

**PLANT ECOLOGICAL STUDIES ON THE ARBORESCENT
VEGETATION OF SHOLAYAR RESERVE FOREST,
SOUTHERN WESTERN GHATS OF INDIA**

Thesis Submitted to
UNIVERSITY OF CALICUT

For the degree of
DOCTOR OF PHILOSOPHY IN BOTANY
(Faculty of Science)

By
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JUNE 2024

DECLARATION

I hereby declare that the thesis entitled “**Plant Ecological Studies on The Arborescent Vegetation of Sholayar Reserve Forest, Southern Western Ghats of India** ” is based on the original research work carried out by me at Sree Narayana College, Nattika, Thrissur under the guidance of **Dr. Abhilash E S** (Research guide), Associate Professor, Department of Botany, Sree Narayana Guru College, Chelannur, Kozhikkod, and **Prof.(Dr.) Anitha C T** (Co-guide), PG and Research Department of Botany, Sree Narayana College Nattika, Thrissur, and no part of the thesis has been presented for the award of any other degree, diploma or other similar titles.

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*Dedicated to My Grandparents
& Valyachan*

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ABSTRACT

An attempt has been made to study the tree species diversity in the Sholayar Reserve forest of Southern Western Ghats of India. The main objectives of the study are to analyze the structural status of the permanent arborescent vegetation, to assess the tree species diversity of different forest types and to evaluate the status of tree species belongs to the category rare, endangered and threatened. For the convenience of the study, the entire study area was divided into two zones based on altitude and vegetation types. The area above 700m altitude was considered as medium elevation zone, and below 700m altitude was considered as low elevation zone. Stratified random sampling technique was adopted for vegetation sampling. Various diversity indices were calculated and compared with other forests of the Western Ghats. Study sites were selected on the vegetation map and located on the ground by using Global Positioning System. In each plot using the census quadrat method (Oosting, 1956), all the tree species of 30cm or above girth at breast height or 1.37m above from the ground were recorded (Roy, 1993). A total of 280 sample plots of 0.1 ha. area was established in the study area. 28 study sites were selected, and 10 quadrats of 0.1ha was laid out in each study site. 10,946 trees belonging to 156 species out of 89 genera and 49 families were enumerated from the total sampling area. From the dense evergreen medium elevation forest 118 species of trees and from the low elevation degraded forest 94 species were recorded. Among the families, Euphorbiaceae is the largest one with 20 species, followed by Lauraceae (11 species), Meliaceae (11 species), Moraceae (9 species), Fabaceae (6 species) and Ebenaceae (6 species). Among 156 tree species recorded 3% of the species belongs to the rare category, 6% are endangered, 6% are vulnerable, 2% are critically endangered and 31% species belongs to the endemic category. A unique riparian vegetation is also observed in the study area. To protect this diverse forest ecosystem, proper conservation efforts, climate change mitigation strategies, and sustainable forest management practices are necessary.

Key words: Sholayar Reserve Forest, phytosociology, stratified random sampling, IVI, and endemic species.

Introduction

CHAPTER -1

INTRODUCTION

1.1. General

The term "biodiversity" describes the range of living forms on earth. It includes the wide variety of living things, their relationships with one another, and their surroundings. Biodiversity is often described at different levels, including species diversity, genetic diversity within species, and environmental diversity. Species diversity is the quantity and variety of various species found in a given region or environment. It encompasses both the total number of species and the relative abundance of each species. The range of genes found in a species is referred to as genetic diversity. It includes the variety of genetic information that each member of a species possesses and plays a role in the species capacity to adjust to shifting environmental circumstances. Diversity of ecosystems is the range of distinct ecosystems or habitats found in a certain location. This covers wetlands, coral reefs, forests, grasslands and more. Every ecosystem has its own distinct population of species and contributes in a particular way to the overall health of biosphere. The resilience and health of ecosystems, as well as the benefits they offer to humans, depend on biodiversity. It supports the productivity, stability, and adaptability of ecosystems to changes in their surroundings. Since every species has distinct qualities and a different evolutionary history, biodiversity also has inherent value. Plant community has an important role in biodiversity conservation (Farooquee and Saxena, 1996). Plants that grow together have relationships with the environment and with each other (Mishra et al., 1997). All the ecological factors are interrelated. These interactions lead to the formation of different vegetation in different areas. There are different measures of biodiversity; species richness is an important measure. Higher the number of species more stable the ecosystem will be. Evolution and extinction are the causal factors that result in the appearance of new species and also lead to the disappearance of some other species. Many floral and faunal species have disappeared already because of their inability to adapt to changes in climate and topography. The increasing demand for natural resources destroys our biodiversity at an alarming rate.

Forest covers about forty percent of the land area. These are important renewable natural resources. Forest is considered as the richest in terms of biodiversity among terrestrial ecosystems (Kumar et al., 2006), and their existence is very essential for maintaining ecological balance. Forests are important components of our environment and increases its quality as a life supporting system.

A forest is just not the totality of trees. Instead it is an ecosystem which supports the interactions of different units such as trees, soil, insects, animals and man. Numerous ecological functions that forests offer are vital to human well-being. These include soil stabilization, nutrient cycling, water regulation, carbon storage, oxygen production, and climate regulation. Because forests absorb carbon dioxide from the atmosphere, they are essential for reducing the effects of climate change.

The term phytodiversity denotes species composition in a plant community. Status and contribution of various species can be assessed by phytosociological studies. Periodical measurement of an ecosystem is necessary for knowing species addition, abundance and replacement due to habitat changes (Schaefer, 1990; Pimm et al., 1995).

Unfortunately, the population size or range of majority of species are declining today. Deforestation, for the purpose of extracting timber and other forest products, is causing forests to disappear at alarming rates (Murphy & Lugo, 1986; Raghubanshi & Tripathi, 2009). Large scale deforestation during post-independence period has affected our biodiversity very badly. Habitat destruction and overexploitation are the major threats to our biodiversity. Alterations in the soil pattern and land use adversely affect the environmental conditions of an area. Changing of land cover to cropland increased worldwide.

Overgrazing is another issue. The regenerative capacity of forests is reduced by overgrazing. For the wellbeing of life existing here, it is necessary to identify the causes of biodiversity loss and conduct proper monitoring of its impacts. A correct measurement of tropical forest area is presently lacking. The collection of national maps and inventories is hindered by many institutional and resource limitations. Many errors are produced due to the absence of standardized data collection and recording techniques. Remote sensing, and other interpretation methods are helping to resolve such uncertainties. But remote sensing is expensive. The uncertainty involved in

estimating forest area and understanding baselines is reflected in widely ranging estimates of rates of deforestation. For better planning, we need accurate and authentic figures agreed by the concerned departments. Ecosystem studies get much attention now a days to address large scale environmental issues.

1.2. Tropical rain forest

India is one of the 12 mega biodiversity countries in the world (Kushwaha,1990). The Western Ghats, the trans-Himalayan, the Indian desert, the Himalayan, the semi-arid zone(s), the Deccan Peninsula, the Gangetic plain, North-East India and the islands and coasts are the different biogeographical zones in India (Rodgers et al., 2000).The total geographical area of our country is about 329 million hectares. Grasslands, forests, deserts, wetlands, coastal and marine habitats are the different kinds of ecosystems in India (FSI, 2011).

