards tip. Nuts obovoid, biconvex, 0.5 - 1 mm long, 0.4 mm in diameter, longitudinal stripes on either side.

Flowering and Fruiting: July - November

Growth form: Helophyte / Tenagophyte

Distribution: Paleotropics

Habitat: Marshy areas in grass lands

SJ 15070 (Nemmara)

Fimbristylis dipsacea (Rottb.) Clarke in Hook. f., Fl. Brit. India 6: 635. 1893; Gamble, Fl. Pres. Madras 1658 (1151). 1931; Vajr., Fl. Palghat Dist. 550. 1990; Rejani, Cyperac. Kerala 262. 1991; Cook, Aquat. Wetland Pl. India 144. 1996; Sasidh., Fl. Parambikulam WLS 375. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 299. 2016. (Fig. 13 f)

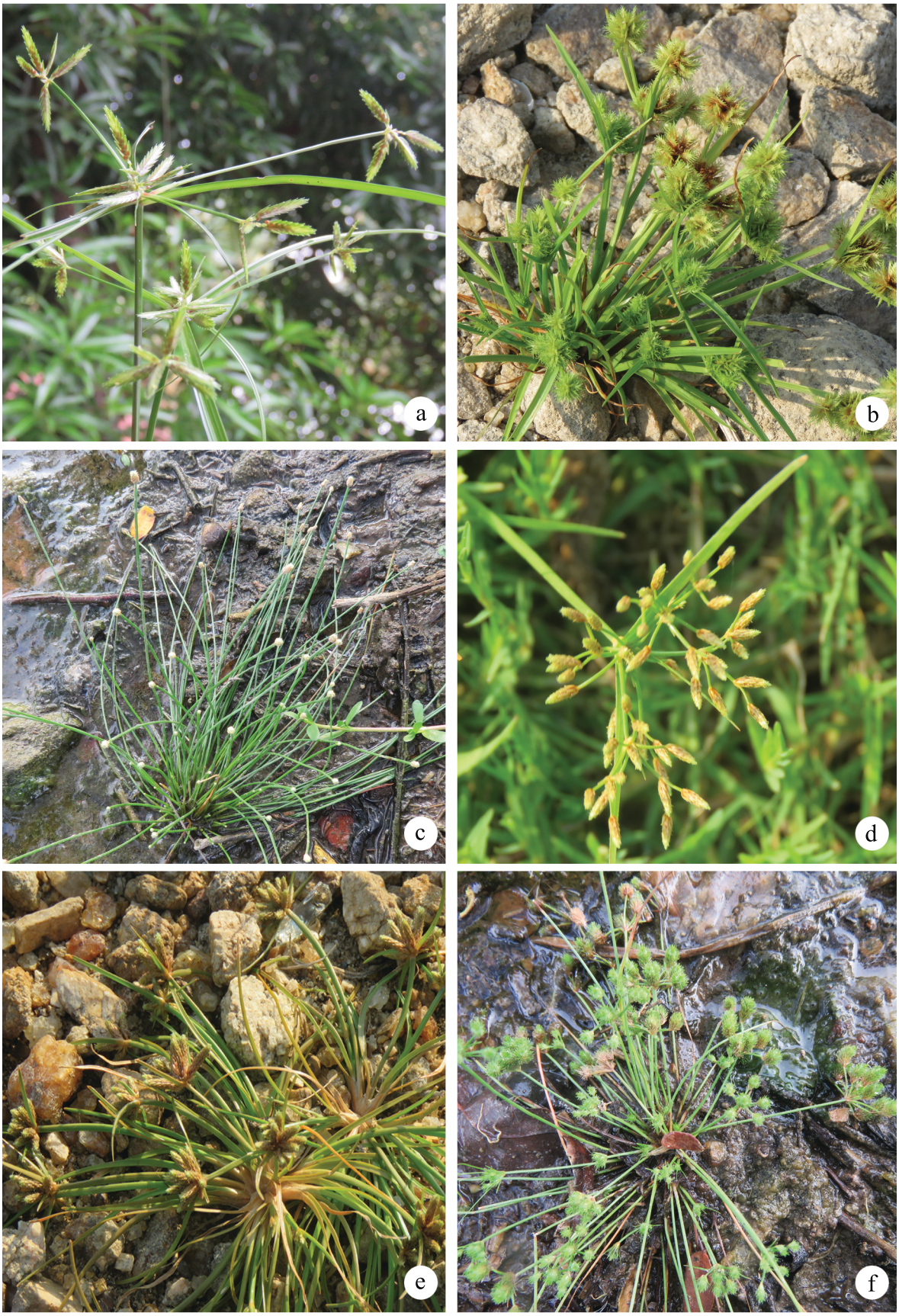


Fig. 13 a) *Cyperus tenuispica* b) *Cyperus squarrosus* c) *Fimbristylis acuminata* d) *Fimbristylis aestivalis* e) *Fimbristylis argentea* f) *Fimbristylis dipsacea*

Annual herbs. Rhizome absent, culms tufted, setaceous, 3 - 7 cm long, 0.2 - 0.5 mm in diameter. Leaf sheath obliquely truncate, membranous; leaves filiform, 2 - 6 cm long, 0.2 - 0.3 mm wide, lower ones blade - less. Ligule absent. Involucral bracts 3 - 5, overtopping the inflorescence, 1 - 1.5 cm long. Inflorescence corymbose with 1 sessile and 2 - 5 stalked spikelets. Spikelets solitary, sub - globose to oblong, squarrose, densely many flowered, 4 - 4.5 mm long, 3.5 - 4 mm in diameter; glumes membranous, lanceolate up to 2 mm long, 0.5 mm wide, glabrous, keel strong, green, 1 nerved, excurrent into a recurved awn with 1 mm length. Stamen 1. Style 1mm long, base pubescent; stigmas 2, bifurcate at 0.6 mm length. Nut sub - terete, sub - cylindrical to elongate obovoid with length less than 0.5 mm, 0.1 mm wide, whitish club - shaped appendage on the sides.

Flowering and Fruiting: April - July

Growth form: Helophyte/ Tenagophyte

Distribution: Tropical Africa and Asia

Habitat: Marshy areas and paddy fields

SJ 15071 (Nemmara)

Fimbristylis quinquangularis (Vahl) Kunth, Enum. Pl. 2: 229. 1807; Hook. f., Fl. Brit. India 6: 644. 1893; Gamble, Fl. Pres. Madras 1659 (1151). 1931; Rejani, Cyperac. Kerala 284. 1991. *Fimbristylis miliacea* (L.) Vahl, Enum. Pl. 2: 287. 1805, nom. rejic.; Hook. f., Fl. Brit. India 6: 644. 1893; Gamble, Fl. Pres. Madras 1660 (1152). 1931; Vajr., Fl. Palghat Dist. 551. 1990; Rejani, Cyperac. Kerala 279. 1991; Joseph, Aquatic Angiosp. Malabar 366. 1991; Cook, Aquat. Wetland Pl. India 144. 1996; Sasidh., Fl. Parambikulam WLS 376. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 302. 2016. (Fig. 14 a)

Erect, tufted, annuals, 10 - 35 cm tall; rhizomes very short; culms compressed, 4 - sided with 2 sharp edges, glabrous. Leaves 10 - 25 cm long, linear, laterally flattened, scabrid on margins; sheaths 2 - 8 cm long, laterally compressed, sharply keeled, lower sheaths bladeless; ligule absent. Inflorescence compound, 4 - 8 cm long and wide, loose,

rays cymose; bracts 2 - 4, up to 1 cm long, setaceous. Spikelets ovoid - globular to globular, 2 - 3 mm long, 2 mm in diameter, densely many flowered; glumes spiral, 1.2 - 1.5 x 1 mm, ovate, obtuse, scarcely keeled, 3 - nerved, margins narrowly hyaline. Stamens 1 - 2; anthers up to 0.3 mm long. Style linear, triquetrous, ciliate at the base of stigmas; stigmas 3 - fid, as long as the style. Nut 0.5 - 1 x 0.5 mm, obovoid, trigonous, cream yellow, warty on surface.

Flowering and Fruiting: August - January

Growth form: Helophyte

Distribution: Tropical Africa, Iraq to tropical and subtropical Asia and north Australia

Habitat: Marshy areas and paddy fields

SJ 15001(Chitali)

Fimbristylis microcarya Muller, Fragm. 1: 200. 1859; Rejani, Cyperac. Kerala 312. 1991; Sunil & Sivadasan, Fl. Alappuzha Dist. 778. 2009; Cook, Aquat. Wetland Pl. India 144. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 302. 2016. *Fimbristylis complanata* var. *microcarya* (Muller) Clarke in Hook. f., Fl. Brit. India 6: 646. 1893.

Annual herbs. Rhizome absent. Culms tufted, slender, 13 cm tall. Leaves few, basal, linear, flat, 10 cm long, 1.25 mm wide. Ligule a dense fringe of short hairs. Involucral bracts 2 - 3, longest 2 cm in length, overtopping the inflorescence. Spikelet very small, not flattened, 3mm long, 1mm wide; glumes ovate, acute, mucronate, 1.25 mm long, 1 mm wide, margins hyaline. Style 3 - cleft, 1mm long. Nuts trigonous, obovoid, 0.5 mm long, 0.4 mm wide, minutely warty.

Note: New report to Palakkad

Flowering and Fruiting: July - September

Growth form: Helophyte

Distribution: North Australia and also reported from India and east Asia. **Habitat:** Marshy areas and riverbanks

SJ 15050 (Mangalam Dam)

FUIRENA Rottb.

Fuirena ciliaris (L.) Roxb., Fl. Ind. 1: 184. 1820; Rejani, Cyperac. Kerala 318. 1991; Joseph, Aquatic Angiosp. Malabar 376. 1991; Cook, Aquat. Wetland Pl. India 153. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 315. 2016. *Fuirena glomerata* Lam., Tabl. Encycl. 1: 150. 1791; Hook. f., Fl. Brit. India 6: 666. 1893; Gamble, Fl. Pres. Madras 1669 (1158). 1931. (Fig. 14 b)

Annual herbs, rhizome absent, culms slender, tufted, 3 - 5 angled near the inflorescence, up to 35 cm tall, slender, 3 – 4 noded, pubescent. Leaves up to 9 cm long and 6 mm wide, linear or linear - lanceolate, pubescent, basal leaves reduced to bladeless sheaths; sheaths to 2.5 cm long; ligules 2 mm long, pubescent. Inflorescence with glomerulus clusters of spikelets; clusters 1 - 2 cm across, bearing 3 - 10 spikelets; spikelets ovate or oblong - elliptic. Glumes oblong - obovate, pubescent, awned; Stamens 3. Stigmas 3, papillose. Nuts up to 0.5 mm, obovoid - ellipsoid.

Note: New report to Palakkad

Flowering and Fruiting: January - March

Growth form: Helophyte

Distribution: Pantropical.

Habitat: Marshy areas and riverbanks

SJ 16949 (Mukkai)

KYLLINGA Rottb.

1a. Rhizome very small; culms tufted; inflorescence of 3 heads ..... *K. tenuifolia*

1b. Rhizome long; culms solitary or in a single row along the rhizome; inflorescence usually of 1 head 2

2a. Rhizome stoloniferous; keel of glume winged ..... *K. brevifolia*

2b. Rhizome decumbent or woody; keel of glume not winged..... *K. nemoralis*

Kyllinga brevifolia Rottb., Desc. Nov. Pl. 13. t. 4, f. 3. 1773; Hook. f., Fl. Brit. India 6: 588. 1893; Gamble, Fl. Pres. Madras 1624 (1130). 1931; Rejani, Cyperac. Kerala 332. 1991; Swarup. *et al.,* Shola For. Kerala 78. 1998; Sasidh., Fl. Parambikulam WLS 377. 2002; Cook, Aquat. Wetland Pl. India 156. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 323. 2016. (Fig. 14 d)

Herb with stoloniferous creeping rhizomes, 1 - 3 mm in diameter, clothed with brown scales. Culms solitary or in a single row, 30 cm long, 1 - 1.5 mm thick. Leaf sheaths membranous, brown to purple, the lower ones almost bladeless. Leaves flat, shorter than or as long as the culms, 1 - 3 mm wide. Involucral bracts 3 - 4, the lowest erect or spreading, the remainder usually spreading. Inflorescence a single head, globose or sub - globose, 8 mm long, 6 mm in diameter, pale green becoming straw coloured at maturity. Spikelets lanceolate - oblong to elliptical, 2 - 4 mm long, 1 mm wide; glumes ovate - elliptical, cuspidate at apex, keel projecting beyond the glume apex, smooth or sparsely spiny towards the tip. Stamens 2. Nuts obovate to elliptical, 1 - 1.5 mm long, 0.5 - 0.8 mm wide.

Flowering and Fruiting: July - September

Growth form: Helophyte

Distribution: North Australia and also reported from India and east Asia **Habitat:** Marshy areas and riverbanks

SJ 15072 (Vallanghi)

Kyllinga nemoralis (J. R & G. Forst.) Dandy ex Hutch. & Dalz., Fl. W. Trop. Africa 2: 486,487. 1936; Vajr., Fl. Palghat Dist. 552. 1990; Rejani, Cyperac. Kerala 338. 1991; *Kyllinga monocephala* Rottb., Desc. Nov. Pl. 13. t. 4, f. 4. 1773, non Roxb. 1820; Hook. f., Fl. Brit. India 6: 588. 1893; Gamble, Fl. Pres. Madras 1624 (1130). 1931; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 325. 2016. (Fig. 14 c)

Perennial herbs. Rhizome long - creeping, covered with brown scales, aromatic. Culms in linear rows along the length of rhizome,

triquetrous. Leaves linear, shorter than or as long as culms, scabrid along the margins on the upper part; sheaths 1 - 3 cm long, purple - brown. Involucral bracts 3 - 4, foliaceous, exceeding the inflorescence, the lowest up to 14 cm long. Inflorescence of capitates heads, subglobose, white; spikelets ovate - elliptic, 2.5 - 3mm long, 1 - 1.5 mm wide. Glumes distichous, boat - shaped, 2 - 2.5 mm long, keel winged, lower 2 glumes smaller, empty. Stamens 2. Nuts oblong - obovoid, dark brown.

Flowering and Fruiting: July - November

Growth form: Helophyte

Distribution: Pantropical

Habitat: Marshy areas, grasslands, wastelands and riverbanks

SJ 15006 (Moochemkund)

Kyllinga tenuifolia Steud., Syn. Pl. Glum. 2: 69. 1855; Manilal & Sivar., Fl. Calicut 311. 1982. Cook, Aquat. Wetland Pl. India 156. 1996. *Kyllinga triceps* Rottb., Desc. Nov. Pl. 14. t. 4, f.6. 1773, nom. illeg.; Hook. f., Fl. Brit. India 6: 587. 1893; Gamble, Fl. Pres. Madras 1623 (1130). 1931. Vajr., Fl. Palghat Dist. 553. 1990; *Cyperus triceps* (Rottb.) Endl., Cat. Hort. Acad. Uindb. 1: 94. 1842; Manilal, Fl. Silent Valley 341. 1988. *Kyllinga bulbosa* P. Beauv., Fl. Oware 1: 11. 1805; Rejani, Cyperac. Kerala 334. 1991; Sasidh., Fl. Parambikulam WLS 377. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 323. 2016. (Fig. 14 e)

Rhizomes short, erect, without stolons. Culms densely tufted, slender but bulb - like or corm - like at base, 5 - 15 cm tall, 0.5 – 1 mm thick. Leaf sheaths stout, light brown, blades well - developed, linear, shorter than the culms, 1 - 2 mm wide. Involucral bracts spreading, reflexed at maturity. Inflorescence of usually 3, sessile spikes, central spike globose to ovoid - globose, 4 - 9 mm long, 5 mm in diameter (the lateral ones somewhat smaller), pale green to greyish white. Spikelets oblong to lanceolate - oblong. Glumes 2, up to 2 mm long and 1 mm wide, cuspidate at apex, smooth or sparsely spiny towards the apex.

Stamens 2, 2 mm long. Style 2 - cleft, 1.25 mm long. Nuts oblong, 1 mm long, 0.5 mm wide, brownish.

Flowering and Fruiting: July - December

Growth form: Helophyte / Tenagophyte

Distribution: Paleotropics

Habitat: Marshy areas, grasslands, wastelands and riverbanks

SJ 15016 (Thenkurissi)

LIPOCARPHA R. Br.

Lipocarpha chinensis (Osbeck) Kern, Blumea, Suppl. 4: 167. 1958. Manilal, Fl. Silent Valley 343. 1988; Vajr., Fl. Palghat Dist. 553. 1990; Rejani, Cyperac. Kerala 344. 1991; Joseph, Aquatic Angiosp. Malabar 380. 1991; Cook, Aquat. Wetland Pl. India 159. 1996; Sasidh., Fl. Parambikulam WLS 377. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 330. 2016. *Lipocarpha argentea* (Vahl) R. Br., Narr. Exp. Congo Appen. 477. 1818; Hook. f., Fl. Brit. India 6: 667. 1893; Gamble, Fl. Pres. Madras 1670 (1158). 1931.

Annual herbs, rhizome absent, culms tufted. Culms 40 - 50 cm high, 2 mm thick, terete, green, pinkish at base. Leaves flat, up to 25 cm long and 4mm wide. Involucral bract 3, longest up to 7.5 cm long. Inflorescence terminal with 2 - 8 unequal spikes; spikes ovoid to globose. Up to 5 mm long and 4 mm wide, silvery white. Glumes spirally arranged, oblong to broadly elliptical, up to 2 mm long, acute; margin hyaline; keel green with midnerve. Stamens 1 rarely 2. Stigma 3, as long as the style. Nut 3 sided, apiculate, brown.

Flowering and Fruiting: September - December

Growth form: Helophyte / Tenagophyte

Distribution: Pantropical

Habitat: Marshy areas in grasslands

SJ 16938 (Mampara)

PYCREUS Beauv.

1a. Glumes with a distinct white margin throughout the length; style longer than stigma ..... *P. macrostachyos*
1b. Glumes without a white margin or white and hyaline only towards the apex; style shorter than stigma ..... *P. polystachyos*

Pycreus macrostachyos (Lam.) Raynal, Kew Bull. 23: 314. 1969; Rejani, Cyperac. Kerala 377. 1991; Cook, Aquat. Wetland Pl. India 169. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 345. 2016. *Cyperus macrostachyos* Lam., Illustr. Gen. 1: 147. 1791; Manilal & Sivar., Fl. Calicut 314. 1982; *Pycreus albomarginatus* Nees in Mart., Fl. Bras. 2, 1: 9. 1842; Gamble, Fl. Pres. Madras 1628 (1133). 1931.

Annual herbs. Rhizome absent. Culms solitary or tufted, 30 cm long, 3 mm wide, glabrous, 3 - sided. Leaves few, flat, up to the 3.5 mm wide. Involucral bracts 3 - 7, erect or spreading, overtopping the inflorescence. Inflorescence simple or compound umbel - like panicles, rays 4 - 10, unequal. Spikelets loosely spreading, compressed, 6 mm long, 1 mm wide. Glumes distichous, obovate with distinct white margins. Stamen 2. Style 2 - cleft, 2.5 mm long. Nut biconvex, oblong, 1mm long, 0.4 mm wide, densely puncticulate.
Note: New report to Palakkad
Flowering and Fruiting: May - August
Growth form: Helophyte / Tenagophyte
Distribution: Pantropical
Habitat: Riverbanks

SJ 15024 (Kalpathy)

Pycreus polystachyos (Rottb.) P. Beauv., Pl. Oware Beinn. 2: 48. t.86. f.2. 1807; Hook. f., Fl. Brit. India 6: 592. 1893; Vajr., Fl. Palghat Dist. 557. 1990; Rejani, Cyperac. Kerala 382. 1991; Cook, Aquat. Wetland Pl. India 170. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 347. 2016. *Cyperus polystachyos* Rottb., Desc. Nov. Pl. 39. t. 11, f. 1. 1773; Manilal, Fl. Silent Valley 340. 1988; Sasidh. *et al.,* Bot. Stud.

Med. Pl. Kerala 13. 1996. *Pycreus odoratus* Urban, Symb. Antill. 2: 164. 1900; Gamble, Fl. Pres. Madras 1627 (1132). 1931.

Rhizome short or absent. Culms tufted, erect, 38 cm tall, 4 mm in diameter, smooth, 3 - sided. Leaves few, flat, longer than the half of the culm, 5 mm wide, sheaths reddish brown. Involucral bracts 3 - 5, overtopping the inflorescence. Inflorescence loose or compact panicle with 3 - 10 rays. Spikelets digitately arranged, linear lanceolate, 0.8 - 2 cm long, 1 mm wide, acute at apex, yellowish to red - brown, rachilla narrowly winged. Glumes ovate elliptical, minutely mucronate, margins hyaline, 2 mm long, 1 mm wide. Stamens 2. Style 2 - cleft, 2.5 mm long. Nut biconvex, narrowly oblong, 1 mm long, 0.4 mm wide.
Flowering and Fruiting: Throughout the year
Growth form: Helophyte / Tenagophyte
Distribution: Tropics and sub tropics
Habitat: Marshy areas in grasslands and riverbanks

SJ 15020 (Nemmara)

RHYNCHOSPORA Vahl.

Rhynchospora corymbosa (L.) Brit., Trans. New York Acad. Sci. 11: 84. 1892; Gamble, Fl. Pres. Madras 1672 (1160). 1931; Rejani, Cyperac. Kerala 408. 1991; Cook, Aquat. Wetland Pl. India 173. 1996; Sasidh., Fl. Parambikulam WLS 379. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 353. 2016. *Rhynchospora aurea* Vahl, Enum. Pl. 2: 229. 1805; Hook. f., Fl. Brit. India 6: 670. 1893. (Fig. 14 f)

Perennial herbs, erect, tufted, rhizome short, thick, stolons absent; culms triangular, 80 - 125 cm tall. Leaves both basal and cauline, many, up to 80 cm long and 2 cm wide, linear, flat, margins scabrid, apex acuminate, keeled, coriaceous; sheaths 4 - 12cm long. Panicles corymbose, terminal, 15 - 20 cm long; rays 6 - 10, up to 10 cm long; leafy bracts up to 25 cm long. Spikelets 0.6 to 1 cm long, up to 2 mm thick, brown, 2 – 3 flowered, lowest flower bisexual, upper one male.

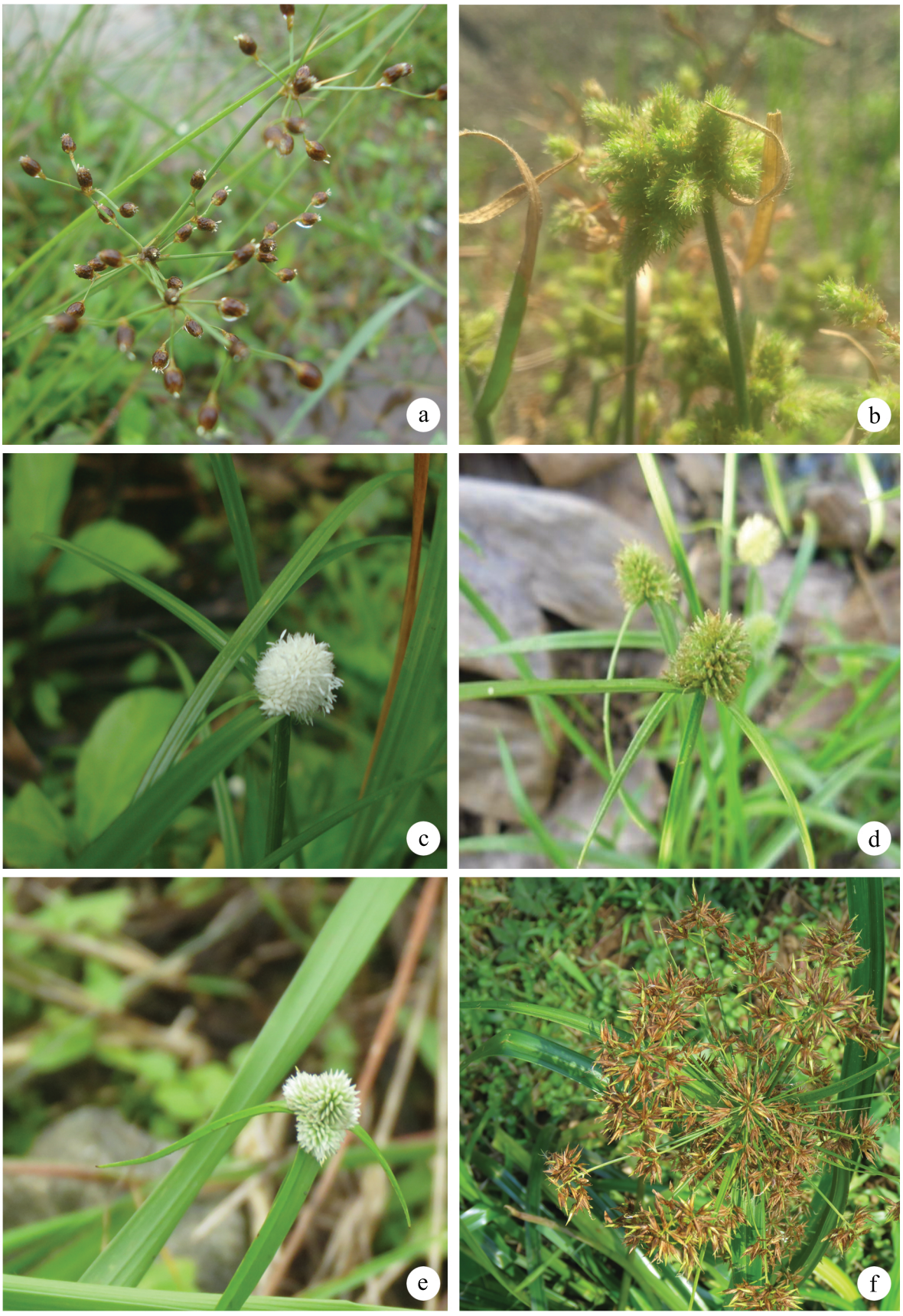


Fig. 14 a) *Fimbristylis quinquangularis* b) *Fuirena ciliaris* c) *Kyllinga nemoralis* d) *Kyllinga brevifolia* e) *Kyllinga tenuifolia* f) *Rhynchospora corymbosa*

Glumes 5 - 7, lower ones smaller, ovate, upper ones up to 5 x 2 mm, oblong - ovate, brown. Stamens 3. Nuts up to 3 x 2 mm, oblong or obovate, brown, crowned by persistent stylar base

Flowering and Fruiting: August - January

Growth form: Helophyte / Tenagophyte / Hyperhydate

Distribution: Pantropical

Habitat: Marshy areas in forests

SJ 15039 (Thoonakkadav)

SCHOENOPLECTIELLA Lye

1a. Spikelets above the middle of stem ..... *S. mucronata*
1b. Spikelets below the middle of stem ..... *S. articulata*

Schoenoplectiella articulata (L.) Lye, Lidia 6: 20. 2003. *Scirpus articulatus* L., Sp. Pl. 47. 1753; Hook. f., Fl. Brit. India 6: 655. 1893; Gamble, Fl. Pres. Madras 1666 (1156). 1931; Swarup. *et al.,* Shola For. Kerala 78. 1998. *Schoenoplectus articulatus* (L.) Palla in Engl., Bot. Jahrb. Syst. 10: 299. 1889; Rejani, Cyperac. Kerala 415. 1991; Joseph, Aquatic Angiosp. Malabar 395. 1991; Cook, Aquat. Wetland Pl. India 175. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 359. 2016. (Fig. 15 b)

Non rhizomatous perennial herbs, up to 45 cm tall, erect, tufted; stem terete, transversely septate, hollow, smooth, glabrous, green. Leaves reduced to 2 - 3 bladeless sheaths. Inflorescence a pseudo lateral head of few to many spikelets, seen below the middle of the stem, generally above the water surface 1 - 3 cm long and wide; bracts 1, erect, continuous with the culm. Spikelets sessile, oblong - ovoid, 8 - 18 mm long and 3 - 4 mm thick; rachilla persistent, wingless; glumes spiral, ovate - acute, 3.5 - 5 mm long and broad, many nerved, shortly keeled; Keel green with a mid - nerve. Stamens 3, anthers oblong, 1 mm long. Style long; stigmas 3, shorter than the style. Nut obovoid, acutely trigonous, smooth, dark brown.

Flowering and Fruiting: September - January

Growth form: Hyperhydate / Tenagophyte

Distribution: Indo – Malesia

Habitat: Ponds

SJ 16992 (Nattukal - Kozhinjampara)

Schoenoplectiella mucronata (L.) J. Jung & H. K. Choi, J. Pl. Biol. 53(3): 230. 2010. *Schoenoplectus mucronatus* (L.) Palla in Engl., Bot. Jahrb. Syst. 10: 299. 1889; Vajr., Fl. Palghat Dist. 558. 1990; Rejani, Cyperac. Kerala 422. 1991; Joseph, Aquatic Angiosp. Malabar 400. 1991; Cook, Aquat. Wetland Pl. India 178. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 366. 2016. *Scirpus mucronatus* L., Sp. Pl. 50. 1753; Hook. f., Fl. Brit. India 6: 657. 1893; Gamble, Fl. Pres. Madras 1666 (1156). 1931; Manilal, Fl. Silent Valley 344. 1988. (Fig. 15 a)

Rhizome short or elongated but without stolons. Culms tufted, sharply 3 - angled with concave sides, up to 85 cm tall, deep green. Leaves reduced to 2 - 3 bladeless sheath; lowest sheath scaly, brown, upper ones cylindrical with a triangular mucro. Involucral bract appeared as the continuation of the culm, 3 - angled, much shorter than the culm. Inflorescence pseudolateral, globose heads of up to 13 spikelets, borne above the middle of the culm. Spikelets sessile, oblong - ovoid, densely many flowered, 7 mm long, 3 mm wide. Glumes broadly ovate, acute, shortly mucronate, 3.5 mm long, 3 mm wide, 3 - nerved. Hypogynous bristles 6, longer than the nut, 2.5 mm long. Style 3 - cleft. Nuts bi convex, broadly obovoid, 1.75 mm long, 1 mm wide, with minute transverse wrinkles.

Flowering and Fruiting: September - January

Growth form: Hyperhydate / Tenagophyte

Distribution: Eurasia, from central and south Europe to Japan

Habitat: Streams

SJ 11825 (Nelliampathy farm)

DROSERACEAE Salisb.

DROSERA L.

1a. Leaves all in basal rosettes..... *D. burmannii*
1b. Leaves cauline 2
2a. Leaf blades linear..... ..... *D. indica*
2b. Leaf blades peltate..... *D. peltata*

Drosera burmannii Vahl, Symb. Bot. 3: 50. 1794; Hook. f., Fl. Brit. India 2: 424. 1878; Gamble, Fl. Pres. Madras 452 (320). 1919; Manilal, Fl. Silent Valley 100. 1988; Vajr., Fl. Palghat Dist. 193. 1990; Sasidh., Fl. Parambikulam WLS 115. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 372. 2016. (Fig. 15 c)

Acaulescent herbs. Leaves all in basal rosettes, obovate - spathulate, rounded at apex, tapering at base to the flat petiole, 5 - 8 x 3 - 6 mm, reddish, covered with viscid stipitate glands on the upper surface. Inflorescence of 10 - 20 flowered erect racemes, 5 - 10 cm tall. Bracts linear. Sepals oblong, 2 - 3 mm long. Petals oblong - oblanceolate, pink to whitish. Ovary ovoid, carpels 5, ovules 2 in each cell, style 5, apically lobed. Capsules ovoid, 3 - 4 mm long, 5 - valved, membranous. Seeds small, reticulate, black.

Flowering and Fruiting: August - January

Growth form: Helophyte

Distribution: Pantropical

Habitat: Marshy areas in grass lands

SJ 16947 (Karashoori)

Drosera indica L., Sp. Pl. 282. 1753; Hook. f., Fl. Brit. India 2: 424. 1878; Gamble, Fl. Pres. Madras 452 (320). 1919; Vajr., Fl. Palghat Dist. 193. 1990; Sasidh., Fl. Parambikulam WLS 115. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 373. 2016. (Fig. 15 d)

Caulescent herbs. Stem erect sometimes decumbent, up to 7 cm tall, glandular - pubescent. Leaves many, all cauline, linear, longer but

hardly broader than petioles, 1.5 - 4 x 0.2 - 0.4 cm, lower leaves spreading or reflexed, the upper ones erect, glandular hairy above. Inflorescence of axillary racemes, erect, up to 3 cm long, 3 - 15 flowered. Flowers pink, 8 - 12 mm across. Bracts linear. Sepals ovate, acute, entire, glandular hairy. Petals oblong - oblanceolate or spathulate, obtuse, pink or white. Ovary ovoid; carpels 3; styles 3, bipartite to the base. Capsules oblong; Seeds minute, ovoid, reticulate.

Flowering and Fruiting: August - December

Growth form: Helophyte

Distribution: Pantropical

Habitat: Marshy areas in grass lands

SJ 11856 (Mampara)

Drosera peltata Smith in Willd., Sp. Pl. 1: 1546. 1797; Hook. f., Fl. Brit. India 2: 424. 1878; Gamble, Fl. Pres. Madras 452 (320). 1919; Manilal, Fl. Silent Valley 100. 1988; Vajr., Fl. Palghat Dist. 193. 1990; Swarup. *et al.,* Shola For. Kerala 47. 1998; Sasidh., Fl. Parambikulam WLS 115. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 373. 2016. (Fig. 15 e)

Caulescent herbs. Stem with a reddish tuber, erect or straggling, up to 25 cm length, Basal leaves in rosette, cauline leaves alternate or sub opposite, peltate, small tentacles along the margins; petiole curved. Inflorescence of axillary racemes, up to 5 cm long, 6 - 10 flowered. Flowers white, nearly 1.5 cm across; pedicels 0.8 - 1.5 cm long. Calyx segments ovate, acute, dentate along margins towards tip. Petals white, spathulate - obovate. Ovary globose, Carpels 3; styles 3, much branched. Capsule 3 - valved. Seeds oblong, black.

Flowering and Fruiting: December - March

Growth form: Helophyte

Distribution: Indo - Malesia to Australia and east Asia

Habitat: Marshy areas in grasslands

SJ 11842 (Meenvani)

ELATINACEAE Dum.

1a. Plants prostrate; trimerous .... *Elatine*

1b. Plants almost erect; pentamerous ..... *Bergia*

BERGIA L.

1a. Stem glabrous, succulent; stamens 10 or more ..... *B. capensis*

1b. Stem glandular hairy, not succulent; stamens 5...*B. ammannioides*

Bergia ammannioides Roxb. ex Roth, Nov. Pl. Sp. 219. 1821; Hook. f., Fl. Brit. India 1: 251. 1874; Gamble, Fl. Pres. Madras 69 (50). 1915; Babu, Fl. Malappuram Dist. 41. 1990; Cook, Aquat. Wetland Pl. India 184. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 375. 2016. (Fig. 15 f)

Annual herbs. Stem prostrate or erect, much branched, up to 35 cm long, terete, slightly swollen at nodes, purple, glandular pubescent, woody at base. Leaves subsessile, oblanceolate - elliptic, acute, serrate with gland - tipped teeth, attenuate at base, 10 - 25 x 3 - 8 mm, glandular - pubescent. Stipules triangular - lanceolate, acute, serrate with gland - tipped teeth. Flowers in dense axillary cymes; sepals 5, linear - ovate, acute or acuminate, fimbriate along margins, 2 x 0.5 mm, reddish - pink; petals 5, ovate, hardly exceeding the sepals, whitish pink. Stamens 5. Ovary subglobose; fruit with 5 longitudinal furrows, dehiscing into 5 valves at maturity; seeds numerous, minute, oblong brown.

Flowering and Fruiting: September - February

Growth form: Helophyte

Distribution: Paleotropics

Habitat: Paddy fields

SJ 15048 (Parambikulam)

Bergia capensis L., Mant. Pl. 2: 241. 1771; Gamble, Fl. Pres. Madras 69 (49). 1915; Joseph, Aquatic Angiosp. Malabar 66. 1991; Cook, Aquat. Wetland Pl. India 185. 1996; Sunil & Sivadasan, Fl.



Fig. 15 a) *Schoenoplectiella mucronata* b) *Schoenoplectiella articulata* c) *Drosera burmannii* d) *Drosera indica* e) *Drosera peltata* f) *Bergia ammannioides*

Alappuzha Dist. 105. 2009. Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 375. 2016. *Bergia verticillata* Willd., Sp. Pl. (ed.4) 770. 1799; Hook. f., Fl. Brit. India 1: 252. 1874. (Fig. 16 a)

Annual herbs. Stem erect or decumbent, rooting at basal nodes, up to 35 cm tall, reddish. Leaves sessile, lanceolate - elliptic, acute, 2 - 4 x 0.8 - 1.5 cm, green with red teeth. Stipules ovate - triangular, membranous. Flowers many, in axillary cymes, 2 mm across; bracts ovate. Sepals 5, elliptic, margins red. Petals 5, linear - oblong, spreading, cream coloured, shorter than sepals. Stamens 10; filaments dilated at base. Ovary globose, style recurved. Capsules globose, green or pale brown, with 5 longitudinal furrows, septicidal. Seeds many, curved, reticulate.

Flowering and Fruiting: September - February

Growth form: Helophyte

Distribution: Pantropical

Habitat: Paddy fields

SJ 16951 (Chittur)

ELATINE L.

Elatine triandra Schkubr, Bot. Nandh. 1: 345. 1808; Ramayya & Rajag., Bull. Bot. Surv. India 13: 330. 1971; Jayasri in B.D. Sharma & Sanjappa, Fl. India 3: 42. 1993; Cook, Aquat. Wetland Pl. India 186. 1996; V.P. Prasad in P. Daniel, Fl. Kerala 1: 323. 2005; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 377. 2016. *Elatine americana* (Pursh) Arn., Edinb. J. Nat. Geogr. Sci. 1: 431. 1930; Hook. f., Fl. Brit. India 1: 250. 1874; Gamble, Fl. Pres. Madras 66 (49). 1915. (Fig. 16 b)

Annual herbs, up to 6 cm. Stem slender, creeping; internodes 6 - 15 mm long, rooting at nodes. Leaves opposite, decussate, oblong - elliptic, obtuse, entire, 3 - 6 mm long, subsessile, with a wing like decurrent base; mid nerve prominent; stipules minute, membranous, triangular, slightly lacerate. Flowers solitary in the upper axils, subsessile, greenish white. Sepals 3, triangular, obtuse. Petals 3,

broadly ovate, obtuse. Stamens 3, alternating the petals; filaments with flattened base. Ovary globose; stigmas 3. Capsules depressed globose, 1.4 mm in diameter, minutely stalked. Seeds cylindric, slightly curved, reticulated, brown.

Flowering and Fruiting: October - February

Growth form: Tenagophyte

Distribution: Cosmopolitan

Habitat: Paddy fields

SJ 16952 (chittur)

ERIOCAULACEAE P. Beauv. Ex Desv.

ERIOCAULON L.

1a. Leaves liner lanceolate never filiform 2
1b. Leaves liner filiform ..... *E. fluviatile*
2a. Seed coat cells isodiametric ..... *E. robustum*
2b. Seed coat cells transversely vertically elongated 3
3a. Appendages of seeds ribbon like or rectangular or represented by ridges on the seeds 4
3b. Appendages setiform 6
4a. Male flower with 2 sepals, cells of seed coat vertically elongated ..... *E. truncatum*
4b. Male flower with 3 sepals, cells of seed coat laterally elongated...5
5a. Floral bracts densely hairy ..... *E. quinquangulare*
5b. Floral bracts glabrous or only sparsly hairy ..... *E. palghatense*
6a. Spathe of male flower closed and tubular ..... *E. sexangulare*
6b. Spathe of male flower split on the abaxial side 7
7a. Spathe of male flowers 2 lobed ..... *E. thwaitesii*
7b. Spathe of male flowers 3 lobed ..... *E. xeranthemum*

Eriocaulon fluviatile Trimen, J. Bot. 23: 270. 1885; Hook. f., Fl. Brit. India 6: 585. 1893; R. Ansari & N.P. Balakr., Eriocaul. India 161 (153). 1994; Cook, Aquat. Wetland Pl. India 194,1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 396. 2016. (Fig. 16 c)

Submeged herbs. Leave linear filiform, broadening up to 2 mm at the base, up to 15 cm long. Peduncles solitary, up to 30 cm, Sheaths up to 7 cm long, glabrous. Heads spherical or hemispherical, 4 - 6 mm across, black. Involucral bracts oblong – ovate, black. Floral bracts oblanceolate, acute, black, hairy. Male flowers: sepals connate into spathe, 3 lobed. Petals 3, minute, unequal. Anthers 6. Female flowers: subsessile, Sepals 3, free. Petals 3, subequal, spathulate. Ovary stalked. Seeds oblong - ovoid. Seed coat cells transversely elongated.

Note: New report to Palakkad

Flowering and Fruiting: December - April

Growth form: Rosulate

Distribution: Western Ghats and Sri Lanka

Habitat: Streams and rivers

SJ 16953(Valiyaparathod)

Eriocaulon palghatense R. Ansari & N.P. Balakr., Eriocaul. India 111. (104) 1994; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 411. 2016.

Acaulescent herbs. Leaves glabrous, linear, acute, up to 1.5 x 0.1 cm. peduncles few, up to 4 cm long, flexuous, glabrous. Sheaths up to 1.5 mm long. Heads obovoid, 1 - 1.5 mm across. Involucral bracts erect or spreading, obovate, glabrous, straw coloured; floral bracts oblanceolate, acute, black. Male flowers: sepals obovate, connate into a spathe, 3 - lobed with obtuse lobes, hairy towards apex, black; petals 3, minute, hairy, with a black gland; anthers 6, globose, black. Female flowers: sessile or pedicelled; sepals 3, free, subequal sparsely hairy at apex, black; petals 3, free, subequal, linear - spathulate. Ovary subsessile, ovoid. Seeds oblong - ellipsoid, cells of seed coat transversely elongated, aligned in vertical rows.

Flowering and Fruiting: July - December

Growth form: Helophyte

Distribution: Endemic to Kerala

Habitat: Wet grass lands

SJ 16902 (Malampuha)

Eriocaulon quinquangulare L., Sp. Pl. 87.1753; Hook. f., Fl. Brit. India 5: 582.1893; Gamble, Fl. Pres. Madras 1620 (1128). 1931; Vajr., Fl. Palghat Dist. 539. 1990; Joseph, Aquatic Angiosp. Malabar 411. 1991; R. Ansari & N.P. Balakr., Eriocaul. India 104 (97) 1994; Cook, Aquat. Wetland Pl. India 199.1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 414. 2016. (Fig. 16 f)

Acaulescent herbs. Leaves rosulate, falcate, acuminate, glabrous, up to 9 x 0.6 cm. Peduncles many, up to 40 cm high; sheath up to 9 cm long, limb small. Head globose, involucral bracts 2 x 2 mm, obovate, toothed at apex. Floral bracts oblanceolate, acuminate, black. Male flowers: sepals black, united into a split sheath, minutely hairy, lobes truncate; petals 3, unequal, oblong, hairy; anthers 6, black. Female flowers: sepals 3, equal, linear, sparsely hairy, black; petals 3, spathulate, hairy, seeds oblong, cells of seed coat transversely elongated.

Flowering and Fruiting: July - November

Growth form: Tenagophyte/ Hyperhydate

Distribution: South Asia

Habitat: Wet grass lands

SJ 15099 (Dhoni)

Eriocaulon robustum Steud., Syn. Pl. Glum. 2: 271. 1855; Hook. f., Fl. Brit. India 6: 572. 1893; Gamble, Fl. Pres. Madras 1618 (1126). 1931; R. Ansari & N.P. Balakr., Eriocaul. India 131 (122). 2009. Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 421. 2016.

Acaualescent herbs; rootstock stout. Leaves rosulate, usually 15 x 2 cm, obtuse lanceolate or oblanceolate, quite glabrous. Peduncles solitary, 15 - 60 cm high, sheaths up to 20 cm long. Heads 1 - 2 cm broad, spherical. Involucral bracts many seriate, glabrous, ovate, acute, black; floral bracts obovate - lanceolate - deltoid, fringed at the top with white hairs. Male flowers; petals oblanceolate, hairy, one

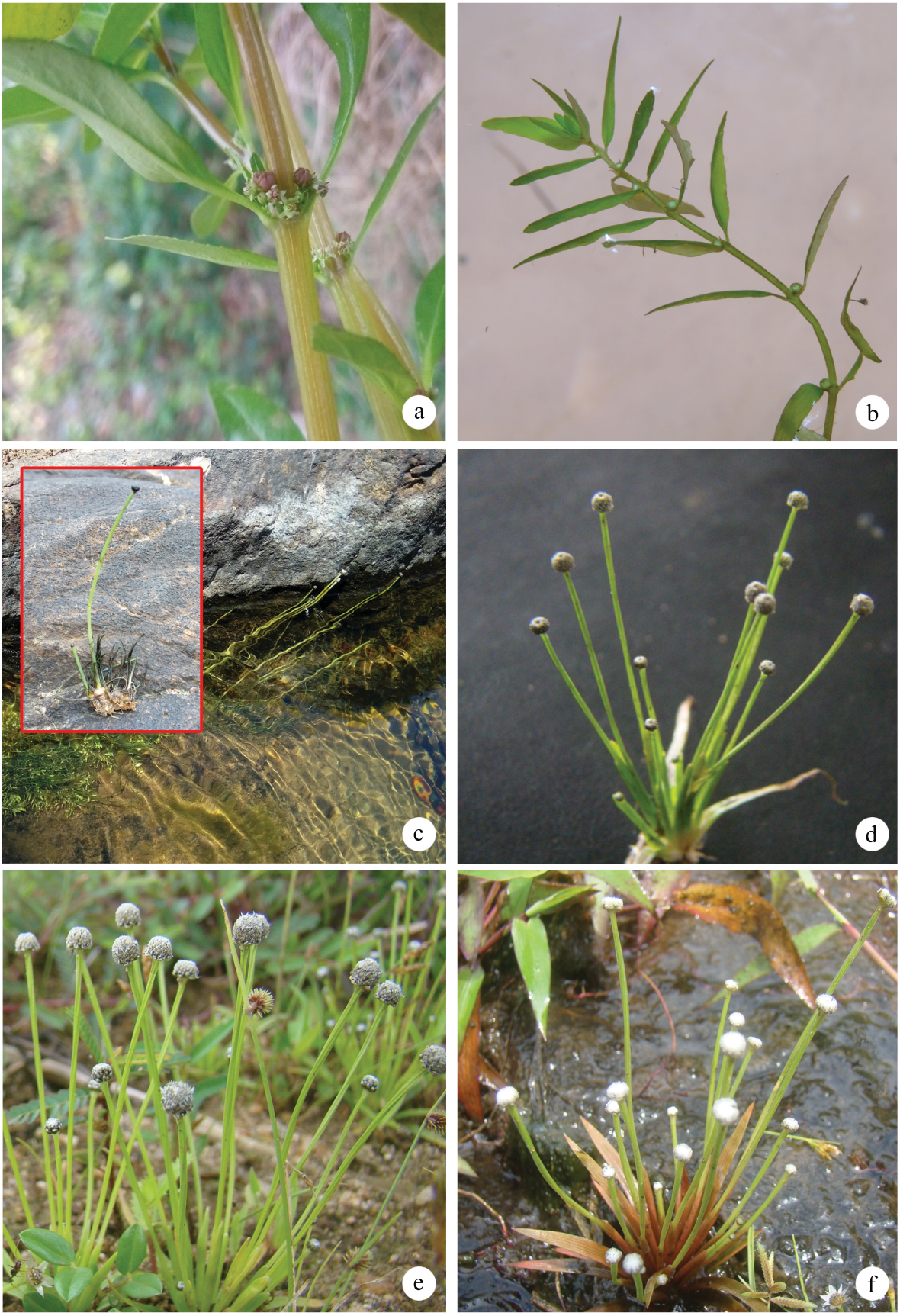


Fig. 16 a) *Bergia capensis* b) *Elatine triandra* c) *Eriocaulon fluviatile* d) *Eriocaulon sexangulare* e) *Eriocaulon thwaitesii* f) *Eriocaulon quinquangulare*

much longer than the other two and the bract, and hairier, all three with a black gland. Anthers 6, black. Female flowers: sepals three; petals 3, subequal, spathulate. Seeds ovoid to spherical, cells of seed coat isodiametric.