Biodiversity is not distributed evenly on earth, and is richest in the tropics (Gaston et al., 2013). One of the richest terrestrial ecosystems, tropical forests sustain a wide range of living forms and contribute significantly to world biodiversity (Shi & Singh, 2002). Tropical forests cover only 7% of the mainland but they provide life for almost half of the world's species (Gallery, 2014), moreover, they are the most genetically diverse terrestrial communities on earth (Hubbel & Foster, 1983). Their abundance of species (Kraft et al., 2008), increased biomass and carbon sequestration (Bonan, 2008) and the net primary productivity globally (Sabine et al., 2004) make them unique. Nearly 90% of all the species on earth are found in the tropical forest ecosystems, which occupy less than 10% of the planet's surface. The systematic studies on tropical forest ecology were initiated by Hubbel (1979).

Currently, tropical forests are disappearing at an alarming pace of between 0.8 and 2% every year. They are one of the most species-diverse terrestrial ecosystems, which yields various kinds of natural resources (Suhs et al., 2019). The unavailability of data and proper monitoring techniques causes a negative impact on the conservation of tropical forests. There are many studies to understand the organization of tropical forests (Hubbel, 1979; Hubbel et al., 1999; Myers et al., 2000; Condit et al., 2002; Forest et al., 2007 and Kraft et al., 2008).

1.3. Western Ghats

The overall land area of India is approximately 329 million hectares, about 80% of the country was covered by forests around 3000BC. But now the forest cover of India constitutes about 21.71% (7,13,789 km²) of total geographical area of the country (FSI, 2021). The country also boasts a coastline spanning more than 7,500km. The nation is home to a wide variety of habitats and ecosystems, including desert, grasslands, wetlands, coastal and marine regions, all of which have rich and distinctive floristic diversity. There are 16 major forest types and 221 subtypes in India (Champion & Seth, 1968). The Western Ghats comprise a distinct biogeographic zone that is home to two identified biotic provinces; a wet coastal plain to the west and an almost uninterrupted stretch of hills and mountains that rise sharply to the west. In terms of biodiversity, the Western Ghats are second only to the Himalayan regions in terms of plant and animal richness. The zone stretches from 22° N in southern Gujarat to 8° N in Tamil Nadu's far south. An approximate of one-third of the estimated 1,60,000 km² area is covered in forest. The creation of tropical rainforests along the windward side of the Western Ghats is one of its most notable aspects and also well known for their biodiversity with high endemism. This mountain range is running parallel to the Western Coastline of Southern India, is one among three biodiversity hotspots of the world (Myers et al., 2000) and is considered as one among the eight hottest hotspots of biodiversity across the world. It is also recognized as one of the worlds heritage sites. The Western Ghats inhabits 7,402 species of flowering plants, 1,814 species of non-flowering plants, 139 mammal species, 508 bird species, 179 amphibian species, 6,000 insect species and 290 freshwater fish species including nearly 325 globally threatened taxa (Bawa and Damisa, 2007). The Western Ghats account for barely 5% of India's overall geographical area yet comprise approximately 27% of the country's plant species. It is estimated that there are almost 1500 endemic plant species exist in the Western Ghats (Nayar, 1997).

The richest area among important eco regions in the Western Ghats are mainly within the Southern Western Ghats region, which extends from the Nilgiri plateau and southwards (Nayar, 1997), the Kerala part of Western Ghats is included in this area. Kerala has richest biodiversity wealth including 5094 flowering plants with 1709 endemic taxa (Sasidharan,2004). The geological antiquity, evolutionary history and

biogeographic patterns, with special emphasis on the endemism of the flora and fauna of the Western Ghats, have been discussed by several authors (Subramanyam & Nayar, 1974; Nair & Daniel, 1986; Ahmedullah & Nayar, 1987; Pascal, 1988; Nair, 1991). This region represents a primary or secondary center of origin and diversification of wild progenitors and wild relatives of several cultivated plants and domesticated animals. The region is rich, by supporting about 145 wild relatives of crop plants belonging to 66 genera (Arora & Nayar, 1984).

Kerala represents an embodiment of the Western Ghats located near the west coast of Peninsular India between latitude 8° 18' & 12° 48' North and longitudes 74° 52' & 72° 22' East, and is popular for the rich vegetation and prominent biological diversity. Western Ghats start from the River Thapti in Gujrat in North-West India and end in Kanyakumari in Tamilnadu, about 450 km area comes within the boundary of Kerala. The elevation of the mountain ranges varies from 900 to 2000 m from the main sea level. The vegetation is actually a remnant of the Gaunduwana land.

Important forest types of Kerala include tropical evergreen, moist deciduous, and dry deciduous forests. The development of tropical rain forests, typically found at elevations of 500 to 1500 meters, on Kerala's windward portion of the Western Ghats, is the most prominent aspect of the region's vegetation. The Ghat zones that particularly in the Kerala region, are home to a very rich variety of tropical forest types that shelter an exceptional biodiversity with significant ecological and economic importance. These forest types are made possible by the region's proximity to the equator and the sea, good monsoon rains, a humid and hot tropical climate, diverse soil layers, altitudinal differences, and numerous perennial hill streams. They produce 40 percent of earth's oxygen. For ecological purposes, a rainforest is described as "a closed, multi-storied forest with broad leaves that is continuously covered in a tree canopy that varies in height and has a distinctive diversity of species and life forms (Sneadaker, 1970).

However, a number of reasons, including commercial plantations, hydroelectric projects, grazing expansion, the exploitation of forest products have led to the persistent deterioration of forests today. Because of these activities, in the Western Ghats, nearly 40 percent of the natural vegetation has disappeared during the last eight decades (Menon & Bawa, 1997). In the Western Ghats, extensive virgin forests have been destroyed as a result of crop plantings and the expansion of teak and

eucalyptus plantings. Hydroelectric and irrigation projects caused the submersion of catchment areas where vegetation was very rich, this also accelerated the destruction of the forest flora.

Over the past ten years, it has become more and more important to conserve biodiversity as rates of habitat and species degradation rise (Wilson, 1988). Quantifiable markers of the composition, structure, and functioning of forests must be found in order to facilitate efficient planning and the sustainable use of forest resources (Noss, 1990).

The current rate of tropical forest loss and disturbances will result in 5- 10% loss of all tropical species per decade over the next quarter century (Mcneely et al., 1990). Therefore, for the best use of available resources, a fairly comprehensive assessment of the plant and animal components of biodiversity is required. Scientific data on bioresources must be gathered and recorded for sustainable use and conservation, since protected areas are the primary centres of biodiversity and conservation. Appropriate action should be done to stop additional depletion of forest resources. Forest ecosystems require timely and reliable information in order to detect changes over time.

It is possible to develop efficient management strategies by conducting in-depth ecological investigations in these hotspot locations. Almost all other rainforest species depend on trees for resources and habitat structure, hence the diversity of trees is essential to the overall biodiversity of rain forests (Gaston et al, 2013). In this context, the present study envisages a tree ecological study of Sholayar reserve forest, an area with unique phytogeography, and with rich flora and fauna, in Southern Western Ghats which have great ecological and environmental significance. For this protected forest, no thorough vegetation analysis of the various tree species has been done to recently.

1.4. Aim and Objectives

1. To analyze the structural status of the permanent arborescent vegetation.
2. To assess the tree species diversity of different forest types.
3. To evaluate the status of tree species belongs to the category rare, endangered and threatened.

Review of Literature

CHAPTER -2

REVIEW OF LITERATURE

The classification of vegetation is the first stage in any synecological investigation. The plant categorization reviews provided by Champion (1936), Chandrasekharan (1962 a, b, c & d), and Champion and Seth (1968) are considered classics. The Champion and Seth (1968) and Champion (1936) forest classification systems are the most extensively used of these. Based on bioclimatic factors, Meher-Homji (1984) identified 14 phytogeographic zones in India, of which three are connected to the Andaman and Nicobar Islands and the Himalayas, while eleven are found in Peninsular India. Twenty-nine varieties of vegetation are included in the eleven zones. The tropical forest covers only 7% in mainland but it provides life for almost half of the world species (Gallery 2014), however at present tropical forests are vanishing at a frightening rate of 0.8 and 2% per annum (Suhs et al., 2019).

In India about 21.71 % of the geographical area is under forest vegetations, out of which 3.04 % is very dense forest, 9.33 % moderately dense forest, and 9.34 % is open forest (FSI, 2021). One of the most species-rich terrestrial ecosystems are tropical forests, which produce a range of natural resources that support the life of local communities (Singh & Kushwaha, 2008; Gupta & Kumar, 2014). Plants and their environment interact with each other. This is the reason for the formation of different vegetation types in different areas. This makes our ecosystem diverse. Walter G. Rosen first used the phrase "biodiversity" in 1985. It is the abundance, diversity, and variability of all living things within a certain geographic area. As the biological system that has produced new organic matter using the successive generation of plants and animals, forests are rich wealth of biodiversity and significant supports of life (Kimmins, 2004). According to Odum (1971), succession is regarded as an ecosystem development process. The term "succession" for community development was used by Tansley (1935).

“Phytosociology” is the study of vegetation in a quantitative manner. Phytosociological studies are conducted to describe the vegetation types, species distribution pattern and also for classifying vegetation in a meaningful way. Distribution of individuals of different species in an area is known as species

diversity. Vegetation data such as frequency, density and abundance were quantitatively analyzed by different workers (Curtis,1959; Phillips,1959; Pound and Clements, 1898). The size of quadrats varies correspondingly for various types of vegetation. The species/area curve approach was used to standardize the minimum area of the quadrat (Cain, 1938). In terms of science, Jaccard (1912) was the first to address the relationship between the number of species and area. Other authors who have done so include Braun-Blanquet (1932), Cain (1938), Misra and Puri (1954), Oosting (1956), Misra (1968), Singh and Khan (1984), Basha (1987), Pascal (1988), and Roy (1993). One of the most significant features of vegetation that has drawn the attention of many ecologists is the distribution of species (Whitford,1948; Cole,1949 and Ashby,1961). Whitford (1948) measured the contagiousness of the plants using the ratio of abundance to percentage frequency. According to Curtis and Cottom (1956), an abundance/frequency value of less than 0.025 often denotes a regular distribution, 0.025 to 0.05 random, and more than 0.05 contagious. In order to compare two distinct plant communities, Jaccard (1912) proposed the idea of the community coefficient. Later, Gleason (1920), Sorenson (1948) and Ellenberg (1956) made modifications to Jaccard's formula. The equation developed by Shannon and Wiener in 1949 has been widely used to quantify several aspects of life, including species diversity. For studying floral diversity and concentration of dominance another index was established by Simpson (1949). A few previous studies of American vegetation, introduced quantitative sampling techniques in small areas or quadrats (Pound and Clements, 1898). The upland hardwood forests of the prairie-forest floristic province of southwestern Wisconsin were studied by Curtis & McIntosh (1951). They adopted random sampling technique. The study examined the interactions between the state's upland hardwood forests and specific environmental physical characteristics in the prairie-forest boundary zone. The relative frequencies, densities, and dominance as well as the IVI of each plant species were also evaluated. IVI is the total of relative dominance, relative density, and relative frequency of a species. Various factors such as climate, rainfall, soil structure, watershed management, pollution, wind, energy etc. are influenced by forests (Menon, 1981 & 1982).

Various measures of a vegetation such as frequency, abundance, density and IVI were analyzed by Muller-Dombois and Ellenberg (1974). Pichi-Sermolli (1948)

developed concept of maturity index. Singh et al. (1984) studied about vegetation of Silent Valley, Menon and Balasubramanian (1985) conducted vegetational studies in Trichur forest division. *Xylia xylocarpa*, *Dillenia pentagyna*, *Tectona grandis*, *Terminalia crenulata* and *Grewia tiliifolia* forming the dominant communities in Thrissur forest division. The forest is moderately mature with respect to its successional status. Srivastava (1986) studied about species diversity in two manmade forests at Dehradun, New Delhi.

The evergreen forests of Silent Valley and Attappadi were studied by Basha (1987). Pascal (1988) studied about the evergreen forests of Western Ghats. There are multiple factors such as micro-environment and biotic factors influence distribution pattern across the slopes and vegetation strata (Joshi and Tiwari, 1990). Woody strata in four *Cedrus deodara* forests in Kanasar range of Chakrata forest division, in Western Himalaya was analyzed quantitatively by Rawat and Kumar (1989).

Vegetation survey and ecological studies of ground vegetation under silver fir and spruce forests of Himachal Pradesh was studied by Singh and Gupta (1992). Tropical evergreen forests of Southwest India were studied by Pascal and Pelissier (1996). Forest vegetation in permanent plots of Thamna in Orissa was analyzed by Varma et al. (1997). Biodiversity and population density of trees of tropical wet evergreen forests of Courtallum was analyzed by Parthasarathy and Karthikeyan (1997). Plant biodiversity at a mid-elevation evergreen forest of Kalakad-Mundanthurai Tiger Reserve, Western Ghats, was studied by Ganesh et al. (1996). Sureshbabu (1998) has done a detailed phytosociological study of shola forests of Eravikulam National park of Kerala. He found that *Syzygium arnottianum*, *Cinnamomum whightii* and *Elaeocarpus oblongus* are the common species in shola forests of Eravikulam. Ghate et al.(1998) studied the patterns of tree diversity in the Western Ghats of India. The composition, abundance, population structure and distribution patterns of all woody species (≥ 30 cm gbh) of an undisturbed and two adjacent human-impacted sites of a tropical wet evergreen forest in Kalakad National Park, Western Ghats, was studied by Parthasarathy(1999). In phytosociological studies of Goodrical reserve forests of Kerala it is found that *Cullenia exarillata*, *Macaranga peltata*, *Agrostistachys borneensis*, *Mesua ferrea* and *Palaquium ellipticum* show higher IVI values. *Vateria indica* was the common species found there. Four different formation types and seven dominant association types were also