Flowering and Fruiting: July - January

Growth form: Helophyte

Distribution: Endemic to southern Western Ghats

Habitat: Grass lands

SJ 11837 (Meenvani)

Eriocaulon sexangulare L., Sp. Pl. 87. 1753; Hook. f., Fl. Brit. India 6: 580. 1893; Gamble, Fl. Pres. Madras 1618 (1126). 1931; Manilal, Fl. Silent Valley 336. 1988; Joseph, Aquatic Angiosp. Malabar 413. 1991; R. Ansari & N.P. Balakr., Eriocaul. India 79 (72). 1994. Cook, Aquat. Wetland Pl. India 201. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 424. 2016. (Fig. 16 d)

Acaulescent herbs. Leaves rosulate, linear - lanceolate, acute. Peduncles many, up to 35 cm long, erect, rigid. Sheaths up to 20 cm long. Heads 4 - 7 mm across, hemispherical or ovoid, white or grey. Involucral bracts spreading, obovate - orbicular, obtuse, coriaceous, glabrous. Floral bracts closely imbricate, obovate, cuneate, apex acute, coriaceous, reddish brown. Male flowers: sepals 3, obovate, connate into a closed spathe; corolla lobes 3, equal, oblong, pubescent, with a black gland in each. Anthers 6, black. Female flowers: sepals 3, free, dissimilar; petals 3, linear, hyaline, barbate towards apex. Seeds up to 0.5 mm long, ovoid; cells of seed coat transversely elongated.

Flowering and Fruiting: November - February

Growth form: Helophyte

Distribution: Indo - Malesia

Habitat: Grass lands and paddy fields

SJ 16946 (Attappadi)

Eriocaulon thwaitesii Koernicke, Linnaea 27: 627. 1854; Hook. f.,

Fl. Brit. India 583. 1893; Gamble, Fl. Pres. Madras 1620 (1128). 1931; Sasidh., Fl. Parambikulam WLS 371. 2002; R. Ansari & N.P. Balakr., Eriocaul. India 63 (60). 1994; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 429. 2016. *Eriocaulon gamblei* C.E.C. Fisch., Bull. Misc. Inform. Kew 1930: 160. 1930; Gamble, Fl. Pres. Madras 1618 (1128). 1931. (Fig. 16 e)

Acaulescent herbs. Leaves rosulate, linear - lanceolate, up to 8 x 0.5 cm, acuminate, glabrous. Peduncles many, up to 18 cm long; heads hemispherical to subglobose, up to 6 x 4 mm. Involucral bracts up to 2 x 1.5 mm, glabrous, oblong, obtuse. Floral bracts oblanceolate, black, cuneate, acute. Male flowers: sepals connate into a spathe, 2 lobed, glabrous, brownish. Petals 3, equal, hairy, glandulose. Anthers 6, black. Female Flowers: sepals 2 or 3, lanceolate, keeled, brown; petals 3, equal, linear. Seeds oblong ellipsoid, cells of seed coat transversely elongated.

Flowering and Fruiting: July - September

Growth form: Helophyte

Distribution: Peninsular India and Sri Lanka

Habitat: Grass lands

SJ 16909 (Karimala gopuram)

Eriocaulon truncatum Bunch. - Ham. ex Mart. in Wall., Pl. Asiat. Rar. 3: 29. 1832; Hook. f., Fl. Brit. India 6: 578. 1893; Gamble, Fl. Pres. Madras 1619 (1127). 1931; Manilal, Fl. Silent Valley 336. 1988; Vajr., Fl. Palghat Dist. 539. 1990; Joseph, Aquatic Angiosp. Malabar 414. 1991; R. Ansari & N.P. Balakr., Eriocaul. India 118 (110). 1994; Cook, Aquat. Wetland Pl. India 204. 1996; Sasidh., Fl. Parambikulam WLS 371. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 432. 2016. *Eriocaulon truncatum* var. *malaccense* Hook.f., Fl. Brit. India 6: 578. 1893.

Acaulescent herb. Leaves rosulate, lanceolate, up to 6 x 0.8 cm. Peduncles many, up to 18 cm long; sheaths up to 4 cm long. Heads

hemispherical, white or straw coloured, 4 mm across. Involucral bracts oblong – obovate, glabrous. Floral bracts obovate, obtuse or acute, glabrous. Male flowers: pedicelled; sepals connate into a spathe, obovate, 2 - lobed, hairy towards apex, black; petals 3, subequal, ovate, hairy; anthers 6, black. Female flowers: sepals 2 or 3, free, oblong or linear; petals 3, free, subequal, spathulate. Seeds 0.4 - 0.5 mm long, oblong – ovoid, cells of seed coat vertically elongated.

Flowering and Fruiting: July - September

Growth form: Helophyte

Distribution: Indo - Malesia

Habitat: Grass lands and marshy areas

SJ 11813 (Pallavur)

Eriocaulon xeranthemum Mart. in Wall., Pl. Asiat. Rar. 3: 29. 1832; Hook. f., Fl. Brit. India 6: 584. 1893; Gamble, Fl. Pres. Madras 1620 (1127). 1931; Joseph, Aquatic Angiosp. Malabar 415. 1991; Cook, Aquat. Wetland Pl. India 205. 1996; Sasidh., Fl. Parambikulam WLS 371. 2002; R. Ansari & N.P. Balakr., Eriocaul. India 58 (54). 1994; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 436. 2016. (Fig. 17 a)

Acaulescent annual herbs. Leaves rosulate, up to 2.5 x 0.3 cm, linear, apex acute. Peduncles few, up to 4 cm long; sheaths up to 2 cm long. Heads hemispherical, grey, up to 4 mm across. Involucral bracts linear - oblong, acuminate, glabrous, grey. Floral bracts. cuneate, truncate, hyaline. Male flowers: pedicels minute; sepals cuneate, connate into a spathe, 3 – lobed; petals 3, subequal, minute; anthers 6, black. Female flowers sessile; sepals 3, free, unequal; petals 3, subequal, spathulate, obtuse. Ovary ovoid; style 3 - fid. Seeds oblong or ellipsoid; cells of seed - coat transversely elongated.

Flowering and Fruiting: July - September

Growth form: Helophyte

Distribution: Tropical Africa and India

Habitat: Wet rocks

SJ 11812 (Pallavur)

EUPHORBIACEAE Juss.

1a. Leaves linear - lanceolate ..... *Homonoia*
1b. Leaves ovate ..... *Mallotus*

HOMONOIA Lour.

Homonoia riparia Lour., Fl. Cochinch. 637. 1790; Hook. f., Fl. Brit. India 5: 455. 1887; Gamble, Fl. Pres. Madras 1333 (933). 1925; Manilal, Fl. Silent Valley 251. 1988; Vajr., Fl. Palghat Dist. 431. 1990; Sasidh., Fl. Parambikulam WLS 293. 2002; N. P. Balakr. & Chakrab., Fam. Euphorbiaceae India 137. 2007; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 444. 2016. (Fig. 17 b)

Large dioecious shrubs; 2 - 3 m tall; branchlets pubescent, reddish. Leaves linear - lanceolate, acute, entire along margins, 10 - 20 x 1 - 1.5 cm, lower surface with circular yellowish scales; lateral nerves about 18 pairs; petioles up to 7 mm long. Spikes axillary, up to 10 cm long. Bracts ovate - lanceolate. Male flowers*:* Tepals copular, 3 - lobed; lobes ovate. Stamens many; filaments united into a central branched column. Female flowers*:* 4 mm across. Tepals 5, similar, ovate, shortly acuminate. Ovary puberulous; styles 3, spreading, linear Capsules subglobose, 4 - 5 mm across, hairy, red.

Flowering and Fruiting: December - May

Growth form: Helophyte

Distribution: Indo - Malesia and south China

Habitat: Along streams and riverbanks

SJ 11860 (Mukkali)

MALLOTUS Lour.

Mallotus nudiflorus (L.) Kulju& Welson, Blumea 52: 124. 2007. *Trewia nudiflora* L., Sp. Pl. 1193. 1753; Hook. f., Fl. Brit. India 5: 423. 1887; Gamble, Fl. Pres. Madras 1319 (922). 1925; Vajr., Fl. Palghat Dist. 440. 1990; Sasidh., Fl. Parambikulam WLS 300. 2002. *Trewia*

polycarpa Benth. in Benth. & Hook.f., Gen. Pl. 3: 318. 1880; Hook. f., Fl. Brit. India 5: 424. 1887; Gamble, Fl. Pres. Madras 1319 (923). 1925; Vajr., Fl. Palghat Dist. 440. 1990. (Fig. 17 c)

Deciduous trees up to 20 m tall, dioecious; bark greyish - brown, smooth. Leaves simple, opposite, broadly ovate, apex acuminate, margin entire, glabrous above, glaucous beneath. Flowers unisexual, pale green. Male flowers: 3 - 5 mm across, numerous on 10 - 20 cm long peduncle. Stamens many, clustered on a convex receptacle. Female flowers: up to 9 mm across, on axillary racemes; ovary superior, 3 - 4 mm across, 2 - 4 - loculed, ovule one in each cell; styles 3. Fruit a capsule 2 - 3 cm across, woody, dark brown, pericarp very thick; seeds ovoid.

Flowering and Fruiting: December - May

Growth form: Helophyte

Distribution: Indo - Malesia

Habitat: Along streams and riverbanks

SJ 15045 (Parambikulam)

FABACEAE Lindl.

1a. Leaves bi pinnate ..... *Neptunia*
1b. Leaves uni pinnate.....2
2a. Leaves paripinnate 3
2b. Leaves imparipinnate..... *Aeschynomene*
3a. Pods articulated, lomentose 4
3b. Pods not articulated, dehiscent .....*Sesbania*
4a. Leaves with 2 pairs of leaflets ..... *Geissaspis*
4b. Leaves with more than 2 pairs of leaflets ..... *Smithia*

AESCHYNOMENE L.

Aeschynomene indica L., Sp. Pl. 713. 1753; Hook. f., Fl. Brit. India 2: 151. 1876; Gamble, Fl. Pres. Madras 313 (234). 1918; Vajr., Fl. Palghat Dist. 145. 1990; Joseph, Aquatic Angiosp. Malabar 168. 1991;

Sanjappa, Legumes Ind. 75. 1992; Cook, Aquat. Wetland Pl. India 208. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 448. 2016. (Fig. 17 d)

Annual herbs up to 1 m tall; stem slightly woody at the base. Branchlets glabrous to hispid. Leaves alternate, rachis up to10 cm long; leaflets 15 - 30 pairs, subsessile, linear - oblong or elliptic - oblong, minutely mucronate at apex. Flowers 7 - 10 mm long in 1 - 4 flowered axillary racemes; pedicel to 5 mm long; calyx 4 - 5 mm long, deeply 2 - lipped, glabrous. Corolla exerted, pale yellow; standard orbicular, red striped; wing obovate; keel oblong. Staminal sheath to 4 mm long. Ovary to 6 mm long; ovules many. Pods, linear, compressed, straight or curved with 4 - 8 joints, up to 3 cm long. Seeds reniform, dark brown.

Flowering and Fruiting: August - December

Growth form: Helophyte / Hyperhydate/ Tenagophyte

Distribution: Pantropical

Habitat: Along margins of ponds and rivers

SJ 16903 (Malampuzha)

GEISSASPIS Wight & Arn.

Geissaspis cristata Wight & Arn., Prodr. 218. 1834; Hook. f., Fl. Brit. India 2: 141. 1876; Gamble, Fl. Pres. Madras 324 (229). 1918; Sanjappa, Legumes Ind. 181. 1992; Joseph, Aquatic Angiosp. Malabar 170. 1991; Vajr., Fl. Palghat Dist. 162. 1990; Cook, Aquat. Wetland Pl. India 208. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 451. 2016.

Diffuse herbs, rooting at lower nodes. Leaves paripinnate with 4 leaflets, obovate, obtuse to emarginate at tip, sessile, entire; petiole 0.5 - 1 cm long; stipules ovate, ciliate along margins. Inflorescence of axillary long - peduncled bracteate spikes; bracts orbicular reniform, margins entire with many long brown hairs. Calyx up to 2.5 mm long, deeply 2 - lipped; upper lip entire, lower 3 - toothed. Corolla 3 - 5 mm

long, purplish; standard to 5 x 3 mm, obovate; wings to 3 x 1.5 mm, obliquely obovate; keel incurved, obtuse. Stamens monadelphous. Ovary, suborbicular; style incurved; stigma minute. Pods of 1 - 2 single seeded joints, orbicular, reticulately veined. Seed up to 2.5 mm long, brown.

Flowering and Fruiting: July - September

Growth form: Helophyte

Distribution: South west India, Sri Lanka and China

Habitat: Marshy areas and wet rocks

SJ 15053 (Kollengode)

NEPTUNIA Lour.

Neptunia oleracea Lour., Fl. Cochinch. 654. 1790; Hook. f., Fl. Brit. India 2: 285. 1878; Gamble, Fl. Pres. Madras 416 (295). 1919; Vajr., Fl. Palghat Dist. 188. 1990; Sanjappa, Legumes Ind. 69. 1992. Cook, Aquat. Wetland Pl. India 209. 1996. *Neptunia prostrata* (Lam.) Baill., Bull. Soc. Linn. Paris 1: 356. 1883; Joseph, Aquatic Angiosp. Malabar 148. 1991; Sunil & Sivadasan, Fl. Alappuzha Dist. 269. 2009; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 589. 2016.

Annual or perennial, floating herbs. Stems horizontal, rooting at nodes, often thickened at internodes developing white, spongy floats. Leaves bipinnate; pinnae 2 - 3 pair; leaflets 8 - 18 pairs, sessile, narrowly oblong, 4 - 12 x 1.5 - 3 mm, sensitive. Stipules obliquely ovate - cordate, persistent. Inflorescence axillary; peduncles erect, 6 - 20 cm long. Flower heads oblong, 1.5 - 2.5 cm long. Flowers 5 - merous, polygamous, yellow, sessile; upper ones bisexual, male in the middle and sterile ones at base. Calyx tube 1.5 - 2 mm long. Petals elliptic, up to 10 mm long. Stamens 10, free. Staminodes in sterile flowers strap shaped. Ovary single chambered, style Pods oblong, beaked. Seeds 4 - 10, compressed, ovoid.

Flowering and Fruiting: August - November

Growth form: Pleustophyte / Hyperhydate

Distribution: Pantropical

Habitat: Ponds

SJ 15082 (Victoria college pond)

SESBANIA Adans.

Sesbania bispinosa (Jacq.) Wight, U.S.D.A. Bur. Pl. Industr. Bull. No. 137. 15. 1909; Vajr., Fl. Palghat Dist. 171. 1990; Sanjappa, Legumes Ind. 242. 1992; Cook, Aquat. Wetland Pl. India 210. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 452. 2016. *Sesbania aculeata* (Willd.) Poir. in Lam., Encycl. 7: 128. 1806; Hook. f., Fl. Brit. India 2: 114. 1876; Gamble, Fl. Pres. Madras 323 (228). 1918. (Fig. 17 e)

Erect, branched annual shrubs, up to 3 m tall; stems with small prickles. Leaves pinnate, up to 35 cm long; stipules membranous, linear - lanceolate, acuminate, leaflets 15 - 40 pairs, linear - oblong, up to 15 mm long and 5 mm wide, apex obtuse, mucronate, base acute, glabrous on both surfaces. Inflorescence a lax axillary raceme. Flowers up to 1.5 cm long, pedicels 6 mm long, filiform; calyx 3 - 4 mm long, membranous, glabrous. Corolla 1 – 1.2 cm long, yellow usually with red dots on the back of the glabrous standard. Pod up to 25 cm long and 2 mm thick, 30 - 40 seeded.

Flowering and Fruiting: July - December

Growth form: Helophyte

Distribution: Pantropical

Habitat: Marshy areas

SJ 16904 (Kadamkode)

SMITHIA Ait.

Smithia blanda Wall. ex Wight & Arn., Prodr. 221. 1834; Hook. f., Fl. Brit. India 2: 151. 1876; Gamble, Fl. Pres. Madras 330 (233). 1918; Manilal, Fl. Silent Valley 87. 1988; Vajr., Fl. Palghat Dist. 172. 1990; Sanjappa, Legumes Ind. 246. 1992; Sasidh. *et al.,* Bot. Stud. Med. Pl.

Kerala 36. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 452. 2016

Branched shrubs or sub - shrubs, lower part of stem prostrate. Leaves paripinnate, rachis with bristles; leaflets 4 - 5 pairs, elliptic - lanceolate, obtuse, mucronate at apex, ciliate on margins. Inflorescence corymbose, axillary and terminal. Calyx 0.5 cm long, 2 - lipped, upper large, emarginate, lower 3 - lobed, ciliate on margins. Petals yellow, up to 1.3 cm long, wing petal with transverse scaly foldings. Stamens 5 + 5. Pods 4 - 5 jointed folded and enclosed in the acrescent calyx.

Flowering and Fruiting: October - January

Growth form: Helophyte

Distribution: India

Habitat: Marshy areas and wet rocks.

SJ 16910 (Karimalagopuram)

GENTIANACEAE Juss.

Ia. Stamens inserted at different levels on corolla tube…….. *Canscora*

Ib. Stamens inserted at same level on corolla tube……*Hoppea*

CANSCORA Lam.

Canscora diffusa (Vahl) R. Br. ex Roem. & Schult., Syst. Veg. 3: 301. 1820; Hook. f., Fl. Brit. India 4: 103. 1883; Gamble, Fl. Pres. Madras 878 (617). 1923. Manilal, Fl. Silent Valley 181. 1988; Vajr., Fl. Palghat Dist. 298. 1990; Sasidh., Fl. Parambikulam WLS 199. 2002. (Fig. 17 f)

Annual herbs. Stem up to 30 cm high, diffusely branched from above the base, 4 - angular. Leaves opposite, sessile, ovate - lanceolate, acute, truncate - cuneate at base, 1.8 - 2.5 x 0.8 - 1.8 cm, glabrous. Inflorescence of terminal and subterminal, dichasial cymes. Bracts linear - lanceolate. Calyx tube 3.5 mm long. Corolla tube 7 - 10 mm long; limb bilabiate, light pink; upper lip 2 - lobed; lower 1 - lobed; the

lobes deeply 2 - fid. Stamens 4, unequal, inserted at different levels on corolla tube; the longer one fertile. Ovary 1 - locular; stigma 2 - lobed. Capsules linear - oblong, 5 mm long.

Flowering and Fruiting: October - January

Growth form: Helophyte

Distribution: Tropical Africa, Asia and Australia

Habitat: Marshy areas in grass lands and along rivers.

SJ 11868 (Attappadi)

HOPPEA Willd.

Hoppea fastigiata (Griseb.) Clarke in Hook.f., Fl. Brit. India 4: 100. 1883; Gamble, Fl. Pres. Madras 877 (616). 1923; Manilal, Fl. Silent Valley 184. 1988; Ramach. & V.J. Nair, Fl. Cannanore Dist. 292. 1988; Vajr., Fl. Palghat Dist. 300. 1990; Cook, Aquat. Wetland Pl. India 212. 1996; Sasidh., Fl. Parambikulam WLS 201. 2002. (Fig. 18 a)

Annual herbs, branched, green throughout. Stems distinctly 4 - winged, up to 10 cm tall; branches clustered and growing upright. Leaves sessile, broadly ovate, acute, rounded or truncate at base, 4 - 8 x 3 - 7 mm. Inflorescence a cyme, terminal and axillary; peduncles up to 5 mm long. Flowers sessile. Calyx tubular; lobes 4, lanceolate. Corolla light yellow, tubular; tube 3 - 4 mm long; lobes 4, oblong. Stamens 4 attached at the throat of corolla tube at the same level; only one fertile. Ovary ellipsoid; stigma 2 - lobed. Capsules ellipsoid, 3 - 4 mm long. Seeds many.

Flowering and Fruiting: September - October

Growth form: Helophyte

Distribution: Peninsular India, Sri Lanka and Myanmar

Habitat: Marshy areas in wet hillocks

SJ 16905 (Malampuzha)

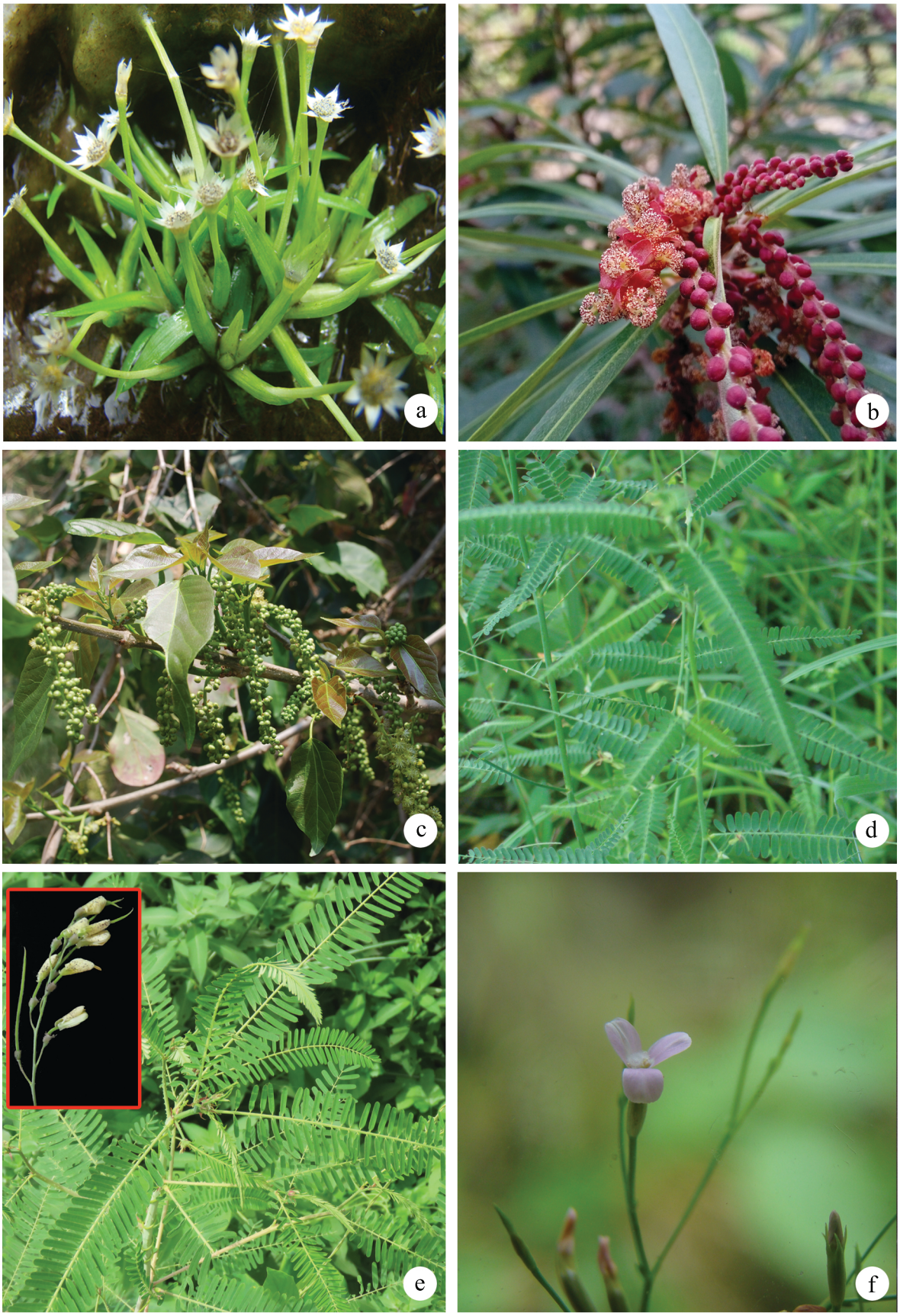


Fig. 17 a) *Eriocaulon xeranthemum* b) *Homonoia riparia* c) *Mallotus nudiflorus* d) *Aeschynomene indica* e) *Sesbania bispinosa* f) *Canscora diffusa*

GESNERIACEAE Dum.

1a. Leaves in rosette..... *Henckelia*
1b. Leaves alternate or opposite..... *Rhynchoglossum*

HENCKELIA Spreng.

Henckelia incana (Vahl) Spreng, Syst. Veg. 1: 38 1824. *Didymocarpus tomentosa* Wight, Ic. t. 1349. 1848; Hook. f., Fl. Brit. India 4: 353. 1884; Gamble, Fl. Pres. Madras 989 (695). 1924; Vajr., Fl. Palghat Dist. 332. 1990; Swarup. *et al.,* Shola For. Kerala 53. 1998; Sasidh., Fl. Parambikulam WLS 221. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 465. 2016. (Fig. 18 b)

Scapigerous herbs. Leaves in a rosette, 6 - 7 x 4 cm, ovate to broadly elliptic, acute or rounded, irregularly crenate - serrate, densely bullate above, densely tomentose below; petiole 1 - 3 cm long; central leaves sessile. Inflorescence few; 5 - 12 cm long. Cymes glandular, slightly tomentose; pedicels 1 - 2 cm long. Flowers purple - blue, sub umbellate; sepals 2.5 x 1 mm, oblanceolate, obtuse, long - hairy; corolla 1 cm long, glandular - hairy, lobes obovate to orbicular; staminodes straight, bristle - like; ovary densely glandular, hairy. Capsule 2 x 0.2 cm, glandular hairy.
Flowering and Fruiting: May - October
Growth form: Helophyte
Distribution: Endemic to peninsular India
Habitat: Wet rocks

SJ 15040 (Parambikulam)

RHYNCHOGLOSSUM Blume

Rhynchoglossum notonianum (Wall.) Burtt, Notes Roy. Bot. Gard. Edinb. 24: 170. 1962; Manilal, Fl. Silent Valley 200. 1988; Vajr., Fl. Palghat Dist. 333. 1990; Sasidh., Fl. Parambikulam WLS 222. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 468. 2016. *Klugia*

notoniana (Wall.) A. DC. in DC., Prodr. 9: 276. 1845; Hook. f., Fl. Brit. India 4: 366. 1889; Gamble, Fl. Pres. Madras 990 (696). 1924. (Fig. 18 c)

Fleshy herbs, 10 - 35 cm high. Leaves alternate or opposite, sometimes reduced to a single leaf, ovate - oblong, acuminate, entire or minutely dentate along margins, unequally cordate at base, 6 - 10 x 3 - 6 cm; petioles 0.5 - 3 cm long. Flowers in terminal racemes; peduncles 1.5 - 6 cm long. Calyx tube 8 - 11 mm long, lobes 5, equal, lanceolate. Corolla bilabiate; tube white, 7 - 10 mm long; upper lip white, small, 2 - lobed; lower lip purplish blue, 16 - 26 x 15 - 20 mm. Stamens 4; anthers connate in pairs. Ovary one celled, ovules many. Capsule obovate, 8 - 10 mm long. Seeds many.

Flowering and Fruiting: July - December

Growth form: Helophyte

Distribution: South west India and Sri Lanka

Habitat: Marshy areas in wet hillocks

SJ 16906 (Elival)

HALORAGACEAE Lindl.

MYRIOPHYLLUM L.

Myriophyllum oliganthum (Wight & Arn.) F. v. Muell., Fragm. Phyt. Austr. 10: 54. 1876; Vajr., Fl. Palghat Dist. 194. 1990; Cook, Aquat. Wetland Pl. India 214. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 470. 2016. *Haloragis oligantha* Wight & Arn., Prodr. 338. 1834. *Myriophyllum intermedium* Clarke in Hook.f., Fl. Brit. India 2: 433. 1878; Gamble, Fl. Pres. Madras 454 (321). 1919.

Perennial aquatic herbs, succulent, submerged or floating, glabrous. Leaves heterophyllous, lower leaves whorled, up to 3 cm long, pinnatisect into filiform lobes. Upper leaves alternate, up to 1.5 cm long and 0.1 cm wide, linear, flat, glabrous, entire or serrate. Flowers sessile, in axillary clusters of 3 - 6 flowers, unisexual or bisexual;

sepals 4, 0.5 mm long, oblong; petals 4, yellowish; stamens 4, filaments short; linear - oblong; ovary subglobose, 4 - celled, ovules solitary in each cell; styles 4, free. Fruit tuberculate.

Flowering and Fruiting: March - April

Growth form: Vittate/ Hyperhydate

Distribution: Endemic to peninsular India

Habitat: Streams

SJ 11898 (Karadi)

HYDROCHARITACEAE Juss

1a. Leaves clearly differentiated into petiole and blade ..... *Ottelia*
1b. Leaves not differentiated into petiole and blade..... 2
2a. Leaves in basal rosettes 3
2b. Leaves in whorls on elongated stem 4
3a. Fertilized female flowers with spirally coiled stalk..... *Vallisneria*
3b. Fertilized female flowers with uncoiled flexible stalk ..... *Blyxa*
4a. Ovary inferior .... *Hydrilla*
4b. Ovary superior ..... *Najas*

BLYXA Noron. ex Thou

Blyxa echinosperma (Clarke) Hook. f., Fl. Brit. India 5: 661. 1888; Gamble, Fl. Pres. Madras 1397 (978). 1928; Vajr., Fl. Palghat Dist. 460. 1990. *Blyxa aubertii* L.C. Rich. var. *echinosperma* (Clarke) Cook & Lound, Aquat. Bot. 15: 14. 1983; Cook, Aquat. Wetland Pl. India 217. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 473. 2016. *Blyxa aubertii* L.C. Rich., Mem. Cl. Sci. Math. Phys. Inst. France 12: 77. t.4. 1812; Manilal, Fl. Silent Valley 266. 1988; Vajr., Fl. Palghat Dist. 460. 1990; Joseph, Aquatic Angiosp. Malabar 418. 1991. *Blyxa oryzetorum* (Decne.) Hook.f., Fl. Brit. India 5: 661. 1888. (Fig. 18 d)

Submerged aquatic herbs. Leaves radical, 6 - 32 x 0.4 - 0.8 cm, linear, gradually tapering to a long acuminate tip, entire. Flowers solitary, bisexual, emergent; pedicel to 20 cm long. Spathe 5 - 6 cm long,

tubular. Sepals 3, up to 1 cm long, linear. Petals 3, linear; filaments to 4 mm long. Ovary 4 - 5 cm long, linear - cylindric, many - ovuled; stigmas 3, white, papillose. Capsules up to 5 cm long, linear - cylindric. Seeds 1 - 2 mm long, ellipsoid, echinate over the surface ridges, tail on both ends.

Flowering and Fruiting: June – September.

Growth form: Rosulate

Distribution: Cosmopolitan

Habitat: Paddy fields, canals and pools

SJ 11828 (Nelliyampathy)

HYDRILLA Rich.

Hydrilla verticillata (L.f.) Royle, Illustr. Bot. Himal. t. 376. 1839; Hook. f., Fl. Brit. India 5: 659. 1888; Gamble, Fl. Pres. Madras 1396 (977). 1928; Joseph, Aquatic Angiosp. Malabar 425. 1991; Vajr., Fl. Palghat Dist. 460. 1990; Cook, Aquat. Wetland Pl. India 218. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 477. 2016.

Submerged, monoecious profusely branched, perennial freshwater herb with 5 - 50 mm long internodes and fibrous roots at some nodes. Leaves cauline, oblong - linear to lanceolate, green, margin toothed, apex acute – apiculate. Inflorescence axillary; male spathe 1.25 - 1.50 mm long, bursting open to liberate male flower, beset with subulate appendages. Male flower solitary, sepals reflexed, 1.5 - 3 mm long; petals linear - spathulate, white; stamens 3. Female flowers with long hypanthium carrying the flower to surface. Sepals 3, petals 3, white. Ovary oblong, style 3. Fruits cylindrical, 5 - 7 mm long. Seeds dark brown.

Flowering and Fruiting: Throughout the year

Growth form: Vittate

Distribution: Asia, Europe and Africa

Habitat: Rivers, canals and ponds

SJ 11885 (Olasseri)

OTTELIA Pers.

Ottelia alismoides (L.) Pers., Syn. Pl. 1: 400. 1805; Hook. f., Fl. Brit. India 5: 662. 1888; Gamble, Fl. Pres. Madras 1398 (978). 1928; Vajr., Fl. Palghat Dist. 461. 1990; Joseph, Aquatic Angiosp. Malabar 428. 1991; Cook, Aquat. Wetland Pl. India 220. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 479. 2016. (Fig. 18 e)

Submerged annual herbs. Root fibrous. Leaves light green, submerged to partly emergent or floating, submerged ones oblong - lanceolate, attenuate to short petiole, floating leaves broadly ovate to nearly orbicular, apex obtuse. Flowers bisexual, axillary, sessile, white and solitary; sepals green, linear - oblong, obtuse, persistent; petals 3, obovate or suborbicular, obtuse, white with yellow spot at the base. Stamens 6 - 9, anthers basifixed, linear, yellow. Ovary oblong, style bifid to the base. Fruit ovoid - cylindrical, 2 - 4 cm long and 3 - 4 cm in diameter. Seeds numerous, fusiform.

Flowering and Fruiting: July - January

Growth form: Rosulate

Distribution: Indo - Malesia to Pacific islands and east Asia

Habitat: Canals, ponds and paddy fields

SJ 11883 (Olasseri)

NAJAS L.

Najas indica (Willd.) Cham., Linnaea 4: 501. 1829; Gamble, Fl. Pres. Madras 1604 (1119). 1931; Manilal, Fl. Silent Valley 335. 1988; Joseph, Aquatic Angiosp. Malabar 449. 1991; Cook, Aquat. Wetland Pl. India 269. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 603. 2016. *Najas falciculata* Braun, J. Bot. 2: 278. 1864; Hook. f., Fl. Brit. India 6: 569. 1893; Gamble, Fl. Pres. Madras 1604 (1119). 1931. *Najas lacerata* Rendle, Trans. Linn. Soc. London 5: 416. 1899; Gamble, Fl. Pres. Madras 1604 (1119). 1931.

Monoecious annual or perennial herbs. Stem slender, branched, without spines; internodes 2 - 3 cm long. Leaves acicular, flat, flexible,

10 - 25 x 2 - 4 mm, margins serrulate with 6 - 18 triangular conspicuous spines; sheaths 1.5 – 4 mm long, auriculate; auricles obscure or ovate and obtuse, serrulate or lacinate with 4 - 10 spines, up to 1 x 0.5 mm. Male flowers: borne in a spathe of 2 - 3 mm long; pedicels up to 1 mm long; stamen 1; anther subsessile, 4 - sporangiate. Female flowers naked; ovary ellipsoid, 2 mm long. Achenes oblong - ellipsoid. Seeds oblong - ellipsoid.

Flowering and Fruiting: September to February

Growth form: Vittate

Distribution: Tropical Asia and Africa

Habitat: Paddy fields

SJ 16915 (Pattanchery)

VALLISNERIA L.

Vallisneria natans (Lour.) Hara, J. Jap. Bot. 49: 136. 1974; Joseph, Aquatic Angiosp. Malabar 431. 1991; Ansari *et al.*, Aquat. Wetland Fl. Kerala. Fl. Pl. 481. 2016. *Physkium natans* Lour., Pl. Cochinch. 2: 663. 1790. *Vallisneria spiralis* sensu Hook.f., Fl. Brit. India 5: 660. 1888; Gamble, Fl. Pres. Madras 1396 (977). 1928; Mohanan, Fl. Quilon Dist. 387. 1984. Cook, Aquat. Wetland Pl. India 221. 1996. (Fig. 18 f)

Submerged acaulescent herbs; stolons to 4 cm long, terete. Leaves radical, strap shaped, up to 50 x 1 cm, 7 - 9 nerved, margin softly toothed, apex obtuse. Inflorescence axillary. Flowers unisexual, dioecious. Male spathes oblong, 6 x 4 mm; peduncle to 3 cm; flowers numerous, pedicelled. Female spathes oblong, up to 1.5 cm long, partially covering the ovary; peduncles spirally coiled or not, up to 60 cm; sepals 3, ovate – oblong; petals 3, minute. Ovary linear, up to 2 mm long; ovules numerous on marginal placentae; styles 3, bilobed. Fruits linear, seeds numerous, oblong.

Flowering and Fruiting: October - February

Growth form: Rosulate

Distribution: Pantropical

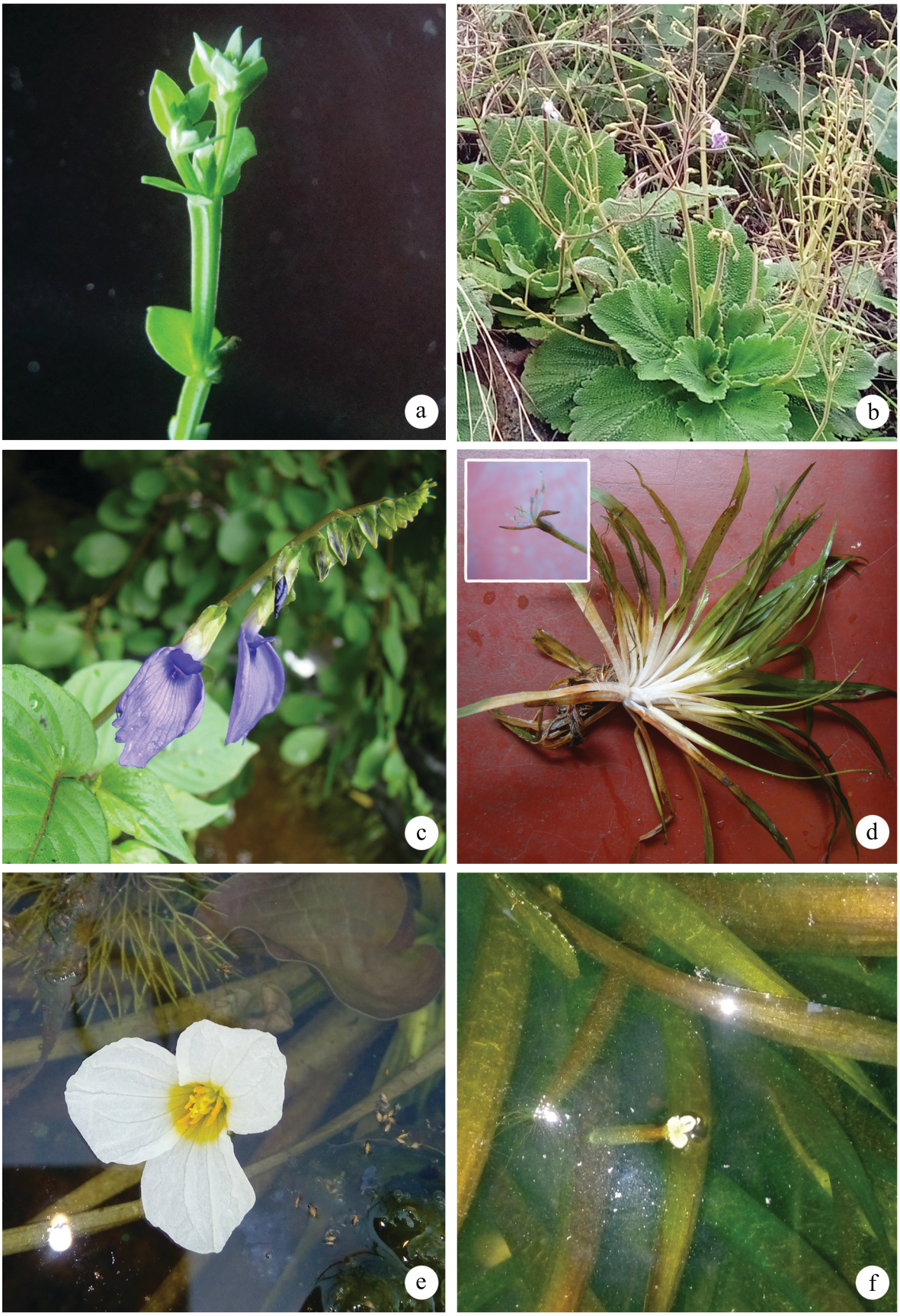


Fig. 18 a) *Hoppea fastigiata* b) *Henckelia incana* c) *Rhynchoglossum notonianum* d) *Blyxa echinosperma* e) *Ottelia alismoides* f) *Vallisneria natans*

Habitat: Canals, ponds and paddy fields

SJ 11886 (Olasseri)

HYDROPHYLLACEAE R. Br. Ex Edwards

HYDROLEA L.

Hydrolea zeylanica (L.) Vahl, Symb. Bot. 2: 46. 1791; Hook. f., Fl. Brit. India 4: 133. 1883; Gamble, Fl. Pres. Madras 884 (621). 1923; Joseph, Aquatic Angiosp. Malabar 76. 1991; Vajr., Fl. Palghat Dist. 301. 1990; Cook, Aquat. Wetland Pl. India 222. 1996; Sasidh., Fl. Parambikulam WLS 201. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 482. 2016. (Fig. 19 a)

Annual herbs, erect or decumbent, rooting at lower nodes, up to 45 cm tall. Leaves alternate, simple up to 7 cm long and 1.5 cm wide, elliptic - lanceolate, apex acute, base cuneate. Inflorescence axillary and terminal racemes; flowers blue, nearly 1 cm across; calyx lobes lanceolate, glandular, acute; corolla lobes 5, ovate, 6.5 mm long, obtuse, deep blue; stamens 5, basally dilated; ovary, oblong, 2.5 mm long, many ovuled, sparsely hispid; stigma globose. Capsule 5 x 2 mm, ovoid, covered by persistent calyx.

Flowering and Fruiting: August - January

Growth form: Helophyte/ Hyperhydate

Distribution: Pantropical

Habitat: Marshy localities and paddy fields

SJ 11872 (Alamkode)

HYPERICACEAE Juss.

HYPERICUM L.

Hypericum japonicum Thunb., Syst. Veg. 702. 1784; Hook. f., Fl. Brit. India 1: 256. 1874; Gamble, Fl. Pres. Madras 70 (51). 1915; Manilal, Fl. Silent Valley 18. 1988; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 37. 1996; Swarup. *et al.,* Shola For. Kerala 53. 1998; Sasidh.,

Fl. Parambikulam WLS 20. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 486. 2016. (Fig. 19 b)

Erect herbs up to 35 cm height; leaves, simple, opposite, decussate, 8 - 10 x 5 mm, lanceolate, apex acute, base auricled, glabrous. Flowers solitary axillary or in terminal cymes; yellow, pedicels 4 - 6 mm long. Sepals 5, persistent, up to 3 mm lung and 1 mm wide, oblong, obtuse. Petals yellow, 4 x 1.5 mm, oblong. Stamens variably numerous. Ovary 1 - celled, ovoid to ellipsoid; styles 3. Capsule ovoid, 4 x 3.5 mm long, smooth; seeds oblong, numerous.

Flowering and Fruiting: September - January

Growth form: Helophyte

Distribution: Indo - Malesia to Australia and New Zealand, and east Asia

Habitat: Marshes of grass lands adjoining evergreen forests

SJ 15086 (Muththikulam)

HYPOXIDACEAE R. Br.

HYPOXIS L.

Hypoxis aurea Lour., Fl. Cochinch. 200. 1790; Hook. f., Fl. Brit. India 6: 277. 1892; Gamble, Fl. Pres. Madras 1501 (1049). 1928; Swarup. *et al.,* Shola For. Kerala 79. 1998; Sasidh., Fl. Parambikulam WLS 351. 2002. (Fig. 19 c)

Slightly fleshy herbs, rhizome globose, 1 cm long, perennial. Leaves, linear, radical, sessile, up to 15 cm long and 5 mm broad. Scapes slender, in groups of 2 or 3, up to 10 cm long. Flowers 1 or 2. Perianth yellow, lobes elliptic - lanceolate. Stamens 6. Stigma 3 - lobed. Capsule 1 cm long, 3 chambered, cylindric - turbinate; seeds subglobose, many.

Flowering and Fruiting: May – August

Growth form: Helophyte / Tenagophyte

Distribution: Indo - Malesia

Habitat: Marshy grass lands and wet rocks

SJ 11827 (Minnampara)

JUNCACEAE Juss.

JUNCUS L.

Juncus prismatocarpus R. Br. **ssp. *leschenaultii*** (Gay ex Laharpe) Kirschner, Preslia 74: 249. 2002; Ratheesh Narayanan, Fl. Stud. Wayanad Dist. 894. 2009. *Juncus leschenaultii* Gay ex Laharpe, Essai Monogr. Jonc. 49. 1825. Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 489. 2016. *Juncus prismatocarpus* sensu Hook. f., Fl. Brit. India 6: 395. 1892; Gamble, Fl. Pres. Madras 1553 (1084). 1931; Manilal, Fl. Silent Valley 328. 1988; Cook, Aquat. Wetland Pl. India 223. 1996. (Fig. 19 d)

Annual or sometimes perennial tufted herbs. Stems flattened, up to 35 cm. Leaves cauline and radical, 4 - 10 x 0.3 - 0.5 cm, linear to lanceolate, hollow and transversely septate within, sheath to 2.5 cm, cymes terminal, corymbose, 4 - 10 flowered, floral bracts solitary, ovate, acuminate. Perianth segments greenish or brown, up to 5 mm. Stamens 3. Ovary one celled, many ovuled, stigma 3 - lobed. Fruit a 3 - sided capsule. Seeds ellipsoid to ovoid.

Flowering and Fruiting: November - January

Growth form: Helophyte / Tenagophyte

Distribution: Indo - Malesia to New Zealand

Habitat: Marshy areas and riverbanks

SJ 16954 (Silent Valley)

LAMIACEAE Lindl.

BASILICUM Moench

Basilicum polystachyon (L.) Moench, Suppl. Meth. 143. 1802; Vajr., Fl. Palghat Dist. 374. 1990. *Moschosma polystachyum* (L.) Benth. in Wall., Pl. Asiat. Rar. 2: 13. 1830; Hook. f., Fl. Brit. India 4: 612. 1885;

Gamble, Fl. Pres. Madras 1117 (781). 1921. (Fig. 19 e)

Slender herbs; erect with quadrangular stems. Height up to 100 cm. Leaves opposite, ovate, 2.5 - 7.0 x 2.4 cm, acuminate, irregularly crenate - serrate. Petioles up to 4.5 cm. Inflorescence a terminal or axillary raceme of 5 - 6 cm. Flowers small in whorls of 6; pedicels up to 1 mm; calyx 2 lipped, upper lobe larger; corolla bilipped, 2.5 - 3 mm long, pink, tube straight, campanulate. Stamens 4, didynamous, filaments filiform. Ovary 4 partite, style glabrous, stigma bifid. Fruit small, nutlets 4, ellipsoid.