identified (Menon, 2006). Species diversity, vegetation structure and plant community status of Great Himalayan National Park was investigated by Singh and Rawat (1999). Rawat and Bhainsora (1999) studied about forest vegetation of the Shivaliks of Doon valley and of outer Himalaya, part of Rajaji National Park. They used stratified random plots. Woody species richness, IVI of trees and of the climax species of the region were analyzed. In Agasthyamalai region of Kerala, at 100-500m altitude, phytosociological studies were conducted by Varghese and Menon (1999). They used random sampling method; 18 species were enlisted under more than 12 families. The *Myristica* swamp forest had a maturity index value of 18.33, stand density of 952 trees/ha, and species density of 18 species/0.1ha was recorded. Nath et al. (2000) conducted biodiversity studies of tree species in Sitaphar forest reserve. Regeneration pattern, tree diversity and qualitative characters of forests in the Tarai-Bhabhar belt of Kumaun, Central Himalaya in Uttar Pradesh was studied by Agni et al. (2000). Khatri (2000) studied the biodiversity in tropical forest ecosystem of Satpura National Park, Madhya Pradesh. The effects of forest management on plant species diversity in a Sierran conifer forest was studied by Battles et al. (2001). Pandey et al. (2002) conducted vegetation analysis of a moist temperate Western Himalayan forest ecosystem in Chamoli, Garhwal Himalaya. Negi (2002) studied about woody species of Sangla Valley, Himachal Pradesh and recorded that seventeen tree species and nine shrub species were dominant. He used quadrat method. Vegetation analysis in the selected study sites of West Siang district of Arunachal Pradesh was conducted by Singh et al. (2002). Vegetation analysis in part of Kolli Hills, Eastern Ghats of Tamil Nadu was done by Jayakumar et al. (2002). Plant vegetation study in New Amarambalam reserved forests of the Nilgiri Biosphere Reserve, Western Ghats of India was conducted by Jayakumar (2003). Phytosociological study of the riparian forests of river Chalakkudy shows that 6 species are endemic to riparian forests. *Syzygium occidentata*, *Barringtonia acutangula*, *Madhuca nerifolia*, etc. are the dominant species on the banks of river Chalakkudy (Bachan, 2005). Kishore (2004) and Abhilash et al. (2005) are different workers whom conducted biodiversity studies in different forest vegetation. Studies of Kishore (2004) showed that there are total 661 angiosperm species in the shola forests of Kerala, which are belonging to 110 families.

Anita (2005) studied about the reduction in herbaceous species in Chir pine forests of Himachal Pradesh. Due to the presence of *Lantana camara* species and its after effects in the floristic composition of that area, the species distribution patterns were changed. In comparison to the invaded site, only a small number of species exhibit regular distribution patterns in the control areas. Changes in rain forest tree diversity, dominance etc. in Western Ghats was studied by Davidar et al. (2005). Dominant species of evergreen forests of Thrissur district are *Ficus beddomei*, *Cullenia exarillata* and *Drypetes elata* etc. In semi-evergreen forests, *Knema attenuata* and *Hydnocarpus pentantra* etc. are dominant species. *Xylia xylocarpa* is dominating in the moist deciduous forests (Menon and Sasidharan, 2005). They conducted sampling by 0.1 ha plots and individuals with gbh \geq 30 considered as trees. Pandey and Shukla (2005) studied about plant community and diversity patterns within the forested landscape of North-Eastern Uttar Pradesh.

Kharkwal et al. (2005) studied about vegetation types in the Central Himalayan regions of India and it is found that altitude and climatic variables have great role in the distribution and species richness pattern. Galav et al. (2005) studied about the role of climatic variation in the phytosociological characters of grasslands of Southern Aravalli hills, Rajasthan, India. Sharma et al. (2006) analyzed phytosociology of tree species and of soil characters in agroforestry of Chhattisgarh, Bilaspur and Raipur Districts, India, and observed that tree species showed random distribution. Kumar et al. (2006) conducted studies of tree species in tropical forest hills, Western Meghalaya. Menon and Balasubramanyan (2006) worked on the phytosociology of selection felled area of Sholayar reserved forest and 94 species were recorded. *Cullenia exarillata*, *Dysoxylum malabaricum*, *Elaeocarpus serratus* etc. were dominant with higher IVI. In the Boudh district of the Eastern Ghats of Orissa, Sahu et al. (2007) conducted vegetational investigations in the tropical dry deciduous forest. They found that *Shorea robusta*, *Buchanania lanzan*, *Madhuca indica*, *Cleistanthus collinus*, and *Diospyros melanoxylon* are the prevalent species. With a Simpson's value of 0.92 and a Shannon-Weiner diversity index of 4.51, it can be concluded that tropical dry deciduous forests exhibit considerable diversity. Kumari and Tripathi (2007) studied about fern community status of a tropical deciduous forest, Tarai forest in the Balmikinagar district West Champaran of Bihar and Kusumi forest, Gorakhpur of Uttar Pradesh. Where *Selaginella* was found to be

maximum in number and *Dryopteris* was the most dominant one. Phylogenetic analysis of the flora of one biodiversity hotspot, the Cape of South Africa was done by Forest et al. (2007). Viraj et al. (2007) analyzed species diversity and community structure of the vegetation of Sangla valley of district Kinnaur in Himachal Pradesh. A total of 26 threatened plant species were identified; belong to 16 families, 5 critically endangered, 7 endangered, and 14 plant species were in vulnerable category according to classification of IUCN.

A phytosociological study in the natural forests in Hastinapur, Uttar Pradesh was conducted by Khurana and Kalpana (2008). Different measures such as richness of species, diversity index, and total plant species in three forest sites were analyzed. Vegetation composition, structure and diversity pattern of tropical wet evergreen forests of Western Ghats, was studied by Giriraj et al. (2008). Reddy et al. (2008) studied about tree species diversity and distribution patterns in tropical forest of Eastern Ghats. In Amarambalam, there are 1135 species of angiosperms of 136 families. About 21 % of the flora is endemic to Western Ghats and 12.5 % species among the endemics are strictly endemic to Southern Western Ghats. 4% of exotics or cultivating species are also present here (Nair and Jayakumar, 2008). Tropical forest structure and diversity in relation to altitude and disturbance in a biosphere reserve in Central India was studied by Sahu et al. (2008). Tree diversity and Carbon stocks of some major forest types of Garhwal, Himalaya was analyzed by Sharma et al. (2010). Nirmalkumar et al. (2010) studied about diversity of tree species and soil characters in three sites of tropical dry deciduous forest of Western India. Tree species of 10 different forest types in Sagar district, Madhya Pradesh was studied by Khare and Thakur (2010). Devlal and Sharma (2011) conducted studies on various ecological measures such as dominance, biodiversity and species richness of tree species of Mandakini catchment of Garhwal Himalaya. They concluded that values of diversity/ha and total basal area were in between 2084 and 600 trees ha⁻¹ and 55.44 - 6.36 m² ha⁻¹ respectively. Magesh and Menon (2011) surveyed the Sulimudi forests in Southern western Ghats of Kerala. 124 species of angiosperms belonging to 56 families were recorded. 34 species are endemics and *Vateria indica* is critically endangered. *Mesua ferrea*, *Vateria indica*, *Palaquium ellipticum* and *Cullenia exarillata* are dominant. Community composition, structure and management of subtropical vegetation of forests in Meghalaya state, Northeast India was studied by

Tripathi (2011). Tree species diversity of Khokhan Wildlife Sanctuary of Kulu district, Himachal Pradesh was studied by Pant and Samant (2012).