Flowering and Fruiting: September - November

Growth form: Helophyte

Distribution: Tropical Africa and Indo - Malesia

Habitat: Marshy areas and paddy fields

SJ 15073 (Kollengode)

LENTIBULARIACEAE Rich.

UTRICULARIA L.

1a. Foliar organs divides into capillary segments..... 2
1b. Foliar organs entire..... 3
2a. Foliar organs with up to six segments, seeds lenticular..*U. exoleta*
2b. Foliar organs with more than six segments, seeds prismatic .... *U. aurea*
3a. Bracts subtending flowers attached at the base.....4
3b. Bracts subtending flowers attached at a point above the base ... 6
4a. Capsule wall thickened along the line of dehiscence 5
4b. Capsule wall uniformly membranous .... *U. lazulina*
5a. Lower lip of corolla deeply 3 lobed..... *U. sunilii*
5b. Lower lip of corolla entire or slightly lobed..... *U. graminifolia*
6a. Corolla pink or white with yellow blotch ..... *U. striatula*
6b. Corolla pink without yellow blotch..... *U. roseopurpurea*

Utricularia aurea Lour., Fl. Cochinch. 26.1790; M. K. Janarth. &



Fig. 19 a) *Hydrolea zeylanica* b) *Hypericum japonicum* c) *Hypoxis aurea* d) *Juncus prismatocarpus* e) *Basilicum polystachyon* f) *Utricularia aurea*

Henry, Bladderworts India 30. 1992; Vajr., Fl. Palghat Dist. 329. 1990; Joseph, Aquatic Angiosp. Malabar 83. 1991; Cook, Aquat. Wetland Pl. India 235. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 506. 2016. *Utricularia flexuosa* Vahl, Enum. Pl. 1: 198. 1804; Hook. f., Fl. Brit. India 4: 329. 1884; Gamble, Fl. Pres. Madras 980 (689). 1924. (Fig. 19 f)

Submerged floating branched herbs; stolon up to 1 m long, foliar organs up to 6 cm long, repeatedly dichotomously branched, ultimate segments capillary, terete. Traps numerous, 2 - 5 mm across, stalked, ovoid or obovoid, green, turning black with age; mouth lateral, oblique; appendages usually 2 or more in number. Racemes arising at intervals on the stolons, up to 18 cm long, nearly10 flowered; scales absent; bracts basifixed, ovate. Flowers up to 1.2 cm long; pedicels to 1.5 cm long. Calyx - lobes subequal, up to 3 mm long, ovate, reflexing in fruit. Corolla bright yellow; upper lip erect, suborbicular, obtuse at apex; lower lip obovate, hairy in throat; spur fairly equal to lower lip in length. Stamens 2; filaments curved. Ovary ovoid; stigma 2 - lipped. Capsule up to 5 mm across, globose with a long beak. Seeds prismatic, winged.

Flowering and Fruiting: August - December

Growth form: Plankton

Distribution: Indo - Malesia to Australia and east Asia

Habitat: Rivers, ponds, and paddy fields.

SJ 15055 (Kollengode)

Utricularia exoleta R. Br., Prodr. 430. 1810; Hook. f., Fl. Brit. India 4: 329. 1884; Gamble, Fl. Pres. Madras 980 (689). 1924; M.K. Janarth. & Henry, Bladderworts India 49. 1992; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 513. 2016. *Utricularia gibba* L. ssp. *exoleta* (R. Br.) Taylor, Mitt. Bot. Stats. Muchen 4: 101. 1961; Manilal & Sivar., Fl. Calicut 208. 1982.

Herbs; rhizoids rarely present; stolons up to 18 cm long, profusely

branched. Foliar organs simple or 1 - 3 times dichotomously divided from base. Traps up to 1.5 mm across, obliquely ovoid, replacing foliar segments or rarely on rhizoids; stalk evenly thickened; mouth lateral, oblique; appendages usually 2 or more. Racemes 4 - 10 cm long, erect, solitary or 1 - 3 flowered; flowers up to 6 mm long; pedicels 2 - 7 mm long terete, erect or suberect; calyx - lobes subequal, ovate – obovate; corolla yellow; upper lip orbicular to ovate up to 3 mm long; lower lip sub orbicular. Stamens about 1 mm long. Ovary globose; style small; stigma 2 - lipped. Capsules about 3 mm across, globose, bivalvate. Seeds lenticular, with a broad irregular wing.

Note: New report to Palakkad

Flowering and Fruiting: November - March

Growth form: Plankton

Distribution: Paleotropics.

Habitat: Rivers.

SJ 11874 (Varani river)

Utricularia graminifolia Vahl, Enum. Pl. 1: 195. 1804; Gamble, Fl. Pres. Madras 981 (690). 1924; Manilal, Fl. Silent Valley 199. 1988; Vajr., Fl. Palghat Dist. 330. 1990; Joseph, Aquatic Angiosp. Malabar 87. 1991; M.K. Janarth. & Henry, Bladderworts India 57. 1992; Cook, Aquat. Wetland Pl. India 239. 1996; Sasidh., Fl. Parambikulam WLS 220. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 514. 2016. *Utricularia caerulea* sensu Clarke in Hook.f., Fl. Brit. India 4: 331. 1884, non L. 1753.

Herbs with small rhizoids of 2.5 mm length. Stolons up to 10 cm long, branched. Foliar organs at the base of the scape and on stolons, up to 8 x 2 mm, strap - shaped. Traps 1 - 3 mm across, subglobose, slightly compressed, mouth basal; appendages 2, subulate simple, glandular. Racemes up to 15 cm long, erect, rarely branched, up to 9 flowered. Flowers up to 10 mm long; pedicels up to 8 mm long, erect, slightly winged; calyx - lobes ovate to lanceolate; upper lobes acuminate; lower one dentate at apex. Corolla blue to violet or pink; upper lip linear -

oblong, longitudinally streaked, obtuse at apex; lower lip, obovate, obscurely 3 - lobed, rounded at apex; spur up to 6 mm long, curved, conical, acute at apex. Stamens up to 2 mm long; filaments strap - shaped. Ovary ovoid; style short; stigma 2 - lipped. Capsules up to 4 mm long, ovoid, thickened along dehiscent margin. Seeds subglobose.

Flowering and Fruiting: November - March

Growth form: Helophyte/ Tenagophyte

Distribution: India and Sri Lanka

Habitat: Wet rocks

SJ 16921 (Malampuzha)

Utricularia lazulina Taylor, Proc. Indian Acad. Sci. (Plant Sci.) 93: 101. 1984; M.K. Janarth. & Henry, Bladderworts India 67. 1992; Cook, Aquat. Wetland Pl. India 240. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 516. 2016. (Fig. 20 a)

Herbs; rhizoids up to 0.3 mm thick and 15 mm long, stolons up to 2 cm long, sparsely branched. Foliar organs up to 10 mm long, obovate to oblanceolate, distributed on stolons and at base of peduncle. Traps 0.7 - 2 mm across, subglobose; mouth basal; appendages 2, glandular. Racemes up to 10 cm long; peduncle angular, winged. Flowers 7 - 11 mm long; pedicels 2 - 5 mm long, erect in flowers, spreading in fruit, narrowly winged. Calyx lobes slightly unequal; upper lobe ovate, acute to acuminate at apex; lower lobes linear - ovate, bidentate or acuminate. Corolla blue to violet, rarely pink; upper lip, oblong, constricted at middle, ciliate along lower margin, rounded at apex; lower lip yellow and hairy at throat. Spur up to 6 mm long. Stamens 1 - 1.5 mm long; filaments strap shaped. Ovary ovoid, compressed; style distinct, broad; stigma 2 - lipped. Capsules 2 - 3 x 1.5 - 2.5 mm, ovoid, wall uniformly membranous. Seeds obovoid.

Flowering and Fruiting: August - October

Growth form: Helophyte/ Tenagophyte

Distribution: Endemic to Western Ghats

Habitat: Wet rocks

SJ 16922 (Malampuzha)

Utricularia roseopurpurea Stapf ex Gamble, Fl. Pres. Madras 983 (691). 1924; M.K. Janarth. & Henry, Bladderworts India 95. 1992; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 11. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 524. 2016. *Utricularia rosea* sensu Clarke in Hook.f., Fl. Brit. India 4: 333. 1884, non Edgew. 1847.

Ephemeral herbs, rhizoids up to 2 cm long; stolons up to 2 cm long, branches opposed to foliar organs. Foliar organs up to 1.5 cm long and 3 mm broad, spathulate to obovate, rounded at apex, rosulate at scape base and on stolons. Traps 1 - 2 mm across, globose to ovoid; mouth terminal; lip extended to a beak - shaped structure and rim around mouth, glandular hairy along edges of beak and rim. Racemes up to 15 cm long, erect, up to 7 flowered. Flowers up to 10 mm long; pedicels 1 - 2 mm long, erect, terete, papillose, often recurved in fruit. Calyx - lobes unequal, upper broadly ovate, obtuse at apex; lower lobe obovate, obtuse at apex. Corolla pink; upper lip about 3 - 6 mm long, linear, constricted at middle; lower lip, suborbicular, gibbous at base, crested, rounded at apex; spur about 3.5 mm long, shorter than lower lip. Stamens about 1.5 mm long; filaments strap shaped, curved; Capsules globose, papillose. Seeds, obovoid, papillose.

Flowering and Fruiting: September - December

Growth form: Helophyte/ Tenagophyte

Distribution: Endemic to peninsular India

Habitat: Streams near wet rocks

SJ 11849 (Nelliampathy)

Utricularia striatula Smith, Res. Cyclop. 37: n.17. 1819; Gamble, Fl. Pres. Madras 983 (691). 1924; Vajr., Fl. Palghat Dist. 331. 1990; Joseph, Aquatic Angiosp. Malabar 94. 1991; M.K. Janarth. & Henry, Bladderworts India 106. 1992; Cook, Aquat. Wetland Pl. India 245. 1996; Sasidh., Fl. Parambikulam WLS 220. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 553. 2016. *Utricularia orbiculata* Wall. ex A.

DC. in DC., Prodr. 8: 18. 1844; Hook. f., Fl. Brit. India 4: 334. 1884. (Fig. 20 b)

Ephemeral herbs; rhizoids up to 2 cm long. Stolons up to 9 cm long, simple, seldom branched. Foliar organs in rosettes at the base of the scape and scattered on stolons, orbicular to obovate, with pseudo petiole. Traps up to 1.5 mm across, globose to obliquely ovoid; mouth lateral; appendages deeply glandular hairy. Racemes up to 5 cm long, erect, often zigzag, glabrous, up to 6 flowered; Calyx lobes unequal; upper lobe obovate to obcordate; lower lobe oblong to ovate. Corolla pink, lilac, violet, white to variously tinged, yellow - blotched near base; upper lip semiorbicular; lower lip up to 5 lobed; Stamens up to 1.2 mm long; filaments strap shaped. Capsules 2 - 3 mm long, obliquely ovoid. Seeds obovoid.

Flowering and Fruiting: September - January

Growth form: Helophyte/ Tenagophyte

Distribution: Paleotropics

Habitat: Wet rocks.

SJ 15054 (Nelliampathy)

Utricularia sunilii Naveen Kumar & KMP Kumar, Phytotaxa 371(2) 140, 2018.

Ephemeral herbs with rhizoids up to 4 cm long, branches capillary. Foliar organs produced on stolons, linear - lanceolate. Traps are found on stolons, foliar organs and rhizoids, globose to sub orbicular, 1.8 - 0.9 mm. Racemes up to 20 cm long, 2 - 6 flowered. Flowers up to 1.5 cm long. Calyx lobes unequal, upper lobe broadly ovate, acuminate at apex; lower lobes lanceolate, bi or tri dentate at apex. Corolla pink to violet; upper lip oblong – oblong lanceolate, constricted near middle and gibbous at base with blue striations; lower lip broadly ovate, deeply three lobed. Stamens 2, up to 2.1 mm long. Capsule elliptic to oblong with numerous seeds.

Flowering and Fruiting: September - January

Growth form: Helophyte/ Tenagophyte

Distribution: Endemic to Palakkad

Habitat: Wet rocks.

SJ 16939 (Nelliampathy)

LINDERNIACEAE Borsch, Kai Mull & Eb. Fisch

1a. Calyx keeled or winged ..... *Torenia*

1b. Calyx not keeled or winged ..... *Lindernia*

LINDERNIA All.

1a. Perfect stamens 4 2

1b. Perfect Stamens 2 6

2a. Capsule much longer than the calyx ..... *L. anagallis*

2b. Capsule equal to or shorter than the calyx 3

3a. Flowers in racemes at the tip of the branches ..... *L. viscosa*

3b. Flowers solitary or paired in the axil of leaves 4

4a. Sepals united to the middle or above ..... *L. crustacea*

4b. Sepals free almost to the base 5

5a. Leaves ovate – orbicular, pinnately nerved ..... *L. caespitosa*

5b. Leaves elliptic, 3 - 5 nerved from the base..... *L. procumbens*

6a. Leaf blades pinnately nerved 7

6b. Leaf blades palmately nerved 8

7a. Calyx united to tip, leaf dentate ..... *L. ciliata*

7b. Calyx divided to the base, leaf serrate ..... *L. antipoda*

8a. Capsule equal or shorter than sepals ..... *L. rotundifolia*

8b. Capsule longer than the sepals ..... *L. hyssopoides*

Lindernia anagallis (Burm. f.) Pennell, J. Arnold Arbor. 24. 252. 1943; Manilal, Fl. Silent Valley 195. 1988; Vajr., Fl. Palghat Dist. 324. 1990; Joseph, Aquatic Angiosp. Malabar 223. 1991; Cook, Aquat. Wetland Pl. India 351. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 866. 2016. *Ruellia anagallis* Burm. f., Fl. Ind. 135. 1768. *Vandellia pedunculata* Benth., Scroph. Ind. 37.1835; Hook. f., Fl. Brit. India 4: 282. 1885; Gamble, Fl. Pres. Madras 959 (673). 1923.

Vandellia angustifolia Benth., Scroph. Ind. 37. 1835; Hook. f., Fl. Brit. India 4: 282. 1884.

Annual herbs, rooting at nodes, 10 - 50 cm long. Stem quadrangular, glabrous. Leaves, ovate to elliptic, base truncate, margin crenate - serrate, apex subacute, glabrous, sessile, 2 x 1 cm. Flowers white or pink, axillary, solitary; pedicel 1 - 1.5 cm long; calyx deeply 5 - lobed almost to the base, lobes linear – lanceolate; corolla tube 6 - 8 mm long; limb 2 - lipped, upper lip entire, lower lip 3 - lobed. Stamens 4, fertile. Capsule to 1.3 cm long, linear, glabrous, much exceeding the persistent calyx. Seeds small, ellipsoid.

Flowering and Fruiting: July - December

Growth form: Helophyte/ Tenagophyte

Distribution: Indo - Malesia

Habitat: Riverbanks and paddy fields.

SJ 11823 (Kalpathy)

Lindernia antipoda (L.) Alston in Trimen, Fl. Ceylon 6: 214. 1931; Vajr., Fl. Palghat Dist. 324. 1990; Joseph, Aquatic Angiosp. Malabar 224. 1991; Cook, Aquat. Wetland Pl. India 352. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 868. 2016. *Bonnaya veronicifolia* (Retz.) Urban, Berl. Deutsch. Bot. Ges. 2: 436. 1884; Hook. f., Fl. Brit. India 4: 285. 1884. (Fig. 20 c)

Annual herbs, stem prostrate, 5 - 30 cm long, rooting at the nodes. Leaves simple, opposite, elliptic - obovate, subsessile, apex obtuse, base cuneate, margin serrate; 2.5 x 1 cm. Flowers solitary, pedicelled, axillary or in terminal racemes; bracts leafy; pedicel 0.4 - 1 cm long. Calyx divided deeply into 5 lobes, lanceolate. Corolla bluish with a yellow mouth, 6 - 8 mm long. Stamens 2, fertile; staminodes 2, hooked. Capsule up to 1.5 cm long, linear - lanceolate; seeds yellow, ridged.

Flowering and Fruiting: August - February

Growth form: Helophyte/ Tenagophyte

Distribution: Tropical and subtropical Asia and Australia

Habitat: Riverbanks and paddy fields.

SJ 15088 (Attappadi)

Lindernia caespitosa (Blume) Panigrahi, Taxon 33: 320. 1984; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 870. 2016. *Lindernia pusilla* (Willd.) Boldingh, Zakfl. Java 165. 1916; Cook, Aquat. Wetland Pl. India 358. 1996; Vajr., Fl. Palghat Dist. 325. 1990; *Vandellia scabra* Benth., Scroph. Ind. 36. 1835; Hook. f., Fl. Brit. India 4: 281. 1884; Gamble, Fl. Pres. Madras 959 (673). 1923. (Fig. 20 d)

Prostrate annual herbs, rooting at nodes, 5 - 15 cm tall. Leaves opposite, 1 - 1.5 x 0.7 - 1 cm, ovate - suborbicular, acute, base rounded, crenate, subsessile. Flowers axillary 2 per node; pedicel 1 - 1.5 cm long, hispid. Calyx - lobes 5, divided to the base, up to 3 mm long, oblong - lanceolate, margin scarious. Corolla tube 4 - 5 mm long, tube white, yellow at mouth, upper lip pale brown or completely violet. Stamens 4, lower pair with knee like appendages. Capsule ovoid - subglobose, equaling or shorter than fruiting calyx; seeds small, cylindrical.

Flowering and Fruiting: August - February

Growth form: Helophyte/ Tenagophyte

Distribution: Africa and tropical Asia

Habitat: Riverbanks and marshy localities.

SJ 11869 (Thavalam)

Lindernia ciliata (Colsm.) Pennell, Brittonia 2: 182. 1936. Vajr., Fl. Palghat Dist. 324. 1990; Cook, Aquat. Wetland Pl. India 352. 1996; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 19. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 870. 2016. *Ilysanthes serrata* (Roxb.) Urban, Berl. Deutsch. Bot. Ges. 2: 436. 1884; Gamble, Fl. Pres. Madras 962 (675). 1923. *Bonnaya brachiata* Link & Otto, Ic. Pl. Select. 25, t.11. 1820; Hook. f., Fl. Brit. India 4: 284. 1884. (Fig. 20 e)

Annual herbs. Stem erect or ascending, branched, rooting at lower nodes, up to 20 cm tall. Leaves simple, opposite, Sessile, elliptic -

oblong, obtuse or acute, base rounded, aristate - dentate, 15 x 6 mm. Flowers in lax terminal racemes; pedicels 1 - 2 mm long. Calyx - lobes 5, linear, 5 mm long. Corolla pink or bluish - pink, 8 mm long, tube curved, 2 - lipped. Stamens and staminodes 2; anthers unequal; staminodes with divergent hooks. Capsule up to 15 mm long, linear, exceeding the fruiting calyx; seeds black.

Flowering and Fruiting: June - January

Growth form: Helophyte/ Tenagophyte

Distribution: Indo - Malesia

Habitat: Riverbanks and marshy localities.

SJ 15074 (Anakatty)

Lindernia crustacea (L.) F.v. Muell., Syst. Cens. Austral. Pl. 1: 97. 1882; Vajr., Fl. Palghat Dist. 324. 1990; Joseph, Aquatic Angiosp. Malabar 225. 1991; Cook, Aquat. Wetland Pl. India 353. 1996; Sasidh., Fl. Parambikulam WLS 216. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 873. 2016. *Vandellia crustacea* (L.) Benth., Scroph. Ind. 35. 1835; Hook. f., Fl. Brit. India 4: 274. 1884; Gamble, Fl. Pres. Madras 959 (673). 1923. (Fig. 20 f)

Annual herbs, prostrate and diffusely branched, rooting at nodes; up to 20 cm tall, stem quadrangular, slightly winged. Leaves opposite, ovate, 15 x 12 mm, apex subacute, base truncate, margin serrate; petiole 5 mm long in lower leaves and is becoming sessile towards apex. Flowers axillary, solitary or 2 - per node on terminal racemes; pedicel 10 - 12 mm long. Calyx 4 mm long, 5 lobed, lobes elliptic - lanceolate, ciliate on margins. Corolla rose to purple, tube 5 mm long. Stamens 4, didynamous. Capsule 3 x 5 mm, ovoid; seeds minute, numerous.

Flowering and Fruiting: August - January

Growth form: Helophyte/ Tenagophyte

Distribution: Africa, America and tropical and subtropical Asia

Habitat: Riverbanks and marshy localities.

SJ 15092 (Malampuzha)

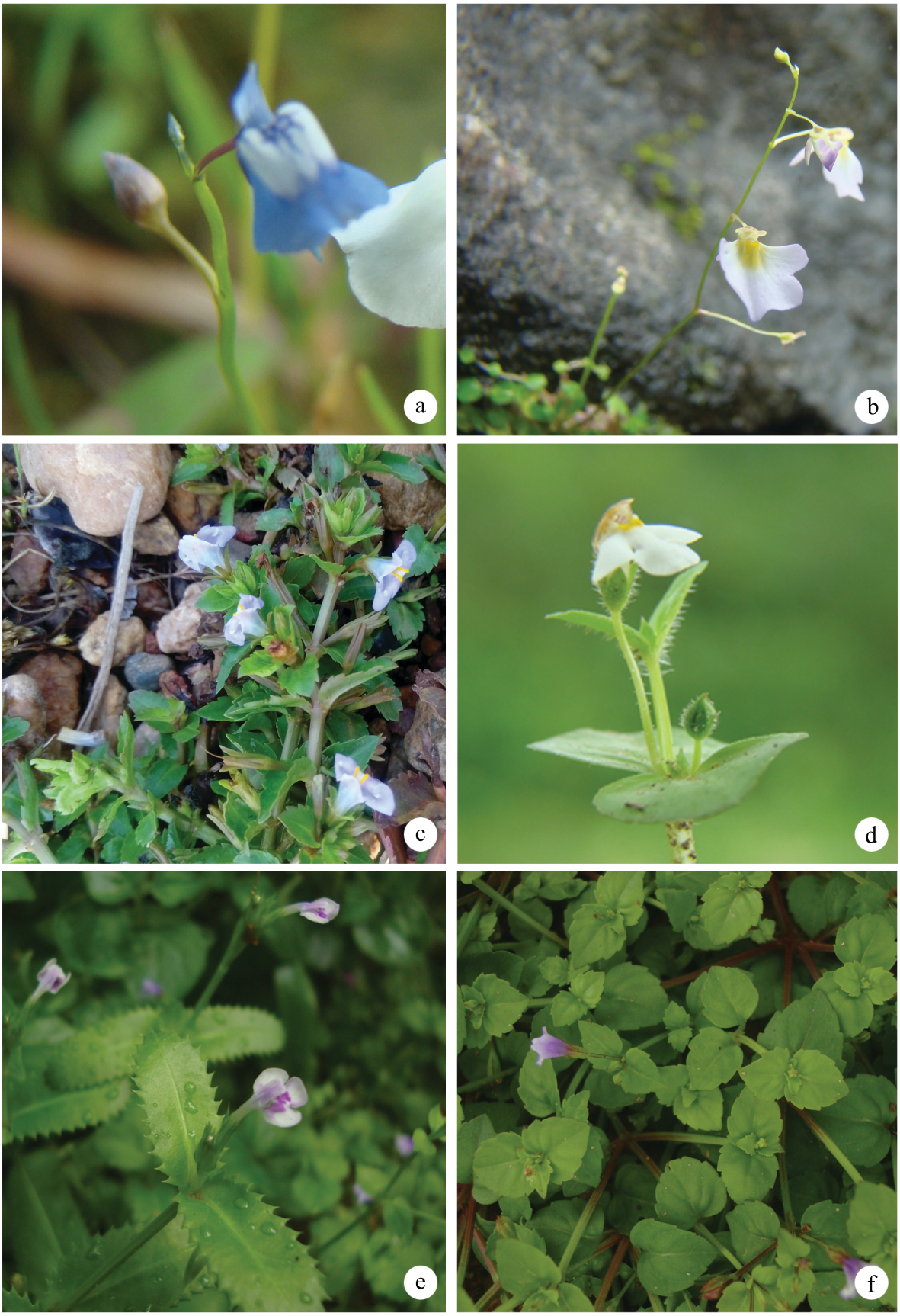


Fig. 20 a) *Utricularia lazulina* b) *Utricularia striatula* c) *Lindernia antipoda* d) *Lindernia caespitosa* e) *Lindernia ciliata* f) *Lindernia crustacea*

Lindernia hyssopoides (L.) Haines, Bot. Bihar and Orissa 635. 1922; Vajr., Fl. Palghat Dist. 325. 1990; Joseph, Aquatic Angiosp. Malabar 227. 1991; Cook, Aquat. Wetland Pl. India 354. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 875. 2016. *Ilysanthes hyssopioides* (L.) Benth. in DC., Prodr. 10: 419. 1846; Hook. f., Fl. Brit. India 4: 283. 1884; Gamble, Fl. Pres. Madras 961 (675). 1923. (Fig. 21 a)

Slender annual erect herbs; up to 35 cm tall, diffusely branched, quadrangular. Leaves sessile, linear - lanceolate, basal ones elliptic - ovate, base cuneate or truncate, apex acute, 20 x 4 mm, 3 - nerved from base, glabrous. Flowers axillary, solitary; bracts linear; pedicels 1 - 2 cm long, filiform, deflexed in fruit; calyx deeply 5 - lobed almost to the base, lobes linear - lanceolate, glabrous; corolla pale lilac or bluish, 6 - 10 mm long, upper lip 2 - lobed at apex, lower lip with dark blue blotches at base of lobes; stamens 2 inserted at the middle of corolla tube; staminodes 2 with hairy appendage. Capsule 4 - 5 mm long, ovoid - ellipsoid. Seeds, oblong, ridged.

Flowering and Fruiting: January - September

Growth form: Helophyte/ Tenagophyte

Distribution: South East Asia, Malesia and China

Habitat: Paddy fields and marshy localities

SJ 15059 (Nedumani)

Lindernia procumbens (Krock.) Philcox, Taxon 14: 30. 1965 & Kew Bull. 22: 29. 1968; Sunil & Sivadasan, Fl. Alappuzha Dist. 503. 2009; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 875. 2016. *Anagalloides procumbens* Krock., Fl. Siles. 2: 398, t. 26. 1790.

Annual herbs; stem erect, up to 15 cm tall. Leaves sessile, elliptic or elliptic to ovoid, margins entire, scabrid, 3 - 5 - nerved from base, obtuse, rounded at the apex 20 x 8 mm. Flowers solitary, axillary; pedicles to 1.2 cm long, slender. Calyx deeply 5 - lobed almost to the base, 2 - 3 mm long; lobes linear - lanceolate. Corolla 3 - 6 mm long,

white. Stamens 4, fertile. Capsule ellipsoid, equal to the calyx. Seeds oblong.

Flowering and Fruiting: January - August

Growth form: Helophyte/ Tenagophyte

Distribution: Indo – Malesia

Habitat: Riverbanks

SJ 11896 (Nellipuzha)

Lindernia rotundifolia (L.) Mukerjee, J. Indian Bot. Soc. 24: 132. 1945; Joseph, Aquatic Angiosp. Malabar 233. 1991; Cook, Aquat. Wetland Pl. India 358. 1996; Sasidh., Fl. Parambikulam WLS 216. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 880. 2016. *Ilysanthes rotundifolia* (L.) Benth. in DC., Prodr. 10: 420. 1846; Hook. f., Fl. Brit. India 4: 254. 1885; Gamble, Fl. Pres. Madras 962 (675). 1923. (Fig. 21 b)

Annual or perennial erect or decumbent herbs. Stems quadrangular, rooting at lower nodes, up to 20 cm tall. Leaves sessile, ovate to orbicular, base and apex rounded, crenate, basally 3 - nerved, 13 x 10 mm. Flowers axillary, solitary; pedicle up to 10 mm long, slender. Calyx deeply divided, lobes 5, lanceolate. Corolla 8 - 10 mm long, white with blue blotches at mouth and lobes; lobes orbicular. Stamens 2; staminodes 2, linear. Capsule ovoid – globose, equal to or slightly shorter than calyx. Seeds oblong.

Flowering and Fruiting: August - December

Growth form: Helophyte/ Tenagophyte

Distribution: Paleotropics

Habitat: Riverbanks and marshy areas

SJ 15091 (Malampuzha)

Lindernia viscosa (Hornem.) Merr., Sp. Blanc. 14. 1918; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 19. 1996; Cook, Aquat. Wetland Pl. India 360. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 882. 2016.*Vandellia hirsuta* Benth., Scroph. Ind. 36. 1835; Hook. f., Fl.

Brit. India 4: 280. 1885; Gamble, Fl. Pres. Madras 959 (673). 1923.

Annual herbs. Stems slender, erect or ascending, up to 15 cm tall, hirsute, branches spreading. Leaves sessile or subsessile, broadly ovate, acute, base rounded, margin crenate - serrate, hirsute on both surfaces. Inflorescence a terminal many flowered glandular pubescent raceme; pedicels 5 - 8 mm long; bracts minute, lanceolate. Calyx deeply 5 lobed almost to the base, glandular hispid; linear - lanceolate, up to 4 mm long. Corolla 2 lipped, 5 mm long, upper lip pale brown, lower lip white with yellow spots at mouth. Stamens 4; didynamous. Capsule, ovoid, glabrous. Seeds shortly cylindric.

Flowering and Fruiting: July - November

Growth form: Helophyte/ Tenagophyte

Distribution: Indo – Malesia and China

Habitat: Riverbanks and marshy areas

SJ 15085 (Mannarkkad)

TORENIA L.

1a. Corolla up to 2.5 cm long ..... *T. bicolor*

1b. Corolla not more than 1 cm ..... *T. lindernioides*

Torenia bicolor Dalz. in Hook.'s J. Bot. Kew Gard. Misc. 3: 38. 1851; Hook. f., Fl. Brit. India 4: 278. 1884; Gamble, Fl. Pres. Madras 957 (672). 1923; Saldanha, Bull. Bot. Surv. India 8: 129. 1966; Manilal, Fl. Silent Valley 198. 1988; Vajr., Fl. Palghat Dist. 327. 1990; Joseph, Aquatic Angiosp. Malabar 249. 1991; Sasidh., Fl. Parambikulam WLS 218. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 888. 2016.

Annual herbs, erect or decumbent; stem quadrangular. Leaves, triangular - ovate, base truncate or subcordate, apex acute, sparsely pubescent, margin serrate, 3.5 x 2.5 cm; petiole up to 1.5 cm long, sparsely hirsute. Flowers axillary, solitary or in pairs; pedicels 2 - 3 cm long. Calyx 1.0 - 1.5 cm long, keeled. Corolla deep purple or tube yellowish and lobes deep purple, up to 2.5 cm long. Stamens 4,

didynamous. Capsule, oblong, 1 - 1.5 cm long. Seeds many subglobose.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte

Distribution: Endemic to Western Ghats

Habitat: Marshy areas.

SJ 16955 (Aruvanpara)

Torenia lindernioides Saldanha, Bull. Bot. Surv. India 8:129.1966; Joseph, Aquatic Angiosp. Malabar 250. 1991; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 890. 2016.

Annual branched herbs, erect, up to 10 cm tall. Leaves opposite, broadly ovate, 10 x 15 mm, acute, rounded at base, serrate; petiole 4 - 6 mm long. Flowers solitary in the axils of upper leaves or in terminal racemes; pedicels up to 1 cm long, slender. Calyx, campanulate, narrowly winged, 5 - lobed at apex, up to 6 mm long; corolla 8 mm long, violet. Stamens 4, didynamous. Capsule ellipsoid, glabrous, up to 5 mm long; seeds minute, ovoid.

Flowering and Fruiting: September to March

Growth form: Helophyte

Distribution: Endemic to southern Western Ghats.

Habitat: Marshy areas and riverbanks.

SJ 15093 (Malampuzha)

LYTHRACEAE Jaume St. - Hil.

1a. Plants floating on the water surface ..... *Trapa*

1b. Plants not floating on the water surface 2

2a. Flowers solitary in leaf axils or in spikes.....*Rotala*

2b. Flowers in axillary cymes..... *Ammania*

AMMANIA L.

Ammannia baccifera L., Sp. Pl. (ed.2) 175. 1762; Hook. f., Fl. Brit. India 2: 569. 1879; Gamble, Fl. Pres. Madras 510 (360). 1919; Vajr.,

Fl. Palghat Dist. 204. 1990; Joseph, Aquatic Angiosp. Malabar 101. 1991; Cook, Aquat. Wetland Pl. India 249. 1996; Sasidh., Fl. Parambikulam WLS 131. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 539. 2016. (Fig. 21 c)

Annual herbs. Stem quadrangular, up to 40 cm tall, usually much branched. Leaves decussate, sessile, linear - lanceolate or oblong, acute, gradually narrowing to base, up to 3.5 cm long and 0.7 cm wide, becoming smaller towards the apex of the stem. Cymes dichasial, axillary, few flowered, sessile, or nearly so. Calyx tube broadly campanulate, 1 – 2.5 mm long, 1 - 2 mm in diameter, with 8 longitudinal ribs. Sepals 4; sepal appendages absent. Petals absent. Stamens 4 included; filaments red. Capsules globose, mature ones purple, exceeding the hypanthium. Seeds many, bright red.

Flowering and Fruiting: August - December

Growth form: Helophyte/ Tenagophyte

Distribution: Tropical Africa, Asia, Europe and Australia.

Habitat: Riverbanks and paddy fields.

SJ 15097 (Chittur)

ROTALA L.

1a. Appendages present between the sepals 2
1b. Appendages absent between the sepals ..... *R. indica*
2a. Petals 3..... *R. malampuzhensis*
2b. Petals 5 ..... *R. mexicana*

Rotala indica (Willd.) Koehne in Engl., Bot. Jahrb. Syst. 1: 172. 1880; Gamble, Fl. Pres. Madras 508 (359). 1919; Vajr., Fl. Palghat Dist. 206. 1990; Joseph, Aquatic Angiosp. Malabar 112. 1991; Swarup. *et al.,* Shola For. Kerala 58. 1998; Cook, Aquat. Wetland Pl. India 257. 1996; Sasidh., Fl. Parambikulam WLS 131. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 555. 2016. *Ammannia peploides* Spreng., Syst. Veg. 1: 444. 1825; Hook. f., Fl. Brit. India 2: 566. 1879. (Fig. 21 b)

Annual herbs. Stems erect or decumbent, terete or 4 - angled, up to 30 cm long. Leaves opposite, decussate, sessile, spathulate – oblong or suborbicular, obtuse or acute, margins cartilaginous, cuneate or obtuse at base, up to 20 x 10 mm. Bracts dimorphic, leaf like on major branches, much smaller and elliptic - oblong on flowering branches. Bracteoles 2, up to 2 mm long, linear - lanceolate, almost as long as the hypanthium. Flowers sessile, either solitary in leaf axils or in spike - like lateral branches. Hypanthium campanulate, 1.5 – 3 mm long, angled on the nerves, pink or red. Sepals 4, triangular, acute or acuminate, 0.5 - 1.5 mm long; appendages absent. Petals 4, linear - elliptic, smaller than calyx lobes, pink sometimes rudimentary. Stamens 4, inserted at the middle of calyx tube; anthers almost on level with the hypanthium. Ovary ellipsoid, style 1mm long, stigma capitate. Capsules ellipsoid, 2 - valved. Seeds hemispherical.

Flowering and Fruiting: July – December

Growth form: Tenagophyte / Hyperhydate

Distribution: Tropical Asia; naturalized in Europe, Africa and America

Habitat: Waterlogged areas and streams

SJ 15075 (Karimba)

Rotala malampuzhensis R.V. Nair ex Cook, Boissiera 29: 98. 1979; Manilal & Sivar., Fl. Calicut 114. 1982; Vajr., Fl. Palghat Dist. 207. 1990; Joseph, Aquatic Angiosp. Malabar 116. 1991; Cook, Aquat. Wetland Pl. India 258,1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 561. 2016. (Fig. 21 c)

Annual creeping herbs, up to 30 cm long. Leaves decussate, sessile; submerged leaves scale like to orbicular; upper leaves linear - lanceolate, up to 1.5 cm long and 0.5 cm wide. Bracts like upper leaves. Bracteoles capillary, almost equal to the hypanthium. Flowers axillary, sessile, solitary, crimson. Hypanthium campanulate, red. Sepals 3, ovate, acute. Appendages 3, minute. Petals 3, elliptic, acute, small, bright red. Stamens 3, inserted above the base of the

hypanthium; anthers projecting above the hypanthium, but not above the sepals. Nectar scales 3, linear. Ovary globose; stigma capitate. Capsules globose, bright red, exceeding the hypanthium, 3 - valved. Seeds semi - ovoid, smooth, bright red.

Flowering and Fruiting: July to September

Growth form: Tenagophyte

Distribution: Endemic to southern Western Ghats

Habitat: Stagnant sedimented pools found in rivers and riverbanks

SJ 11822 (Malampuzha)

Rotala mexicana Schltdl. & Cham. Linnaea 5: 67. 1830. *Rotala rosea* (Poir.) Cook, Boissiera 29: 86. 1979; Joseph, Aquatic Angiosp. Malabar 122. 1991; Vajr., Fl. Palghat Dist. 207. 1990; *Ammannia rosea* Poir. in Lam., Suppl. Encycl. 329. 1810. Cook, Aquat. Wetland Pl. India 260. 1996; Ansari *et al.*, Aquat. Wetland Fl. Kerala. Fl. Pl. 567. 2016. *Rotala leptopetala* (Blume) Koehne in Engl., Bot. Jahrb. Syst. 1: 162. 1880; Gamble, Fl. Pres. Madras 508(358). 1919. *Ammannia pentandra* Roxb., Fl. Ind. 1: 427. 1820; Hook. f., Fl. Brit. India 2: 568. 1879.

Marshy annual herbs. Stems erect or creeping at base, up to 25 cm tall. Leaves opposite, decussate, linear - lanceolate, obtuse or acute, cuneate or obtuse at base, up to 2.5 cm long and 0.6 cm wide. Bracts leaf - like, exceeding the flowers. Bracteoles shorter than the hypanthium. Flowers axillary, solitary, sessile. Hypanthium campanulate. Sepals 5, shallowly triangular; appendages subulate, as long as the sepals. Petals 5, obovate, dentate at apex, pink. Stamens 5, inserted just below the middle of hypanthium; anthers included within the hypanthium. Ovary globose; stigma capitate. Capsules globose, exceeding the hypanthium, 3 - valved. Seeds ovoid, brownish, smooth.

Flowering and Fruiting: August - February

Growth form: Tenagophyte/ Hyperhydate

Distribution: Indo - Malesia and east Asia

Habitat: Along streams, paddy fields and marshy areas.

SJ 16964 (Pattanchery)

TRAPA L.

Trapa natans L., Sp. Pl. 120. 1753; Vajr., Fl. Palghat Dist. 209. 1990; Joseph, Aquatic Angiosp. Malabar 255. 1991; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 895. 2016. *Trapa natans* L. var. *bispinosa* (Roxb.) Makino, Iinuma Somoku - Dzusezii (ed.3) 1: 137. 1907; Cook, Aquat. Wetland Pl. India 363. 1996; *Trapa bispinosa* Roxb., Pl. Corom. t. 234. 1815; Hook. f., Fl. Brit. India 2: 590. 1879; Gamble, Fl. Pres. Madras 518 (366). 1919. (Fig. 21 f)

Annual or perennial aquatic herbs. Stems elongate, rooted at the bottom. Leaves dimorphic; submerged leaves sessile, linear; floating leaves 1 - 3 x 1.5 - 4 cm, dentate, in terminal rosettes; petiole up to 10 cm long, dilated near the leaf base. Flowers bisexual and solitary. Sepals up to 5 mm long, ovate. Petals white, 8 mm long. Fruit a large, woody, spinose nut, mostly with two large and two small spines.
Flowering and Fruiting: September - May
Growth form: Ephydate
Distribution: Cosmopolitan
Habitat: Rivers

SJ 16962 (Chittur)

MARANTACEACE Petersen

INDIANTHUS Suksathan & Borchs.

Indianthus virgatus (Roxb.) Suksathan & Borchs., Bot. J. Linn. Soc. 159: 393. 2009. *Schumannianthus virgatus* (Roxb.) Rolfe, J. Bot. 14: 244. 1907; Gamble, Fl. Pres. Madras 1494 (1043). 1928; Manilal, Fl. Silent Valley 315. 1988; Vajr., Fl. Palghat Dist. 502. 1990; Sasidh., Fl. Parambikulam WLS 347. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 572. 2016. *Clinogyne virgata* (Roxb.) Benth. in Benth. &



Fig. 21 a) *Lindernia hyssopoides* b) *Lindernia rotundifolia* c) *Ammannia baccifera* d) *Rotala indica* e) *Rotala malampuzhensis* f) *Trapa natans*

Hook. f., Gen. Pl. 3: 651. 1883; Hook. f., Fl. Brit. India 6: 258. 1892. (Fig. 22 a)

Erect shade tolerant shrubs; up to 4 m high. Stems terete, branching dichotomously, thickened at nodes. Leaves alternate, ovate to oblong, acuminate and cuspidate, rounded at base, up to 40 x 18 cm; petiole 1 - 3 cm long; sheath up to 20 cm long. Panicle terminal, up to 40 cm long, dichotomously branched, lax flowered; branches slender. Bracts narrowly oblong - lanceolate, up to 4 cm long and 0.5 cm wide. Flowers paired in each bract, white. Sepals 3, ovate - lanceolate. Corolla tube 1 - 1.5 cm long; lobes oblong. Staminal tube elongate; fertile stamen 1; anther with a petaloid appendage; outer staminodes petaloid, white, up to 1.5 cm long; inner staminodes smaller. Ovary villous, 3 - celled; ovules solitary in each cell. Berry ovoid.

Flowering and Fruiting: July - March

Growth form: Helophytes

Distribution: South India and Sri Lanka

Habitat: Marshy areas in forests.

SJ 16956 (Aruvanpara)

MELASTOMATACEAE Juss.

1a. Flowers 3 - merous..... *Sonerila*

1b. Flowers 4 or 5 merous ..... *Melastoma*

MELASTOMA L.

Melastoma malabathricum L., Sp. Pl. 390. 1753; Hook. f., Fl. Brit. India 2: 523. 1879; Gamble, Fl. Pres. Madras 495 (350). 1919; Manilal & Sivar., Fl. Calicut 110. 1982; Sivar. & Mathew, Fl. Nilambur 269. 1997; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 573. 2016. (Fig. 22 b)

Branched shrubs, up to 1.5 m tall. Stems covered with adpressed pectinate hairs. Leaves elliptic - oblong or lanceolate, acute at apex, attenuate at base, 4 - 10 x 1.2 - 4 cm, 5 - ribbed, scabrous above,

tomentose below; petioles up to 1.5 cm long. Inflorescence of terminal condensed panicles. Flowers large, showy, purple up to 5 cm across. Bracts boat shaped, pubescent. Hypanthium campanulate. Petals 5, obovate, up to 2 cm long and 1 cm wide. Stamens 10; alternating ones large and small; anthers dimorphic. Ovary ovoid, 5 locular. Capsules irregularly dehiscent. Seeds many, minute.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte

Distribution: South east Asia

Habitat: Wet grass lands and riverbanks

SJ 16957 (Aruvanpara)

SONERILA Roxb.

Sonerila rotundifolia Bedd., Madras J. Lit. Sci. ser. 3, 1: 74. 1861 & Ic. t. 169. 1868 - 1874; Hook. f., Fl. Brit. India 2: 538. 1879; Gamble, Fl. Pres. Madras 500 (353). 1919; Manilal, Fl. Silent Valley 112. 1988; Vajr., Fl. Palghat Dist. 204. 1990; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 24. 1996; Sasidh., Fl. Parambikulam WLS 130. 2002. (Fig. 22 c)

A small acaulescent herb. Leaves fleshy simple, radical and cordate, 9 ribbed, pilose among the ribs; petiole up to 10 cm long. Inflorescence a long peduncled cyme, 6 - 10 flowered, up to 15 cm long. Flowers confined to the apex of scape. Pedicel 1 cm long, pink. Sepals 1.5 - 3 mm, triangular. Petals up to 12 mm long and 9 mm wide, obovate, pink. Anthers 6 mm long, acuminate, deeply cleft at base, filaments around 6 mm long. Style purple, around 1 cm long. Stigma minutely capitate.

Flowering and Fruiting: July - October

Growth form: Helophyte

Distribution: Endemic to southern Western Ghats

Habitat: Wet rocks in forest areas

SJ 11826 (Nelliyampathi)

MENYANTHACEAE Dum.

NYMPHOIDES Seguier

1a. Corolla densely hairy; flowers distylous..... *N. indica*
1b. Corolla not densely hairy; flowers homostylous... *N. hydrophylla*

Nymphoides hydrophylla (Lour.) O. Ktze., Rev. Gen. Pl. 2: 429. 1891; Vajr., Fl. Palghat Dist. 297. 1990; Joseph, Aquatic Angiosp. Malabar 133. 1991; *Menyanthes hydrophylla* Lour., Fl. Cochinch. 129. 1790. Cook, Aquat. Wetland Pl. India 264. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 579. 2016. *Nymphoides cristata* (Roxb.) O. Ktze, Rev. Gen. Pl. 1: 429. 1891; Manilal & Sivar., Fl. Calicut 175. 1982. *Limnanthemum cristatum* (Roxb.) Griseb., Gen. Sp. Gent. 342. 1839; Hook. f., Fl. Brit. India 4: 131. 1883; Gamble, Fl. Pres. Madras 883 (620). 1923. (Fig. 22 d)

Annual or perennial herbs. Rhizomes short. Primary shoots many. Secondary fertile branches sympodial with several nodes producing single leaves and flower clusters. Leaves monomorphic, floating, ovate - orbicular, rounded at apex, entire, deeply cordate at base with narrow sinus, 6 - 12 cm across, green with purplish blotches above; nerves obscure above, prominent on lower surface; petioles up to 2.5 cm long. Flowers bisexual and female, white, in umbellate clusters of 10 - 20, from the nodes; pedicels 3 - 6 cm long. Bracts ovate, 2 mm long. Calyx lobes 5, linear to lanceolate, acute, 4 mm long; corolla tube with yellow throat; lobes 5, oblong, obtuse or retuse, with membranous undulate margins and a median longitudinal crest within, up to 10 x 4mm, white. Stamens 5, reduced to staminodes in female flowers; anthers and filaments yellow. Ovary with 5 minute disc glands at the base; Stigma 2 lobed. Capsules oblong. Seeds 4 - 6 in each capsule, discoid; surface rough.