The role of altitude and climatic variables in distribution of species and species richness pattern was revealed in a study of tree vegetation of temperate forest in Uttarakhand by Rawat and Chandra (2012). Biodiversity in Gorumara National Park in West Bengal was examined by Ghosh (2012). Moist habitat showed maximum species diversity. Two fenced areas in Dhanolti reserve forest of Mussoorie forest division were analyzed for understanding biodiversity by Virkar et al. (2012). Tree species of Katerniaghat Wildlife Sanctuary, Uttar Pradesh were studied by Bajpai et al. (2012). Anitha et al. (2010) studied the phytosociology of tropical forest of Western Ghats, Anakatty in Tamil Nadu. There were totally 106 species of trees and *Albizia amara*, *Nothopegia recemosa* etc. were abundant. Vegetation structure and composition and diversity of tropical dry deciduous forest of Sariska National Park was done by Kidwai (2013). Sinha and Sinha (2013) studied the phytosociology of forests of Korla district of Chattisgarh, India. *Woodfordia fruticosa* showed highest IVI and it is the dominant species in Korian forests. Anbarashan and Parthasarathy (2013) worked on tree diversity of tropical dry evergreen forests in the Coromandel Coast of India. Floristic composition and ecological assessment of tree species diversity in tropical forests of Srikakulam and Vizianagaram districts of Andhra Pradesh was done by Rao et al. (2013).

The size of quadrat for sampling in evergreen forest of Parambikulam Wildlife Sanctuary was quantified by Suraj et al. (2014). Ecological study at Parambikulam Tiger Reserve was done by Magesh (2014). Anbarasu and Balasubramanian (2015) worked on tree diversity of the tropical montane evergreen forest in the Nilgiri mountains, Western Ghats, India. Comparison of riparian species diversity between the main river channel and sub water sheds of Meenachil river basin was done by Vincy (2014). The floristic study of Attappady reveals that there are 1661 species of angiosperms belonging to 160 families. Among the 1661 species 387 are endemic to Southern Western Ghats and 101 are belonging to Western Ghats (Anilkumar, 2015). Vegetation analysis and regeneration status of *Q. floribunda* dominated forests of Nainital in Kumaun, Himalaya was studied by Pandey and Lodhiyal (2015). Phytosociological studies of tree vegetation of Moraghat forest range, India was done by Sarkar (2015). Studies on phytosociological and species diversity in the Khammam

district of Telangana state was conducted by Rao et al. (2015). Shahid and Joshi (2015) did analysis of phytosociology and tree distribution pattern in the forests of Doon Valley, Shivalik hills of lower Himalaya.

The status of biodiversity of tree species in Ramshai forest range, Gorumara National Park was analyzed by Kumar (2016). Mohandas et al. (2016) worked on floristic species composition and structure of a mid-elevation tropical montane evergreen forest of Western Ghats. Plant diversity of North-Eastern Uttar Pradesh was studied by Shukla and Srivastava (2017). Rakesh et al. (2018) conducted a study related to ecology and conservation of an endangered tree species *Aporosa bourdillonii* in Kerala. Tree diversity, distribution, and population structure of a riparian forest along Dikhu river in Nagaland was studied by Devlin and Maibam (2018). Bohara et al. (2018) worked on biodiversity and Carbon stock in Kharsu Oak dominated forest in Nainital district of Kumaun, Himalaya. Woody species in sub-tropical forest of Manipur was studied by Sophia et al. (2018). Structure, composition and diversity of trees within the dry evergreen reserve forest of Kondapalli, Eastern Ghats was studied by Prasad and Kumari (2019). Tree species diversity, distribution and soil nutrient status along altitudinal gradients in Saptasajya hill range, Eastern Ghats was studied by Sahu et al. (2019). Phytosociological assessment and diversity of woody species in Omo Biosphere Reserve, Nigeria was studied by Akinyemi et al. (2019). The ecology of tree species of Karian Shola in Parambikulam Wildlife Sanctuary was studied by Manoj (2019).

A comparative phytosociological assessment of three terrestrial ecosystems of Wayanad Wild life Sanctuary was conducted by Chandran et al. (2020). Vegetation dynamics studies in forests of West Bengal was done by Das and Das (2020). Status of tree biodiversity in Veerakkal tropical moist deciduous forest in Western Ghats was analyzed by Remya et al. (2020). Biodiversity significance of low-elevation riparian forests in Vazhachal was studied by Pooja et al. (2020). Phytosociology and regeneration status in different permanent preservation plots across different forest types in Madhya Pradesh was studied by Singh et al. (2021). Phytosociology of tree vegetation in Jakhu hills, Shimla, Himachal Pradesh was studied by Thakur et al. (2021). Plant biodiversity and phytosociological studies on tree species diversity of Ratanpur forest, Bilaspur district was conducted by Soni and Namdeo (2022).

Dudipala et al. (2023) studied about species diversity, phytosociological attributes and regeneration status of Pench Tiger Reserve, Maharashtra.

Due to the increasing anthropogenic disturbances in our forests there occurs a great loss of biodiversity so that to maintain the biodiversity, effective management of conservation strategies are necessary. A large number of species are under threat of extinction. This may cause serious impact on the existence of life on our earth. Biodiversity loss causes serious impact on the natural ecosystem locally, moreover which leads to an imbalance in global ecosystem too.

Studying ecology is very important because it helps us to know about the biodiversity status of a vegetation. Basic understanding of the components of ecosystem, plant diversity and dominant species are necessary to adopt various biodiversity conservation methods.

Study Area

CHAPTER-3

STUDY AREA

3.1. Location:

Sholayar reserve forest is a part of Vazhachal forest division, which falls in Chalakkudy taluk of Thrissur district nearby to Kollathirumedu, Vazhachal, Charpa and Athirapilly ranges. Geographically this region lies between 10⁰15 and 10⁰25 N latitude and 76⁰40 and 76⁰55 E longitude in central part of Kerala. Total forest area coming under Vazhachal division is 353.41sq.km. Sholayar range comprises about 78.35 sq.km area. Sholayar was the largest range in Vazhachal up to 2015-16 and now the Athirapilly is the largest range since the merging of 60.53 sq.km of Sholayar to the Parambikulam Tiger Reserve in 2015-16. Sholayar is on the right bank of the Chalakkudy river. The highest point is Numberpara. Earlier the highest peak was Karimalagopuram. Now it became part of the Parambikulam Tiger Reserve (Fig.1.)