Flowering and Fruiting: Throughout the year

Growth form: Ephydate

Distribution: Indo - Malesia and south China

Habitat: Ponds and stagnant waters in rivers

SJ 11808 (Kalpathy)

Nymphoides indica (L.) O.Ktze., Rev. Gen. Pl. 2: 429. 1891; Vajr., Fl. Palghat Dist. 297. 1990; Joseph, Aquatic Angiosp. Malabar 136. 1991; Cook, Aquat. Wetland Pl. India 265. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 581. 2016. *Menyanthes indica* L., Sp. Pl. 145. 1753. *Limnanthemum indicum* (L.) Griseb., emend Thw., Enum. Pl. Zeyl. 205. 1860; Hook. f., Fl. Brit. India 4: 131. 1883; Gamble, Fl. Pres. Madras 883 (621). 1923. (Fig. 22 e)

Annual or perennial herbs. Rhizome up to 5 cm thick, with scars and scale leaves. Primary shoots many. Secondary branches sympodial, trailing on water surface, with several nodes producing single leaf and flowers. Leaves monomorphic, floating, ovate - orbicular, rounded, entire and deeply cordate at base with narrow sinus, 25 cm across, thick and leathery; petioles up to 2.5 cm long. Flowers bisexual, distylous, in umbel - like clusters, 10 - 35 flowered; pedicels 5 - 12 cm long. Bracts oblong - lanceolate. Calyx deeply 5 - 6 partite; lobes ovate – lanceolate, acute. Corolla tube 2.5 mm long, with yellow or white throat; lobes 5, oblong - lanceolate, acute, up to 15 x 5 mm, densely covered with long, white hairs within. Stamens 5, dimorphic, longer than pistil in short - styled flowers and shorter than pistil in long - styled flowers. Disc glands 5, orbicular. Capsules ellipsoid. Seeds 18 - 25 per capsule, brown with scattered tubercles.

Flowering and Fruiting: Throughout the year

Growth form: Ephydate

Distribution: Paleotropics

Habitat: Ponds and stagnant waters in river

SJ 16916 (chittur)

MOLLUGINACEAE Hutch.

1a. Leaves all cauline; staminodes present ..... *Glinus*

1b. Leaves radical and cauline; staminodes absent ..... *Mollugo*

GLINUS L.

1a. Leaves and tepals stellate tomentose..... *G. lotoides*
1b. Leaves and tepals glabrous or pubescent..... *G. oppositifolius*

Glinus lotoides L., Sp. Pl. 463. 1753; Vajr., Fl. Palghat Dist. 220. 1990; Sasidh., Fl. Parambikulam WLS 140. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 591. 2016. *Mollugo lotoides* (L.) O. Ktze., Rev. Gen. Pl. 1: 214. 1891; Gamble, Fl. Pres. Madras 552 (390). 1919. *Mollugo hirta* Thunb., Prodr. Fl. Cap. 24. 1794; Hook. f., Fl. Brit. India 2: 662. 1879.

Annual procumbent herbs. Stem up to 50 cm long, densely, grey, tomentose. Leaves 3 - 5 in a cluster, obovate, suborbicular or spathulate, obtuse, entire, subacute - cuneate at base, 1 - 2.5 × 0.5 - 2 cm, stellate - tomentose; petioles up to 7 mm long. Stipules linear, acute. Flowers 5 – 5 in a node, 10 mm across. Tepals 5, oblanceolate, basally connivent, densely stellate, tomentose. Stamens 5, subequal; staminodes bifid or not. Ovary ovoid, 3 celled, ellipsoid, glabrous; styles 3. Capsules globose, membranous, enclosed in calyx. Seeds many, ovoid, black.

Flowering and Fruiting: February - May

Growth form: Helophyte

Distribution: Widespread in tropics and subtropics

Habitat: Riverbanks and shores of lakes and ponds

SJ 11877 (Walayar Dam)

Glinus oppositifolius (L.) A. DC., Bull. Herb. Boissier ser. 2, 1: 552. 1901; Vajr., Fl. Palghat Dist. 220. 1990; Sasidh. Fl. Parambikulam WLS 140. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 593. 2016. *Mollugo oppositifolia* L., Sp. Pl. 89. 1753; Gamble, Fl. Pres. Madras 552 (390). 1919. *Mollugo spergula* L., Syst. Nat. (ed. 10) 881. 1759; Hook. f., Fl. Brit. India 2: 662. 1879. (Fig. 22 f)

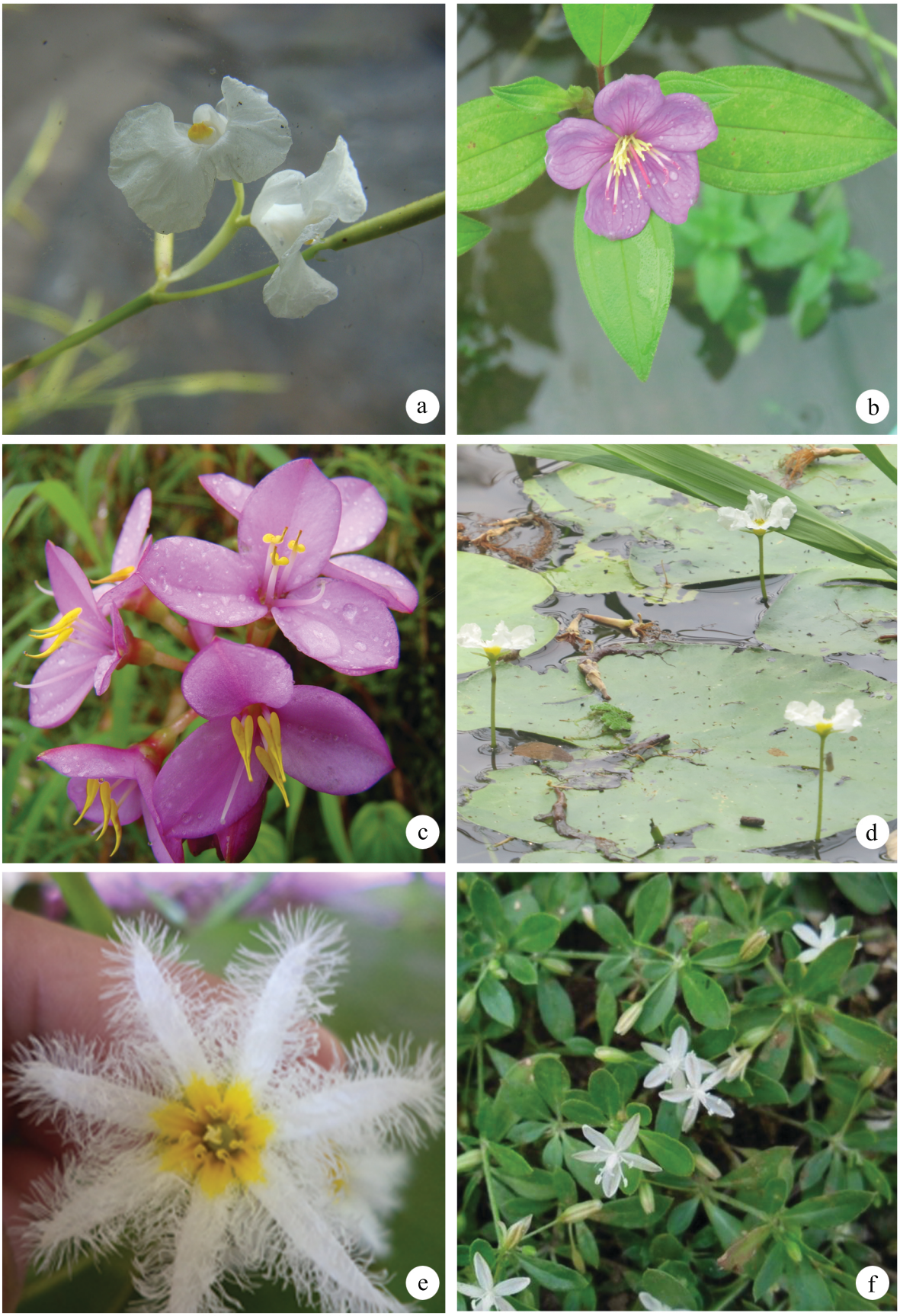


Fig. 22 a) *Indianthus virgatus* b) *Melastoma malabathricum* c) *Sonerila rotundifolia* d) *Nymphoides hydrophylla* e) *Nymphoides indica* f) *Glinus oppositifolius*

Prostrate herbs. Stem up to 30 cm long, glabrous. Leaves in whorls of 3 - 5, unequal, glabrous, subsessile, oblanceolate - spathulate, obtuse or acute at apex, attenuate at base, 7 - 25 x 3 - 8 mm. Flowers white in axillary fascicles. Tepals 5, oblong, obtuse or acute at apex, hyaline along margins, 5 - 6 x 2 - 3 mm, glabrous, spreading at anthesis, closing again in fruit. Stamens 5, alternating with linear, often bifid staminodes; anthers oblong. Ovary ellipsoid, styles 3, recurved; stigmas capitate. Capsules oblong or subglobose, 3 - valved. Seeds many, reniform, with a pair of filiform, unequal appendages at the hilum, dark reddish brown.

Flowering and Fruiting: February - April

Growth form: Helophyte

Distribution: Pantropical

Habitat: Lakeshores and streambanks

SJ 16965 (Pattanchery)

MOLLUGO L.

Mollugo pentaphylla L., Sp. Pl. 89. 1753; Gamble, Fl. Pres. Madras 553 (390). 1919; Vajr., Fl. Palghat Dist. 221. 1990; Sasidh., Fl. Parambikulam WLS 140. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 597. 2016. *Mollugo stricta* sensu Clarke in Hook. f., Fl. Brit. India 2: 663. 1879. (Fig. 23 a)

Annual herbs. Stems ascending, glabrous, up to 25 cm tall. Radical leaves obovate - spathulate; cauline leaves 2 - 6 in a whorl, oblong - lanceolate or elliptic, obtuse – subacute, entire, cuneate - attenuate at base, unequal, up to 3.5 cm long and 1.2 cm wide, glabrous; petioles up to 2 mm long. Inflorescence of axillary and terminal, dichasial cymes. Flowers white; pedicels filiform. Bracts about 1 mm long. Tepals 5, oblong - elliptic, obtuse, 2 - 3 mm long, green with white scarious margins. Stamens 3. Ovary ovoid, 3 or 5 – valved. Seeds many, reniform, reddish brown

Flowering and Fruiting: June – october

Growth form: Helophyte

Distribution: Pantropical

Habitat: Open areas and along banks of streams and ponds

SJ 15081 (Parali)

NELUMBONACEAE Dum.

NELUMBO Adans.

Nelumbo nucifera Gaertn., Fruct. 1: 73. t.19. f.2. 1788; Vajr., Fl. Palghat Dist. 53. 1990; Joseph, Aquatic Angiosp. Malabar 152. 1991; Cook, Aquat. Wetland Pl. India 272. 1996. Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 603. 2016. *Nymphaea nelumbo* L., Sp. Pl. 511. 1753. *Nelumbium speciosum* Willd., Sp. Pl. 2: 1258. 1779; Hook. f., Fl. Brit. India 1: 116. 1872; Gamble, Fl. Pres. Madras 34 (24). 1915.

Large perennial herbs with milky latex. Rhizomes creeping. Stems dimorphic; vegetative and storage rhizomes. Leaves flat and floating when young, cup - like and emerged when mature, orbicular, peltate, 30 - 100 cm in diameter, glabrous and glaucous on both surfaces, coriaceous, veins prominent, radiating; petioles up to 2 m long, with spines. Flowers emergent, up to 20 cm across, rose or white; pedicels usually exceeding the petiole, with scattered spines. Perianth segments many, free; outer 3 - 5 sepal like, ovate – elliptic, 2.5 – 4.5 x 1.2 - 3 cm, greenish white or pinkish green; inner ones petal - like, elliptic, obtuse, 4 - 10 x 2 - 5 cm. Stamens numerous; filaments 1 - 2 cm long; anthers about 1.2 cm long; connectives with fleshy terminal appendages. Receptacles obconical, spongy, 2 - 3.5 cm across on the broad upper surface. Carpels many, free, loosely embedded in pits on receptacle. Fruit a head of hard coated nutlets, ovoid.

Flowering and Fruiting: August - January

Growth form: Ephydate/ Hyperhydate

Distribution: South and east Asia to far eastern Russia and to Australia

Habitat: Ponds

SJ 15080 (Kodumba)

NYMPHAEACEAE Salisb.

NYMPHAEA L.

1a. Leaves pubescent beneath ..... *N. omrana*
1b. Leaves glabrous..... 2
2a. Anther appendage white..... *N. nouchali*
2b. Anther appendage blue or purple.....3
3a. Leaves with dark brown patches..... *N. caerulea*
3b. Leaves without any dark patches above..... *N. micrantha*

Nymphaea caerulea Savi., Dec. Egypt. 3: 74. 1793; R.L. Mitra in B. D. Sharma *et al.,* Fl. India 1: 434. 1993; Ansari & Jeeja, Waterlilies India 42. 2009; Sunil & Sivadasan, Fl. Alappuzha Dist. 88. 2009; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 609. 2016. (Fig. 23 c)

Attractive herb, rhizomes erect. Leaves suborbicular, retuse, margins entire or sinuate - dentate towards base, up to 25 cm across, pale green with dark brown patches above, glabrous, cleft almost near to petiole base; veins raised beneath; petioles brownish green. Flowers up to 15 cm across, dark sky blue, fragrant. Sepals oblong - lanceolate, obtusely cucullate at apex, entire, brownish green with purple streaks outside. Petals up to 20 in number, sky - blue, lanceolate - elliptic, obtusely cucullate, inner ones acute. Stamens below 100, reflexed at the base of filaments and the anthers become erect forming a wide ring around the stigma. In aged flowers the inner anthers incurved; filaments yellow; anthers blue. Carpels up to 18; stigmatic surface, flat, 2 cm across.

Flowering and Fruiting: Throughout the year

Growth form: Ephydate

Distribution: Native of north Africa, introduced to gardens.

Habitat: Ponds and home gardens.

SJ 15076 (Pathirippala)

Nymphaea micrantha Guill. & Perr., Fl. Seneg. Tent. 1: 16. 1830; Ansari & Jeeja, Waterlilies India 46. 2009. Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 612. 2016. (Fig. 23 b)

Rhizomatous herbs. Leaves sub peltate, ovate - orbicular, obtuse or retuse, entire or sinuate - dentate and undulate along margins, around 26 cm across, dark shiny green above, pale green or purplish green with dark brown spots and patches beneath, glabrous, raised above water when crowded, veins about 19, raised beneath; petioles purplish green, glabrous. Flowers up to 13 cm across, purple coloured, slightly fragrant. Sepals spreading, ovate, acute and cucullate at apex, entire, up to 5 cm long and 2.5 cm wide, green with brownish red streaks outside, pale purple inside with green prominent veins, glabrous. Petals 20 - 25, in three rows, purple with prominent central vein; outer ones elliptic, obtusely cucullate. Stamens above 100 in number, reflexed at the base of filament and anthers becoming erect forming a wide ring around the stigma or in aged flowers inner ones incurved; filaments of outer stamens up to 15 mm long and 6 mm wide, yellow. Inner stamens up to 4mm long and 2 mm wide, yellow; anthers up to 12 mm long, purple or inner ones yellow; sterile appendages up to 5 mm long. Carpels 1around 20; stigmatic surface 1.5 cm across, flattened with a conical central core, yellow; Seeds oblong - ellipsoid, brown.

Flowering and Fruiting: Throughout the year

Growth form: Ephydate

Distribution: Native of tropical Africa; introduced to gardens

Habitat: Ponds and home gardens

SJ 15057 (Palakkad)

Nymphaea nouchali Burm.f., Fl. Ind. 120. 1768; Vajr., Fl. Palghat Dist. 53. 1990; Joseph, Aquatic Angiosp. Malabar 155. 1991; Cook, Aquat. Wetland Pl. India 275. 1996; Ansari & Jeeja, Waterlilies India 53. 2009; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 614. 2016. *Nymphaea stellata* Willd., Sp. Pl. 2: 1153. 1799; Gamble, Fl. Pres.

Madras 33 (24). 1915. (Fig. 23 d)

Perennial rhizomatous aquatic herbs. Rhizomes often producing long runners. Leaves alternate, elliptic or orbicular, elliptic - sagittate when young, entire or irregularly sinuate at margin, rounded - acute at apex, up to 45 x 40 cm, reddish purple beneath; main nerves 7 - 15, palmate; midnerve grooved above. Petioles terete, 2 - 5 mm thick, glabrous. Flowers up to 15 cm across, slightly fragrant. Sepals lanceolate to oblong - lanceolate, obtuse, 7.5 cm long and 2.5 cm wide, green, streaked purple outside. Petals 8 - 15, elliptic - lanceolate, up to 6 cm long and 1.2 cm wide. Stamens 20 - 60, yellow; outer ones 2.5 cm long; the inner shorter; connective appendages up to 3 mm long; anthers 0.5 - 1.5 cm long. Ovary with numerous ovules on superficial placentae; stigmas 8 - 20, radiating, connate at base. Fruits globose, up to 3.5 cm. Seeds ellipsoid – globose.

Flowering and Fruiting: Throughout the year

Growth form: Ephydate

Distribution: Indo - Malesia and tropical Africa

Habitat: Ponds and rivers

SJ 16914 (Chittur)

Nymphaea omarana Hort. ex Gard., Tr. 8: 96. 1895; Ansari & Jeeja, Waterlilies India 35. 2009. Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 612. 2016. (Fig. 23 e)

Aquatic herbs, rhizomes not prominent. Leaves subpeltate, broadly ovate - orbicular, obtuse, sinuately dentate and undulate along margins, up to 35 cm long and 32 cm wide, dark reddish green on both surfaces. veins around 15, radiating from petiole base, raised beneath; petioles brownish green, pubescent. Flowers up to 18 cm in diameter, dark pink or red. fragrant. Receptacles brownish green, pubescent. Sepals oblong - lanceolate, acute, entire, 2.5 - 9.5 x 0.8 - 2.8 cm, pinkish green outside, dark pink inside. Petals 16 - 25, dark pink or red; up to 9.5 x 2.8 cm. Stamens less than 100, erect and

coherent to each other forming a tube around the stigma or in aged flowers the inner ones incurved; sterile appendages absent. Carpels 16 - 20; stigmatic surface up to 1.5 cm in diameter. Fruits with persistent floral whorls, 15mm long and 13 mm thick. Seeds ellipsoid, brown.

Flowering and Fruiting: Throughout the year

Growth form: Ephydate

Distribution: Native of south America and introduced to gardens

Habitat: Gardens and streams

SJ 11900 (Nelliampathy)

ONAGRACEAE Juss.

LUDWIGIA L.

1a. Petals creamy white ..... *L. adscendens*
1b. Petals Yellow.....2
2a. Stamens as many as sepals..... *L. perennis*
2b. Stamens twice as many as sepals.....3
3a. Capsule inflated above and narrow below..... *L. hyssopifolia*
3b. Capsule uniform from top to bottom.....4
4a. Capsule terete, 8 ribbed..... *L. octovalvis*
4b. Capsule 4 angled, 4 ribbed .....,,..... *L. peruviana*

Ludwigia adscendens (L.) Hara, J. Jap. Bot. 28: 290. 1953; Joseph, Aquatic Angiosp. Malabar 159. 1991; Cook, Aquat. Wetland Pl. India 276. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 619. 2016. *Jussiaea adscendens* L., Mant. Pl. 1: 69. 1767. *Jussiaea repens* L., Sp. Pl. 1: 388. 1753, non *Ludwigia repens* Forst. 1771; Hook. f., Fl. Brit. India 2: 587. 1879; Gamble, Fl. Pres. Madras 516 (365). 1919. (Fig. 23 f)

Aquatic or semi aquatic herbs; stems prostrate and ascending or if floating aerophores spongy, white coloured, fusiform. Leaves oblong - elliptical, base attenuate, apex obtuse, lower surface glossy.

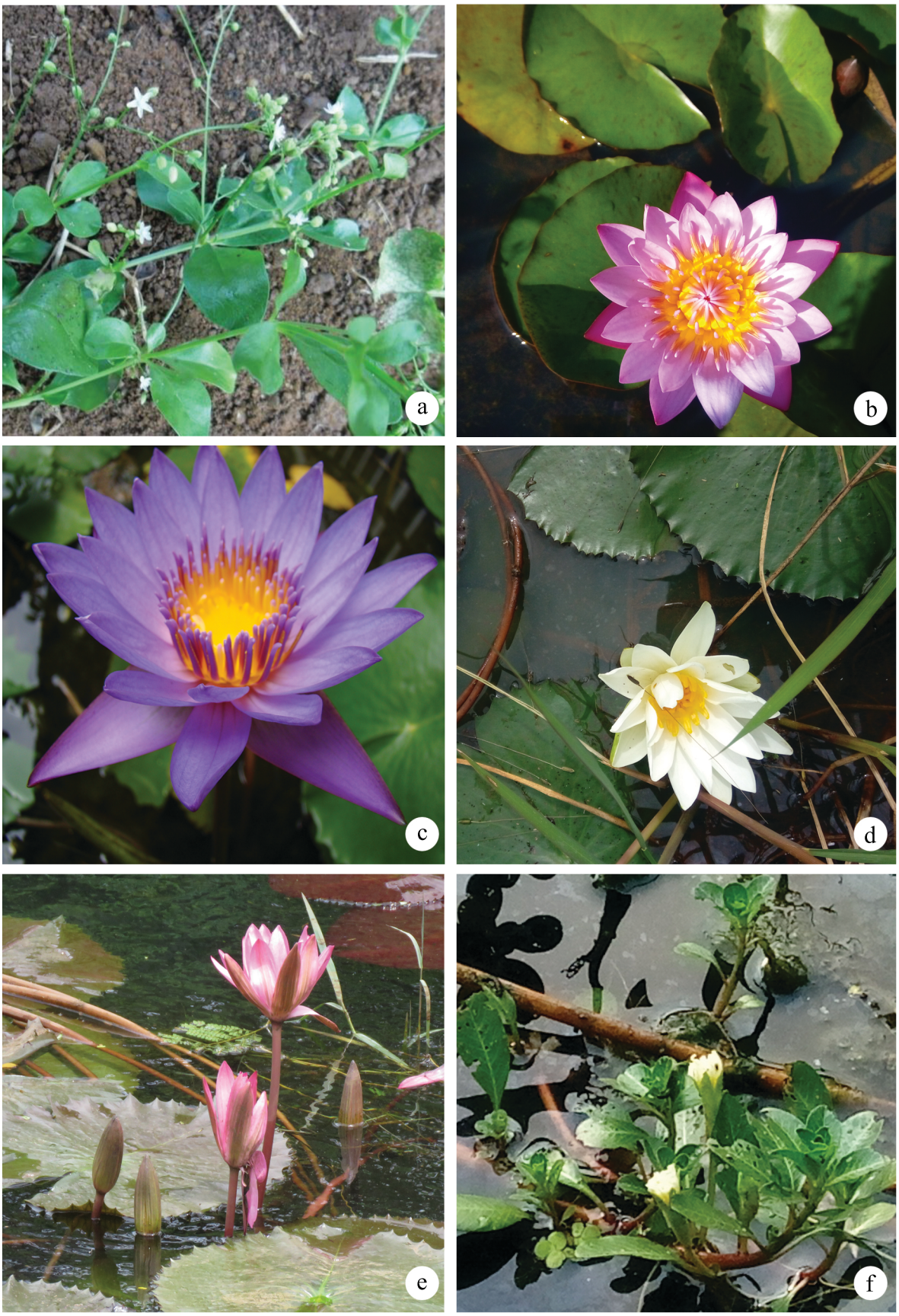


Fig. 23 a) *Mollugo pentaphylla* b) *Nymphaea micrantha* c) *Nymphaea caerulea* d) *Nymphaea nouchali* e) *Nymphaea omarana* f) *Ludwigia adscendens*

Flowers solitary in leaf axils, up to 3 cm across. Hypanthium up to 1 cm long, pubescent; lobes 5, narrow - lanceolate. Petals 5, obovate to broadly elliptic, emarginate, creamy white. Stamens 10; filaments subequal. Ovary 5 - locular; ovules many; style hairy at base; stigma globose. Capsule 2.5 - 3 cm long, terete, 10 - ribbed. Seeds uniseriate.

Flowering and Fruiting: Throughout the year

Growth form: Pleustophyte/ Hyperhydate

Distribution: Continental Asia, Malesia and Australia

Habitat: Ponds

SJ 16923 (Kalluttiyaal)

Ludwigia hyssopifolia (G. Don) Exell, Garcia de Orta 5: 471. 1957; Joseph, Aquatic Angiosp. Malabar 161. 1991; Vajr., Fl. Palghat Dist. 208. 1990; Sasidh., Fl. Parambikulam WLS 132. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 619. 2016. *Jussiaea linifolia* Vahl, Ecolg. Amer. 2: 32. 1798, non *Ludwigia linifolia* Poir., 1813; Gamble, Fl. Pres. Madras 1875 (1298). 1936. Cook, Aquat. Wetland Pl. India 277.1996. (Fig. 24 a)

Annual herbs or undershrubs. Stem erect and quadrangular, narrowly winged, often woody at base. Leaves simple, up to 3 x 7.5 cm, elliptic - lanceolate, apex gradually acute to acuminate, base cuneate, glabrous, membranous; petiole to 1 cm long. Flowers solitary, axillary. Hypanthium narrow; sepals 4, lanceolate, persistent. Petals 4, obovate, yellow. Stamens 8. Ovary quadrangular; ovules many; stigma 4 lobed. Capsule up to 2 cm long, linear, terete, 8 ribbed; seeds dimorphic, uniseriate below and pluriseriate above.

Flowering and Fruiting: August - December

Growth form: Helophyte / Tenagophyte

Distribution: Pantropical

Habitat: Ponds, paddy fields and riverbanks

SJ 15042 (Parambikkulam)

Ludwigia octovalvis (Jacq.) Raven, Kew Bull 15:476.1962; Manilal,

Fl. Silent Valley 114. 1988; Joseph, Aquatic Angiosp. Malabar 162. 1991; Cook, Aquat. Wetland Pl. India 277. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 622. 2016. *Ludwigia octovalvis* (Jacq.) Raven ssp. *sessiliflora* (Michx.) Raven, Kew Bull 15: 476. 1962; Vajr., Fl. Palghat Dist. 208. 1990. *Jussiaea suffruticosa* L., Sp. Pl. 388. 1753; Hook. f., Fl. Brit. India 2: 587. 1879; Gamble, Fl. Pres. Madras 516 (365). 1919, non *Ludwigia suffruticosa* Walt. 1788. (Fig. 24 b)

Robust well - branched undershrubs, woody at the base, up to 2.5 m tall, subglabrous, puberulent, or densely villous. Leaves simple, alternate, sub ovate - lanceolate, apex attenuate, base narrowly to broadly cuneate; petioles up to 10 mm long. Flowers solitary in leaf axils, up to 2 cm across. Sepals 4, ovate to lanceolate, 3 - 15 mm long. Petals yellow, broadly obovate, 3 - 17 mm long, emarginate; stamens 8. Disk at apex of ovary slightly elevated, with a depressed white - pubescent nectary around the base of each epipetalous stamen; stigma subglobose. Capsule thin walled, up to 4 cm long, terete, pale brown with 8 dark brown ribs. Seeds in several rows in each locule, free, obovoid, brown.

Flowering and Fruiting: May - November

Growth form: Helophyte

Distribution: Pantropical

Habitat: Marshy areas

SJ 15060 (Walayar)

Ludwigia perennis L., Sp. Pl. 119. 1753; Vajr., Fl. Palghat Dist. 208. 1990; Joseph, Aquatic Angiosp. Malabar 164. 1991; Cook, Aquat. Wetland Pl. India 278. 1996; Sasidh., Fl. Parambikulam WLS 132. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 624. 2016. *Ludwigia parviflora* Roxb., Fl. Ind. 1:440.1820; Hook. f., Fl. Brit. India 2:588.1879; Gamble, Fl. Pres. Madras 517 (365).1919. (Fig. 24 c)

Annual herbs, stems erect, up to 70 cm tall, terete, hollow, often woody at the base. Leaves simple, alternate, linear to narrowly elliptic, up to

11 cm long 2.5 cm wide, apex subacute, base narrowly cuneate; petioles 2 - 15 mm long. Flowers from the upper leaf axils; bracteoles reduced or up to 1 mm long. Sepals 4, up to 3.5 mm long, glabrous or puberulent. Petals yellow, elliptic, 1 - 3 mm in length. Stamens 8. Stigma globose. Capsule terete, up to 10 mm long with 4 longitudinal ribs. Seeds subglobose – ellipsoid, brown.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte

Distribution: Tropical Africa, Asia and Australia

Habitat: Marshy areas

SJ 16924 (Malampuzha)

Ludwigia peruviana (L.) H. Hara, J. Jap. Bot. 28: 293. 1953; Manilal, Fl. Silent Valley 114. 1988; Vajr., Fl. Palghat Dist. 208. 1990; Cook, Aquat. Wetland Pl. India 278. 1996; Sasidh., Fl. Parambikulam WLS 132. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 624. 2016. *Jussiaea speciosa* Ridley, J. Bot. 59. 1921; Gamble, Fl. Pres. Madras 1875 (1298). 1936. (Fig. 24 d)

Perennial herbs. Stem erect, up to 3m tall, terete, hollow; branchlets villous. Long inflated pneumatophores arising from submerged roots. Leaves elliptic – lanceolate, acute or acuminate, entire, cuneate at base, up to 10 x3 cm. Flowers solitary in leaf axils, up to 3.5 cm across, yellow. Pedicels quadrangular, villous. Sepals 4, lanceolate, acuminate, serrate and villous. Petals 4, suborbicular, yellow. Stamens 8, filaments up to 2.5 mm long. Ovary quadrangular, 4 loculed. Capsule quadrangular and villous with 4 prominent ribs. Seeds ellipsoid.

Flowering and Fruiting: February - April

Growth form: Helophyte

Distribution: America and the old world

Habitat: Marshy areas and riverbanks

SJ 16974 (Mukkali)

OROBANCHACEAE Vent.

1a. Corolla tube more than 2.5 cm long, leaves dissected..... *Rhamphicarpa*
1b. Corolla tube less than 2.5 cm long, leaves entire ..... *Centranthera*

CENTRANTHERA R. Br

Centranthera indica (L.) Gamble, Fl. Pres. Madras 971 (683). 1924; Manilal, Fl. Silent Valley 195. 1988; Joseph, Aquatic Angiosp. Malabar 214. 1991; Cook, Aquat. Wetland Pl. India 341. 1996; Sasidh. *et al.,* Bot. Stud. Med. Pl. Kerala 19. 1996; Sasidh., Fl. Parambikulam WLS 215. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 850. 2016. *Rhinanthus indica* L., Sp. Pl. 603. 1753.*Centranthera procumbens* Benth. in DC., Prodr. 10: 525. 1846; Hook. f., Fl. Brit. India 4: 301. 1884. (Fig. 24 f)

Diffuse herbs. Lower leaves opposite, upper ones alternate, 2 x 1 cm, sessile, elliptic, oblong or linear - oblong, base rounded, apex obtuse or acute, hairy on both sides. Flowers subsessile, axillary, solitary. Calyx up to 1 cm long, spathaceous, oblique, split on one side, faintly 3 - 5 - lobed at apex. Corolla rose or white coloured, tube long, incurved, lobes 5, spreading. Stamens 4, didynamous, included; filaments villous. Ovary globose; style simple. Capsule up to 7 mm long, ovoid, covered by persistent calyx lobes, dark brown. Seeds small, oblong.

Flowering and Fruiting: September - January

Growth form: Helophyte

Distribution: Indo - Malesia, China and Australia

Habitat: Marshy areas

SJ 11817 (Kollengode)

RHAMPHICARPA Benth.

Rhamphicarpa fistulosa (Hochst.) Benth. Prodr. 10: 504 1846.

Buchnera longiflora Arn., Nov. Acta Phys. Med. Acad. Caes. Leop. Carol. Nat. Cur. 18: 356. 1836. *Rhamphicarpa longiflora* (Arn.) Benth. in Hook.'s Bot. Mag. 1: 368. 1836; Hook. f., Fl. Brit. India 4: 300. 1884; Gamble, Fl. Pres. Madras 969(681). 1924; Vajr., Fl. Palghat Dist. 325. 1990. Cook, Aquat. Wetland Pl. India 362. 1996 ('Ramphicarpa' *orth. Mut.*); Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 885. 2016. (Fig. 24 e)

Erect, slender, ephemeral herbs to 25 cm tall; stem quadrangular. Leaves 1 - 6 cm long, pinnatisect; segments linear, terete, green to brown. Flowers white, axillary, solitary, 3 - 4 cm long, subsessile; Calyx - lobes 5. Corolla salvershaped, white; tube 3 - 3.5 cm long, lobes 5, obovate, obtuse or emarginate at apex. Stamens 4, didynamous. stigma bifid. Capsule 1 cm long, compressed, curved. Seeds oblong, reticulate.

Flowering and Fruiting: August - November

Growth form: Helophyte

Distribution: India

Habitat: Wet rocks

SJ 11818 (Malampuzha)

OXALIDACEAE R. Br.

OXALIS L.

Oxalis corniculata L., Sp. Pl. 435. 1753; Hook. f., Fl. Brit. India 1: 436. 1874; Gamble, Fl. Pres. Madras 132(94). 1915; Manilal, Fl. Silent Valley 38. 1988; Vajr., Fl. Palghat Dist. 98. 1990; Swarup. *et al.,* Shola For. Kerala 63. 1998; Sasidh., Fl. Parambikulam WLS 41. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 624. 2016. *Oxalis corniculata* L. var. *hispida* Blatt., Journ. Bombay Nat. Hist. Soc. 34: 898. 1931. (Fig. 25 a)

Annual prostrate herbs with creeping stem, rooting at lower nodes. Leaves digitately trifoliate; leaflets up to 1.5 x 2 cm, broadly obcordate,

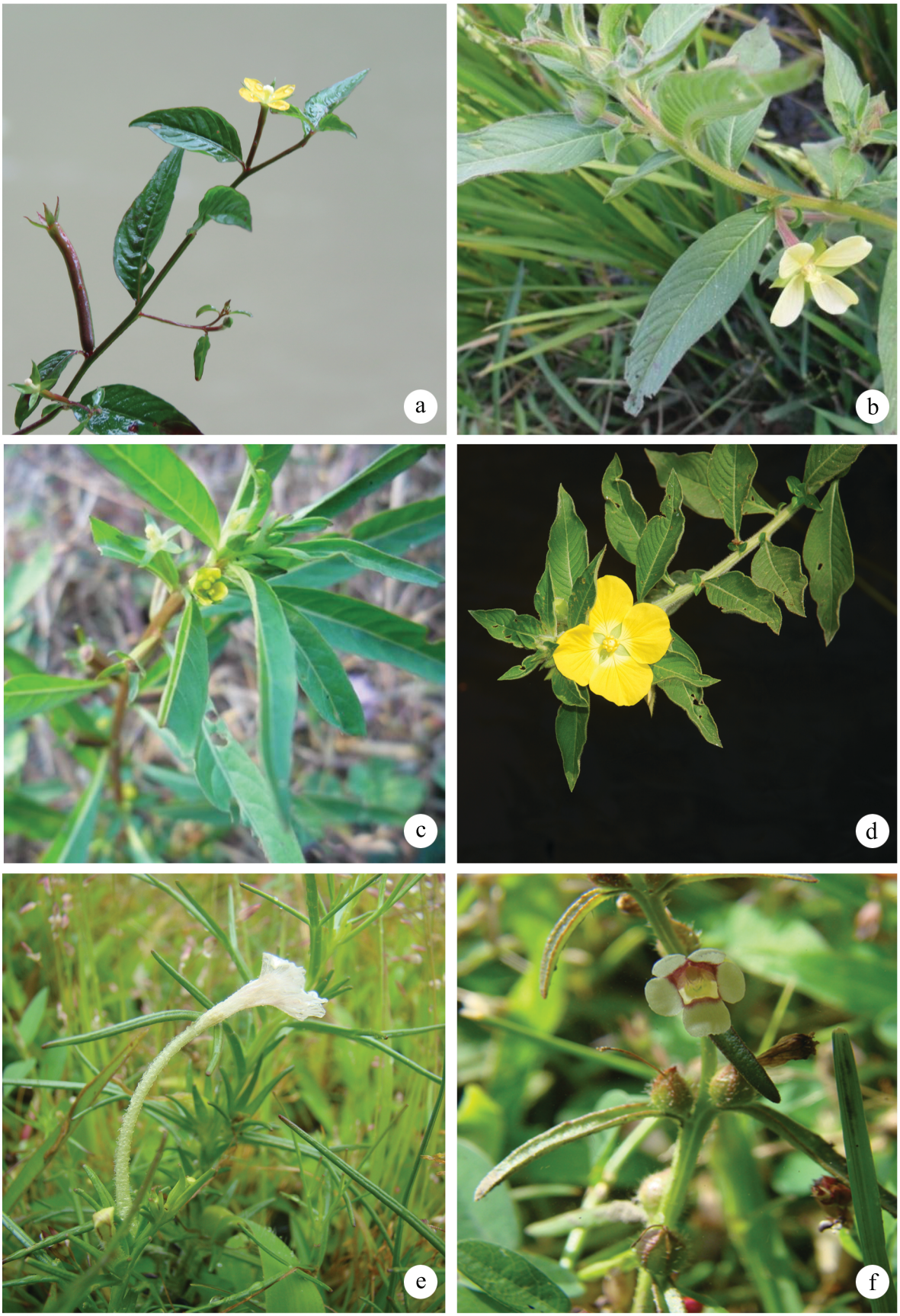


Fig. 24 a) *Ludwigia hyssopifolia* b) *Ludwigia octovalvis* c) *Ludwigia perennis* d) *Ludwigia peruviana* e) *Rhamphicarpa fistulosa* f) *Centranthera indica*

apex emarginate, base cuneate; petioles 1.5 - 3 cm long. Flowers yellow, solitary or in axillary umbels; peduncles 4 - 10 cm long; pedicels 0.5 - 1 cm long. Sepals 5, 2 - 3 mm long, ovate - lanceolate. Petals 5, up to 6 mm long and 4 mm wide, ovate - lanceolate. Stamens 10, in two rows. Ovary 5 - celled; ovules many; styles 5, distinct. Capsules up to 1,5 cm long, linear, hairy outside; seeds many, minute, brown.

Flowering and Fruiting: March - December

Growth form: Helophyte

Distribution: Cosmopolitan

Habitat: Marshy areas

SJ 15061 (Olavakkode)

PANDANACEAE R. Br.

PANDANUS Parkinson

1a. Sorosis composed of 2 – many celled phalanges..... *P. kaida*
1b. Sorosis composed of 1 celled drupes 2
2a. Fruit cylindrical..... *P. palakkadensis*
2b. Fruit ellipsoid ..... *P. canaranus*

Pandanus canaranus Warb. in Engl., Pflanzenreich Pandan. 75. 1900; Gamble, Fl. Pres. Madras 1570(1095). 1931; Manilal & Sivar., Fl. Calicut 301. 1982; Ramach. & V.J. Nair, Fl. Cannanore Dist. 491. 1988; Vajr., Fl. Palghat Dist. 529. 1990. *Pandanus unipapillatus* Dennst., Schleusss.15, 23,27. 1818; Nicolson *et al.,* Interpr. Hort. Malab. 306.1988; Nadaf and Zanan, Ind. Pandanaceae 35. 2012; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 634. 2016. (Fig. 25 c & d)

Large shrubs attaining the size of small trees, distally branching, stem grayish brown, ringed by leaf scars; prop roots stout. Leaves spirally arranged, linear - oblong, acuminate at apex, up to 2.1 m long and 5 cm wide, prickly on margins. Female inflorescence oblong - ovoid, up

to 24 cm long. Sorosis ellipsoid, composed of numerous simple drupes. Male inflorescence spicate, lower bracts with spinulose flagelliform tips. Spike up to 7 cm long and 2.3 cm wide, composed of a central axis from which many androphores arise. Stamens 17 - 27 from each androphore.

Flowering and Fruiting: July - September

Growth form: Helophyte

Distribution: Endemic to peninsular India

Habitat: Along streams

SJ 15083 (Olavakkode)

Pandanus kaida Kurz, J. Asiat. Soc. Bengal 38: 148. 1869; Manilal *et al.,* New Botanist 11: 1201. 1984; Sunil & Sivadasan, Fl. Alappuzha Dist. 718. 2009. Nadaf and Zanan, Ind. Pandanaceae 74. 2012. (Fig. 25 b)

A small tree with an erect trunk, up to 4 m tall, branched above; prop - roots basal. Leaves linear - ensiform, green on both sides, margins and midrib below armed with prickles. Inflorescences bracteate and terminal. Male inflorescence a raceme of spikes, each spike subtended by a white spathe. Spikes composed of numerous densely crowded stemonophores bearing crowded, white stamens. Female inflorescence pedunculate with foliaceous bracts, the peduncle up to 50 cm long. Spadix solitary or 3 - 7 together; each with green to white spathes. Phalanges, cuneate, 2 - 4 celled intermingled with 1 celled ones. Sorosis oblong – ellipsoid, up to 23 x 15 cm.

Flowering and Fruiting: September - November

Growth form: Helophyte

Distribution: Endemic to India

Habitat: Along rivers

SJ 16985 (Chittur)

Pandanus palakkadensis Nadaf, Zanan and Wakte, Kew Bull. 66: 1. 2011; Nadaf and Zanan, Ind. Pandanaceae 39. 2012. (Fig. 25 e & f)

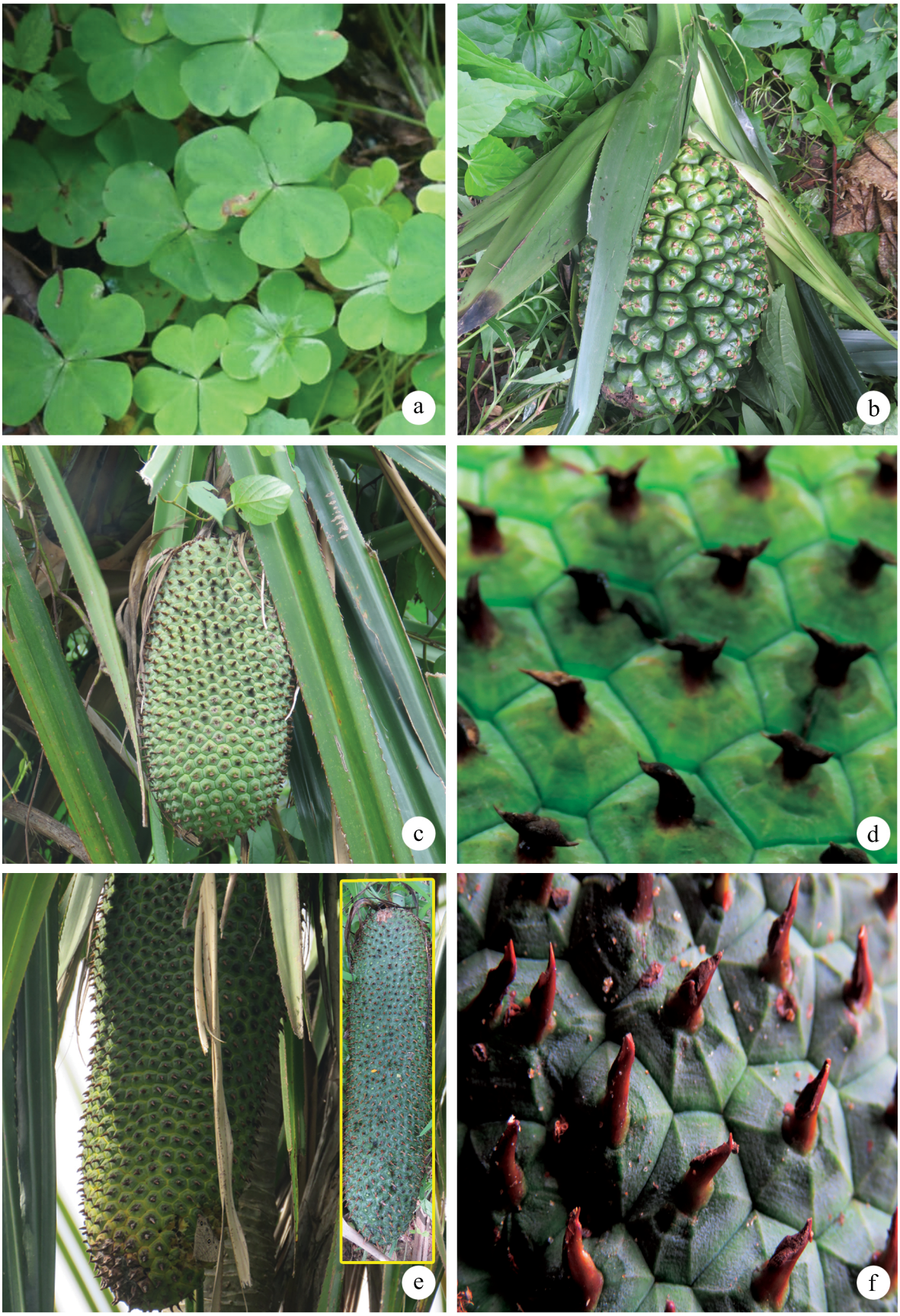


Fig. 25 a) *Oxalis corniculata* b) *Pandanus kaida* c) *Pandanus canaranus* d) *P. canaranus* fruit surface e) *Pandanus palakkadensis* f) *P. palakkadensis* fruit surface

Large shrubs divaricately branched; prop roots absent or rarely present, when present very short at the base of stem; stem erect, rough. Leaves linear, up to 3 m long and 7 cm wide, both margins and midvein spiny the apex. Female inflorescence terminal, Sorosis cylindrical, bracteate, drupes 1500 - 1600 per infructescence. Staminate inflorescence terminal, compound spike; spathe 100 - 120 cm long; bracts 9 - 10, yellowish, linear, lanceolate with variable length, margin and midrib prickled, moderately fragrant; staminate spike 6 - 15 × 2 cm, cylindrical; androphore 0.6 - 0.8 cm long, stemonophore 0.3 - 0.4 cm long with 8 - 10 stamens; stamens 0.3 - 0.4 cm long; filaments 0.1 cm long, arranged in pairs; anther 0.2 - 0.3 cm long.

Flowering and Fruiting: July - October

Growth form: Helophyte

Distribution: Endemic to Palakkad

Habitat: Along streams and Paddy field

SJ 15077 (Puthupariyaram)

PHRYMACEAE Schauer

MICROCARPAEA R. Br.

Microcarpaea minima (Koenig ex Retz.) Merr., Philipp. J. Sci. 7: 100. 1912 Joseph, Aquatic Angiosp. Malabar 251. 1991; Cook, Aquat. Wetland Pl. India 360. 1996; Sasidh., Fl. Parambikulam WLS 217. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 634. 2016. *Paederota minima* Koenig ex Retz., Obs. Bot. 5: 10. 1788. *Microcarpaea muscosa* R. Br., Prodr. 436. 1810; Hook. f., Fl. Brit. India 4: 286. 1884; Gamble, Fl. Pres. Madras 963 (677). 1924.