3.2. Rainfall and temperature:

The average rainfall is 3300mm in the Vazhachal division. The major portion of the Sholayar range is medium elevation zone(>700m) where the range receives a rainfall of >4000mm, followed by a period of 2-3 dry months. And the area along Anakkayam-Sholayar river downstream is low elevation zone(<700m), with a rainfall >3000mm<4000mm, followed by 3-4 months of dry period (Bachan,2019). The temperature varies from 14⁰ C to 36⁰C. During the year 2020-21, the study area got an annual rain of 3805mm. In 2021-22 the average rainfall was 4055mm. During the year 2022-23 Sholayar range got an annual rainfall of 4299.5mm. Rain fall data was collected from Kerala State Electricity Board (Fig.2-4).

Typically, the nights are chilly and the days are scorching. During this time, deciduous plants that grow on rocky soils start to lose their leaves. The three months that make up the hot season are March, April, and May. during this season, the temperature is quite hot and the humidity is at its highest. It's the warmest time of year. In the middle of the early monsoon in May, there are a few pre-monsoon showers that fall upon the scorching season.

Fig.1. Map of Sholayar Reserve Forest

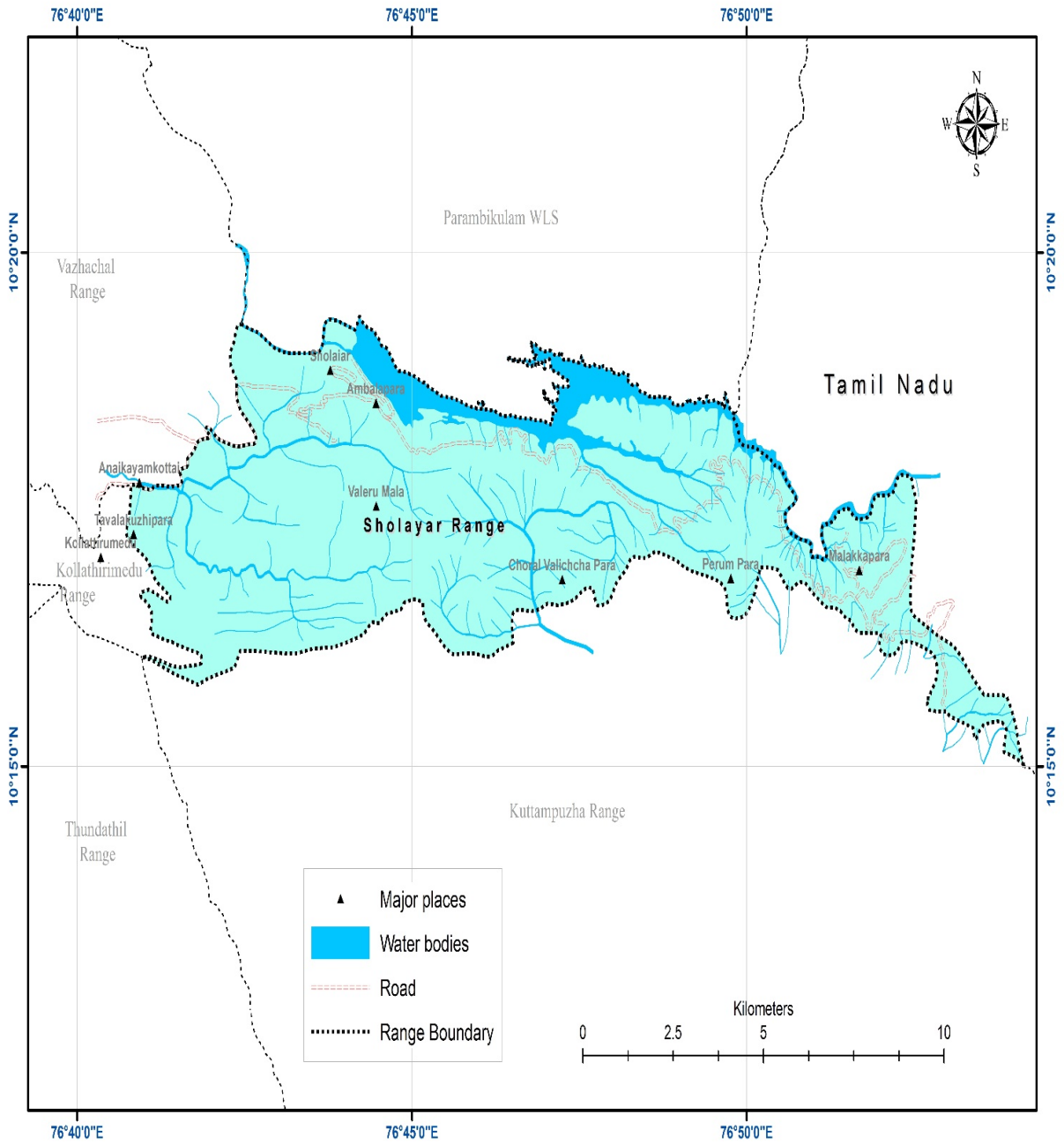


Fig: 2. Rainfall data of the study area during the year 2020-21

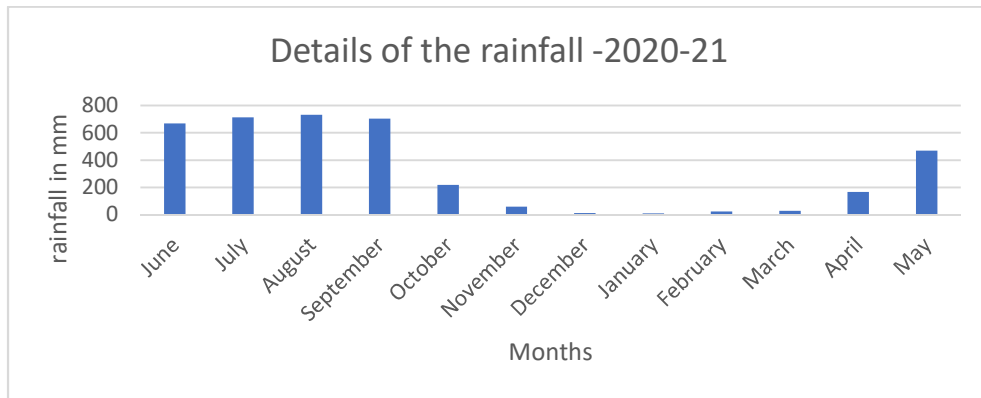


Fig: 3. Rainfall data of the study area during the year 2021-22

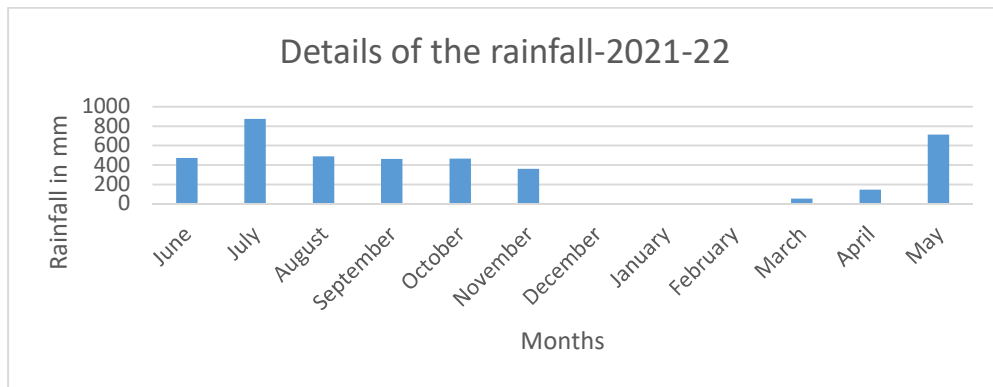
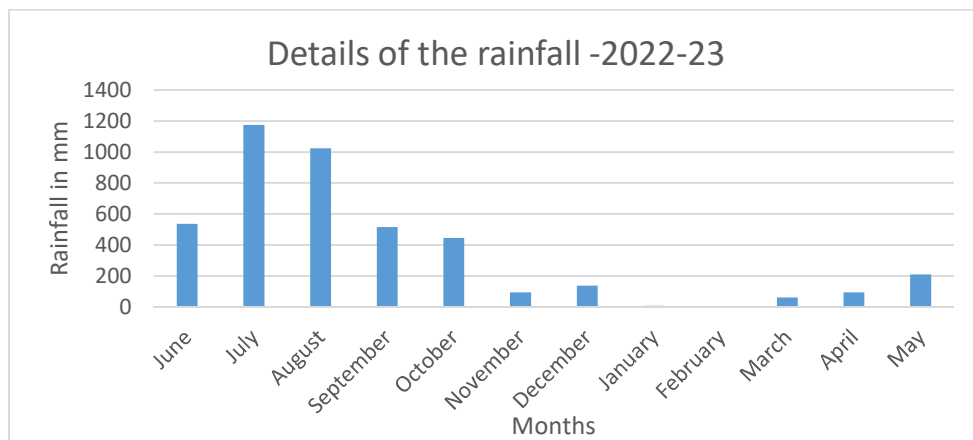


Fig:4. Rainfall data of the study area during the year 2022-23



Sholayar range falls in the tropical zone. This region experiences three distinct seasons: the rainy, hot, and cold seasons. The cold season lasts from November through February. A good pre-monsoon rain may be received in the month of May and it happens very frequently. June to November is when the rainy season often occurs. The typical rainy season begins in March or April with pre-monsoon rains, is followed by a brief period of dry weather, and ends in May or June with the arrival of the Southwest monsoon. The northeast monsoon, which finishes in November to make way for the onset of the dry season, closely follows this period of rainfall.

3.3. Physiography:

The entire area is hilly in the Vazhachal forest division. Sholayar is an important valley in the rugged eastern portion of the division. It is situated in the western slope of the Western Ghats. Based on the area of the height classes, Sholayar range is composed of distinctive levels in its area, (i) Highly elevated plateaus (>1000 m) (ii) medium elevation zone (600-1000m) of which a great extent is in between 800-1000 m. and (iii) slightly ascending low elevation zone (400-600 m).

Crystalline rocks of Archean age, either igneous or metamorphic in nature, make up the region's geology. The most common types are magnetite quartz and narrow bands of pyroxene granulates, and they are primarily composed of Charnockites, granites, and granitic gneisses.

There are various sorts of soil, varies from deep filler grained soil in the valleys on the lower slopes to extremely shallow gravelly soil on the upper slopes. Alluvial deposition as a result of geological erosion is the reason for this. Along the banks of rivers and streams, alluvial deposits are frequently seen.

The type of vegetation cover has an additional impact on the characteristics of the soil. The majority of the study area has rich organic content and deep soil structure. The two types of soil in the study area are very deep, well-drained clayey-loam with mild erosion mixed with gravelly-loam soil on gentle slopes along the forested parts, or clayey loam with moderate erosion mixed with rocks along the exposed rocky terrain.

3.4. Drainage:

The main water source is the Sholayar river, which is a tributary of the Chalakkudy river. Sholayar river is perennial but regulated with Kerala Sholayar reservoir. Many perennial streams are located in the Sholayar range; Anakkayam and Chandanthodu are important streams.

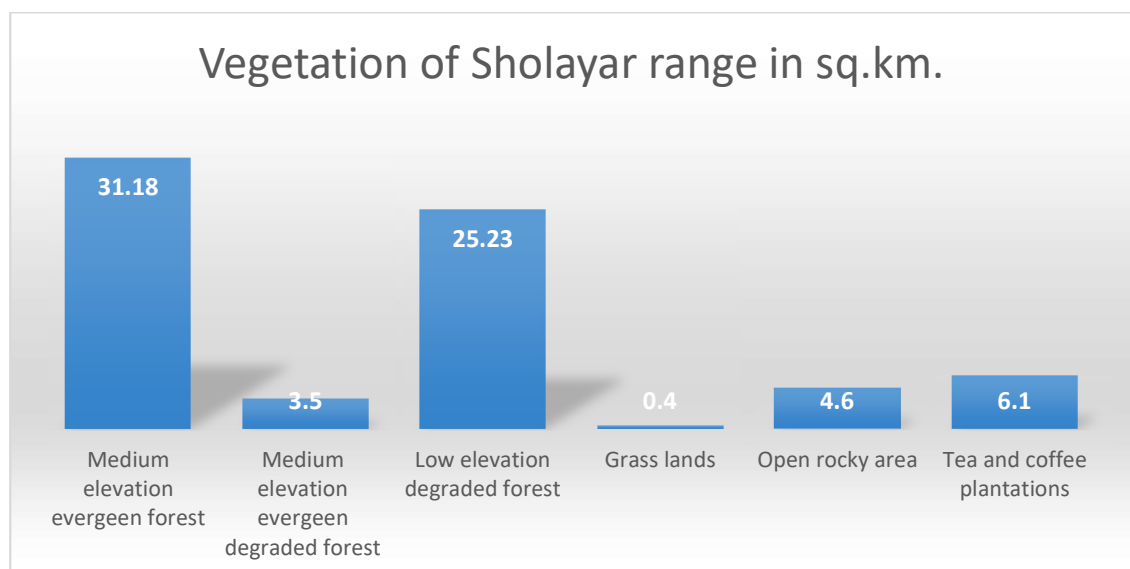
3.5. Tribal Settlements:

There are four tribal settlements in the study area, Thavalakuzhipara, Anakayam, Sholayar and Malakapara. The Primitive tribes 'Malayan' are settled in Thavalakuzhipara and tribes 'Kadar' are settled in other settlements.

3.6. Vegetation:

Sholayar reserve forest is inhabited to a variety of vegetation types, including tea and coffee plantations, natural high elevation grasslands, degraded open rocky areas, low elevation evergreen degraded forest, and medium elevation evergreen forest. Typical wet evergreen forests present in most of the area, where ground vegetation other than the recruits of the main species is very poor or absent (Rajesh,2018) (Fig.5).