Annual prostrate herbs rooting at nodes. Leaves minute, decussate, elliptic - oblong, subsessile, base decurrent, apex obtuse. Flowers minute, sessile, axillary, solitary. Calyx tubular, lobes 5, lanceolate, ciliate at margin. Corolla purplish, up to 3 mm long, caducous; upper

lip 2 - lobed, lower lip 3 - lobed, all ciliate along margins. Stamens 2; filaments filiform. Capsule 2 mm long, ellipsoid, included in the persistent calyx.

Flowering and Fruiting: August - December

Growth form: Helophyte

Distribution: Paleotropics

Habitat: Marshy areas

SJ 15007 (Pappanchalla)

PLANTAGINACEAE Juss.

1a. Perfect stamens 2 ..... *Dopatrium*
1b. Perfect stamens 4 2
2a. Anther cells parallel .....*Bacopa*
2b. Anther cells divergent 3
3a. Seeds terete..... *Stemodia*
3b. Seeds angular ..... *Limnophila*

BACOPA Aubl.

Bacopa monnieri (L.) Pennell, Proc. Acad. Nat. Sci. Philad. 98: 94. 1946; Vajr., Fl. Palghat Dist. 322. 1990; Joseph, Aquatic Angiosp. Malabar 211. 1991; Cook, Aquat. Wetland Pl. India 340. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 849. 2016. *Moniera cuneifolia* Michx., Fl. Bor. Amer. 2: 22. 1803, "Monniera"; Gamble, Fl. Pres. Madras 953 (669). 1923. *Herpestis monnieria* (L.) Kunth, Nov. Gen. Sp. 2: 366. 1818; Hook. f., Fl. Brit. India 4: 272. 1884. (Fig. 26 a)

Annual or perennial herbs, stems creeping with ascending branches. Leaves opposite, decussate, sessile, succulent, oblong – cuneate, obtuse, entire, gland dotted, rounded at base, up to 20 x 7 mm. Flowers solitary, axillary; pedicels to 25 mm long. Calyx - lobes 5, unequal. Corolla bluish - white, up to 8 mm long, broadly campanulate. Capsule up to 4 x 2 mm, oblong – globose. seeds minute, oblong, reticulate.

Flowering and Fruiting: September - march

Growth form: Helophyte / Hyperhydate

Distribution: Paleotropics

Habitat: Marshy areas

SJ 11857 (Nelliyampathi)

DOPATRIUM Buch. - Ham ex Benth.

1a. Pedicels in fruit deflexed ..... *D. nudicaule*

1b. Pedicels in fruit erect ..... *D. junceum*

Dopatrium junceum (Roxb.) Buch. - Ham. ex Benth., Scroph. Ind. 31. 1835; Hook. f., Fl. Brit. India 4: 274. 1884; Gamble, Fl. Pres. Madras 954 (670). 1923; Vajr., Fl. Palghat Dist. 322. 1990; Joseph, Aquatic Angiosp. Malabar 218. 1991; Cook, Aquat. Wetland Pl. India 342. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 852. 2016. *Gratiola juncea* Roxb., Pl. Corom. 2: 16, t.127. 1798. (Fig. 26 b)

Annual aquatic or amphibious, herbs, erect, semi sacculent, up to 40 cm tall. Roots spongy white. Basal leaves decussate, oblong, base and apex acute, fleshy, sessile; upper ones reduced. Flowers axillary, solitary, lower ones sessile, upper ones pedicellate. Calyx - lobes 5, obtuse. Corolla bluish - pink, lobes 5, upper lip covering the lower lip in bud. Stamens 2, lobes unequal. Capsule 2 - 3 mm across, globose, on erect pedicel. Seeds numerous, minute, ovoid, brown, longitudinally ribbed.

Flowering and Fruiting: August - October

Growth form: Helophyte / Hyperhydate

Distribution: Eastern tropics

Habitat: Marshy areas

SJ 16913 (Nedumani)

Dopatrium nudicaule (Willd.) Benth., Scroph. Ind. 31. 1835; Hook. f., Fl. Brit. India 4: 274. 1884; Gamble, Fl. Pres. Madras 954 (669). 1923; Swarup. *et al.,* Shola For. Kerala 70. 1998; Sasidh., Fl.

Parambikulam WLS 215. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 854. 2016. *Gratiola nudicaulis* Willd., Ges. Naturf. Freunde Berlin Neue Schriften 4: 193. 1803. (Fig. 26 c)

Annual Herbs, glabrous. Stem erect, up to 20 cm tall. Leaves somewhat crowded at the base, up to 7 x 3 mm, obovate, apex obtuse; cauline leaves 2 or 3 pairs, linear, minute. Flowers axillary, solitary or in pairs towards the apex; pedicels up to 11 mm long, slender; calyx tube 1 mm long, lobes 5, linear - lanceolate; corolla pale blue – bluish purple, 6 mm long, throat shortly hairy. Stamens 2; anthers unequal. Capsule oblong - obovoid, 3 mm long; seeds rugulose.

Flowering and Fruiting: August - October

Growth form: Helophyte / Hyperhydate

Distribution: South India, Sri Lanka and Philippines

Habitat: Marshy areas

SJ 15098 (Vellaramkadavu)

LIMNOPHILA R. Br.

1a. Leaves dimorphic 2
1b. Leaves similar..... 3
2a. Flowers pedicellate..... *L. indica*
2b. Flowers sessile or subsessile ..... *L. heterophylla*
3a. Leaves opposite throughout ..... *L. repens*
3b. Leaves verticillate throughout or both verticillate & opposite 4
4a. Capsule ellipsoid ..... *L. aromatica*
4b. Capsule ovoid – globose ..... *L. chinensis*

Limnophila aromatica (Lam.) Merr., Interpr. Rumph. Herb. Amboin. 466. 1917; Joseph, Aquatic Angiosp. Malabar 239. 1991; Cook, Aquat. Wetland Pl. India 344. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 857. 2016. *Ambulia aromatica* Lam., Encycl. 1: 128. 1783. *Limnophila gratissima* Blume, Bijdr. 749. 1826; Hook. f., Fl. Brit. India 4: 266. 1884; Gamble, Fl. Pres. Madras 951 (667). 1923. (Fig. 26 d)

Annual or perennial erect fleshy glabrous herbs, up to 60 cm tall. Stem emergent, rooting at nodes, basal part usually submerged. Leaves opposite or in whorls of 3, up to 6 x 1.5 cm, oblong - lanceolate, rounded and semi - amplexicaul at base, margin serrulate, apex subacute. Flowers in many - flowered, terminal or axillary racemes; pedicels 3 - 10 mm long. Calyx campanulate, glandular; lobes 5, sub - equal. Corolla purple, about 1 cm across; tube 8 - 10 mm long. Stamens 4, didynamous. Capsule ellipsoid. Seeds many, minute.

Flowering and Fruiting: August - December

Growth form: Hyperhydate

Distribution: Indo - Malesia, China, Japan to Northern Australia

Habitat: Marshy areas

SJ 15044 (Parambikulam)

Limnophila chinensis (Osbeck) Merr., Amer. J. Bot. 3: 581. 1916. Cook, Aquat. Wetland Pl. India 345. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 857. 2016. *Stemodia hirsuta* Heyne ex Benth., Bot. Reg. 17: sub. t. 1470, sp. 15. 1832. *Limnophila hirsuta* (Heyne ex Benth.) Benth. in DC., Prodr. 10: 388. 1846; FBI 4: 268. 1884; Gamble, Fl. Pres. Madras 951 (668). 1924.

Annual herbs, stem prostrate or decumbent, quadrangular, pubescent, up to 40 cm tall. Leaves 4 x 1.5 cm, sessile, ovate - lanceolate, apex acute, amplexicaul, serrate, pubescent. Flowers axillary, solitary or in terminal or axillary racemes, violet; pedicels to 1.5 cm; calyx lobes 6 mm, lanceolate, subequal, hirsute; corolla pink, purple or blue; 5 mm across, pubescent. Stamens 4, didynamous; filaments 3 - 5 mm. Capsule ovoid globose. Seeds many, minute.

Flowering and Fruiting: February - April

Growth form: Hyperhydate / Helophyte

Distribution: Paleotropics

Habitat: Marshy areas and riverbanks

SJ 16963 (Chittur)

Limnophila heterophylla (Roxb.) Benth., Scroph. Ind. 25. 1835; Hook. f., Fl. Brit. India 4: 270. 1884; Gamble, Fl. Pres. Madras 952 (668). 1923; Joseph, Aquatic Angiosp. Malabar 241. 1991; Cook, Aquat. Wetland Pl. India 346. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 860. 2016. *Columnea heterophylla* Roxb., Fl. Ind. 3: 97. 1832. (Fig. 26 e)

Annual or perennial herbs. Stems up to 50 cm tall. Submerged part spongy. Aerial leaves opposite or verticillate, up to 20 x 4 mm, elliptic to oblong, base sub amplexicaul, margin serrulate, apex subacute, glabrous, sessile; submerged leaves in whorls of 3 - 8, deeply dissected with capillary lobes. Flowers solitary, sessile or sub sessile in the upper axils. Calyx 3 mm long; lobes ovate - lanceolate, glabrous. Corolla up to 5 mm long, pale pink, throat sparsely pilose; upper lip 2 - lobed, lower lip 3 - lobed. Stamens 4, included, didynamous. Capsule globose. Seeds minute, brown.

Flowering and Fruiting: September - March
Growth form: Hyperhydate / Helophyte
Distribution: Indo - Malesia and China
Habitat: Marshy areas and paddy fields

SJ 16966 (Pattanchery)

Limnophila indica (L.) Druce, Rev. Bot. Soc. Exch. Club. Br. Isles 1913, 3: 420. 1914; Vajr., Fl. Palghat Dist. 323. 1990; Joseph, Aquatic Angiosp. Malabar 242. 1991; Cook, Aquat. Wetland Pl. India 346. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 860. 2016. *Hottonia indica* L., Syst. Nat. (ed.10) 919. 1759. *Limnophila gratioloides* R. Br., Prodr. 442. 1810; Hook. f., Fl. Brit. India 4: 271. 1884; Gamble, Fl. Pres. Madras 952 (668). 1923.

Annual or perennial amphibious herbs. Submerged leaves deeply dissected with flattened or capillary lobes; upper leaves decussate to whorled, variously dissected, 15 x 6 mm, linear - lanceolate, base cuneate, margin serrulate, apex acute, basally 3 - nerved,

chartaceous, subsessile. Flowers pedicellate, solitary, axillary; pedicels to 7 - 10 mm long. Calyx tube 2 - 3 mm long, lobes as long as the tube, linear - lanceolate, greenish white. Corolla tube white, mouth yellow with purple shades, 10 mm long. Stamens 4, didynamous. Capsule 2 – 3.5 mm long, ellipsoid or sub - globose. Seeds small, black, numerous.

Flowering and Fruiting: September - February

Growth form: Hyperhydate / Helophyte

Distribution: Pantropical

Habitat: Marshy areas, canals and ponds

SJ 11833 (Malampuzha)

Limnophila repens (Benth.) Benth. in DC., Prodr. 10. 387. 1846; Joseph, Aquatic Angiosp. Malabar 245. 1991; Cook, Aquat. Wetland Pl. India 349. 1996; Sasidh., Fl. Parambikulam WLS 215. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 862. 2016. *Stemodia repens* Benth., Bot. Reg. 17: sub t. 1470. 1832. *Limnophila conferta* Benth. in DC., Prodr. 10: 386.1846; Hook. f., Fl. Brit. India 4: 265. 1884; Gamble, Fl. Pres. Madras 952(667). 1923. *Limnophila sessilis* (Benth.) C.E.C. Fisch., Bull. Misc. Inform. Kew 1932: 62. 1932. (Fig. 26 f)

Annual aromatic herbs, decumbent, up to 40 cm tall, rooting at nodes. Leaves opposite, subsessile, oblong – lanceolate or elliptic, acute, serrate, cuneate at base. Inflorescence axillary, solitary or a raceme. Flower sessile or subsessile. Calyx 4 mm long, lobes 5, lanceolate. Corolla pink, 5 mm across; tube 5 mm long. Stamens 4, didynamous. Capsule 3 - 4 mm long, ellipsoid. Seeds small, angular, brown.

Flowering and Fruiting: July – December

Growth form: Hyperhydate / Helophyte

Distribution: Tropical Asia

Habitat: Marshy areas, canals and ponds

SJ 16911 (Parambikulam)

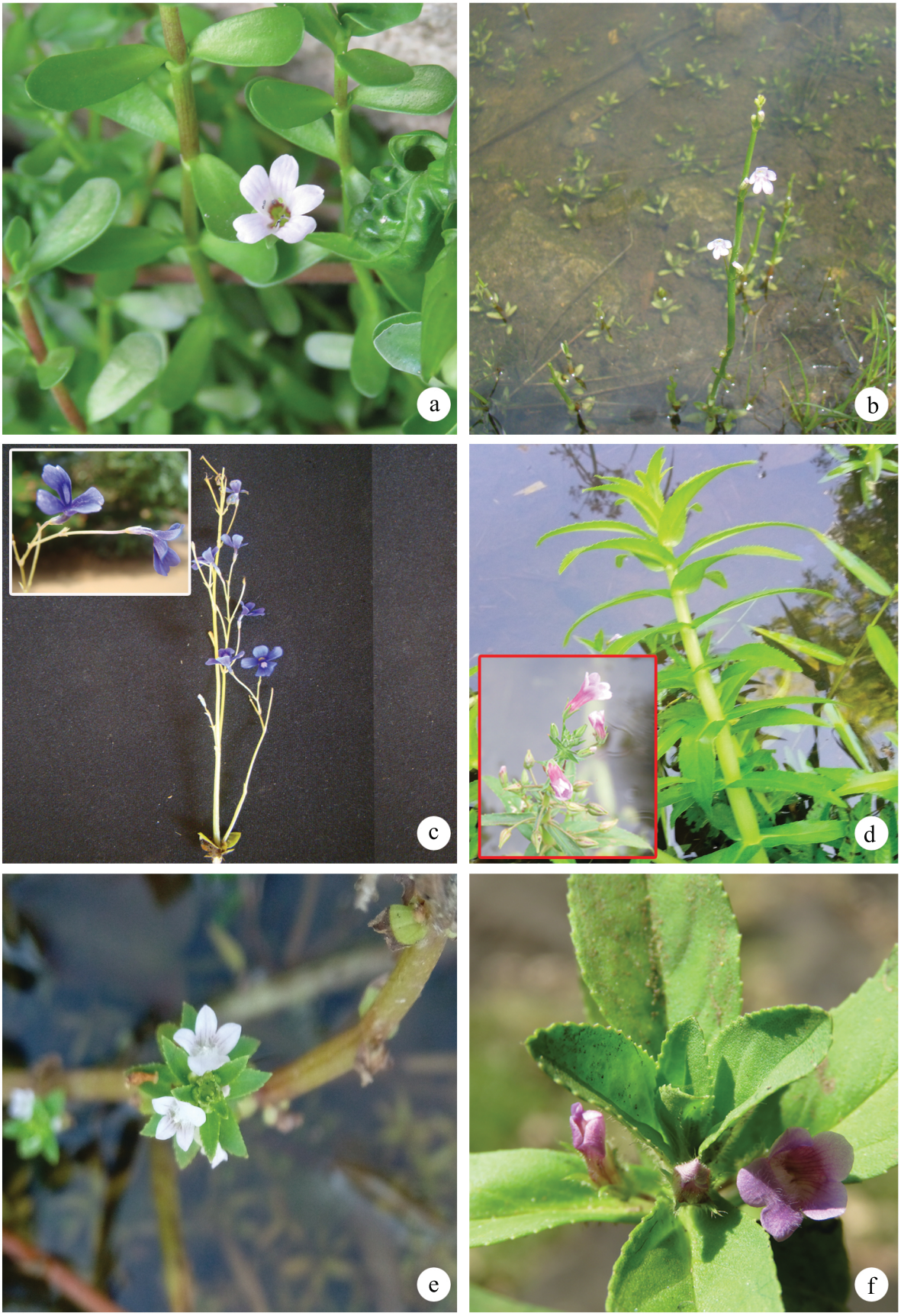


Fig. 26 a) *Bacopa monnieri* b) *Dopatrium junceum* c) *Dopatrium nudicaule* d) *Limnophila aromatica* e) *Limnophila heterophylla* f) *Limnophila repens*

STEMODIA L.

Stemodia verticillata (Mill.) Sprague, Bull. Misc. Inform. Kew 1921: 211. 1921; Ramach. *et al.,* Journ. Econ. Tax. Bot. 5: 939. 1984; Sivar. & Babu, Journ. Econ. Tax. Bot. 5: 942. 1984; Ramach. & V.J. Nair, Fl. Cannanore Dist. 320. 1988; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 862. 2016.

Annual herbs, erect, up to 15 cm tall, branched, hirsute. Lower leaves opposite, upper ones in verticils of 3, broadly ovate, truncate at base, subacute at apex, coarsely crenate - serrate, 15 x 14 mm, scabrid along nerves beneath; petioles up to 1 cm long, glandular - hispid. Flowers axillary, solitary. Pedicels 1 mm long. Calyx lobes subequal, linear - lanceolate, up to 3.5 mm long, acuminate at apex. Corolla tube cylindric, blue coloured, 3 - 4 mm long, minutely glandular, pale green, with longitudinal light purple lines. Stamens 4, didynamous; filaments glabrous, anthers divergent. Style short; stigma bent. Capsule orbicular biconvex, 4 valved.
Seeds terete, longitudinally ribbed, dark brown.
Flowering and Fruiting: February - April
Growth form: Helophyte
Distribution: Pantropical
Habitat: Marshy areas and canals.

SJ 11871 (Palakkad)

POACEAE Barnhart

1a. Leaf sheath strongly inflated and functioning as float .... *Hygroryza*
1b. Leaf sheath not strongly inflated to function as float 2
2a. Spikelets strictly 2 florets, dorsally compressed, breaking up at maturity below the glumes 3
2b. Spikelets with 1 - several florets, laterally compressed, Breaking up at maturity above the glumes. If breaking up below the glumes then not with 2 florets 12

3a. Spikelets always unisexual ..... *Coix*
3b. Spikelets bisexual or with male male or barren and bisexual ... 4
4a. Lower glumes almost as long as spikelets 5
4b. Lower glumes either absent or shorter than spikelets 7
5a. Inflorescence a true panicle or false panicle of racemes 6
5b. Inflorescence of solitary or digitate racemes ..... *Ischaemum*
6a. Panicle densely silky villous .... *Saccharum*
6b. Panicle not densely silky villous ..... *Chrysopogon*
7a. Inflorescence of open lax or contracted panicle 8
7b. Inflorescence a spiciform raceme 9
8a. Panicle contracted .....*Sacciolepis*
8b. Panicle open Lax ..... *Panicum*
9a. Lower glume absent or reduced to minute scale..... *Paspalum*
9b. Lower glume well developed..... 10
10a. Lower glumes turned towards the axis ..... *Brachiaria*
10b. Lower glumes turned away from the axis..... 11
11a. Inflorescence a dense panicle of Spiciform raceme .... *Echinochloa*
11b. Inflorescence a distant panicle of Spiciform raceme... *Paspalidium*
12a. Stamens 6 13
12b. Stamens 1 - 3 14
13a. Sterile lemma absent ..... *Leersia*
13b. Sterile lemma present ..... *Oryza*
14a. Lemma or rachilla with long silky hairs enveloping lemma 15
14b. Lemma and rachilla glabrous, or if hairy not enveloping lemmas..... 16
15a. Lemma hairy, lower floret bisexual ..... *Arundo*
15b. Lemma glabrous, lower floret male or empty ..... *Phragmites*
16a. Inflorescence of digitate or sub digitate raceme or spike ..... *Dactyloctenium*
I6b. Inflorescence not as above 17
17a. Spikelets with both bisexual and male or neuter flowers...*Isachne*
17b. Spikelets with all bisexual flower ..... *Eragrostis*

ARUNDO L.

Arundo donax L., Sp. Pl. 1: 81. 1753; Hook. f., Fl. Brit. India 7: 302. 1896; Gamble, Fl. Pres. Madras 1805 (1250). 1934; Vajr., Fl. Palghat Dist. 566. 1990; Cook, Aquat. Wetland Pl. India 284. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 648. 2016. (Fig. 27 a)

Perennial herbs. Rhizomes woody, creeping. Culms erect, up to 3 m high, tufted. Leave linear – lanceolate, distichous, up to 60 x 5 cm, entire, acuminate, shallowly cordate at the base. Sheath up to 3.5 cm long, hairy or glabrous. Inflorescence an erect dense panicle, up to 60 cm long and 8 cm wide, feathery. Spikelets 10 - 15 mm long, lanceolate to narrowly lanceolate, 2 - 3 flowered; florets bisexual. Glumes nearly similar, 3 nerved, lanceolate, acuminate. Lemma lanceolate, 5 nerved. Palea elliptic or oblong lanceolate, 2 nerved. Stamens 3. Stigmas 2, feathery. Seeds oblong.

Flowering and Fruiting: August - December

Growth form: Helophyte

Distribution: Mediterranean region eastwards to north Africa, India - Pakistan

Habitat: Riverbanks

SJ 11873 (Mukkai)

BRACHIARIA (Trin.) Griseb.

Brachiaria mutica (Forssk.) Stapf in Prain, Fl. Trop. Africa 9:526.1919; Gamble, Fl. Pres. Madras 1769 (1226). 1934; Joseph, Aquatic Angiosp. Malabar 456. 1991; Sreek. & V.J. Nair, Fl. Kerala Grasses 221. 1991; Cook, Aquat. Wetland Pl. India 285. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 654. 2016. *Panicum muticum* Forssk., Fl. Aeg. - Arab. 20. 1775; Hook. f., Fl. Brit. India 7: 34. 1896. (Fig. 27 b)

Perennial large herbs. Culms, erect, tufted up to 150 cm; nodes densely bearded. Leaves linear - lanceolate, up to 30 x 2 cm,

acuminate, rounded or cordate at base. Sheaths hairy. Ligules membranous. Racemes pseudo paniculate, up to 20 in number, each 5 - 8 cm long. Rachis flat, ribbon - like. Pedicels with a few white bristles. Spikelets elliptic, 2.5 - 3.5 mm, crowded, arranged in 2 rows. Lower glume ovate, acute. Upper glume ovate, 3.5 x 1.5 mm, acute, chartaceous. Lower floret male. Upper floret bisexual. First lemma ovate, acute. Palea elliptic or ovate - elliptic, 2 nerved. Stamens 3. Second lemma ovate, rounded at apex, faintly 3 - nerved. Palea ovate, or ovate - elliptic, 2 - 2.5 x 1 mm, rounded at apex, rugulose except on margins. Lodicules obovate. Seeds oblong - elliptic.

Flowering and Fruiting: November - March

Growth form: Helophyte

Distribution: Native of America; widespread in all tropical regions

Habitat: Streams and rivers

SJ 15033 (Attappadi)

COIX L.

Coix lacryma - jobi L., Sp. Pl. 972. 1753; Hook. f., Fl. Brit. India 7: 100. 1896; Gamble, Fl. Pres. Madras 1705 (1182). 1934; Manilal, Fl. Silent Valley 350. 1988; Vajr., Fl. Palghat Dist. 569. 1990; Joseph, Aquatic Angiosp. Malabar 460. 1991; Sreek. & V.J. Nair, Fl. Kerala Grasses 207. 1991; Cook, Aquat. Wetland Pl. India 288. 1996; Sasidh., Fl. Parambikulam WLS 388. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 666. 2016. (Fig. 27 c)

Annual herbs. Culms tufted, up to 1.2 m tall; nodes glabrous. Leaves, linear - oblong, up to 45 x 3.5 cm, margin scaberulous, acuminate, cordate at base. sheaths to 6 cm long, glabrous; ligules membranous. Inflorescence terminal and axillary peduncled, false spikes, up to 8 cm long. Spikelets unisexual. Male spikelets 2 or 3, up to 12 x 4 mm, elliptic - lanceolate. Lower glume ovate - elliptic, 2 - keeled. Upper glume 3, elliptic - lanceolate, acuminate. Lower floret male. Upper floret male or barren. Stamens 3. Female spikelets enclosed within an

involucre, globose or ovoid, bony, up to 10mm long, shining white or grey. Lower glume ovate - oblong, acute. Upper glume ovate. Lower floret female or barren. Upper floret female. Caryopsis 5 - 7 mm, subglobose.

Flowering and Fruiting: July - March

Growth form: Helophyte

Distribution: Tropical Africa; introduced elsewhere

Habitat: Marshy areas

SJ 11899 (Karappara)

DACTYLOCTENIUM Willd.

Dactyloctenium aegyptium (L.) P. Beauv., Ess. Agrost. 10. 1812; Gamble, Fl. Pres. Madras 1840 (1273). 1934; Sreek. & V.J. Nair, Fl. Kerala Grasses 367. 1991; Sasidh., Fl. Parambikulam WLS 389. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 671. 2016. (Fig. 27 d)

Annual herbs. Culms up to 50 cm long, procumbent, rooting at the nodes; nodes glabrous. Leaves, oblong lanceolate or linear lanceolate, rounded or shallowly cordate at base, acuminate. Sheaths up to 5 cm long. Ligules ovate, fimbriate, membranous. Inflorescence 2 - 6 digitate spikes, each 2 – 3.5 cm long. Spikelets sessile, 3 - 4 - flowered, ovate or oblong, compressed laterally, in 2 rows. Lower glume boat - shaped, keeled. Upper glume ovate - elliptic or obovate, aristate, keeled. Lemmas ovate, aristate. Palea ovate - lanceolate, acuminate. Stamens 3; Caryopsis long, obovate and transversely rugose.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte

Distribution: Native of south America, naturalized in paleotropics

Habitat: Marshy areas

SJ 15062 (Kalpathy)

ECHINOCHLOA P. Beauv.

1a. Lower lemma awned ..... *E. cruss - galli*

1b. Lower lemma without awn 2
2a. Racemes densly crowded ..... *E. frumentacea*
2b. Racemes openly spaced .....,,,,,,..... *E. colona*

Echinochloa colona (L.) Link, Enum. Hort. Berol., 2: 209. 1833; Gamble, Fl. Pres. Madras 1776 (1230). 1934; Vajr., Fl. Palghat Dist. 572. 1990; Sreek. & V.J. Nair, Fl. Kerala Grasses 245. 1991; Joseph, Aquatic Angiosp. Malabar 465. 1991; Cook, Aquat. Wetland Pl. India 290. 1996; Sasidh., Fl. Parambikulam WLS 391. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 677. 2016. *Panicum colonum* L., Syst. Nat. (ed. 10) 870. 1759; Hook. f., Fl. Brit. India 7: 32. 1896. (Fig. 27 e)

Annuals herbs. Culms tufted, erect; nodes glabrous. Internodes up to 10 cm. Leaves linear - lanceolate, rounded or cordate at base, acuminate; sheaths keeled; ligules absent. Panicles 3 - 15 cm long, spiciform; racemes 4 - 10, each one up to 3 cm long. Spikelets 2 - 4 mm long, ovate - lanceolate, greenish - yellow. Lower glume ovate, acuminate, 5 - nerved. Upper glume boat - shaped, acuminate. Lower floret barren. Upper floret bisexual. First lemma ovate, 7 - nerved. Palea ovate - oblong, 2 - keeled. Second lemma ovate - elliptic. Palea ovate - oblong, mucronate, 2 - keeled. Stamens 3; violet or purple. Ovary oblong. stigmas 2, pink.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte

Distribution: Tropical Asia and Africa

Habitat: Marshy areas and paddy fields

SJ 16925 (Tattamangalam)

Echinochloa crus - galli (L.) P. Beauv., Ess. Agrost. 53: 161. 1812; Gamble, Fl. Pres. Madras 1777(1231). 1934; Vajr., Fl. Palghat Dist. 572. 1990; Sreek. & V.J. Nair, Fl. Kerala Grasses 246. 1991; Joseph, Aquatic Angiosp. Malabar 466. 1991; Cook, Aquat. Wetland Pl. India 291. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 679. 2016. *Panicum crus - galli* L., Sp. Pl. 56. 1753; Hook. f., Fl. Brit. India 7: 30.

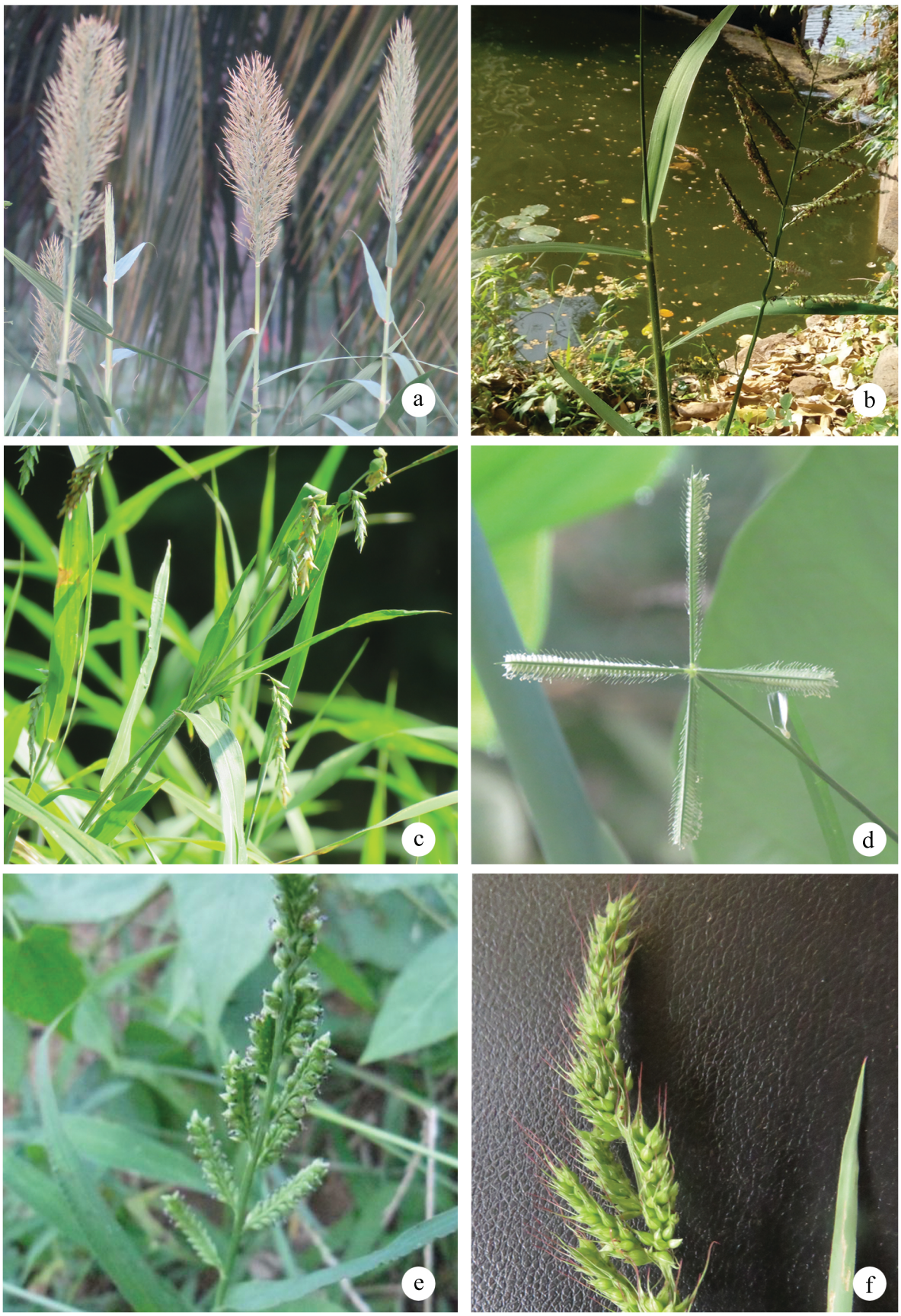


Fig. 27 a) *Arundo donax* b) *Brachiaria mutica* c) *Coix lacryma - jobi* d) *Dactyloctenium aegyptium* e) *Echinochloa colona* f) *Echinochloa crus - galli*

1896. (Fig. 27 f)

Annual herbs. Culm erect or ascending, tufted, up to 90 cm high, robust; nodes glabrous. Leaves linear lanceolate, up to 35 x 2 cm, rounded at base, acuminate at apex. Sheaths keeled; ligules absent. Inflorescence a panicle, up to 20 cm long; racemes 5 - 15, congested. Spikelets ovate - lanceolate, awned. Lower glume ovate, 5 - nerved. Upper glume ovate - lanceolate, 5 - nerved. Lower floret male or barren. Upper floret bisexual. First lemma ovate - lanceolate, awned, 5 - 7 - nerved. Palea elliptic - oblong, 2 - keeled. Second lemma ovate, acuminate. Palea elliptic - oblong, 2 - keeled, 2 - nerved. Stamens 3, yellow. Stigma feathery. Ovary 0.5 mm long, oblong.

Distribution: Flowering and Fruiting: Throughout the year

Growth form: Helophyte

Distribution: India, south east Asia and Africa

Habitat: Marshy areas and paddy fields

SJ 16926 (Ayyarmala)

Echinochloa frumentacea Link, Enum. Hort. Berol. 1: 234. 1827; Sreek. & V.J. Nair, Fl. Kerala Grasses 247. 1991; Cook, Aquat. Wetland Pl. India 291. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 681. 2016. *Panicum frumentaceum* Roxb., Fl. Ind. 1: 307. 1820, non Salisb. 1796. *Panicum crusgalli* L. var. *frumentaceum* (Link) Trimen, Syst. Cat. Vey. Pl. 104. 1885; Hook. f., Fl. Brit. India 7: 31. 1896.

Annual herbs; culms erect, up to 1.3 m tall. Leaf-blades often broad, up to 30 cm long and 2 cm wide; ligule absent; sheaths glabrous. Inflorescence lanceolate, up to 20 cm long, the racemes several-rowed with crowded spikelets, 1 - 3 cm long, simple, closely spaced, overlapping; incurved at maturity. Spikelets broadly ellipsoid, up to 3.5 mm long; lower floret barren; upper floret bisexual. Stamens 3; anthers violet. Stigma feathery

Distribution: Flowering and Fruiting: June - September

Growth form: Helophyte/Tenagophyte/ Hyperhydate
Distribution: Tropical East Africa, India, Pakistan and Australia
Habitat: Marshy areas and paddy fields

SJ 16991 (Chammanampathy)

ERAGROSTIS Wolf.

1a. Florets in spikelets breaking up from above downwards..*E. riparia*
1b. Florets in spikelets breaking up from below upwards ....*E. unioloides*

Eragrostis riparia (Willd.) Nees, Agrost. Brass. 512. 1829; Gamble, Fl. Pres. Madras 1825 (1263). 1934; Sasidh., Fl. Parambikulam WLS 392. 2002; Sunil & Sivadasan, Fl. Alappuzha Dist. 851. 2009. Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 691. 2016. *Eragrostis tenella* (L.) P. Beauv. var. *riparia* (Willd.) Stapf in Hook.f., Fl. Brit. India 7: 315. 1896.

Perennial herbs. Culms tufted, up to 30 cm long, nodes glabrous. Leaves, linear - lanceolate, up to 80 x 4 mm, base rounded, apex acuminate; sheaths up to 3 cm long, slightly keeled towards apex, mouth bearded; ligule represented by a row of hairs. Panicles contracted, spiciform up to 8 cm long. Spikelets oblong, 5 - 10 - flowered, pale yellow. Lower glume ovate - lanceolate, 1 - nerved. Upper glume ovate - lanceolate, 1 - nerved. Lemmas ovate - oblong, apex rounded, 3 - nerved. Paleas obovate or oblanceolate, 2 - keeled, ciliate along the keels. Stamens 3. Anthers purple. Stigmas greenish brown. Grains ovoid – ellipsoid.
Flowering and Fruiting: December - June
Growth form: Helophyte
Distribution: Endemic to peninsular India
Habitat: Riverbanks and marshy areas

SJ 15046 (Parambikulam)

Eragrostis unioloides (Retz.) Nees ex Steud., Syn. Pl. Glum.

1:264.1854; Gamble, Fl. Pres. Madras 1826 (1264). 1934; Hook. f., Fl. Brit. India 7: 317.1896; Manilal, Fl. Silent Valley 354. 1988; Vajr., Fl. Palghat Dist. 575. 1990; Sreek. & V.J. Nair, Fl. Kerala Grasses 392. 1991; Cook, Aquat. Wetland Pl. India 293. 1996; Sasidh., Fl. Parambikulam WLS 393. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 694. 2016. *Eragrostis amabilis* sensu Stapf in Hook.f., Fl. Brit. India 7: 317. 1896, non Wight & Arn. ex Nees 1838. (Fig. 28 a)

Annual herbs; culms tufted, erect, up to 60 cm tall; nodes glabrous. Leaves linear - lanceolate, acuminate, base rounded or shallowly cordate. Sheaths up to 5 cm long; ligules membranous with fimbriate apex. Panicles 5 - 20 cm long, lax. Spikelets broadly ovate - oblong, 10 40 flowered, purplish. Lower glume lanceolate, 1 - nerved; upper glume ovate - lanceolate; lemmas broadly ovate, 3 - nerved; paleas elliptic, 2 - keeled. Stamens 3, anthers violet. Stigmas 2, feathery, white. Grains up to 1 mm long, ellipsoid, reddish - brown.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte

Distribution: South east Asia, India and Africa

Habitat: Riverbanks and paddy fields

SJ 11867 (Thavalam)

HYGRORYZA Nees

Hygroryza aristata (Retz.) Nees ex Wight & Arn., Edinb. New Phil. J. 15: 380. 1833; Hook. f., Fl. Brit. India 7: 95. 1896; Gamble, Fl. Pres. Madras 1846 (1277). 1934; Vajr., Fl. Palghat Dist. 578. 1990; Sreek. & V.J. Nair, Fl. Kerala Grasses 429. 1991; Joseph, Aquatic Angiosp. Malabar 471. 1991; Cook, Aquat. Wetland Pl. India 295. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 698. 2016. (Fig. 28 b)

Annuals or perennial herbs. Culms floating and forming mats on water surface, up to 50 cm long, rooting at nodes; nodes bearded. Leaves ovate - oblong or lanceolate, base cordate, apex acute or obtuse.

Sheaths to 6 cm long, expanded, spongy, forming floats. Panicles lax, up to 6 cm long; pedicels with a red band below the middle. Spikelets 6 - 8 mm long, lanceolate, 1 - flowered. Glumes absent. Lemma lanceolate, acuminate, chartaceous, awned; awns up to 1.25 cm long, scabrid. Palea elliptic - lanceolate, keels scabrid or ciliate. Stamens 6. Anthers brown. Grain oblong.

Flowering and Fruiting: October - February

Growth form: Pleustophyte

Distribution: India and Sri Lanka

Habitat: Canals and streams

SJ 16967 (Ponnamkode)

ISACHNE R. Br

Isachne globosa (Thunb.) O. Ktze., Rev. Gen. Pl. 2: 778. 1891; Vajr., Fl. Palghat Dist. 578. 1990; Sreek. & V.J. Nair, Fl. Kerala Grasses 421. 1991; Cook, Aquat. Wetland Pl. India 298. 1996; Sasidh., Fl. Parambikulam WLS 396. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 702. 2016. *Milium globosum* Thunb., Fl. Japan 49. 1784. *Isachne australis* R. Br., Prodr. 1: 196. 1810; Hook. f., Fl. Brit. India 7: 24. 1896. *Isachne dispar* Hook.f., Fl. Brit. India 7: 26. 1896p.p., non Trin. 1828. *Isachne miliacea* Roth, Nov. Pl. Sp. 58. 1821; Hook. f., Fl. Brit. India 7: 25. 1896; Gamble, Fl. Pres. Madras 1797(1244). 1934; Manilal, Fl. Silent Valley 356. 1988; Joseph, Aquatic Angiosp. Malabar 477. 1991; Cook, Aquat. Wetland Pl. India 298. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 704. 2016. (Fig. 28 c)

Perennial or annual herbs. Culms tufted, erect or decumbent, 20 - 60 cm tall; nodes glabrous or bearded with white long hairs. Leaves oblong - lanceolate, acuminate, base rounded, margin serrulate; sheath glabrous; ligule a tuft of hairs. Panicle up to 12 cm long. Spikelets 2 - 3 mm long, globose. Glumes subequal, ovate, boat shaped; florets unequal; lower male and upper bisexual. Lower lemma oblong elliptic, obtuse, 7 - 7 nerved. Lower palea like lemma but 2

nerved. Upper lemma ovate – elliptic, obtuse. Upper palea with incurved margins. Stamens 3; anthers yellow. Stigma purplish.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte

Distribution: Tropical Asia

Habitat: Paddy field bunds and marshy areas

SJ 16979 (Tattamangalam)

ISCHAEMUM L.

Ischaemum rugosum Salisb., Icon. Strip. Rar. 1, t, 1. 1791; Hook. f., Fl. Brit. India 7: 127. 1896; Gamble, Fl. Pres. Madras 1722 (1194). 1934; Sreek. & V.J. Nair, Fl. Kerala Grasses 159. 1991; Joseph, Aquatic Angiosp. Malabar 482. 1991; Cook, Aquat. Wetland Pl. India 301. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 729. 2016. (Fig. 28 b)

Annuals or perennial herbs. Culms tufted, erect, up to 70 cm tall; nodes bearded. Leaves linear - lanceolate, acuminate, tapering towards base, up to 15 x 0.6 cm; ligules ovate, membranous. Racemes 2, up to 5 cm long, often adherent to each other. Sessile spikelets 4 - 6 mm long, oblong - lanceolate, awned; lower glume oblong - lanceolate, with prominent nodules connected by shallow ridges and furrows; upper glume oblong - lanceolate, keeled. Lower floret male; upper floret bisexual; lower lemma - lanceolate; palea oblong - lanceolate, 2 - keeled; stamens 3; upper lemma notched, awned, hyaline; awns to 8 mm long; palea oblong - lanceolate, hyaline, 2 - keeled, with a few wart like growths towards apex; stamens 3. Pedicelled spikelets oblong, awnless. Florets like those of the sessile spikelets, Lower glume transversely rugose.

Flowering and Fruiting: November - February

Growth form: Helophyte/ Hyperhydate

Distribution: Tropical Africa and Asia

Habitat: Paddy field bunds and marshy areas

SJ 16936 (Chittur)

LEERSIA Soland. Ex Sw.

Leersia hexandra Sw., Prodr. 21. 1788; Hook. f., Fl. Brit. India 7: 94. 1896; Gamble, Fl. Pres. Madras 1845 (1277). 1934; Joseph, Aquatic Angiosp. Malabar 485. 1991; Sreek. & V.J. Nair, Fl. Kerala Grasses 430. 1991; Cook, Aquat. Wetland Pl. India 302. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 735. 2016.

Perennial herbs. Culms, erect or trailing; nodes bearded, up to 1.6 m tall. Leaves linear - lanceolate, acuminate, base rounded, scaberulous, up to 17 x 1 cm. Sheaths to 5 cm long; ligules membranous. Inflorescence a lax panicle, up to 12 cm long; branches to 5 cm long. Spikelets oblong, compressed, 1 - flowered, cream - yellow. Glumes absent. Lemma oblong, coriaceous, 5 - nerved, laterally compressed, keeled. Palea linear - oblong, coriaceous, 3 - nerved, ciliate along the keels. Stamens 6; anthers 2 mm long, yellow. stigmas 2, cream - coloured. Caryopsis elliptic.

Flowering and Fruiting: August - February
Growth form: Helophyte/ Pleustophyte/Hyperhydates
Distribution: Pantropical
Habitat: Ponds and riverbanks.

SJ 16943 (Chittur)

ORYZA L.

1a. Awns 3 - 10 cm long ..... *O. rufipogon*
1b. Awns less than 3 cm 2
2a. Rhizomes prominent, leaves up to 40 cm ..... *O. officinalis*
2b. Rhizomes not prominent, Leaves up to 60 cm ..... *O. sativa*

Oryza officinalis Wall. ex Watt, Dict. Econ. Prod. India 5:501. 1891. *Oryza officinalis* Wall. ex Watt ssp. *malampuzhaensis* (Krishnasw. & Chandrasek.) Tateoka, Bot. Mag. (Tokyo) 75: 422. 1962; Vajr., Fl.

Palghat Dist. 582. 1990; Sreek. & V.J. Nair, Fl. Kerala Grasses 432. 1991; Sasidh. & Sivar., Fl. Pl. Thrissur For. 520. 1996. *Oryza malampuzhaensis* Krishnasw. & Chandrasek., Madras J. Agri. Sci. 45: 471. 1958. (Fig. 28 e)

Perennial herbs. Culms tufted, erect or trailing, rhizomatous, up to 1.2 m; nodes glabrous. Leaves lanceolate or linear - lanceolate, up to 40 x 2 cm, base rounded or shallowly cordate. Sheaths keeled. Ligule ovate, membranous, with a fringe of hairs. Panicles lax, 10 - 30 cm long. Spikelets broadly oblong, deciduous, 5 - 6 mm long, awned; awns 1 - 2 cm long, mature ones black coloured. Sterile lemma oblong - acute, 1.5 - 2 mm long, coriaceous. Grains brownish white.

Flowering and Fruiting: May - November

Growth form: Helophyte/Hyperhydates

Distribution: India to Papua New Guinea and Australia

Habitat: Marshy areas in forests

SJ 15038 (Peruvarippallam)

Oryza rufipogon Griff., Notul. Pl. Asiat. 3: 5. 1851; Vajr., Fl. Palghat Dist. 582. 1990; Sreek. & V.J. Nair, Fl. Kerala Grasses 432. 1991; Cook, Aquat. Wetland Pl. India 304. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 744. 2016.

Annual herbs. Culms to 80 cm high, erect, tufted; nodes glabrous. Leaves linear - lanceolate, base rounded, apex acuminate, up to 35 x 1.2 cm. Sheaths to 20 cm long, keeled; ligules ovate, membranous. Panicles 12 - 25 cm long, lax. Glumes 2 - 3 mm long, ovate, unequal. Lemmas ovate - oblong, laterally compressed, 3 - nerved, awned; awns up to 10 cm long. Palea oblong. Stamens 6: anthers yellow. Stigmas cream - coloured. Grains 5 - 6 mm long, elliptic.

Flowering and Fruiting: September - March

Growth form: Hyperhydates

Distribution: India, Sri Lanka and tropical Australia

Habitat: Paddy fields and ponds

SJ 15084 (Palakkad)

Oryza sativa L., Sp. Pl. 333. 1753; Hook. f., Fl. Brit. India 7: 92. 1896; Gamble, Fl. Pres. Madras 1844(1276). 1934; Vajr., Fl. Palghat Dist. 582. 1990; Sreek. & V.J. Nair, Fl. Kerala Grasses 433. 1991; Joseph, Aquatic Angiosp. Malabar 490. 1991; Cook, Aquat. Wetland Pl. India 304. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 746. 2016. (Fig. 28 f)

Annual herbs. Culms erect, up to 1.5 m high, rooting at the lower nodes; nodes glabrous. Leaves linear - lanceolate or linear, acuminate, up to 60 x 1.2 cm, scabrid; sheaths ciliate along the margins; ligules 2 - 3 mm long, membranous. Panicles up to 30 cm long, lax. Spikelets, oblong, awned or awnless. Glumes reduced. Lower lemma 7 - 10 mm long, oblong - lanceolate, empty. Upper lemma 6 - 8 mm long, oblong - lanceolate, granulate, fertile. Palea oblong - lanceolate, acuminate. Stamens 6. Grains oblong, tightly enclosed by the lemma and palea.
Flowering and Fruiting: September - June
Growth form: Hyperhydates
Distribution: Cultivated in tropical regions
Habitat: Paddy fields.

SJ 16968 (Ponnamkode)

PANICUM L.

Panicum repens L., Sp. Pl. (ed. 2) 87. 1762; Hook. f., Fl. Brit. India 7: 49. 1896; Gamble, Fl. Pres. Madras 1783 (1235). 1934; Joseph, Aquatic Angiosp. Malabar 494. 1991; Sreek. & V.J. Nair, Fl. Kerala Grasses 271. 1991; Cook, Aquat. Wetland Pl. India 306. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 752. 2016.

Perennial herbs. Culms erect or trailing, rhizomatous, rooting at the lower nodes; nodes glabrous, up to 75 cm tall. Leaves linear or linear - lanceolate, base shallowly cordate, apex acuminate, distichous. Sheaths to 7 cm long, ciliate along the margins; ligules membranous,

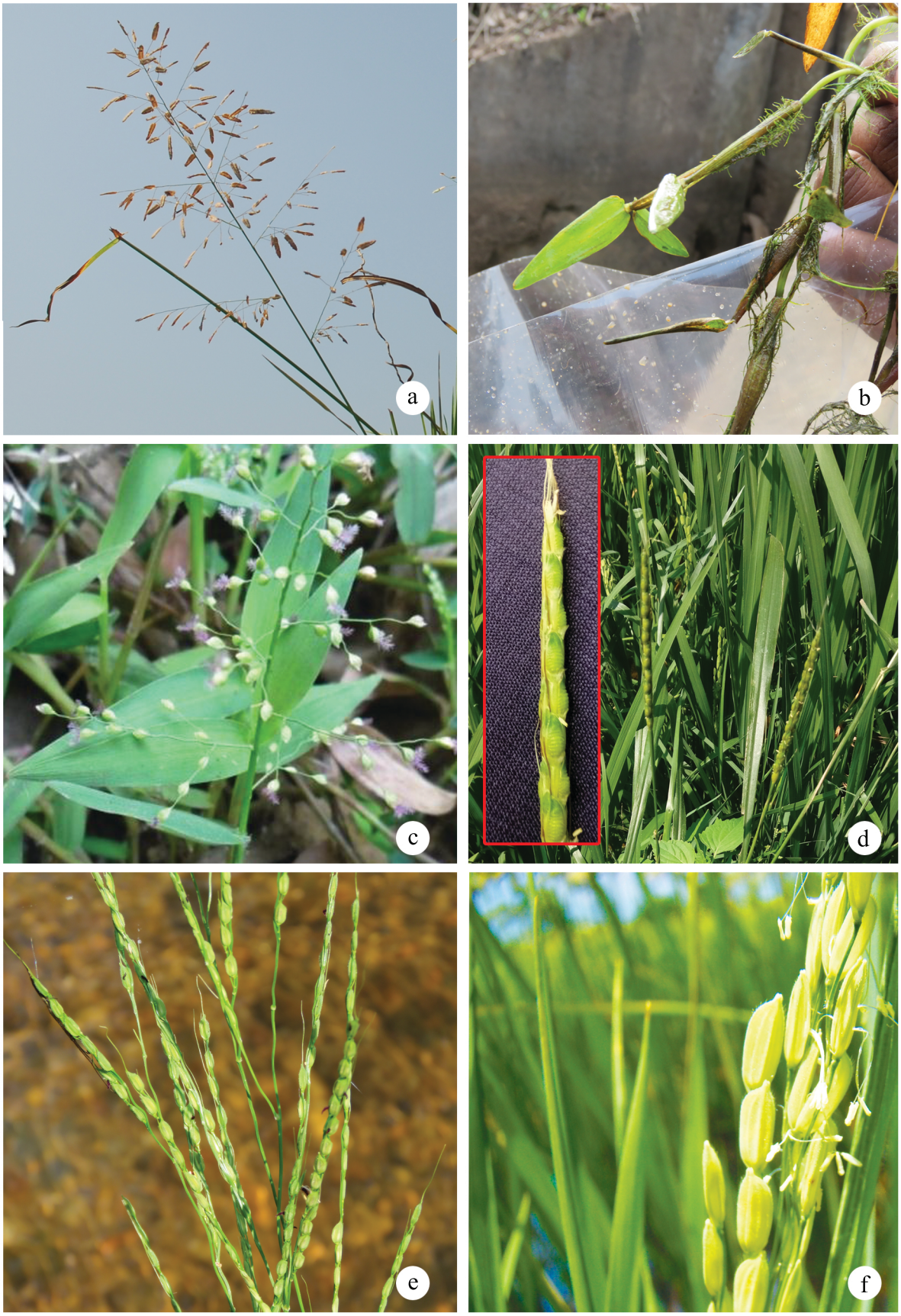


Fig. 28 a) *Eragrostis unioloides* b) *Hygroryza aristata* c) *Isachne globosa* d) *Ischaemum rugosum* e) *Oryza officinalis* f) *Oryza sativa*

with dense tuft of hairs. Panicles 6 - 18 cm long. Spikelets oblong - lanceolate, acute; pedicels 2 - 5 mm long. Lower glume ovate. Upper glume ovate - lanceolate, acute. Lower floret male. Upper floret bisexual. First lemma ovate - lanceolate. Palea oblong - lanceolate, hyaline, 2 - keeled. Stamens 3. Second lemma oblong, subcoriaceous. Palea elliptic, subcoriaceous. Stamens 3. Ovary ovate; stigma brown.

Flowering and Fruiting: July - November

Growth form: Helophyte/ Hyperhydates/ Pleustophyte

Distribution: Tropical and subtropical regions

Habitat: Ponds and rivers.

SJ 16927 (Koduvayur)

PASPALUM L.

1a. Upper glumes with long hairy margin..... *P. conjugatum*
1b. Upper glumes without long hairy margin ..... *P. scrobiculatum*

Paspalum conjugatum Berg., Act. Helv. Phys. Math. 7: 129. 1772; Hook. f., Fl. Brit. India 7: 11. 1896; Gamble, Fl. Pres. Madras 1772 (1228). 1934; Manilal, Fl. Silent Valley 359. 1988; Vajr., Fl. Palghat Dist. 584. 1990; Joseph, Aquatic Angiosp. Malabar 503. 1991; Sreek. & V.J. Nair, Fl. Kerala Grasses 285. 1991; Cook, Aquat. Wetland Pl. India 308. 1996; Sasidh., Fl. Parambikulam WLS 399. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 763. 2016.

Perennial herbs; culms creeping or stoloniferous, rooting at the nodes, up to 75 cm tall; nodes glabrous. Leaves lanceolate, base rounded, acuminate up to 18 x 1.3 cm. Sheaths 3 - 6 cm long, keeled, glabrous except at the collar and mouth. Ligules membranous. Racemes 2, conjugate. Spikelets, orbicular or broadly elliptic, long hairy, acute, creamy - yellow. Lower glume absent; upper glume ovate, long ciliate along the margins, membranous. Lower floret barren. Upper floret bisexual. Lower lemma orbicular or ovate, membranous; Upper lemma oblanceolate - elliptic, crustaceous, 2 - keeled. Stamens 3; anthers yellow. Stigmas white.

Flowering and Fruiting: Throughout the year
Growth form: Helophyte/ Hyperhydates
Distribution: Pantropical
Habitat: Riverbanks and marshy areas

SJ 16935 (Chittur)

Paspalum scrobiculatum L., Mant. Pl. 1: 29. 1767; Hook. f., Fl. Brit. India 7: 10. 1896; Gamble, Fl. Pres. Madras 1772 (1227). 1934; Manilal, Fl. Silent Valley 360. 1988; Vajr., Fl. Palghat Dist. 584. 1990; Joseph, Aquatic Angiosp. Malabar 501. 1991; Sreek. & V.J. Nair, Fl. Kerala Grasses 287. 1991; Cook, Aquat. Wetland Pl. India 309. 1996; Sasidh., Fl. Parambikulam WLS 399. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 765. 2016. *Paspalum orbiculare* Forst., Fl. Ins. Aust. Prodr. 7. 1786; Gamble, Fl. Pres. Madras 1772(1227). 1934. (Fig. 29 a)

Annuals or perennial herbs; culms tufted, erect or creeping and rooting at the lower nodes, up to 80 cm tall. Nodes glabrous. Leaves lanceolate to linear, acuminate, base rounded. Sheaths to 12 cm long; ligules membranous, ciliate. Racemes usually 2 with flat rachis. Spikelets 2 - ranked, ovate - orbicular or obovate, obtuse. Lower glume absent. Upper glume ovate or orbicular, membranous. Lower floret barren. Upper floret bisexual. Lower lemma ovate or orbicular, crustaceous; palea, ovate or orbicular, inflexed. Stamens 3; anthers yellow or brown. Stigmas reddish brown.
Flowering and Fruiting: Throughout the year
Growth form: Helophyte/ Hyperhydates
Distribution: India and Pakistan
Habitat: Marshes, ponds, and waterlogged areas

SJ 16945 (Attappadi)

PHRAGMITES Adans.

Phragmites karka (Retz.) Trin. ex Steud., Nomencl. Bot. (ed.2) 2: 324. 1841; Hook. f., Fl. Brit. India 7: 304. 1896; Gamble, Fl. Pres. Madras

1807 (1251). 1934; Vajr., Fl. Palghat Dist. 586. 1990; Sreek. & V.J. Nair, Fl. Kerala Grasses 331. 1991; *Arundo karka* Retz., Obs. Bot. 4: 21. 1786. *Phragmites vallatoria* (Pluk. Ex L.) Veldcamp in Blumea 37: 233.1992; Cook, Aquat. Wetland Pl. India 309. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 770. 2016.

Perennial large herbs with stoloniferous rhizomes. Culms tufted, reed - like, erect, up to 3 m tall, rhizome creeping; nodes glabrous. Leaves linear to narrowly lanceolate, acuminate, base rounded, margins scabrid, up to 60 x 2 cm; sheaths up to 10 cm long; ligule a narrow fringe of hairs. Panicles up to 40 cm long, pyramidal, lax, silky hairy. Spikelets up to 1.3 cm, linear - lanceolate, 3 - 6 flowered. Lower glume ovate - lanceolate. Upper glume elliptic - lanceolate. Lowest lemma barren, narrowly elliptic. Fertile lemmas linear - lanceolate. Paleas oblong - lanceolate, hyaline, 2 - keeled. Stamens 3. Caryopsis crowned by style base.

Flowering and Fruiting: Throughout the year

Growth form: Helophyte/ Hyperhydates

Distribution: Paleotropics

Habitat: Marshes, rivers and waterlogged areas

SJ 15027 (Shiruvani bridge)

SACCHARUM L.

Saccharum spontaneum L., Mant. Pl. 2: 183. 1771; Hook. f., Fl. Brit. India 7: 118. 1896; Gamble, Fl. Pres. Madras 1709 (1185). 1934; Vajr., Fl. Palghat Dist. 588. 1990; Sreek. & V.J. Nair, Fl. Kerala Grasses 185. 1991; Cook, Aquat. Wetland Pl. India 311. 1996; Sasidh., Fl. Parambikulam WLS 402. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 775. 2016. (Fig. 29 b)

Perennial tall herbs. Culms to 3 m high, erect, rhizomatous, nodes waxy. Leaves linear - lanceolate, Up to 150 x 1.5 cm, acuminate, base rounded, margins serrulate, involute. Sheaths to 40 cm long, silky villous at the collar; ligules membranous, ovate. Inflorescence a large

feathery panicle bearing numerous spreading branches, up to 32 cm long, densely silky white. Spikelets paired, one sessile and the other pedicelled, similar, lanceolate, reddish - brown. Lower glume ovate - lanceolate, subcoriaceous, margins hyaline, ciliate. Upper glume ovate - lanceolate, dorsally keeled, margins ciliate. Lower floret empty. Upper floret bisexual. First lemma ovate - acute, hyaline. Second lemma, linear - lanceolate, hyaline. Stamens 3; anthers yellow or reddish. Ovary oblong; stigma white.

Flowering and Fruiting: November to March

Growth form: Helophyte/ Hyperhydates

Distribution: Paleotropics

Habitat: Marshes, rivers and waterlogged areas

SJ 16928 (Pezhumkara)

SACCIOLEPIS Nash

Sacciolepis interrupta (Willd.) Stapf in Prain, Fl. Trop. Africa 9:757.1920; Gamble, Fl. Pres. Madras 1787 (1238). 1934; Vajr., Fl. Palghat Dist. 589. 1990; Sreek. & V.J. Nair, Fl. Kerala Grasses 299. 1991; Joseph, Aquatic Angiosp. Malabar 510. 1991; Cook, Aquat. Wetland Pl. India 313. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 777. 2016. *Panicum interruptum* Willd., Sp. Pl. (ed. 4) 341. 1798; Hook. f., Fl. Brit. India 7: 40. 1896. (Fig. 29 c)

Annual herbs. Culms inflated, hollow, lower part creeping, up to 90 cm tall, rooting at the nodes below; nodes glabrous. Leaves linear or lanceolate, acute or acuminate, base rounded. Sheaths to 15 cm long; ligules ovate, membranous. Panicles spiciform, interrupted, up to 25 cm long. Spikelets ovate - lanceolate. Lower glume ovate - oblong. Upper glume ovate - lanceolate. Lower floret male or barren. Upper floret bisexual. First lemma similar to the upper glume. Palea oblong, hyaline. Second lemma ovate - oblong, subcoriaceous. Palea elliptic, 2 - keeled, hyaline. Stamens 3; anthers dark purple. Stigmas pink. Grains 2 mm long, ovoid.

Flowering and Fruiting: Throughout the year
Growth form: Hyperhydates / Pleustophytes
Distribution: Tropics of south east Asia and Africa
Habitat: Marshes, ponds and water - logged areas

SJ 16929 (Pezhumkara)

CHRYSOPOGON Trin.

Chrysopogon zizanioides (L.) Roberty, Bull. Inst. Franç. Afrique Noire, A 22: 106 1960. *Vetiveria zizanioides* (L.) Nash in Small, Fl. South - East U.S. 67. 1903; Gamble, Fl. Pres. Madras 1733 (1201). 1934; Sreek. & V.J. Nair, Fl. Kerala Grasses 203. 1991; Cook, Aquat. Wetland Pl. India 314. 1996; Ansari *et al.*, Aquat. Wetland Fl. Kerala. Fl. Pl. 788. 2016. *Phalaris zizanioides* L., Mant. Pl. 2: 183. 1771. *Andropogon squarrosus* sensu Hook.f., Fl. Brit. India 7: 186. 1896, non L.f. 1781. (Fig. 29 d)

Perennial herbs. Culms tufted, erect, up to 1.75 m. Nodes glabrous. Leaves linear or linear - lanceolate, up to 60 x 1 cm, midrib prominent; sheaths to 30 cm long, sharply keeled; ligules membranous. Inflorescence a panicle of pyramidal shape, up to 30 cm long; racemes to 14 cm long, whorled. Spikelets in pairs, dissimilar. Sessile spikelets up to 5 mm long, lanceolate; lower glume lanceolate, coriaceous, spinulose; upper glume lanceolate. Lower floret empty. Upper floret bisexual. Lower lemma, elliptic, 3 - 5 nerved. Upper lemma 2 - 3 mm long, oblong. Palea oblong, hyaline. Stamens 3; ovary elliptic. Pedicelled spikelets 3 - 4 mm long, lanceolate; glumes lanceolate, coriaceous. Lower floret empty. Upper floret male. Lower lemma elliptic. Upper lemma lanceolate. Palea oblong. stamens 3. Caryopsis oblong enclosed in spiny glumes.
Flowering and Fruiting: July - December
Growth form: Helophytes
Distribution: India, Myanmar and Sri Lanka
Habitat: Marshes, ponds and riverbanks

SJ 15090 (Attappadi)

PODOSTEMACEAE Rich.ex C.A. Agardh

1a. Stamens free..... 2
1b. Stamens monadelphous.....3
2a. Roots thalloid ..... *Dalzellia*
2b. Roots thread like..... *Indotristicha*
3a. Chambers of ovary equal..... *Polypleurum*
3b. Chambers of ovary unequal..... 4
4a. Flowering shoots elongated with six rows of leaves..... *Willisia*
4b. Flowering shoots small with 2 rows of leaves..... *Zeylanidium*

DALZELLIA Wight

Dalzellia zeylanica (Gard.) Wight, Ic. t. 1919 - 1920. 1852; Nagendran & Arekal, Bull. Bot. Surv. India 23: 229. 1981; Joseph, Aquatic Angiosp. Malabar 180. 1991; Cook, Aquat. Wetland Pl. India 317. 1996; Mathew & Satheesh, Aqua. Bot. 57: 248. 1997; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 791. 2016. *Tristicha zeylanica* Gard., Calcutta J. Nat. Hist. 7: 117. 1847. *Lawia zeylanica* (Gard.) Tul., Ann. Sci. Nat. Bot. ser. 3, 2: 112. 1849; Gamble, Fl. Pres. Madras 1195 (836). 1925. *Terniola zeylanica* (Gard.) Tul., Podost. Monogr. 190. t. 13. 1852; Hook. f., Fl. Brit. India 5: 62. 1886; Vajr., Fl. Palghat Dist. 393. 1990. (Fig. 29 e)

Small aquatic herbs. Roots thalloid, prostrate, irregularly branched, green or bright red, attached to roots by haptera. Leaves scaly, numerous on edges and top of thallus. Flowers solitary, terminal to the thallus, pedicelled, emerging from a leafy cupule. Pedicels 2 - 3 mm long elongating to 1.5 – 2 cm in fruit. Perianth lobes 3. Stamens 3. Ovary minute, 3 - celled; ovules many. Capsule up to 2 mm long, ellipsoid, 9 ribbed. Seeds minute, many.

Flowering and Fruiting: February - March

Growth form: Haptophyte

Distribution: Endemic to South India and Sri Lanka

Habitat: On rocks in fast flowing streams

SJ 16973 (Attappadi)

INDOTRISTICHA van Royen

Indotristicha ramosissima (Wight) van Royen, Acta Bot. Neerl. 8: 474. 1959; Joseph, Aquatic Angiosp. Malabar 184. 1991; Cook, Aquat. Wetland Pl. India 320. 1996; Mathew & Satheesh, Aqua. Bot. 57: 246. 1997; Sasidh., Fl. Parambikulam WLS 259. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 797. 2016. *Tristicha ramosissima* (Wight) Willis, Ann. Roy. Bot. Gard. (Peradeniya) 1: 208. 1902 & 1:293 - 306. ff. 5 - 9. 1902; Gamble, Fl. Pres. Madras 1194 (836). 1925. (Fig. 29 f)

Roots long and slender, creeping, attached to rocks by haptera and rhizoids. Stem branched, up to 60 cm long, with 1.5 - 2.5 cm long ramuli and scale leaves. Flowers solitary, pedicellate, arising from cupule formed by scale leaves and 1 - 3 ramuli. Perianth 3, free, 2 - 3 mm long, ovate. Stamens 3. Ovary 2.5 mm long, ellipsoid,3 lobed; stigma 3. Capsule 3 locular,9 ribbed. Seeds small, numerous.

Flowering and Fruiting: January - March

Growth form: Haptophyte

Distribution: Endemic to southern Western Ghats

Habitat: On rocks in fast flowing streams

SJ 15028 (Pathrakkadavu)

POLYPLEURUM (Taylor ex. Tul.) Warm.

1a. Pedicels up to 8 mm..... *P. dichotomum*

1b. Pedicels up to 4 cm..... *P. stylosum*

Polypleurum dichotomum (Gard.) Hall, Kew Bull. 26: 131. 1972; Joseph, Aquatic Angiosp. Malabar 188. 1991; Vajr., Fl. Palghat Dist. 392. 1990; Cook, Aquat. Wetland Pl. India 322. 1996; Sasidh., Fl. Parambikulam WLS 259. 2002. Ansari *et al.,* Aquat. Wetland Fl.



Fig. 29 a) *Paspalum scrobiculatum* b) *Saccharum spontaneum* c) *Sacciolepis interrupta* d) *Chrysopogon zizanioides* e) *Dalzellia zeylanica* f) *Indotristicha ramosissima*

Kerala. Fl. Pl. 801. 2016. *Podostemum dichotomum* Gard., Calcutta J. Nat. Hist. 7: 185. 1846; Hook. f., Fl. Brit. India 5: 64. 1886. *Dicraeia dichotoma* (Gard.) Tul., Ann. Sci. Nat. Bot. ser. 3, 11:101. 1849; Gamble, Fl. Pres. Madras 1196 (837). 1925. (Fig. 30 a)

Roots to 25 x 0.6 cm, branched, ribbon like, free floating, base attached on rocks; Vegetative shoots developed along the margins. Leaves unequal. Flowers solitary on secondary shoot, pedicellate; pedicels 3 - 6 mm long in flower and up to 8 mm in fruit; stamens 2, monadelphous; style about 1 mm long; stigmas 2; Fruit 3 mm, ellipsoid, 8 - ribbed, isolobous. Seeds many.

Flowering and Fruiting: November - March

Growth form: Haptophyte

Distribution: Endemic to southern Western Ghats

Habitat: On rocks in fast flowing streams

SJ 15029 (Pathrakkadavu)

Polypleurum stylosum (Wight) Hall, Kew Bull. 26: 131. 1971; Vajr., Fl. Palghat Dist. 393. 1990; Joseph, Aquatic Angiosp. Malabar 189. 1991; Cook, Aquat. Wetland Pl. India 323. 1996; Mathew & Satheesh, Aqua. Bot. 57: 257. 1997; Sasidh., Fl. Parambikulam WLS 259. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 803. 2016. *Dicraeia stylosa* Wight, Ic. t. 1917. f.2. 1852; Gamble, Fl. Pres. Madras 1196 (837). 1925; Manilal, Fl. Silent Valley 228. 1988. *Podostemum stylosus* (Wight) Benth. ex Hook. f., Fl. Brit. India 5: 64. 1886. *Podostemum algaeformis* (Bedd.) Benth. ex Hook.f., Fl. Brit. India 5: 65. 1886. (Fig. 30 b)

Roots ribbon like, branched, attached to the substratum only at the base and other parts free floating, 15 - 20 cm long. Vegetative shoots developed along the margins at regular interval towards the base of the floating part, which will later develop into flowering shoots. Flowers solitary, terminal, pedicellate; pedicel 10 mm long developing up to 4 cm in fruits. Tepals 2; stamens 2; monadelphous. Stigmas 2;

subequal. Capsule long pedicellate, ovoid, 6 ribbed. Seeds many.

Flowering and Fruiting: October - February

Growth form: Haptophyte

Distribution: India and Sri Lanka

Habitat: On rocks in fast flowing streams

SJ 16930 (Nelliampathy)

WILLISIA Warm.

Willisia arekaliana Shivamurthy & Sadanant., Kew Bull. 243. 1997; Biju in Manoharan *et al.,* Silent Valley - Whispers Reason 173. 1999. Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 805. 2016. (Fig. 30 c)

Submerged herbs. Roots crustaceous, attached to the substratum by haptera, extensively branched. Vegetative shoots near the margin of the thallus, simple. Flowering shoots erect, up to 1.75 cm long. Leaves triangular in six rows. Flowers solitary, terminal, 3 x 2 mm, sessile. Tepals 2, 1mm long, shorter than the ovary. Stamens 2, monadelphous. Stigmas 2. Capsule opening by 2 unequal valves. Seeds numerous.

Flowering and Fruiting: December - February

Growth form: Haptophyte

Distribution: Endemic to Silent valley National Park

Habitat: On rocks in fast flowing streams

SJ 16958 (Sairandri)

ZEYLANIDIUM (Tul.) Engler

1a. Leaves caducous ..... *Z. lichenoides*

1b. Leaves persistent ..... *Z. subulatum*

Zeylanidium lichenoides (Kurz) Engl. in Engl. & Prantl, Naturl. Pflanzenfam. (ed. 2) 18a:62. 1928; Joseph, Aquatic Angiosp. Malabar 193. 1991; Cook, Aquat. Wetland Pl. India 324. 1996; Mathew & Satheesh, Aqua. Bot. 57: 265. 1997; Sasidh., Fl. Parambikulam WLS

260. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 808. 2016. *Hydrobryum lichenoides* Kurz, J. Asiat. Soc. Bengal 42:103. 1873; Gamble, Fl. Pres. Madras 1199 (839). 1925. *Podostemum acuminatus* Wedd. in DC., Prodr. 17: 75. 1873; Hook. f., Fl. Brit. India 5: 66. 1886. *Podostemum microcarpus* Wedd. in DC., Prodr. 17: 76. 1873; Hook. f., Fl. Brit. India 5: 66. 1886. (Fig. 30 d)

Roots ribbon like, pinnately branched. Vegetative shoots short, simple and marginal. Leaves filiform, 3 - 6 mm long; flowering shoots arising from the margin of the thallus, with distichous leaves, terminating in a caducous thread like tip. Spathella boat shaped, prostrate, splitting along the upper side. Flowers 2.5 x 1 mm, zygomorphic, pedicellate. Pedicels 1 - 4 mm long. Tepals 2, 1 mm long, scarious, subulate; stamens 2, monadelphous, andropodium up to 1.2 mm long; anthers bilobed, lobes unequal. Stigma bilobed, lobes unequal, smooth. Capsule 2 x 1 mm, anisolobous, ellipsoid, ribs 8. Seeds minute, many.
Flowering and Fruiting: February - March
Growth form: Haptophyte
Distribution: India and Sri Lanka
Habitat: On rocks in fast flowing streams

SJ 15030 (Pathrakkadavu)

Zeylanidium subulatum (Gardner) C. Cusset, Bull. Mus. Natl. Hist. Nat., B, Adansonia 14: 32. 1992. *Podostemum subulatum* Gard., Calcutta J. Nat. Hist. 7: 184. 1846; Hook. f., Fl. Brit. India 5: 65. 1886; Gamble, Fl. Pres. Madras 1196(838). 1925; Joseph, Aquatic Angiosp. Malabar 185. 1991; Cook, Aquat. Wetland Pl. India 321. 1996; Mathew & Satheesh, Aqua. Bot. 57: 257. 1997; '*subulatus*' (*Orth, Mut*,) Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 800. 2016. (Fig. 30 e)

Thallus dichotomously branched. Leaves distichous, very dense, sheathing at base, long subulate at apex, up to 6 cm long. Flowers axillary, pedicellate; pedicels 1.5 -5 mm long. Spathella variable, splitting irregularly into 4 or 5 lobes. Tepals 2, shorter than ovary.

Stamens 2, monadelphous; andropodium up to 6 mm. Ovary bicarpellate 2.5 x 1.5 mm, 6-ribbed, stigma lobes equal. Capsule 3 x 1.5 mm, 2 valved; valves unequal; each valve 3 ribbed.

Flowering and Fruiting: January - March
Growth form: Haptophyte
Distribution: South India and Sri Lanka
Habitat: On rocks in fast flowing streams

SJ 16932 (Nelliampathy)

POLYGONACEAE Juss.

1a. Leaf blades less than 3 cm long ..... *Polygonum*
1b. leaf blades more than 3 cm long ..... *Persicaria*

PERSICARIA Mill.

1a. Nuts trigonous ..... *P. barbata*
1b. Nuts biconvex..... *P. glabra*

Persicaria barbata (L.) Hara, Fl. E. Himal. 1: 70. 1966; Joseph, Aquatic Angiosp. Malabar 198. 1991; Sasidh., Fl. Parambikulam WLS 258. 2002; Ratheesh Narayanan, Fl. Stud. Wayanad Dist. 676. 2009. *Polygonum barbatum* L., Sp. Pl. 362. 1753; Hook. f., Fl. Brit. India 5: 37. 1886; Gamble, Fl. Pres. Madras 1189(833). 1925; Vajr., Fl. Palghat Dist. 390. 1990; Cook, Aquat. Wetland Pl. India 325. 1996. Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 812. 2016. (Fig. 30 e)

Perennial herbs, to 1.2 m tall, erect. Leaves simple, opposite, subsessile, 7 - 15 x 1.5 - 3 cm, lanceolate, apex acute or acuminate, base acute to cuneate, glabrous except the margins and midribs; ocrea tubular, 1.5 - 3 cm long, mouth truncate, long barbate. Inflorescence terminal, paniculate, up to 11cm long. Perianth white; lobes 5, 2 - 3 mm long, oblong. Stamens 5. Style with three arms. Nutlets trigonous, included within perianth tube, black.

Flowering and Fruiting: August – March.



Fig. 30 a) *Polypleurum dichotomum* b) *Polypleurum stylosum* c) *Willisia arekaliana* d) *Zeylanidium lichenoides* e) *Zeylanidium subulatum* f) *Persicaria barbata*

Growth form: Helophyte

Distribution: Paleotropics

Habitat: Marshy areas and riverbanks

SJ 11865 (Olavakkode)

Persicaria glabra (Willd.) Gomez, Ann. Inst. Segunda Ensef. Habana 2: 278. 1896; Manilal, Fl. Silent Valley 227. 1988; Sasidh., Fl. Parambikulam WLS 258. 2002; *Polygonum glabrum* Willd., Sp. Pl. 2: 447.1799; Hook. f., Fl. Brit. India 5:34.1886; Gamble, Fl. Pres. Madras 1189 (832). 1925; Vajr., Fl. Palghat Dist. 391. 1990; Cook, Aquat. Wetland Pl. India 325. 1996. Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 812. 2016. (Fig. 31 a)

Perennial stout herbs, up to 1.5 m tall. Leaves, lanceolate, base acute or cuneate, apex gradually acuminate, up to 14 x 2.5 cm; ochrea tubular, truncate at mouth. Pedicels up to 3 mm long. Bracts oblong or broadly triangular, margin scarious. Perianth tubular - campanulate, rose or pink coloured; lobes 5, oblong, obtuse.

Stamens 5. Style 2. Nut biconvex, included within the perianth tube, black.

Flowering and Fruiting: August – December.

Growth form: Helophyte

Distribution: Paleotropics

Habitat: Marshy areas and riverbanks

SJ 15079 (Mannarkkad)

POLYGONUM L.

Polygonum plebeium R. Br., Prodr. 420. 1810; ('plebejum' *orth. Mut.*) Hook. f., Fl. Brit. India 5: 27. 1886; Gamble, Fl. Pres. Madras 1188 (832). 1925; Vajr., Fl. Palghat Dist. 391. 1990; Cook, Aquat. Wetland Pl. India 327.1996; Sasidh., Fl. Parambikulam WLS 258. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 816. 2016. (Fig. 31 b)

Prostrate woody herbs forming dense mats. Leaves alternate, sessile, up to 10 x 4 mm, linear - oblong, acute, glabrous; ochrea hyaline, obliquely tubular, white, ciliate. Flowers 3 - 7 together in axillary clusters, sessile. Tepals 5, ovate, acute, glabrous. Stamens 5. Nut 1.5 mm long, trigonous with persistent style, glabrous, brown.

Flowering and Fruiting: March - April

Growth form: Helophyte

Distribution: Pantropical

Habitat: Margins of dams.

SJ 11880 (Walayar Dam)

PONTEDERIACEAE Kunth

1a. Anthers basifixed ..... *Monochoria*
1b. Anthers dorsifixed ..... *Eichhornia*

EICHHORNIA Kunth.

Eichhornia crassipes (Mart.) Solms. in A. & C. DC., Monogr. Phan. 4:527.1883; Gamble, Fl. Pres. Madras 1530 (1069). 1928; Vajr., Fl. Palghat Dist. 512. 1990; Joseph, Aquatic Angiosp. Malabar 515. 1991; Cook, Aquat. Wetland Pl. India 329. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 819. 2016. (Fig. 31 c)

Perennial floating herbs sometimes growing terrestrial in marshy places, 30 - 50 cm high, with short stem and many long fibrous roots. Leaves glabrous, radical, rosulate, broadly ovate to orbicular, entire, obtuse, base cuneate or rounded, 7 - 18 cm long and wide. Petiole glabrous and spongy, 6 - 30 cm long, with a fusiform bulbous portion about the middle. Peduncle spongy. Inflorescence a spike of 20 - 30 flowers. Flowers lilac, tinged blue, withering soon. Perianth tubular below, 6 lobed, posterior segment with a yellow spot. Stamens 6, anthers purple - blue. Style glandular; stigma 3 - lobed, glandular. Capsule ovoid, glabrous. Seeds 8 - 10 ribbed.

Flowering and Fruiting: October - February

Growth form: Hyperhydate / Pleustophyte
Distribution: South America; now naturalized in the paleotropics
Habitat: Ponds and rivers.

SJ 11807 (Pattambi)

MONOCHORIA C. Presl

Monochoria vaginalis (Burm. f.) Presl, Reliq. Haenk. 1:128.1827; Gamble, Fl. Pres. Madras 1529 (1068). 1931; Vajr., Fl. Palghat Dist. 512. 1990; Joseph, Aquatic Angiosp. Malabar 517. 1991; Cook, Aquat. Wetland Pl. India 330. 1996; Sasidh., Fl. Parambikulam WLS 354. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 823. 2016. (Fig. 31 d)

Annual or perennial erect, semi - aquatic herbs, up to 45 cm tall. Leaves radical, 8 x 4.5 cm, obovate, base cordate, apex abruptly acuminate, thinly coriaceous; petiole 5 - 25 cm long, sheathing at base. Inflorescence of solitary terminal raceme, to 10 cm long. Flowers up to 2 cm across; pedicel 1 - 1.8 cm long. Perianth campanulate, deeply 6 lobed, deep blue, oblong - obovate. Stamens 6; one larger than the others. Style up to 5 mm long; stigma 3 lobed. Capsule ellipsoid, 1 cm long. Seeds many, oblong, longitudinally ribbed.
Flowering and Fruiting: July - November
Growth form: Hyperhydate / Tenagophyte
Distribution: India to China, Malesia and Japan
Habitat: Ponds, paddy fields and riverbanks.

SJ 11878 (Walayar Dam)

POTAMOGETONACEAE Dum.

POTAMOGETON L.

Potamogeton nodosus Poir., Encyc. Suppl. 4: 535. 1818. Cook, Aquat. Wetland Pl. India 333. 1996. *Potamogeton indicus* Roxb., Fl. India 1: 471. 1820, non Roth ex Roem. & Schultes, 1818; Hook. f., Fl.

Brit. India 6: 565. 1893; Gamble, Fl. Pres. Madras 1600 (1116). 1931. (Fig. 31 e)

Perennial, rhizomatous, robust, creeping and aquatic herb. Stem up to 1m long, branched, leafy, terete; nodes often swollen. Leaves dimorphic, submerged leaves petiolate, lanceolate to lanceolate - oblong, 6 - 15 cm long; floating leaves ovate to elliptic, coriaceous, 4 - 10 cm long, 2 - 4 cm broad, entire, stipules free. Spikes cylindric, 3 - 8 cm long, 1.5 - 3 mm broad; peduncles rigid, erect, emergent, up to 11 cm long. Flowers sessile, small. Perianth segments small, obtuse, entire. Drupe sharply keeled, 3 - 4 x 2 - 3 mm broad, beaked.

Flowering and Fruiting: October - December

Growth form: Ephydate

Distribution: Indo - Malesia, Europe, Africa and America

Habitat: Rivers

SJ 11834 (Malampuzha canal)

RUBIACEAE Juss.

1a. Flowers pentamerous..... *Dentella*

1b. Flowers tetramerous ..... *Oldenlandia*

DENTELLA J. R. & Forst.

Dentella repens (L.) J. R. & G. Forst., Char. Gen. Pl. 26. t.13. 1776; Hook. f., Fl. Brit. India 3: 42. 1880; Gamble, Fl. Pres. Madras 590 (416). 1921; Vajr., Fl. Palghat Dist. 230. 1990; Cook, Aquat. Wetland Pl. India 337. 1996; Sasidh., Fl. Parambikulam WLS 148. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 839. 2016. (Fig. 31 f)

Annual or perennial prostrate herbs, rooting at nodes. Leaves simple, opposite, subsessile, elliptic - oblong, up to 5 x 2.5 mm, base cuneate, apex acute. Flowers axillary, solitary, sessile. Calyx tube up to 2 mm long; lobes 5, subulate, hairy. Corolla white; tube 2 - 3 mm long, funnel - shaped, hairy within; lobes 5. Stamens 5, included, attached



Fig. 31 a) *Persicaria glabra* b) *Polygonum plebeium* c) *Eichhornia crassipes* d) *Monochoria vaginalis* e) *Potamogeton nodosus* f) *Dentella repens*

in the middle of corolla tube; anthers linear. Stigma 2 - lobed. Fruits subglobose, up to 3 mm in diameter, indehiscent, densely hairy, crowned by the persistent sepals; seeds minute, brown.

Flowering and Fruiting: March - April

Growth form: Helophyte

Distribution: Indo – Malesia

Habitat: Riverbanks and wet localities

SJ 11810 (Kalpathy)

OLDENLANDIA L.

1a. Flowers blue..... *O. dineshii*
1b. Flowers white..... 2
2a. Leaves orbicular..... *O. trinervia*
2b. Leaves linear – lanceolate..... 3
3a. Stem quadrangular ..... *O. corymbosa*
3b. Stem terete..... *O. diffusa*

Oldenlandia corymbosa L., Sp. Pl. 119.1753, Hook. f., Fl. Brit. India 3: 64. 1880; Gamble, Fl. Pres. Madras 600 (423). 1921; Vajr., Fl. Palghat Dist. 239. 1990; Cook, Aquat. Wetland Pl. India 337. 1996; *Hedyotis corymbosa* (L.) Lam., Encycl. 1: 272. 1792; Swarup. *et al.,* Shola For. Kerala 67. 1998; Sasidh., Fl. Parambikulam WLS 150. 2002; Dutta & Deb, Taxonomic Revision Hedyotis 149. 2004; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 839. 2016. (Fig. 32 a)

Annual herbs, stem prostrate with ascending branches, quadrangular. Leaves simple, opposite, subsessile, up to 25 x 4 mm, linear - lanceolate, acute at apex, base attenuate, entire and inrolled along margins. Inflorescence an axillary corymbose cymes with 3 - 8 flowers; peduncles 4 - 8 mm long. Hypanthium about 1 mm long, lobes triangular. Corolla white, tetramerous. Stamens 4 inserted at corolla base. Capsules subglobose, l2 mm across. Seeds minute.

Flowering and Fruiting: April - October

Growth form: Helophyte

Distribution: Pantropical

Habitat: Riverbanks and wet localities

SJ 16912 (Malampuzha)

Oldenlandia diffusa (Willd.) Roxb., Fl. Ind. 1: 444. 1820; Hook. f., Fl. Brit. India 3: 65. 1880; Gamble, Fl. Pres. Madras 601(423). 1921; Cook, Aquat. Wetland Pl. India 337. 1996. *Hedyotis diffusa* Willd., Sp. Pl. 1: 566. 1768; Manilal, Fl. Silent Valley 132. 1988; Joseph, Aquatic Angiosp. Malabar 203. 1991; Dutta & Deb, Taxonomic Revision Hedyotis 144. 2004; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 840. 2016. *Oldenlandia brachypoda* DC., Prodr. 4: 424. 1830; Cook, Aquat. Wetland Pl. India 336. 1996. *Hedyotis brachypoda* (DC.) Sivar. & Biju, Taxon 39: 672. 1990; Joseph, Aquatic Angiosp. Malabar 202. 1991; Sasidh., Fl. Parambikulam WLS 149. 2002. (Fig. 32 b)

Annual diffuse herbs; stem terete, sparsely pubescent towards nodal regions. Leaves linear – lanceolate, up to m, 20 x 5 mm, lateral veins absent; stipules sheathing, shortly pectinate on the margins. Flowers axillary, solitary or in pairs, sessile or sub sessile. Hypanthium subglobose, up to 1.5 mm diameter; lobes triangular, up to 1mm long. Corolla white; tube 1 - 2 mm long; style shortly exserted; stigma papillate. Capsule subglobose, 2 mm long, laterally compressed, dehiscing loculicidally at tip; seeds minute, angular, reticulate.

Flowering and Fruiting: August - December

Growth form: Helophyte

Distribution: Tropical and subtropical Asia and America

Habitat: Riverbanks and wet localities

SJ 16931 (Malampuzha dam)

Oldenlandia dineshii Sojan & V. Suresh, Kew Bulletin 70 (13):1. 2015. (Fig. 33)

Profusely dichotomous branched erect ephemeral herbs, 5 – 20 cm tall; stem acutely 4 - angled, angles minutely winged, glabrous. Leaves linear - lanceolate, sparsely scabrid, sessile, 1 - nerved, apex acute,

base attenuate, 10 – 20 × 5 – 8 mm. Stipules with 2 – 3 bristles, base broad up to 5 mm, bristles 2 – 4 mm long. Inflorescence axillary, solitary or terminal 2 – 4 - flowered cymes. Flowers, 5 – 7 × 4 – 6 mm; pedicel 4 – 6 mm long. Hypanthium ovoid, puberulous; calyx lobes 4, 0.7 – 1 × 0.5 – 0.7 mm, acute at tip, margins setulose. Corolla broadly campanulate, dark blue; tube 2.5 – 4 mm long; lobes oblong, tip acute, 2.5 – 3.5 mm long, minutely pubescent outside and glabrous inside of the tube. Stamens 4, inserted and introrse; filaments 0.7 – 1 mm long, hairy, included within the corolla lobes; anthers oblong, glabrous, 1 – 1.2 mm long. Ovary 0.5 – 0.7 mm long, ovules numerous in each locule with axile placentation; stigma bifid, lobes 0.4 – 0.6 mm long, hispid; style glabrous. Capsule ovoid, 2.5 – 3 × 1.5 – 2.5 mm, crown raised above; seeds many, angular, 0.3 – 0.5 × 0.3 – 0.5 mm.

Note: New discovery

Flowering and Fruiting: August - October

Growth form: Helophyte

Distribution: Endemic to Kerala.

Habitat: Wet rocks

SJ 11830 (Nemmara)

Oldenlandia trinervia Retz., Obs. Bot. 4:23.1786; Hook. f., Fl. Brit. India 3:66.1880; Gamble, Fl. Pres. Madras 597 (421). 1921. *Hedyotis trinervia* (Retz.) Roem. & Schult., Syst. Veg. 3: 197. 1819; Dutta & Deb, Taxonomic Revision Hedyotis 132. 2004. (Fig. 32 c)

Annual prostrate herbs, branches diffuse, slender, stem slightly winged. Leaves opposite, up to 12 x 7 mm, orbicular, broadly ovate, acute, often mucronate at apex, narrowed at base to short petiole, membranous, punctate, pale green when dry, 3 - nerved below. Stipules connate, short, about 1 mm long. Flowers 2 - 3 mm long in axillary clusters of 2 - 6 flowers or sometimes solitary; pedicel 1 - 1.5 mm, pilose. Calyx tube 1 - 1.2 mm long, globose, lobes 4, triangular to ovate - lanceolate. Corolla tube very short; lobes up to 1.8 mm long. Stamens 4, included. Ovary up to 1 mm long; ovules many; style up

to 0.5 mm long; stigma capitate, bilobed. Capsule globose, laterally compressed. Seeds many, triangular.

Note: New report to Palakkad

Flowering and Fruiting: November - April

Growth form: Helophyte

Distribution: Indo - Malesia and tropical Africa

Habitat: Riverbanks

SJ 15036 (Karimbuzha)

SALICACEAE Mirb.

SALIX L.

Salix tetrasperma Roxb., Pl. Corom. t. 97. 1798; Hook. f., Fl. Brit. India 5: 626. 1888; Gamble, Fl. Pres. Madras 1390 (973). 1928; Manilal, Fl. Silent Valley 266. 1988; Vajr., Fl. Palghat Dist. 458. 1990; Sasidh., Fl. Parambikulam WLS 314. 2002. (Fig. 32 d)

Deciduous dioecious trees, up to 25 m high. Leaves simple, alternate; stipules lateral, ovate, caducous; petiole 1 - 3 cm, slender, glabrous, grooved above; lamina up to 15 x 5 cm, ovate or ovate - lanceolate; base acute or rounded; apex acuminate; margin serrate, glabrous and shining above, glaucous beneath, coriaceous. Inflorescence catkin, axillary, up to 7 cm long. Male flowers yellow; female greenish; bracts ovate, densely woolly; perianth absent; stamens 5 - 12, unequal, free, with 2 glands at the base; anthers basifixed. stigma 2. Fruit a capsule, 4 mm. Seeds 1 - 4, oblong, hairy.

Flowering and Fruiting: September – February.

Growth form: Helophyte

Distribution: Indo - Malesia and south China

Habitat: Riverbanks

SJ 16959 (Attappadi)

SPHENOCLEACEAE T.Baskerv.

SPHENOCLEA Gaertn.

Sphenoclea zeylanica Gaertn., Fruct. 1: 113,t.24. f.5. 1788; Hook. f., Fl. Brit. India 3: 438. 1881; Gamble, Fl. Pres. Madras 739 (520). 1921; Vajr., Fl. Palghat Dist. 261. 1990; Joseph, Aquatic Angiosp. Malabar 253. 1991; Cook, Aquat. Wetland Pl. India 363. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 163. 2016.

Annual herbs; stem erect or decumbent, swollen at the base, up to 125 cm high, divaricately branched. Leaves alternate, stipules absent, blades oval to oblong - elliptic, up to 10 cm long and 3 cm wide, cuneate or abruptly acute at base, subacute to obtuse at apex, entire; petioles 1 - 3 cm long. Inflorescence a terminal dense spike up to 6.5 cm long and around 1 cm in diameter; flowers many. Bracts spathulate, up to 3 x 2 mm, clawed, inflexed over calyx. Bracteoles lateral to bracts, linear, 2 - 3 mm long. Calyx tube cupular, 1 mm long; pale green. Corolla white; bell shaped, tube 1 - 1.5 mm long. Stamens 5, Filaments glabrous. Ovary semi inferior, 2 locular: style 1; stigma flattened, slightly forked. Capsule globose, 3 - 3.5 mm in diameter; seeds minute, numerous.

Flowering and Fruiting: August - October

Growth form: Helophyte

Distribution: Pantropical

Habitat: Riverbanks and wet localities

SJ 11824 (Kalpathy)

TYPHACEAE L.

TYPHA L.

Typha angustifolia L., Sp. Pl. 971. 1753; Guha & Mondal, Journ. Econ. Tax. Bot. 22: 519. 1998; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 897. 2016. *Typha domingensis* Pers., Syn. Pl. 2: 532. 1807.

Cook, Aquat. Wetland Pl. India 365.1996. *Typha angustata* Bory & Chaub., Exped. Sci. Moree Bot. 1: 338. 1832; Hook. f., Fl. Brit. India 6: 489. 1893; Gamble, Fl. Pres. Madras 1571 (1096). 1931; Vajr., Fl. Palghat Dist. 530. 1990; Joseph, Aquatic Angiosp. Malabar 523. 1991. (Fig. 32 e)

Robust perennial herbs, up to 2.5 m tall. Rhizomes creeping, up to 1,5 cm in girth. Stems terete. Leaves distichous, linear, up to 2 m long, flattened towards apex, thick, spongy. Inflorescence a cylindrical spike of unisexual flowers; male spike is positioned above the female one and is separated from other by a distance ranging from 1 - 5 cm. Male spike up to 18 cm long; male flowers densely packed in the spike and mixed with simple, linear spathulate hairs; stamens 2 or 3. Female spikes to 20 cm long, terete; female flowers on compound stalks interspersed with bracts and sterile flowers; style to 3 mm long; stigma flattened. Fruit about 2 mm long, fusiform.

Flowering and Fruiting: November - March

Growth form: Hyperhydate

Distribution: Cosmopolitan

Habitat: Rivers and ponds

SJ 16961 (Kannadi)

URTICACEAE Juss.

ELATOSTEMA Gaudich.

Elatostema lineolatum Wight **var. *falcigera*** Thw., Enum. Pl. Zeyl. 260. 1861; Hook. f., Fl. Brit. India 5: 565. 1888; Gamble, Fl. Pres. Madras 1377 (963). 1928; Manilal, Fl. Silent Valley 262. 1988; Sasidh., Fl. Parambikulam WLS 302. 2002. (Fig. 32 f)

Annual or perennial herbs, branches scandent, pilose. Leaves 8 long and 2.5 cm broad, linear, apex acuminate, gibbous at one side, crenate, base 3 - ribbed, sessile. Male flowers pedicellate; bracteoles 3 mm long, oblanceolate; perianth lobes 4, up to 1,5 mm long, hairy at



Fig. 32 a) *Oldenlandia corymbosa* b) *Oldenlandia diffusa* c) *Oldenlandia trinervia* d) *Salix tetrasperma* e) *Typha angustifolia* f) *Elatostema lineolatum*

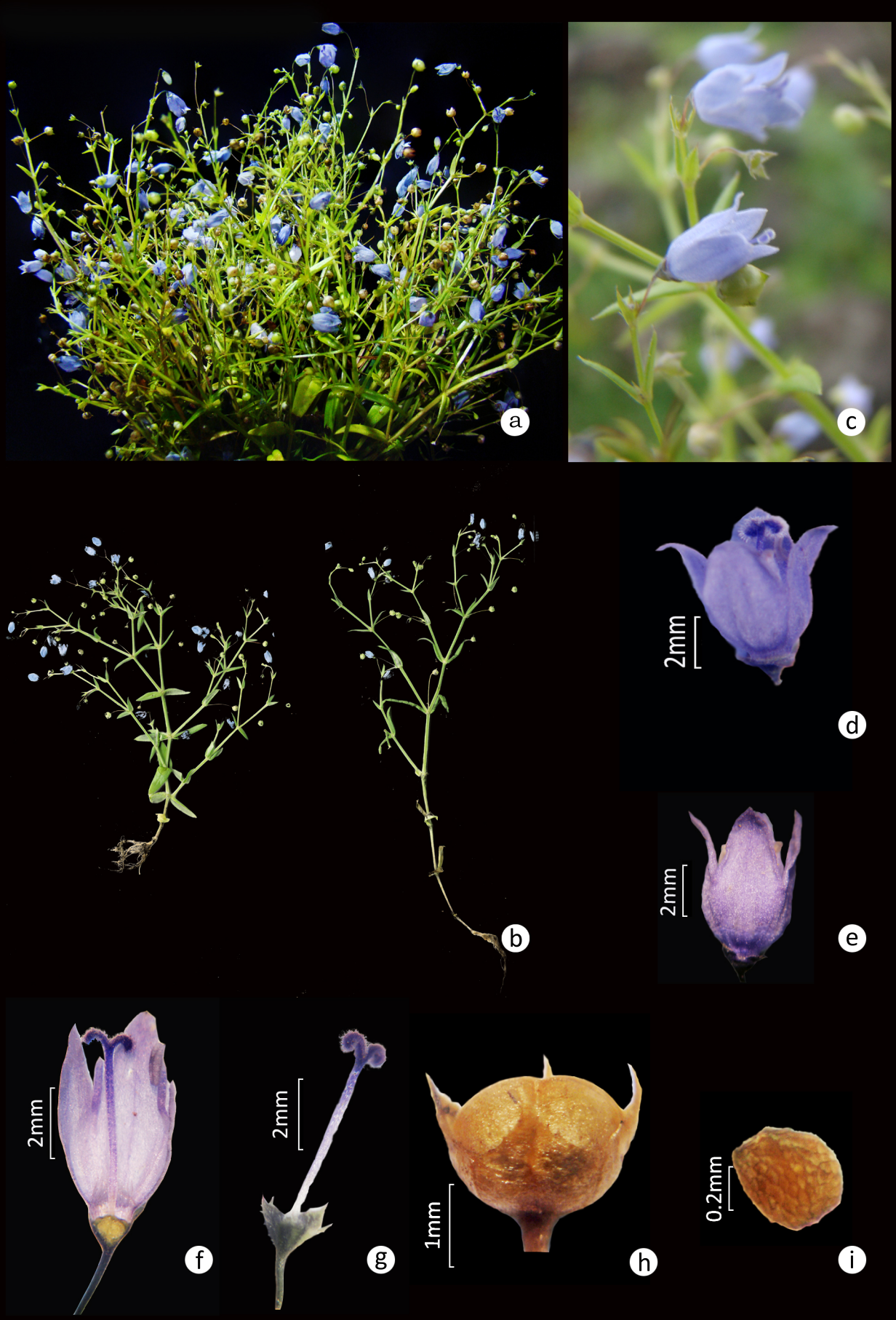


Fig. 33 *Oldenlandia dineshii*. a & b) habit c) close up of flower d) single flower e) abaxial view of flower f) corolla split open g) style with bifid stigma h) fruit i) seed

apex, glandular; stamens 4, anthers deeply cleft at base. Female flowers with 3 - 4 perianth lobes. Stigma sessile.

Flowering and Fruiting: August - May

Growth form: Helophytes

Distribution: Indo - Malesia

Habitat: On the rocks along water courses in evergreen forests

SJ 11843 (Meenvani)

VERBENACEAE Jaume St. - Hill

PHYLA Lour.

Phyla nodiflora (L.) Greene, Pittonia 4: 46. 1899; Vajr., Fl. Palghat Dist. 367. 1990; Cook, Aquat. Wetland Pl. India 366. 1996; Sasidh., Fl. Parambikulam WLS 241. 2002; Rajendran & Daniel, Indian Verbenaceae 206. 2002; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 906. 2016. *Lippia nodiflora* (L.) A. Rich. in Michx., Fl. Bor. Amer. 2: 15. 1803; Hook. f., Fl. Brit. India 4: 563. 1885; Gamble, Fl. Pres. Madras 108 8(762). 1924.

Prostrate herbs, stem rooting at nodes, up to 75cm long. Leaves simple, opposite, obovate - spathulate or oblanceolate, sometimes elliptic, apex rounded or obtuse, base cuneate, margin sharply serrate above the middle, fleshy, up to 3cm long and 1.3 cm broad; petiole to 8 mm long, decurrent. Flowers on ascending shoots in cylindrical spikes. pentamerous, sessile, 1 - 2 cm long and up to 9 mm in diameter. Peduncle up to 5 cm long. Calyx cupular, lobes lanceolate. Corolla pink to white, 2 - 2.5 mm long, salver shaped, 2 - lipped. Stamens 4. Drupe globose. Seeds 2 per drupe, plano - convex.

Flowering and Fruiting: November - December

Growth form: Helophytes

Distribution: Tropics and subtropics

Habitat: Paddy fields and wet localities

SJ 16972 (Agali)

XYRIDACEAE C.A. Agardh.

XYRIS L.

Xyris pauciflora Willd., Phytogr. 1: 2, t.1,f.1. 1794; Hook. f., Fl. Brit. India 6: 365. 1892; Gamble, Fl. Pres. Madras 1532 (1070). 1928; Manilal, Fl. Silent Valley 324. 1988; Joseph, Aquatic Angiosp. Malabar 526. 1991; Cook, Aquat. Wetland Pl. India 369. 1996; Ansari *et al.,* Aquat. Wetland Fl. Kerala. Fl. Pl. 911. 2016.

Annual, tufted, erect herbs. Culms nearly terete, up to 20 cm tall. Leaves linear, acuminate, margins sometimes thickened, up to 15 cm long. Heads globose – ellipsoid, up tp 7 x 5 mm. Bracts closely imbricating, broadly ovate – orbicular, brown, mucronate. Sepals 3, unequal; lateral ones keeled, curved. Petals 3, obovate, emarginate at apex, yellow. Stamens 3, attached to the base of petals; staminodes 3, alternating with petals. Capsule oblong. Seeds ellipsoid with longitudinal ridges.

Flowering and Fruiting: August - October

Growth form: Helophytes

Distribution: Indo - Malesia to Australia

Habitat: Marshy areas and wet rocks.

SJ 11814 (Pallavur)

5.4 Systematic treatment of aquatic and wetland pteridophytes

The pteridophytes are generally treated under two groups *i.e.,* Ferns and Fern allies. The former is considered as advanced, originated during the late Carboniferous period whereas Fern allies originated and established during the Silurian period (Madhusoodanan, 2015). During the present explorations in Palakkad, ten wetland species belonging to nine families were collected. Only one species (*Calamaria coromandelina* (L. f.) Kuntze) belongs to the Lycophyte (Fern ally) and all others belong to the group of Ferns.

5.5 Key to the families of aquatic and wetland pteridophytes of Palakkad district

1a. Fronds scale-like ..... Equisetaceae
1b. Fronds not as above 2
2a. Sporocarp present 3
2b. Sporocarp absent 4
3a. Plants free floating ..... Salviniaceae
3b. Plants rooted hydrophytes ..... Marsileaceae
4a. Sporangia at the base of grass like fronds ..... Isoetaceae
4b. Sporangia not as above 5
5a. Lamina simple ..... Polypodiaceae
5b. Lamina pinnate 6
6a. Fertile portion on the apex of the lamina as tassels... Osmundaceae
6b. Fertile portion not as tassels 7
7a. Sori protected with indusia 8
7b. Sori marginal with false indusia .... Pteridaceae
8a. Fronds with superficial linear sori ..... Athyriaceae
8b. Fronds with superficial 'V' shaped sori ..... Thelypteridaceae

5.6 Enumeration and description of taxa

ATHYRIACEAE Alston

DIPLAZIUM Sw.

Diplazium esculentum (Retz.) Sw., J. Bot. (Schrad.) 1801 (1): 312. 1803; Bedd., Handb. Ferns. Brit. India. 192. 1883; Manickam & Irud., Pterid. FI. W. Ghats - S. India 241. Pl. 187. 1992; B. K. Nayar & Geev., Fern Fl. Malabar 195. 1993. (Fig. 34 a & b)

Medium sized terrestrial herbs. Rhizome short, erect; scales linear - lanceolate. Frond dimorphic; pinnate when young (primary); bipinnate when mature; purplish glands scattered throughout the stipe and rachis; lamina deltoid, apex acuminate, bipinnate at base, simple pinnate at apex. Pinnae up to 10 pairs, basal 1 or 2 opposite or

subopposite, others alternate. Sori linear along veins, dark brown. Spores monolete, bilateral and perinate.

Fertile: July - April

Growth form: Hyperhydate/Helophyte

Distribution: Asia and Oceania

Habitat: Ponds, canals and paddy fields.

SJ 11862 (Mannarkkad)

EQUISETACEAE Michx. ex DC.

EQUISETUM L.

Equisetum ramosissimum Desf., Fl. Atlant. 2: 398 - 399. 1799; Manickam & Irud., Pterid. Fl. W. Ghats - S. India 44. Pl. 24. 1992; Cook, Aquat. Wetland Pl. India 232. 1996. (Fig. 34 c)

Rhizome cylindrical, long, creeping, branched, dark brown, rooting at nodes, giving rise to erect stems. Erect stems jointed, evergreen and smooth. Nodes and internodes with ridges and furrows. Nodes with campanulate or funnel shaped sheeths at node. Fronds scale like, borne on the upper edge of the nodal sheath, margins incised. Strobili terminal, spindle shaped; sporophylls laterally attached on the axis with outgrowths bearing pendulous sporangia on the inner surface. Spores spherical, green with four elaters.

Fertile: August - April

Growth form: Helophyte

Distribution: South and east Asia.

Habitat: Streams in forest.

SJ 16971 (Attappadi)

ISOETACEAE Dumort.

CALAMARIA Boehm.

Calamaria coromandelina (L. f.) Kuntze, Revis. Gen. Pl. 2: 828.1891.

Isoetes coromandeliana L. f., Suppl. Pl. Syst. Veg. ed. II 447. 1781; Manickam & Irud., Pterid. Fl. W. Ghats - S. India 43. Pl. 23. 1992; Cook, Aquat. Wetland Pl. India 23. 1996. (Fig. 34 d & e)

Plants with grass like fronds, up to 80 cm tall in pools and up to 15 cm tall on wet rocks in shallow ditches. Corm subterranean, fleshy. Leaves linear with broad base and tapering tips. Ligules conspicuous, broad, short truncate in older leaves, pointed in young leaves. Sporangia borne at the base of the leaves, heterosporangiate. Megasporangia on outer whorl of leaves; megaspores large, white, trilete, spherical and with tuberculate exine. Microspores minute, reddish brown, bilateral and with smooth or granulose exine

Fertile: Novembert - April

Growth form: Rosulate / Tenagophyte

Distribution: Tropical Asia, north Australia and north Italy

Habitat: Shallow pools and wet rocks

SJ 15089 (Attappadi)

MARSILEACEAE Mirb.

MARSILEA L.

Marsilea minuta L., Mant. 308. 1771; Manickam & Irud., Pterid. FI. W. Ghats - S. India 342. Pl. 259. 1992; B. K. Nayar & Geev., Fern Fl. Malabar 94. 1993; Cook, Aquat. Wetland Pl. India 26. 1996. (Fig. 34 f)

Perennial plants with narrow, long, creeping rhizome; submerged or emergent. Stipe narrow, cylindrical, glabrous or with few hairs bearing four leaflets at the tip of the petiole. Fronds obovate, apex round, margin crenate or serrate. Sporocarps bean shaped, brown, bisporangiate, with long stalk produced in clusters. Heterosporous, both mega and micro sporangia in the same sporocarp; young sporocarp hairy and mature ones generally glabrous. Microspores globose, yellowish - brown. Megaspores spherical, trilete, tetrahedral.

Fertile: December - April



Fig. 34 a) *Diplazium esculentum* b) *D. esculentum* sporophyll showing sporangia c) *Equisetum ramosissimum* d) *Calamaria coromandelina* habit e) *C. coromandelina* lower part of sporophyll f) *Marsilea minuta* habit & sporocarp

Growth form: Tenagophyte

Distribution: Tropical Africa and Asia

Habitat: Rivers, ponds and paddy fields

SJ 11893 (Malampuzha)

OSMUNDACEAE Martinov

OSMUNDA L.

Osmunda huegeliana C. Presl, Suppl. Tent. Pterid. 64. 1945; Manickam & Irud., Pterid. FI. W. Ghats-S. India 59. Pl. 36. 1992. *Osmunda regalis* L., Sp. PI. 2. 1063. 1753; B. K. Nayar & Geev., Fern Fl. Malabar 84. 1993. (Fig. 35 a)

Herbs with massive, erect or sub erect rhizome. Frond tufted, dimorphic; bipinnate; stipe erect, shallowly grooved above; lamina pale green. Sterile pinnae lanceolate, opposite, short stalked, up to 10 pairs, base cordate, apex obtuse or rounded. Fertile pinnae compressed. light green brownish, forming cylindrical panicles. Sporangia large with incipient annulus.

Fertile: July - December

Growth form: Hyperhydate/ Tenagophyte.

Distribution: Endemic to India

Habitat: Riverbanks in forest areas

SJ 16989 (Valiyaparathod)

POLYPODIACEAE J. Presl & C. Presl

MICROSORUM Link

Microsorum pteropus (Blume) Copel., Univ. Calif. Publ. Bot. 16 (2): 112. 1929; Manickam & Irud., Pterid. FI. W. Ghats - S. India 329. Pl. 147. 1992; S. Nampy & Madhus., Fern. Fl. S. India 80. 1998. *Kaulinia pteropus* (Blume) Nayar, Taxon 13. 67. 1964; B. K. Nayar & Geev., Fern

Fl. Malabar. 385. 1993. Cook, Aquat. Wetland Pl. India 27. 1996. (Fig. 35 b)

Rhizome creeping, up to 5 mm thick, irregularly branched, with numerous roots. Scales lanceolate, pale brown. Frond simple, erect, up to 15cm or longer. Lamina simple or 3 or 5 - lobate, linear - lanceolate, acuminate, narrowed at base, dark green, black when dry. Sori circular - ovate, scattered irregularly within the main areoles. Spores yellowish - green.

Fertile: August - December

Growth form: Helophyte

Distribution: Tropical Asia

Habitat: Shallow streams and rivulets above 500 m tenaciously attached to rocks under water. Exposed during summer and become fertile

SJ 16980 (Attappadi)

PTERIDACEAE E. D. M. Kir

CERATOPTERIS Brongn.

Ceratopteris thalictroides (L.) Brongn., Bull. Sci. Soc. Philom. Paris. 8: 186. 1821; Manickam & Irud., Pterid. FI. W. Ghats - S. India 91. Pl. 67. 1992; B. K. Nayar & Geev., Fern Fl. Malabar 89. 1993. Cook, Aquat. Wetland Pl. India 28. 1996. (Fig. 35 c)

Rhizome short, erect, covered with overlapping leaf bases, bearing long fibrous roots, apex scaly; scales ovate, pale - brown. Stipes fleshy. Fronds dimorphic, sterile leaves bipinnate with broad lamina, fertile leaves tripinnate and needle like. Sterile lamina oblong, apex acute. Fertile lamina much larger than sterile ones, margins reflexed, completely covering the two rows of sporangia. Sporangia globose, short stalked, with oblique annulus. Spores large, globose, up to 400 µm, golden, trilete with striate exine.

Fertile: July - February

Growth form: Hyperhydate/ Tenagophyte.

Distribution: Pantropical

Habitat: Ponds, canals and paddy fields. Grows as free floating in 'Sudds'

SJ 16907 (Kotumbu)

SALVINIACEAE Martinov

1a. Roots absent, sporocarps isomorphic ..... *Salvinia*

1b. Roots present, sporocarps heteromorphic ..... *Azolla*

AZOLLA Lam.

Azolla pinnata R. Br., Prodr. Fl. Nov. Holl. 167. 1810; Manickam & Irud., Pterid. Fl. W. Ghats S. India 345. Pl. 261. 1992; Cook, Aquat. Wetland Pl. India 22. 1996. (Fig. 35 d)

Plants triangular, free floating. Stem short creeping. Fronds two lobed, aerial, green, dorsal lobe fleshy containing mucilaginous cavities harboring the symbiotic blue green algae (*Anabaena azollae*), upper surface of the aerial lobe with minute trichomes or with their scars; ventral lobes transparent, ovate. Microsporocarps globose, brown. Megasporocarp elongate, cylindrical with globose head.

Fertile: December - April

Growth form: Pleustophyte

Distribution: Tropical Asia and Africa

Habitat: Paddy fields, stagnant waters in rivers, and ponds. Used as biofertilizer in paddy cultivation.

SJ 16960 (Kannadi)

SALVINIA Seg.

Salvinia adnata Desv., Mém. Soc. Linn. Paris 6: 177. 1827. *Salvinia molesta* D. S. Mitch., Brit. Fern Gaz. 10 (5): 251. 1972; Manickam & Irud., Pterid. Fl. W. Ghats - S. India 344. Pl. 260. 1992. Cook, Aquat. Wetland Pl. India 30.1996. (Fig. 35 e)

Perennial free - floating plants. Rhizome short, creeping and spongy. Fronds polymorphic, 2 at each node, floating, and one submerged dissected branch. Floating fronds short petiolate and exhibit two growth forms; oblong elliptic – obovate when young and cuneate folded when mature. Upper surface of floating fronds with egg – beater like hairs and lower surface with branched acicular hairs. Sporocarps borne at the tip of submerged branches arranged in zig - zag manner on the modified submerged branches at nodes. Megasporocarps one or two at base of the sporocarp bunch bearing a single globose megasporangium. Microsporocarps slightly larger bearing many globose microsporangia on branched sporangiophore mostly with aborted microspores.

Fertile: December - April

Growth form: Pleustophyte

Distribution: Native of south America but naturalized in Old World tropics (Africa, Australia and Asia)

Habitat: Paddy fields, canals, stagnant waters in rivers, and ponds.

SJ 16969 (Ponnamkode)

THELYPTERIDACEAE Pic. Serm.

CYCLOSORUS Link

Cyclosorus interruptus (Willd.) H. Ito, Bot. Mag. (Tokyo) 51 (608): 714. 1937; Manickam & Irud., Pterid. FI. W. Ghats - S. India 187. Pl. 142. 1992; B. K. Nayar & Geev., Fern Fl. Malabar 309. 1993. (Fig. 35 f)

Medium sized marshy plants forming clumps. Rhizome long creeping, branched, scaly, apex acuminate. Fronds narrowly triangular, bipinnate; lateral pinna elliptic - lanceolate, with dentate margin, shortly stalked, lower side with yellowish - brown scales, hairy. Sori medial on the veins, in 2 rows, arranged in V – shaped manner; Sporangial stalk with capitate hairs. Spores pale brown

Fertile: Throughout the year

Growth form: Helophyte/ Tenagophyte

Distribution: Pantropical

Habitat: Ponds, marshy areas and abandoned paddy fields as thickets

SJ 16977 (Chittur)

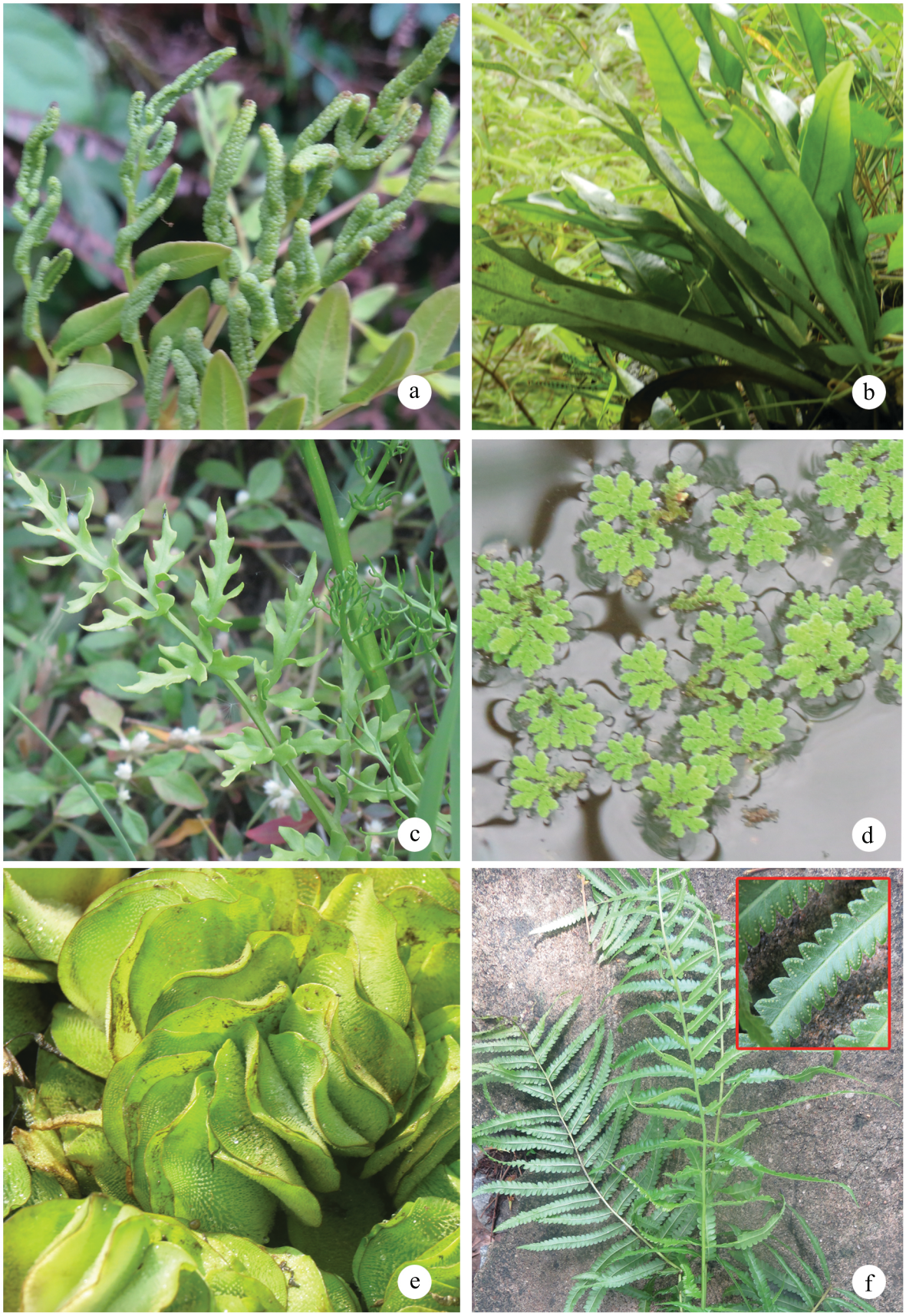


Fig. 35 a) *Osmunda huegeliana* b) *Microsorum pteropus* c) *Ceratopteris thalictroides* d) *Azolla pinnata* e) *Salvinia adnata* f) *Cyclosorus interruptus*

Chapter 6

DISCUSSION

6.1 Floristic analysis of angiosperms

The field explorations in the wetlands of Palakkad resulted in the collection and enumeration of 237 species of angiosperms belonging to 136 genera under 62 families. The total number of wetland species reported by Cook (1996) from India is 644 species. The number of species reported from whole of Kerala by Ansari *et al.* (2016) is 701 species. Vajravelu (1990) in flora of Palakkad district had reported nearly 155 aquatic and wetland species from Palakkad. Thus, Palakkad district harbors 33.81 % of the wetland angiosperms reported from Kerala. *Oldenlandia dineshii* Sojan & V Suresh is a taxonomic novelty from the study area and two species *viz., Enydra fluctuans* Lour. and *Cyperus platyphyllus* Roemer & Schultes. are new reports to the flora of Kerala. Eleven species including *Merremia gangetica* (L.) Cufod, *Cyperus alopecuroides* Rottb., *Cyperus clarkei* Cooke, *Cyperus nutans* Vahl ssp. *nutans*, *Cyperus digitatus* Roxb., *Fimbristylis microcarya* Muller, *Fuirena ciliaris* (L.) Roxb., *Pycreus macrostachyos* (Lam.) Raynal, *Eriocaulon fluviatile* Trimen, *Pandanus kaida* Kurz, and *Oldenlandia trinervia* Retz. were reported as new distributional record for Palakkad. The families with maximum representation of species include Cyperaceae (9 genera and 39 species), Poaceae (18 genera and 23 species), Linderniaceae (2 genera and 11 species), Araceaea (7 genera and10 species), Asteraceae (9 genera and 10 species), and Plantaginaceae (4 genera 9 species) (Fig. 36). The genera with maximum representation include *Cyperus* (20), *Lindernia* (9), *Eriocaulon* (8), *Fimbristylis* (7), and *Utricularia* (7).

6.1.1 Growth forms

Sculthorpe (1971) opined that the growth forms of hydrophytes are of notable value for ecologists since it acts alone or in combination as a diagnostic character to distinguish plant communities. He

classified the aquatic plants into two major groups as a.) Hydrophytes attached to the substrate with three subgroups *viz.,* emergent hydrohytes, floating leaved hydrophytes and submerged hydrophytes and b.) free floating hydrophytes The classification of Sculthorpe (1971) is limited to hydrophytes and many wetland species were not included in it. However, Cook (1996) has given much more elaborated classification which can accommodate all wetland species. The basic problem in classification lies in the fact that there is no clear demarcation between aquatic plants and borderline wetland taxa. In the present study, among the various growth forms, helophytes formed the major group (113) which accounted for 47.7 % of the total species recorded. 35 species were found to have both helophyte and tenagophyte growth forms. 21 species were found to have both hyperhydate and helophyte growth forms. 12 species exhibited both hyperhydate and tenagophyte growth forms. Ephydate growth form was found in eight species. Nine species were found to exhibit hyperhydrate, tenagophyte and helophyte growth forms. All the seven members of Podostemaceae exhibited haptophyte growth form. (Table 1, Fig. 37)

6.1.2 Endemism

Tropical regions have higher frequency of endemics when compared with temperate regions (Sculthorpe, 1971). Palakkad being positioned in the largest gap of the majestic Western Ghats, has a unique milieu when compared with the surrounding regions. The Palakkad pass has a profound effect on the climate of the area. The district harbours 55 endemic plant species and it holds the highest number of endemic taxa among the various districts of Kerala (Reddy, 2007). The present study too has reported many endemic plants from this region.

Among the plants collected, twenty - nine species recorded were endemic to different geographical regions. *Utricularia sunilii* Naveen Kumar & KMP Kumar, *Willisia arekaliana* Shivamurthy & Sadanant.,

and *Pandanus palakkadensis* Nadaf *et al.* are endemic to Palakkad. Three species are endemic to Kerala *viz., Eriocaulon palghatense* R. Ansari & N.P. Balakr., *Lagenandra keralensis* Sivad. & Jaleel, and *Oldenlandia dineshii* Sojan & V. Suresh. Seven species including *Eriocaulon robustum* Steud., *Lagenandra toxicaria* Dalz, *Indotristicha ramosissima* (Wight) van Royen, *Polypleurum dichotomum* (Gard.) Hall, *Rotala malampuzhensis* R.V. Nair ex Cook, *Sonerila rotundifolia* Bedd., and *Torenia lindernioides* Saldanha are endemic to Southern Western Ghats. Four species are endemic to Western Ghats *viz., Impatiens scapiflora* Heyne ex Roxb, *Lagenandra meeboldii* (Engl.) C.E.C. Fisch, *Torenia bicolor* Dalz., and *Utricularia lazulina* Taylor. Four species including *Cyperus clarkei* Cooke, *Cyperus platyphyllus* Roemer & Schultes, *Zeylanidium subulatum* (Gardner) C. Cusset, and *Dalzellia zeylanica* (Gard.) Wight are endemic to south India and Sri Lanka. *Heliotropium keralense* Sivar. & Manilal is found to be endemic to south India. *Cryptocoryne retrospiralis* (Roxb.) Kunth is endemic to south and north east India. Six species including *Henckelia incana* (Vahl) Spreng, *Eragrostis riparia* (Willd.) Nees, *Murdannia semiteres* (Dalz.) Sant, *Myriophyllum oliganthum* (Wight & Arn.) F. v. Muell., *Pandanus canaranus* Warb., and *Utricularia roseopurpurea* Stapf ex Gamble are endemic to Peninsular India. (Table 2)

The limited distribution of taxa to particular region is a result of both historical events and ecological factors. Historical events explain how a taxon became restricted to its present range whereas ecological factors elucidate the present limits of endemic taxa (Morrone, 2008). It is estimated that nearly 30 percent of the floristic elements of Kerala are endemic to Peninsular India and due to their relict characters, they are very sensitive to environmental changes and anthropogenic disturbances (Sasidharan, 2013). In the present study, 12.23 % of the plants collected were endemic to various regions. Nayar (1996) treated the endemic flora of Western Ghats as remnants of ancient flora and aptly grouped under paleoendemics.

Morrone (2008) describes Paleoendemics as those taxa which have a long evolutionary history and whose dispersal is restricted by barriers or by extensive extinction in the remaining areas where they were previously distributed. Endemic species are vulnerable to extinction due to various reasons which include small range and population size, low genetic diversity, and specific habitat requirements (Myers *et al.*, 2000; Kani, 2011; Gaston, 2012). Gaston (2012) also opined that endemic species are having extinction risk at a higher rate merely by chance alone. It rightly points out the importance of conserving endemic species. Generating a clear picture on the patterns and underlying processes of extinction risk in endemic species would help to develop conservation strategies and efforts (Chen *et al.*, 2019). Palakkad district being a hub of endemic species and its wetlands are under tremendous pressure due to anthropogenic activities, the area deserves utmost priority in conserving the endemic plant resources.

6.1.3 Alien invasive species

Those species which cross their range of natural distribution and get introduced to new areas are termed as alien species (Saxena, 1991). Such species generally become free from its natural enemies who controlled their population in the native land and thus they get an opportunity for population explosion in the new locality, provided abiotic factors are favourable (Elton, 1958; Williamson, 1996). Alien species which have spread in the new location at the cost of the local biota are called as alien invasive species (Keane and Crawley, 2002). They are considered as a major threat to biodiversity and ecosystem functioning throughout the world (Pejchar and Mooney, 2009). In the present study thirteen species of angiosperms belonging to eleven families have been identified as alien invasive species *viz.,* *Alternanthera philoxeroides* (Mart.) Grisb., *Asclepias curassavica* L., *Sphagneticola trilobata* (L.) Pruski, *Mikania micrantha* Kunth, *Eichhornia crassipes* (Mart.) Solms., *Ipomoea aquatica* Forssk.,

Ipomoea fistulosa Mart. ex Choisy, *Ludwigia perennis* L., *Pistia stratiotes* L., *Saccharum spontaneum* L., *Typha angustifolia* L., *Limnocharis flava* (L.) Buch., and *Sesbania bispinosa* (Jacq.) Wight. Among them, 1 species each native of tropical Africa, tropical west Asia and China. All others are native of tropical America (Table 3). Sankaran *et al.* (2012) have listed 82 species of plants as Alien invasive plants of Kerala where they have excluded the aquatic invasives but included semi aquatic invasives. *Enydra fluctuans* Lour. is new report to the flora of Palakkad and this plant grows luxuriantly in the rivers of Palakkad especially in Shokanashini river and Kalpathy river. More studies are required to establish its invasive nature.

6.1.4 Conservation status

The present study could locate two critically endangered species *i.e.*, *Pandanus palakkadensis* Nadaf *et al.* and *Oldenlandia dineshii* Sojan & V. Suresh. The endemic species *Willisia arekaliana* Shivamurthy & Sadanant. found in Silent Valley National Park is found to be endangered. It has been found that *Oryza officinalis* Wall. ex Watt has been treated under the IUCN category - Least Concern (LC) whereas *Oryza malampuzhaensis* Krishnasw. & Chandrasek. which is considered as a synonym of *Oryza officinalis* Wall. ex Watt is included in the Vulnerable category (VU) by the IUCN. So, it has to be concluded that the genotype represented by *Oryza malampuzhaensis* Krishnasw. & Chandrasek. is under vulnerable (VU) category.

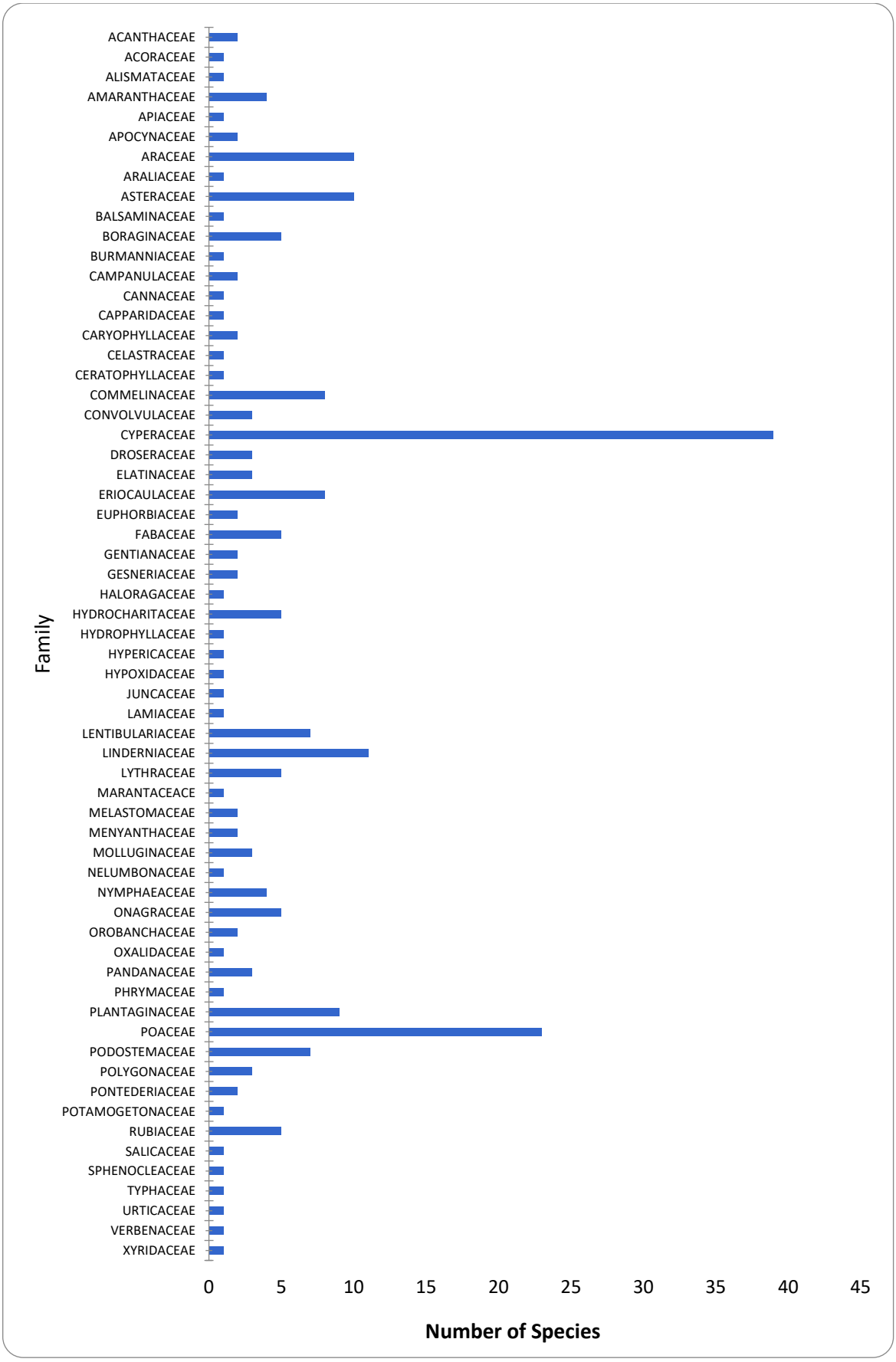


Fig. 36 Family wise representation of plants

Table 1 Plant Growth Form

Growth form	Number of Species
Ephydate	8
Haptophyte	7
Helophyte	113
Hyperhydrate	4
Plankton	3
Pleustophyte	5
Rosulate	4
Tenagophyte	2
Vittate	2
Ephydate – Hyperhydrate	1
Hyperhydrate – Pleustophyte	6
Helophyte – Tenagophyte	35
Rosulate – Tenagophyte	1
Hyperhydrate – Tenagophyte	12
Hyperhydrate – Helophyte	21
Vittate – Hyperhydrate	1
Ephydate - Hyperhydrate - Tenagophyte	1
Hyperhydrate - Tenagophyte - Helophyte	9
Helophyte - Pleustophyte - Hyperhydrate	2

Fig. 37 Growth forms

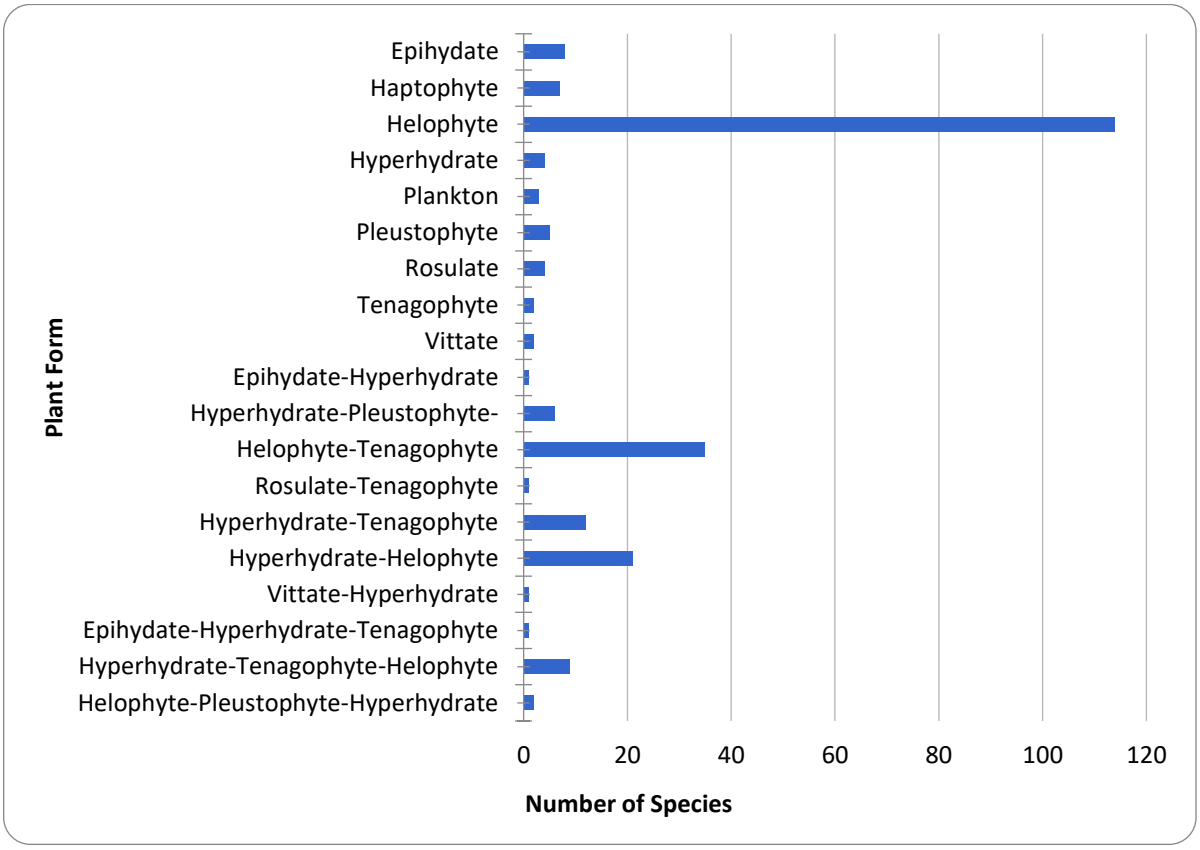


Table 2 Endemism	
Distribution	**Endemism**
Endemic to Kerala	*Eriocaulon palghatense* R. Ansari & N.P. Balakr.
	Lagenandra keralensis Sivad. & Jaleel
	Oldenlandia dineshii Sojan & V. Suresh
Endemic to Palakkad	*Pandanus palakkadensis* Nadaf *et al.*
	Utricularia sunilii Naveen Kumar & KMP Kumar
	Willisia arekaliana Shivamurthy & Sadanant.
Endemic to Peninsular India	*Henckelia incana (Vahl) Spreng*
	Eragrostis riparia (Willd.) Nees
	Murdannia semiteres (Dalz.) Sant
	Myriophyllum oliganthum (Wight & Arn.) F. v. Muell.
	Pandanus canaranus Warb.

	Utricularia roseopurpurea Stapf ex Gamble
Endemic to South and North East India	*Cryptocoryne retrospiralis* (Roxb.) Kunth
Endemic to South India	*Heliotropium keralense* Sivar. & Manilal
Endemic to South India and Sri Lanka	*Cyperus clarkei* Cooke
	Cyperus platyphyllus Roemer & Schultes
	Dalzellia zeylanica (Gard.) Wight
	Zeylanidium subulatum (Gardner) C. Cusset
Endemic to Southern Western Ghats	*Eriocaulon robustum* Steud.
	Indotristicha ramosissima (Wight) van Royen
	Lagenandra toxicaria Dalz
	Polypleurum dichotomum (Gard.) Hall
	Rotala malampuzhaensis R.V. Nair ex Cook
	Sonerila rotundifolia Bedd.
	Torenia lindernioides Saldanha
Endemic to Western Ghats	*Impatiens scapiflora* Heyne ex Roxb.
	Lagenandra meeboldii (Engl.) C.E.C. Fisch
	Torenia bicolor Dalz.
	Utricularia lazulina Taylor

Table 3 Alien invasive species of the wetlands of Palakkad

Sl No	Alien Invasive Species	Family	Nativity
1	*Alternanthera philoxeroides*	Amaranthaceae	Trop. America
2	*Asclepias curassavica*	Apocynaceae	Trop. America
3	*Eichhornia crassipes*	Pontederiaceae	Trop. America
4	*Ipomoea aquatica*	Convolvulaceae	China
5	*Ipomoea fistulosa*	Convolvulaceae	Trop. America
6	*Ludwigia perennis*	Onagraceae	Trop. Africa

7	*Mikania micrantha*	Asteraceae	Trop. America
8	*Pistia stratiotes*	Araceae	Trop. America
9	*Saccharum spontaneum*	Poaceae	Trop. West Asia
10	*Sesbania bispinosa*	Fabaceae	Trop. America
11	*Typha angustata*	Typhaceae	Trop. America
12	*Limnocharis flava*	Alismataceae	Trop. America
13	*Sphagneticola trilobata*	Asteraceae	Trop. America

6.2 Floristic analysis of pteridophytes

The floristic explorations of wetlands of Palakkad resulted in the documentation of ten species of pteridophytes belonging to ten genera and 9 families. A thorough data on the wetland pteridophytes of India was given by Cook (1996) and it includes 29 species belonging to 8 genera and 7 families. Madhusoodanan *et al.* (1992) have enumerated 8 species of aquatic pteridophytes *viz.*, *Acrostichum aureum, Azolla pinnata, Ceratopteris thalictroides, Equisetum ramosissimum, Isoetes coromandelina, Maesilia minuta, Microsorum pteropus* and *Salvinia molesta* from Kerala and Madhusoodanan *et al.* (1993) have studied their taxonomy, ecology, distribution, cytology and palynology. Among the eight species, seven are located from Palakkad except *Acrostichum aureum* which is a halophyte that grows luxuriantly in coastal districts of Kerala. The present study could locate seven species reported by Cook as wetland species. Intensive observation of wetland species of pteridophytes in Palakkad district enabled to add three more species to the wetland species which are not included by Cook (1996). They include *Diplazium esculentum* (Retz.) Sw., *Osmunda huegeliana* C. Presl. and *Cyclosorus interruptus* (Willd.) H. Ito. Among the plants recorded, 2 species are pleustophytes, 2 are helophytes, 1 tenagophyte, 3 recorded to have both hyperhydate and tenagophyte form, 1 recorded to have both rosulate and tenagophyte form and, 1 is

recorded with both helophyte and hyperhydate forms. According to Fraser-Jenkins (2008), *Osmunda huegeliana* C. Presl. is an endemic species restricted to south and central India. Salviniaceae is the only family in Palakkad district that has two wetland species. *Salvinia adnata* Desv. is the only alien invasive species of pteridophyte recorded from the wetlands of Palakkad. Though this species has been reported as an aggressive weed in many parts of the state, in Palakkad, this plant creates comparitively little problems except in paddy fields and associated ponds forming a large mat of population. *Cyclosorus interruptus* (Willd.) H. Ito. invades abandoned paddy fields and other shallow wetlands forming thickets competing with other vegetation. *Diplazium esculentum* (Retz.) Sw. and *Marsilea minuta* L. are used as leafy vegetables in some parts of the Palakkad especially by the tribal people.

6.3 Salient features of the wetlands of Palakkad

The Palakkad district holds a characteristic climate and edaphic features distinct from other districts of Kerala due to the influence of the Palghat gap of Western Ghats which is 32 km wide. Palakkad is a place where maximum temperature is experienced (up to 40 °C) during summer and rainfall is comparatively less (2135 mm). Palakkad shares some features of the neighbouring Tamil Nadu in having high temperature and dominance of Palmyra palm (*Borassus flabellifer* L.). The palmyra palm is characteristic feature of Palakkad district. Nowhere in Kerala, this palm is so frequently seen. However, the distribution of this palm extends to almost all over Tamil Nadu. The soil type in some part of the district resembles the neighbouring Coimbatore district. The black soil found in Chittur taluk is an extension of the soil found in Coimbatore. In Kerala, black soils are found only in Chittur taluk. These soils are dark, low in organic matter, calcareous, with pH ranging from 7.0 – 8.5. In certain regions of Chittur, there is a special type of soil called “Poonthalpadam” soil. It is found as a slushy layer to a depth of 0.5 m to 1.5 m. A layer of

limestone is seen underneath the slushy soil. The biggest river Bharathapuzha originates in Anamalai region of Tamil Nadu and Palakkad district of Kerala and then it joins the Arabian sea through Malappuram district. Though it overflows during monsoon, the river becomes a narrow stream in the summer. The major tributaries of Bharathapuzha include Kunthi river, Gayathri river, Kalpathy river, Kannadi river, etc. The Kalpathy river and Kannadi river meet at Parali to form a larger river and from there it flows by the name of Bharathapuzha. The Gayathri river will join it before Ottappalam. The Kunthi river originates from the Silent Valley National Park and joins Bharathapuzha at the border of Malappuram district in the Pattambi taluk. Floods and spill overs are frequent during the rainy season and they deposit nutrient rich alluvial soil on either bank of the river contributing to the adjacent wetlands. The Bhavani river which flows through attappady region is one among the east flowing rivers of Kerala. It harbors numerous populations of *Salix tetrasperma* Roxb., *Cryptocoryne retrospiralis* (Roxb.) Kunth, *Dalzellia zeylanica* (Gard.) Wight, etc.

The district is blessed with forests and their abundant flora. The Silent Valley National Park is considered as the hottest hotspot of biodiversity. It is home for rare wetland species like *Willisia arekaliana* Shivamurthy & Sadanant and the endemic royal fern *Osmunda huegeliana* C. Presl. The Nelliampathy forests are home for many endemic plants. Many interesting aquatic species like *Myriophyllum oliganthum* (Wight & Arn.) F. v. Muell., *Lagenandra keralensis* Sivad. & Jaleel, *Utricularia sunilii* Naveen Kumar & KMP Kumar, *Polypleurum dichotomum* (Gard.) Hall, etc. are found here. The Parambikulam Tiger reserve harbors many species of *Utricularia* and *Eriocaulon* . The wild rice *Oryza officinalis* Wall. ex Watt is common in the streams of this protected area.

The major wetlands of the district include erstwhile paddy fields which are abandoned due to various economic and social problems

and has become a swamp. Intermittent with the paddy fields, there are many ponds which meet the agricultural and social requirement of water during the early summer. Some of them will get dry during the peak of summer. All the wetlands of Palakkad are freshwater ecosystems.

The most frequent plants of the wetlands of Palakkad are *Eichhornia crassipes* (Mart.) Solms., *Salvinia adnata* Desv., *Cyperus rotundus* L., *Pistia stratiotes* L., *Saccharum spontaneum* L., *Typha angustifolia* L., and *Sphagneticola trilobata* (L.) Pruski. Populations of *Enydra fluctuans* Lour. and *Trapa natans* L. are frequently seen in some parts of Palakkad but are not common in other parts of Kerala. *Cyperus* is the largest genera with 20 species. A major component of the flora includes ephemeral or seasonal plants. They appear during the rainy season and disappear during the withdrawal of rains each year. Many plants grow on the seasonal ditches formed on granite hillocks which are filled with sediments brought by wind. *Calamaria coromandelina* (L. f.) Kuntze are seen in the seasonally wet ditches of the hillocks of Chittur taluk. *Utricularia* spp., *Eriocaulon* spp., *Murdannia semiteres* (Dalz.) Sant., *Hoppea fastigiata* (Griseb.) Clarke, *Centranthera indica* (L.) Gamble, *Xyris pauciflora* Willd., *Rhamphicarpa fistulosa* (Hochst.) Benth. and *Drosera indica* L. are the common ephemeral plants seen on these microecosystems of wet granite hillocks. *Oldenlandia dineshii* Sojan & Suresh is found on the wet hillocks of Nemmara. The destruction of hillocks for extraction of granite results in loss of many endemic and endangered species of plants (Jose *et al.*, 2016).

The perennial fast flowing rivers are home for all the Podostemaceae members. They grow on the rocks as haptophytes. They are found on the two sides of Palghat gap *i.e.*, either the Nelliampathy – Parambikulam part or the Attappady – Silent valley part of the Western Ghats. *Indotristicha ramosissima* (Wight) van Royen and *Willisia arekaliana* Shivamurthy & Sadanant. are found

only in the Silent Valley National Park. The *Eriocaulon fluviatile* Trimen is also found in the fast-flowing perennial river Kunthipuzha of Silent Valley National Park. Though the endangered and endemic *Willisia arekaliana* Shivamurthy & Sadanant. is found only in the Silent Valley National Park, our concern regarding the conservation of the species is limited due to the high priority being given for conservation of Silent Valley National Park. At present, the only potential threat to the population of *Willisia arekaliana* Shivamurthy & Sadanant. is climate change. It is already known that the magnitude and velocity of climate change trends will probably exceed the potential of numerous species to survive and adapt to new environmental conditions and will lead to higher extinction rates (Keith *et al.*, 2008; Bellard *et al.*, 2012).

Many species like *Sonerila rotundifolia* Bedd., *Henckelia incana* (Vahl) Spreng, *Geissaspis cristata* Wight & Arn. are commonly found in the open wet rocks of the forests. The marshlands of forests of Palakkad are also rich with plant diversity. *Coix lacryma-jobi* L., *Rhynchospora corymbosa* (L.) Brit., *Oryza officinalis* Wall. ex Watt, *Elatostema lineolatum* Wight var. *falcigera* Thw., *Melastoma malabathricum* L., and *Hypericum japonicum* Thunb. are found in various forest marshlands of Palakkad. *Oryza officinalis* Wall. ex Watt and *Rhynchospora corymbosa* (L.) Brit., are very common in the marshy lands named 'Vayals' of Parambikulam Tiger reserve.

Peninsular India is considered as a center of origin of cultivated rice. Palakkad plains and Chittoor black soil is treated as a unique agroecosystem among the six agroecosystems identified for rice cultivation in Kerala (Leena, 2016). Paddy fields form home for many plant species. Majority of them are treated as weeds and are removed. *Acmella calva* (DC.) R.K. Jansen, *Marsilea minuta* L., *Salvinia adnata* Desv., *Dentella repens* (L.) J. R. & G. Forst., *Lindernia hyssopoides* (L.) Haines, *Ammannia baccifera* L., *Dopatrium junceum* (Roxb.) Buch. - Ham. ex Benth., *Hydrolea zeylanica* (L.) Vahl, *Blyxa echinosperma* (Clarke) Hook. f., *Ottelia alismoides* (L.) Pers., *Najas indica* (Willd.)

Cham., *Echinochloa colona* (L.) Link, *Cyperus rotundus* L., *Oryza rufipogon* Griff., and *Monochoria vaginalis* (Burm. f.) Presl are the common floristic elements of paddy fields which are treated as weeds. *Azolla pinnata* R. Br. is used in the paddy fields as biofertilizer. The abandoned paddy fields have much more diversity. Many sedges and grasses are found in the abandoned paddy fields. *Dactyloctenium aegyptium* (L.) P. Beauv., *Cyperus iria* L., *Echinochloa colona* (L.) Link, *Echinochloa crus-galli* (L.) P. Beauv., *Isachne globosa* (Thunb.) O. Ktze., *Ischaemum rugosum* Salisb., *Sacciolepis interrupta* (Willd.) Stapf in Prain, *Cyperus articulatus* L., *Cyperus rotundus* L., *Fimbristylis argentea* (Rottb.) Vahl are common in abandoned paddy fields. Ferns like *Cyclosorus interruptus* (Willd.) H. Ito, *Ceratopteris thalictroides* (L.) Brongn. are also often found in abandoned paddy fields. The endemic screw pine *Pandanus palakkadensis* Nadaf *et al.* is found in the boundary of paddy fields and are being destroyed by farmers since it acts as a pathway for rodents to the coconut trees grown on the field bunds of paddy fields. This critically endangered and endemic taxon need special attention for conservation.

The rivers of Palakkad are home for many plant species and these riverine ecosystems harbor more than eighty percent of the wetland and aquatic species. Since rivers traverse different regions with varied climate, they act as local gene pool for numerous plants and animals. Wetland trees like *Crataeva magna* (Lour.) DC., *Salix tetrasperma* Roxb., *Mallotus nudiflorus* (L.) Kulju & Welson are found in association with the rivers. *Crataeva magna* (Lour.) DC., *Mallotus nudiflorus* (L.) Kulju & Welson are widely distributed whereas *Salix tetrasperma* Roxb., is confined to streams and rivers of the forests and nearby localities. *Eichhornia crassipes* (Mart.) Solms. is a common aggressive exotic weed found in rivers of Palakkad. The growth and proliferation of this plant creates serious damage to the native flora of the rivers. The damage attains maximum magnitude during the summer season when water level is low and the downstream flow is

minimum. The monsoon showers generally take these noxious weeds away along with the fast-flowing water. *Trapa natans* L. also grows abundantly in Shokanashini and Varani rivers. Though the fruit of *Trapa natans* is consumed in many parts of the country, it is not used by the people of Palakkad for consumption. *Hygroryza aristata* (Retz.) Nees ex Wight & Arn. is found both in rivers and canals of Malampuzha and Kanjirapuzha areas. *Rotula aquatica* Lour. is found in riparian localities of Thootha and Gayathri river. *Homonoia riparia* Lour. is a common shrub in the rivers of Attappdy and Silent valley. They are not generally found in the rivers like Kalpathy, shokanashini, Varani, Gayathri, etc. but these rivers harbor many populations of *Oxystelma esculentum* (L. f.) R.Br. ex Schultes – a climber with ornamental potential due to its attractive flowers.

6.4 Threats and future of wetlands of Palakkad

The major threats of the aquatic vegetation are the destruction of wetlands for developmental programmes and other anthropogenic activities. The ever-growing human population of the district (from 2,617,482 in 2001 to 2,809,934 in 2011) demands more food and space for their existence. They were once treated as waste lands without knowing their ecological importance and the impact of the destruction of these fragile habitats. In fact, wetlands are the store house of water and are considered as the “kidneys” of an area since they play vital role in purification, recycling and refilling of the palatable water resources. Moreover, there is considerable decrease in the level of ground water in the recent years probably due to the destruction of wetlands. Palakkad is also bestowed with manmade ponds, tanks and wells which are traditionally maintained for irrigation, maintenance of cattle and drinking. Currently all these sources are facing drought from the beginning of the summer. Though thirteen Alien invasive angiosperms and one pteridophyte are reported to be alien invasive plants, the major problematic species are *Eichhornia crassipes* (Mart.) Solms., *Salvinia adnata* Desv., and

Sphagneticola trilobata (L.) Pruski and *Alternanthera philoxeroides* (Mart.) Grisb. The aquatic alien invasive plants are posing threat to the native aquatic vegetation and quality of water. *Eichhornia crassipes* (Mart.) Solms., *Salvinia adnata* Desv., and *Sphagneticola trilobata* (L.) Pruski are brought to Kerala by enthusiasts for horticultural purpose and escaped from cultivation to the nearby waterbodies and spread aggressively. When compared to other parts of Kerala, the impacts of these aquatic weeds in Palakkad is less probably due to seasonal destruction (partly) due to severe summer drought. In other parts of Kerala especially in lowlands, these exotic weeds create problems in agriculture irrigation, water transport, fisheries and electricity generation. *Alternanthera philoxeroides* (Mart.) Grisb. is common in the riverbanks. They grow gregariously and dominate the vegetation of the area. It is believed that the species reached India along with some packing material (Maheshwari, 1965). It is commonly called as Alligator weed and has been found to be a fast spreading weed in the aquatic ecosystems of Kerala (Madhusoodanan and Kumar, 1993).

The conversion of paddy fields for mango, rubber, coconut and areca nut platations are common in Palakkad. This leads to loss of paddy fields. The conversion paddy fields for rubber completely removes the wetland flora of the ecosystem.

6.5 Exigency of conservation of the wetlands of Palakkad

The climate change, rapid urbanization, and change in land use pattern will have serious effects on the extent and number of wetlands. The Palakkad district has varied climatic and edaphic features due to its unique position in the Palakkad gap of Western Ghats. This really boosts biodiversity of the district. Unfortunately, reduction in paddy cultivation, rapid urbanization, invasion by alien species and various anthropogenic activities has already caused considerable loss in wetland biodiversity. Since the wetlands of Palakkad district harbors one third of the wetland plant wealth of the state and has many endemic and rare plants as discussed earlier, it requires utmost

priority in conservation. Both in-situ and ex–situ conservation strategies are required for conservation of these species and emphasize should be given to maintain these ecosystems as such for posterity.

Chapter 7

SUMMARY

The Palakkad district is blessed with various types of wetlands. The unique position of the district in the largest pass of the majestic Western Ghats that straddles the border of Kerala and Tamil Nadu makes it a land of diverse vegetation. The present study focusing the vascular wetland plants has successfully enumerated 237 species of angiosperms belonging to 136 genera under 62 families along with ten wetland pteridophytes classified under 9 families and ten genera.

The study was successful in discovering *Oldenlandia dineshii* Sojan & V Suresh as a floristic novelty from Palakkad. Two species *i.e., Enydra fluctuans* Lour. and *Cyperus platyphyllus* Roemer & Schultes. are two new records for the flora of Kerala. Eleven Species including *Merremia gangetica* (L.) Cufod, *Cyperus alopecuroides* Rottb., *Cyperus clarkei* Cooke, *Cyperus nutans* Vahl ssp. *nutans*, *Cyperus digitatus* Roxb., *Fimbristylis microcarya* Muller, *Fuirena ciliaris* (L.) Roxb., *Pycreus macrostachyos* (Lam.) Raynal, *Eriocaulon fluviatile* Trimen, *Pandanus kaida* Kurz, and *Oldenlandia trinervia* Retz. were reported as new distributional record for Palakkad.

The families with maximum representation of species include Cyperaceae (39), Poaceae (23), Linderniaceae (11), Araceae (10), Asteraceae (10), and Plantaginaceae (9). The genera with maximum representation include *Cyperus* (20), *Lindernia* (9), *Eriocaulon* (8), *Fimbristylis* (7), and *Utricularia* (7). Regarding the growth forms, helophytes formed the major group (113) which accounted for 47. 7 % of the total species recorded. 35 species were found to have both helophyte and tenagophyte growth forms. 21 species were found to have both hyperhydate and helophyte growth forms.

Twenty nine species of angiosperms recorded were endemic to different geographical regions. *Utricularia sunilii* Naveen Kumar & KMP

Kumar, *Willisia arekaliana* Shivamurthy & Sadanant., and *Pandanus palakkadensis* Nadaf *et al.* are endemic to Palakkad. Three species are endemic to Kerala. Seven species are endemic to southern Western Ghats. Four species are endemic to Western Ghats. Four species are endemic to south India and Sri Lanka. One species is endemic to south India, one species is endemic to south and north east India, and six species are endemic to peninsular India.

Among pteridophytes, two species are found to be pleustophytes, two species are helophytes, one tenagophyte, three species recorded to have both hyperhydate and tenagophyte form, one recorded to have both rosulate and tenagophyte form, and one is recorded with both helophyte and hyperhydate form. *Osmunda huegeliana* C. Presl. is found to be endemic to south and central India.

Thirteen species of angiosperms and one species of pteridophyte are found to be alien invasives of the wetlands of Palakkad. The Palakkad district is found to have one third of the aquatic and wetland plant diversity of Kerala and is facing serious threats due to anthropogenic pressures and climatic variations. Immediate remedial measures and conservation strategies are to be adopted for conserving the wetland plant diversity of the district.

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INDEX OF TAXA

A

ACANTHACEAE 32
Acmella 51, 52, 53, 266
Acmella calva 51, 53, 266
Acmella radicans 51, 52, 53
ACORACEAE 34
Acorus 34, 37
Acorus calamus 34, 37
Aeschynomene 131, 137
Aeschynomene indica 131, 137
ALISMATACEAE 35
Alstonia 7
Alstonia scholaris 7
Alternanthera 36, 37, 38, 42, 256, 261, 269, 279
Alternanthera ficoidea 36, 37
Alternanthera paronychioides 35, 36, 37
Alternanthera philoxeroides .. 35, 38, 42, 256, 261, 269, 279
Alternanthera sessilis 36, 38, 42
Alternanthera tenella 36
Alternanthera triandra 38
AMARANTHACEAE 35
Ambulia 194
Ambulia aromatica 194
Ammania 163
Ammannia 163, 164, 166, 168, 266
Ammannia baccifera 163, 168, 266
Ammannia pentandra 166
Ammannia peploides 164
Ammannia rosea 166
Anabaena 249
Anabaena azollae 249
Anagalloides 160
Anagalloides procumbens 160
Andropogon 219
Andropogon squarrosus 219
Aneilema 77, 78
Aneilema paniculatum 78
Aneilema pauciflorum 77
Aneilema semiteres 78
APIACEAE 39
APOCYNACEAE 39
ARACEAE 41
ARALIACEAE 50
Arundo 200, 201, 205, 217
Arundo donax 201, 205
Arundo karka 217
Asclepias 39, 40, 42, 256, 261
Asclepias curassavica 40, 42, 256, 261
Asteracantha 33
Asteracantha longifolia 33
ASTERACEAE 50
Azolla 12, 14, 249, 252, 262, 267
Azolla pinnata 249, 252, 262, 267

B

Bacopa 192, 198
Bacopa monnieri 192, 198
BALSAMINACEAE 59
Basilicum 147, 149
Basilicum polystachyon 147, 149
Bergia 120, 121, 122, 126
Bergia ammannioides 120, 121
Bergia capensis 120, 126
Bergia verticillata 122
Blyxa 23, 140, 144, 266, 274
Blyxa aubertii 140
Blyxa echinosperma 140, 144, 266
Blyxa kasargodensis 23
Blyxa oryzetorum 140
Bonnaya 156, 157
Bonnaya brachiata 157
Bonnaya veronicifolia 156
BORAGINACEAE 60
Brachiaria 200, 201, 205
Brachiaria mutica 201, 205
Buchnera 186
Buchnera longiflora 186
Bulbostylis 82, 83, 91
Bulbostylis barbata 82, 91
Bulbostylis puberula 82, 83
Burmannia 64, 70
Burmannia coelestis 64, 70
Burmannia pusilla 64
BURMANNIACEAE 64

C

Calamaria 242, 244, 246, 265
Calamaria coromandelina 242, 244, 246, 265
CAMPANULACEAE 65
Canna 66, 70
Canna indica 66, 70
Canna orientalis 66
CANNACEAE 66
Canscora 135, 137
Canscora diffusa 72, 135, 137
Capparis 67
Capparis magna 67
CARYOPHYLLACEAE 68
CELASTRACEAE 69
Centella 39, 42
Centella asiatica 39, 42
Centranthera 185, 187, 265
Centranthera indica 185, 187, 265
Centranthera procumbens 185

CERATOPHYLLACEAE 71
Ceratophyllum 71, 75
Ceratophyllum demersum 71, 75
Ceratopteris 248, 252, 262, 267
Ceratopteris thalictroides . 248, 252, 262, 267
Chlorophytum 23, 282
Chlorophytum palghatense 23
Chrysopogon 200, 219, 222
Chrysopogon zizanioides 219, 222
Clinogyne 167
Clinogyne virgata 167
Coix 200, 202, 205, 266
Coix lacryma-jobi 266
Coldenia 60, 62
Coldenia procumbens 60, 62
Colocasia 41, 42
Colocasia antiquorum 41
Colocasia esculenta 41, 42
Columnea 196
Commelina 72, 73, 75
Commelina benghalensis 72, 75
Commelina diffusa 72, 73, 75
Commelina glabra 73
Commelina wightii 72, 73, 75
COMMELINACEAE 72
CONVOLVULACEAE 78
Crataeva 67, 70, 267
Crataeva magna 67, 70, 267
Crataeva nurvala 67
Crataeva religiosa 67
Crinum 21, 279
Crinum malabaricum 21, 279
Crinum thaianum 279
Cryptocoryne 41, 43, 48, 255, 261, 264
Cryptocoryne retrospiralis ... 43, 48, 255, 261, 264
Cyanotis 72, 74, 75
Cyanotis axillaris 74, 75
Cyclosorus 250, 252, 262, 267
Cyclosorus interruptus 250, 252, 262, 267
CYPERACEAE 82
Cyperus ..82, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 106, 111, 113, 253, 255, 261, 265, 267, 271, 296
Cyperus alopecuroides 85, 91, 253, 271
Cyperus aristatus 101
Cyperus articulatus 84, 86, 91, 267
Cyperus cephalotes 85, 87, 91
Cyperus clarkei 84, 87, 253, 255, 261, 271
Cyperus compressus 84, 88
Cyperus cyperinus 84, 89, 91
Cyperus difformis 85, 90, 91
Cyperus digitatus 85, 90, 253, 271
Cyperus distans 85, 92
Cyperus dubius 84, 93
Cyperus exaltatus 85, 94
Cyperus flavidus 101
Cyperus haspan 85, 94
Cyperus iria 84, 95, 100, 267
Cyperus macrostachyos 113
Cyperus malaccensis 84, 96, 100
Cyperus nutans 85, 92, 97, 100, 253, 271
Cyperus platyphyllus ... 85, 97, 100, 253, 255, 261, 271, 296
Cyperus platystylis 85, 98, 100
Cyperus polystachyos 113
Cyperus rotundus 85, 99, 100, 265, 267
Cyperus squarrosus 84, 101, 106
Cyperus tenuispica 85, 101, 106
Cyperus triceps 111

D

Dactyloctenium 200, 203, 205, 267
Dactyloctenium aegyptium 203, 205, 267
Dalzellia 220, 222, 255, 261, 264
Dalzellia zeylanica 220, 222, 255, 261, 264
Dentella 231, 232, 266
Dentella repens 231, 232, 266
Dichaespermum 78
Dichaespermum paniculatum 78
Dicraeia 223
Dicraeia dichotoma 223
Dicraeia stylosa 223
Didymocarpus 138
Didymocarpus tomentosa 138
Diplazium 243, 246, 262
Diplazium esculentum 243, 246, 262
Dopatrium 192, 193, 198, 266
Dopatrium junceum 193, 198, 266
Dopatrium nudicaule 193, 198
Drosera 118, 119, 121, 265
Drosera burmannii 118, 121
Drosera indica 118, 121, 265
Drosera peltata 118, 119, 121
DROSERACEAE 118
Drymaria 68, 70
Drymaria cordata 68, 70
Drymaria diandra 68

E

Echinochloa 200, 204, 205, 206, 267
Echinochloa colona 204, 205, 267
Echinochloa crus-galli 204, 205, 267
Echinochloa frumentacea 204, 206
Eclipta 51, 52, 53
Eclipta alba 52
Eclipta prostrata 52, 53
Eichhornia 12, 15, 57, 229, 232, 256, 261, 265, 267, 268
Eichhornia crassipes 229, 232, 256, 261, 265, 267, 268
ELATINACEAE 120
Elatine 120, 122, 126
Elatine americana 122

Elatine triandra 122, 126
Elatostema 238, 239, 266
Elatostema lineolatum 238, 239, 266
Enhydra 54
Enhydra fluctuans 54
Enydra 51, 54, 57, 253, 257, 265, 271, 296
Enydra fluctuans .. 54, 57, 253, 257, 265, 271, 296
Equisetum 244, 246, 262
Equisetum ramosissimum 244, 246, 262
Eragrostis 200, 207, 214, 255, 260
Eragrostis amabilis 208
Eragrostis riparia 207, 255, 260
Eragrostis tenella 207
Eragrostis unioloides 207, 214
ERIOCAULACEAE 123
Eriocaulon 21, 22, 23, 123, 124, 125, 126, 127, 128, 129, 137, 253, 255, 260, 261, 264, 265, 266, 271, 273, 274, 276, 280, 281, 283, 284, 285, 286
Eriocaulon albotetrandra 23, 274
Eriocaulon baramaticum 21
Eriocaulon biappendiculatum 22, 280
Eriocaulon cheemenianum 22, 274
Eriocaulon devendranii 22, 23
Eriocaulon fluviatile ... 123, 126, 253, 266, 271
Eriocaulon gamblei 128
Eriocaulon gopalakrishnanum 22, 283
Eriocaulon govindiana 23, 285
Eriocaulon idukkianum 23, 280
Eriocaulon kannurense 22, 285
Eriocaulon madayiparense 22, 286
Eriocaulon malabaricum 22
Eriocaulon manoharanii 22
Eriocaulon palghatense ... 123, 124, 255, 260
Eriocaulon parvicephalum 21, 276
Eriocaulon peninsulare 21, 283
Eriocaulon periyarense 22
Eriocaulon pradeepii 23, 273
Eriocaulon pykarense 21
Eriocaulon quinquangulare 123, 125, 126
Eriocaulon robustum 123, 125, 255, 261
Eriocaulon sexangulare 123, 126, 127
Eriocaulon thwaitesii 123, 126, 127
Eriocaulon truncatum 123, 128
Eriocaulon vandaanamense 22, 285
Eriocaulon wayanadense 22, 286
Eriocaulon xeranthemum 123, 129, 137
EUPHORBIACEAE 130

F

FABACEAE 131
Fimbristylis .. 82, 103, 104, 105, 106, 107, 108, 115, 253, 267, 271
Fimbristylis acuminata 102, 103, 106
Fimbristylis aestivalis 102, 103, 106
Fimbristylis argentea 102, 104, 106, 267
Fimbristylis bisumbellata 102, 105
Fimbristylis complanata 108
Fimbristylis dipsacea 102, 105, 106
Fimbristylis microcarya 102, 108, 253, 271
Fimbristylis miliacea 107
Fimbristylis quinquangularis 103, 107, 115
Floscopa 72, 76, 81
Floscopa scandens 76, 81
Fuirena 82, 109, 115, 253, 271
Fuirena ciliaris 109, 115, 253, 271
Fuirena glomerata 109

G

Geissaspis 131, 132, 266
Geissaspis cristata 132, 266
GENTIANACEAE 135
GESNERIACEAE 138
Glinus 172, 173, 174
Glinus lotoides 173
Glinus oppositifolius 173, 174
Grangea 50, 55, 57
Grangea maderaspatana 55, 57
Gratiola 193, 194
Gratiola juncea 193
Gratiola nudicaulis 194

H

HALORAGACEAE 139
Haloragis 139
Haloragis oligantha 139
Hedyotis 233, 234, 235
Hedyotis brachypoda 234
Hedyotis corymbosa 233
Hedyotis diffusa 234
Hedyotis trinervia 235
Heliotropium 60, 61, 62, 63, 70, 255, 261
Heliotropium indicum 61, 62
Heliotropium keralense 61, 63, 255, 261
Heliotropium ovalifolium 61, 63, 70
Henckelia 138, 144, 255, 260, 266
Henckelia incana 138, 144, 255, 260, 266
Herpestis 192
Herpestis monnieria 192
Hingtsha 54
Hingtsha repens 54
Homonoia 130, 137, 268
Homonoia riparia 130, 137, 268
Hoppea 135, 136, 144, 265
Hoppea fastigiata 136, 144, 265
Hottonia 196
Hottonia indica 196
Hydrilla 140, 141
Hydrilla verticillata 141
Hydrobryum 225
Hydrobryum lichenoides 225
HYDROCHARITACEAE 140
Hydrocotyle 50, 53

Hydrocotyle javanica 50, 53
Hydrolea 145, 149, 266
Hydrolea zeylanica 145, 149, 266
HYDROPHYLLACEAE 145
Hygrophila 33, 37
Hygrophila angustifolia 33
Hygrophila auriculata 32, 33, 37
Hygrophila quadrivalvis 33
Hygrophila ringens 32, 33, 37
Hygrophila salicifolia 33
Hygrophila schulli 33
Hygroryza 199, 208, 214, 268
Hygroryza aristata 208, 214, 268
HYPERICACEAE 145
Hypericum 145, 149, 266
Hypericum japonicum 145, 149, 266
HYPOXIDACEAE 146
Hypoxis 146, 149
Hypoxis aurea 146, 149

I

Ilysanthes 157, 160, 161
Ilysanthes hyssopioides 160
Ilysanthes rotundifolia 161
Ilysanthes serrata 157
Impatiens 23, 59, 62, 255, 261, 277
Impatiens sahyadrica 23, 277
Impatiens scapiflora 59, 62, 255, 261
Indianthus 167, 174
Indianthus virgatus 167, 174
Indotristicha 220, 221, 222, 255, 261, 265
Indotristicha ramosissima 221, 222, 255, 261, 265
Ipomoea 78, 79, 80, 81, 256, 261
Ipomoea aquatica 78, 81, 256, 261
Ipomoea carnea 79
Ipomoea fistulosa 78, 79, 81, 257, 261
Ipomoea reniformis 80
Ipomoea reptans 79
Isachne 200, 209, 214, 267
Isachne australis 209
Isachne dispar 209
Isachne globosa 209, 214, 267
Isachne miliacea 209
Ischaemum 200, 210, 214, 267
Ischaemum rugosum 210, 214, 267
Isoetes 245, 262
Isoetes coromandeliana 245

J

JUNCACEAE 147
Juncellus 85
Juncellus alopecuroides 85
Juncus 147, 149
Juncus leschenaultii 147
Juncus prismatocarpus 147, 149
Jussiaea 180, 182, 183, 184
Jussiaea adscendens 180
Jussiaea linifolia 182
Jussiaea repens 180
Jussiaea speciosa 184
Jussiaea suffruticosa 183

K

Kaulinia 247
Kaulinia pteropus 247
Klugia 138
Klugia notoniana 139
Kyllinga 82, 110, 111, 115
Kyllinga brevifolia 109, 110, 115
Kyllinga bulbosa 111
Kyllinga monocephala 110
Kyllinga nemoralis 109, 110, 115
Kyllinga tenuifolia 109, 111, 115
Kyllinga triceps 111

L

Lagenandra . 41, 44, 45, 46, 48, 255, 260, 261, 264
Lagenandra insignis 45
Lagenandra keralensis 44, 255, 260, 264
Lagenandra meeboldii 44, 255, 261
Lagenandra ovata 44, 45, 48
Lagenandra toxicaria 44, 46, 48, 255, 261
LAMIACEAE 147
Lawia 220
Lawia zeylanica 220
Leersia 200, 211
Leersia hexandra 211
Lemna 12, 41, 46, 48, 49
Lemna paucicostata 46
Lemna perpusilla 46, 48
Lemna polyrhiza 49
LENTIBULARIACEAE 148
Limnanthemum 171, 172
Limnanthemum cristatum 171
Limnanthemum indicum 172
Limnocharis 35, 37, 257, 262
Limnocharis flava 35, 37, 257, 262
Limnophila 192, 194, 195, 196, 197, 198
Limnophila aromatica 194, 198
Limnophila chinensis 194, 195
Limnophila conferta 197
Limnophila gratioloides 196
Limnophila gratissima 194
Limnophila heterophylla 194, 196, 198
Limnophila hirsuta 195
Limnophila indica 194, 196
Limnophila repens 194, 197, 198
Limnophila sessilis 197
Lindernia 155, 156, 157, 158, 159, 160, 161, 168, 253, 266, 271
Lindernia anagallis 155
Lindernia antipoda 155, 156, 159

Lindernia caespitosa.....155, 157, 159
Lindernia ciliata 155, 157, 159
Lindernia crustacea 155, 158, 159
Lindernia hyssopoides 155, 160, 168, 266
Lindernia procumbens.....155, 160
Lindernia pusilla 157
Lindernia rotundifolia 155, 161, 168
Lindernia viscosa 155, 161
LINDERNIACEAE 155
Lipocarpha 82, 112
Lipocarpha argentea.....112
Lipocarpha chinensis.....112, 194
Lippia 241
Lippia nodiflora 241
Lobelia 65, 66, 70
Lobelia alsinoides 65, 70
Lobelia heyneana.....65, 66
Lobelia trialata 66
Ludwigia 21, 180, 181, 182, 183, 184, 187, 257, 261, 274
Ludwigia adscendens.....180, 181
Ludwigia hyssopifolia 180, 182, 187
Ludwigia linifolia 182
Ludwigia octovalvis.....180, 182, 187
Ludwigia parviflora.....183
Ludwigia perennis.....180, 183, 187, 257, 261
Ludwigia peruviana.....180, 184, 187
Ludwigia repens 180, 194
Ludwigia suffruticosa.....183
LYTHRACEAE 163

M

Mallotus 130, 137, 267
Mallotus nudiflorus.....130, 137, 267
MARANTACEACE.....167
Mariscus.....87, 89, 93, 101
Mariscus bulbosus 87
Mariscus clarkei.....87
Mariscus cyperinus 89
Mariscus dubius 93
Mariscus squarrosus 101
Marsilea.....245, 246, 263, 266
Marsilea minuta.....245, 246, 263, 266
Melastoma.....169, 174, 266
Melastoma malabathricum 169, 174, 266
MENYANTHACEAE 171
Menyanthes 171, 172
Menyanthes hydrophylla.....171
Menyanthes indica.....172
Merremia 78, 80, 81, 253, 271
Merremia emarginata 80
Merremia gangetica.....80, 81, 253, 271
Microcarpaea.....191
Microcarpaea minima.....191
Microcarpaea muscosa.....191
Microsorum 247, 252, 262
Microsorum pteropus.....247, 252, 262
Mikania 51, 55, 57, 256, 262
Mikania cordata.....55
Mikania micrantha.....55, 57, 256, 262
Mikania scandens 55
Milium 209
Milium globosum 209
MOLLUGINACEAE.....172
Mollugo 173, 175, 181
Mollugo hirta 173
Mollugo lotoides 173
Mollugo oppositifolia.....173
Mollugo pentaphylla.....175, 181
Mollugo spergula.....173
Mollugo stricta 175
Moniera.....192
Moniera cuneifolia.....192
Monochoria 229, 230, 232, 267
Monochoria vaginalis.....230, 232, 267
Moschosma 147
Moschosma polystachyum 147
Murdannia 72, 76, 77, 78, 81, 255, 260, 265
Murdannia japonica 76
Murdannia pauciflora.....76, 77, 81
Murdannia semiteres..... 76, 78, 81, 255, 260, 265
Myriophyllum 139, 255, 260, 264
Myriophyllum intermedium.....139
Myriophyllum oliganthum .139, 255, 260, 264

N

Najas.....140, 142, 266
Najas falciculata.....142
Najas indica 142, 171, 266
Najas lacerata 142
Nelumbium.....176
Nelumbium speciosum.....176
Nelumbo 176, 280, 281
Nelumbo nucifera.....176
NELUMBONACEAE.....176
Neptunia.....131, 133
Neptunia oleracea.....133
Neptunia prostrata 133
Nymphaea.... 20, 176, 177, 178, 179, 181, 273
Nymphaea caerulea 177, 181
Nymphaea micrantha 177, 178, 181
Nymphaea nelumbo 176
Nymphaea nouchali.....177, 178, 181
Nymphaea omarana.....179, 181
Nymphaea stellata 178
NYMPHAEACEAE.....177
Nymphoides... 20, 23, 171, 172, 174, 274, 285
Nymphoides balakrishnanii 23, 274
Nymphoides cristata.....171
Nymphoides hydrophylla 171, 174
Nymphoides indica 171, 172, 174

O

Oldenlandia. 23, 231, 233, 234, 235, 239, 240, 253, 255, 257, 260, 265, 271, 278, 285, 296
Oldenlandia brachypoda.....234
Oldenlandia corymbosa.....233, 239
Oldenlandia diffusa.....233, 234, 239
Oldenlandia dineshii..23, 233, 234, 240, 253, 255, 257, 260, 265, 271, 278, 296
Oldenlandia trinervia. 233, 235, 239, 253, 271
Oldenlandia vasudevanii.....23, 285
ONAGRACEAE.....180
OROBANCHACEAE.....185
Oryza . 200, 211, 212, 213, 214, 257, 264, 266, 267, 279
Oryza malampuzhaensis.....212, 257
Oryza officinalis.....211, 214, 257, 264, 266
Oryza rufipogon.....211, 212, 267
Oryza sativa.....211, 213, 214, 279
Osmunda.....247, 252, 262, 264, 272
*Osmunda huegeliana*247, 252, 262, 264, 272
Osmunda regalis.....247
OSMUNDACEAE.....247
Ottelia.....140, 142, 144, 266
Ottelia alismoides.....142, 144, 266
OXALIDACEAE.....186
Oxalis.....186, 190
Oxalis corniculata.....186, 190
Oxystelma.....39, 40, 42, 268
Oxystelma esculentum.....40, 42, 268

P

Paederota.....191
Paederota minima.....191
PANDANACEAE.....188
Pandanus.....21, 23, 188, 189, 190, 253, 255, 257, 260, 267, 271, 272, 281
Pandanus canaranus.....188, 190, 255, 260
Pandanus kaida.....188, 189, 190, 253, 271
Pandanus palakkadensis....21, 23, 188, 189, 190, 255, 257, 260, 267, 272, 281
Pandanus unipapillatus.....188
Panicum.....200, 201, 204, 206, 213, 218
Panicum colonum.....204
Panicum crusgalli.....206
Panicum frumentaceum.....206
Panicum interruptum.....218
Panicum muticum.....201
Panicum repens.....213
Parnassia.....69
Parnassia mysorensis.....69
Paspalidium.....200
Paspalum.....200, 215, 216, 222
Paspalum conjugatum.....215
Paspalum orbiculare.....216
Paspalum scrobiculatum.....215, 216, 222
Persicaria.....226, 227, 228, 232
Persicaria barbata.....226, 227
Persicaria glabra.....226, 228, 232
Phalaris.....219
Phalaris zizanioides.....219
Phragmites.....12, 200, 216, 275
Phragmites karka.....216, 275
Phragmites vallatoria.....217
PHRYMACEAE.....191
Phyla.....241
Phyla nodiflora.....241
Pilea.....23, 278
Pilea victoriae.....23, 278
Pistia.....41, 47, 48, 257, 262, 265
Pistia stratiotes.....47, 48, 257, 262, 265
PLANTAGINACEAE.....192
POACEAE.....199
PODOSTEMACEAE.....220
Podostemum.....223, 225
Podostemum acuminatus.....225
Podostemum algaeformis.....223
Podostemum dichotomum.....221, 223
Podostemum microcarpus.....225
Podostemum stylosus.....223
Polycarpon.....68, 69, 75
Polycarpon loeflingiae.....69
Polycarpon prostratum.....69, 75
POLYGONACEAE.....226
Polygonum.....226, 228, 232
Polygonum barbatum.....226
Polygonum glabrum.....228
Polygonum plebeium.....228, 232
*Polypleurum*220, 221, 223, 227, 255, 261, 264
*Polypleurum dichotomum*221, 227, 255, 261, 264
Polypleurum stylosum.....221, 223, 227
PONTEDERIACEAE.....229
Potamogeton.....230, 232
Potamogeton indicus.....230
Potamogeton nodosus.....230, 232
POTAMOGETONACEAE.....230
Pycreus.....82, 113, 253, 271
Pycreus albomarginatus.....113
Pycreus macrostachyos.....113, 253, 271
Pycreus odoratus.....114
Pycreus polystachyos.....113

R

Rhabdia.....64
Rhabdia lycioides.....64
Rhamphicarpa.....185, 187, 265
Rhamphicarpa fistulosa.....185, 187, 265
Rhamphicarpa longiflora.....186
Rhinanthus.....185
Rhinanthus indica.....164, 185
Rhynchoglossum.....138, 144
Rhynchoglossum notonianum.....138, 144
Rhynchospora.....82, 114, 115, 266

Rhynchospora aurea 114
Rhynchospora corymbosa 114, 115, 266
Rotala .. 21, 163, 164, 165, 166, 168, 255, 261, 273, 277, 278, 279, 280, 282, 283, 284, 285, 287
Rotala anamika 21
Rotala andamanensis 21, 280
Rotala belgaumensis 21, 287
Rotala cheruchakkiensis 21
Rotala dhaneshiana 21, 283
Rotala indica 164, 168
Rotala kanayensis 21
Rotala kasaragodensis 21, 282
Rotala khaleeliana 285
Rotala khaliliana 21
Rotala leptopetala 166
Rotala malabarica 21, 282
Rotala malampuzhensis ... 164, 165, 168, 255
Rotala meenkulamensis 21
Rotala mexicana 164, 166
Rotala rosea 166
Rotala sahyadrica 21, 277
Rotala tulunadensis 21, 282
Rotula 60, 64, 268
Rotula aquatica 64, 268
RUBIACEAE 231
Ruellia 155
Ruellia anagallis 155

S

Saccharum 200, 217, 222, 257, 262, 265
Saccharum spontaneum . 217, 222, 257, 262, 265
Sacciolepis 200, 218, 222, 267
Sacciolepis interrupta 218, 222, 267
SALICACEAE 236
Salix 236, 239, 264, 267
Salix tetrasperma 236, 239, 264, 267
Salvinia ... 14, 15, 249, 252, 262, 265, 266, 268
Salvinia adnata .. 249, 252, 263, 265, 266, 268
Salvinia molesta 249, 262
Schoenoplectiella 82, 116, 117, 121
Schoenoplectiella articulata 116, 121
Schoenoplectiella mucronata .. 116, 117, 121
Schoenoplectus 116, 117
Schoenoplectus articulatus 116
Schoenoplectus mucronatus 117
Schumannianthus 167
Schumannianthus virgatus 167
Scirpus 116, 117
Scirpus articulatus 116
Scirpus mucronatus 117
Sesbania 131, 134, 137, 257, 262
Sesbania aculeata 134
Sesbania bispinosa 134, 137, 257, 262
Smithia 131, 134
Smithia blanda 134
Sonerila 169, 170, 174, 255, 261, 266
Sonerila rotundifolia .. 170, 174, 255, 261, 266
Sphaeranthus 50, 56, 57
Sphaeranthus indicus 56, 57
Sphagneticola .. 51, 59, 62, 256, 262, 265, 269
Sphagneticola trilobata 59, 62, 256, 262, 265, 269
Sphenoclea 237
Sphenoclea zeylanica 237
SPHENOCLEACEAE 237
Spilanthes 51, 52, 56, 62
Spilanthes acmella 51
Spilanthes calva 51
Spilanthes ciliata 56, 62
Spilanthes radicans 52
Spirodela 41, 49, 53
Spirodela polyrhiza 49, 53
Stemodia 192, 195, 197, 199
Stemodia hirsuta 195
Stemodia repens 197
Stemodia verticillata 199
Struchium 50, 58, 62
Struchium sparganophorum 58, 62

T

Terniola 220
Terniola zeylanica 220
Tetraotis 54
Tetraotis paludosa 54
Tonningia 74
Tonningia axillaris 74
Torenia 155, 162, 163, 255, 261
Torenia bicolor 162, 255, 261
Torenia lindernioides 162, 163, 255, 261
Trapa 163, 167, 168, 265, 268
Trapa bispinosa 167
Trapa natans 167, 168, 265, 268
Trewia 130
Trewia nudiflora 130
Trewia polycarpa 131
Tristicha 220, 221
Tristicha ramosissima 221
Tristicha zeylanica 220
Typha 12, 15, 237, 239, 257, 262, 265
Typha angustata 238, 262
Typha angustifolia 237, 239, 257, 265
Typha domingensis 237
TYPHACEAE 237

U

URTICACEAE 238
Utricularia 21, 23, 24, 148, 149, 150, 151, 152, 153, 154, 159, 253, 254, 260, 261, 264, 265, 271, 281
Utricularia aurea 148, 149
Utricularia caerulea 151
Utricularia exoleta 148, 150

Utricularia flexuosa 150
Utricularia gibba 150
Utricularia graminifolia.....148, 151
Utricularia lazulina.....148, 152, 159, 255, 261
Utricularia orbiculata.....153
Utricularia rosea 153
Utricularia roseopurpurea 148, 153, 255, 261
Utricularia striatula 148, 153, 159
Utricularia sunilii ... 23, 24, 148, 154, 254, 260, 264, 271, 281

V

Vallisneria.....140, 143, 144
Vallisneria natans.....143, 144
Vallisneria spiralis 143
Vandellia.....155, 157, 158, 161
Vandellia angustifolia 156
Vandellia crustacea 158
Vandellia hirsuta.....161
Vandellia pedunculata.....155
Vandellia scabra.....157
VERBENACEAE 241
Vetiveria.....219
Vetiveria zizanioides.....219

W

Wedelia.....59
Wedelia trilobata 59
Willisia 220, 224, 227, 254, 257, 260, 264, 265, 272
Willisia arekaliana 224, 227, 254, 257, 260, 264, 265, 272
Wolffia.....41, 49, 53
Wolffia arrhiza 49
Wolffia globosa.....49, 53

X

XYRIDACEAE 242
Xyris.....242, 265
Xyris pauciflora.....242, 265

Z

Zeylanidium 22, 220, 224, 225, 227, 255, 261, 278
Zeylanidium crustaceum.....22
Zeylanidium lichenoides.....224, 227
Zeylanidium subulatum ... 224, 225, 227, 255, 261

List of Publications

In Peer Reviewed Journals

Sojan Jose, Suresh V., Prakashkumar R & Madhusoodanan P V (2015) *Enydra fluctuans* Lour – an addition to the flora of Kerala, India. Jour. Bom. Nat. Hist. Soc. 112 (1) 46- 47.

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Muhsina A., **Sojan Jose,** Suresh V., Prakashkumar R & Madhusoodanan P V (2019) *Cyperus platyphyllus* Roemer & Schultes – an addition to the flora of Kerala, India. Jour. Bom. Nat. Hist. Soc. (Communicated).

Papers Presented

Sojan Jose, Suresh V., Prakashkumar R & Madhusoodanan P V "Hillocks and wetlands – Shrinking pockets of diversity in the Palakkad gap of Western Ghats" paper presented in the National seminar on Biodiversity and Importance of Western Ghats at Government College Kasargod on 28th August 2017.

Sojan Jose, Suresh V., Prakashkumar R & Madhusoodanan P V "Impact of Climate change on wetland plant diversity" paper presented at the national seminar on Climate change organized by Department of Botany Government College Chittur on 29 th September 2018.

Sojan Jose, Prakashkumar R & Madhusoodanan P V "Host range of *Cuscuta chinensi*s Lam in Palakkad district and its use as a biocontrol agent against the aquatic weed *Enydra fluctuans* Lour" paper presented at the International Biodiversity Congress, Dehradun on 5th October 2018.

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