Fig.5 Vegetation of Sholayar in sq.km.



Materials and Methods

Chapter -4

MATERIALS AND METHODS

4.1. Phytosociological studies:

Among the broader context of ecology, phytosociology explores the dynamics, composition, and structure of plant communities. To characterize and categorize plant communities according to aspects including species composition, abundance, and distribution patterns, phytosociology employs an array of methods, such as vegetation surveys, statistical analysis and classification strategies. This area of focus is important for ecosystem management, conservation biology and improving our awareness of how changes in the environment affect plant communities. It would take too much time to survey every inch of vegetation in even one segment. By sampling, data from sample plots or transects can be used to draw conclusions about the larger plant population that are statistically valid. Researchers can extrapolate findings to estimate factors like species richness, diversity, and community structure with a certain degree of confidence by using proper sampling techniques and statistical analysis. Therefore, when sampling vegetation, one must take into account four steps: (a) segmenting the vegetation cover or identifying entities (b) choosing samples within the recognized segments (c) deciding on the size and shape of the samples and (d) deciding what information to record once the samples are established (Muller-Dombois and Ellenberg, 1974).

A thorough reconnaissance study was carried out prior to the fieldwork. For the convenience, the whole study area was divided into two zones on the basis of altitude and vegetation. Above 700m altitude was considered as medium elevation zone and below 700 m altitude was considered as low elevation zone. Stratified random sampling technique was adopted for vegetation sampling (Abhilash, 2007; Menon, 2001; Magesh and Menon, 2011; Manoj, 2019). For tree sampling, 0.1 hectare (33 x 33 m) quadrat size was utilized. The convenience of using 0.1 ha quadrats for obtaining phytosociological data on trees has been recognized. Number and locations of sample plots were decided based on altitude and vegetation types. Study sites were selected on the vegetation map and located on the ground by using Global Positioning System. In each plot using the census quadrat method (Oosting, 1956), all the tree

species of 30cm or above girth at breast height or 1.37m above from the ground were recorded (Roy, 1993). Several studies conducted in Western Ghats, estimated an ideal size of 0.1 ha as sample size (Suresh and Sukumar, 1999; Vijayan et al., 1999; Rajasekharan, 2000). Based on relative density, relative frequency and relative basal area, the Importance Value Index (IVI) was calculated and associations among tree species were derived. Dominance and ecological success of species can be understood from the Importance Value Index (IVI) (Curtis and McIntosh, 1951).

A total of 280 quadrats were laid out in the study area, among them 180 quadrats were established in the medium elevation zone including the riparian forest area and 100 quadrats were established in the low elevation zone including the riparian area. Study sites were denoted by numbers from 1 to 28. Binomial names of different tree species were determined with the help of specialists, scientific literatures, floras and monographs (Gamble and Fischer, 1936; Mathews, 1983; Sasidharan, 2004).

4.2. Primary analysis:

Various parameters like density, frequency, abundance, basal area and Importance Value Index (IVI) were calculated by following Muller-Dombois and Ellenberg, 1974; Menon and Balasubramanian, 1985; Pascal, 1988; Mani and Parthasarathy, 2006; Magesh and Menon, 2011 and Kumar and Sharma, 2014.

4.2.1. Density(D)

This parameter relates to the counting of individuals per unit area. This is done by adding the total number individuals of each species for the total sample area (Curtis and Mc-Intosh, 1951).

$$\text{Density (D)} = \frac{\text{Total number of individuals}}{\text{Total number of quadrats studied}}$$

The relative values of density (RD) were determined according to Phillips (1959)

$$\text{RD} = \frac{n_i}{N} \times 100$$

(where n_i = Number of individuals of i^{th} species;

'N' = total number of individuals in the plot).

4.2.2. Frequency (F)

It is stated as the proportion of occurrence of a specific species in the sample plots under study. For comparison of different communities, frequency is expressed in terms of percentage values (frequency %) or 'Frequency Index' as:

$$\text{Percentage Frequency (PF)} = \frac{c_i}{C} \times 100$$

where, c_i = Number of plots where species present

C = Total number of plots studied

Raunkiaer (1934) divided the percentage frequency into 5 classes such as:

Class A - 0 to 20 % frequency

Class B - 21 to 40 % frequency

Class C - 41 to 60 % frequency

Class D - 61 to 80 % frequency

Class E - 81 to 100 % frequency

Raunkiaer (1934) derived the 'Law of Frequency' which states that:

in a homogeneous vegetation frequency class is $A > B > C \Leftrightarrow D < E$.

The relative frequency (RF) was calculated by (Phillips, 1959).

$$\text{RF} = \frac{\text{PF}}{F} \times 100$$

Where, $F = \sum \text{PF}$

4.2.3. Abundance (A)

Abundance is described as the number of individuals per quadrat of occurrence (Curtis and Mc-Intosh, 1951).

$$\text{Abundance (A)} = \frac{\text{Total number of individuals}}{\text{Number of quadrats of occurrence}}$$

4.2.4. Species distribution

Species distribution is one of the important aspects in ecological studies, the abundance/frequency ratio was proposed by Whitford (1948) as a contagiousness metric. Regular distribution is indicated by the high frequency and low abundance whereas the low frequency and high abundance indicates contagious distribution. < 0.025 indicates regular, 0.025 to 0.05 random and >0.05 contagious distribution (Curtis and Cottom, 1956).

4.2.5. Basal Area (BA)

This is an index of dominance. It refers to the ground actually occupied by the stems. Higher the basal area, greater will be the dominance. Basal area (BA) is sum of the basal areas of individuals of same species.

Basal area of an individual = πr^2 (where r = radius derived from gbh)

$$\text{Relative Basal Area (RBA)} = \frac{\text{BA}}{\text{D}} \times 100$$

Where 'D' is the basal area of all the species in the plot

4.2.6. Importance Value Index (IVI)

In order to express dominance and ecological success of any species, a single value index has been developed by Curtis and Mc-Intosh (1951). This index was derived from three characteristics of vegetation viz: Relative Frequency (RF), Relative Density(D), and Relative Basal Area (RBA)as:

$$\text{IVI} = \text{Relative Density} + \text{Relative Frequency} + \text{Relative Basal Area}$$

From the quadrat data obtained during the field work the following secondary quantitative analysis were carried out.

4.3. Secondary analysis:

4.3.1. Maturity Index (MI)

The succession can be defined as the "the gradual change which occurs in vegetation of a given area of the earth's surface on which the population succeeds the other" (Tansely, 1935). Based on the frequency percentage of each species in the stands of a community, Pichii-Sermolli (1948) proposed an index for the establishment of maturity in plant communities. According to him,

$$\text{Maturity Index (MI)} = \frac{\text{Total frequency (\%) of a community}}{\text{Total number of species present}}$$

4.3.2. Community coefficient or Index of similarity (IS)

The Jaccard (1912) community coefficient is a very basic mathematical equation for the similarity of the plant communities. The number of species that are common to two locations and the overall number of species, are the basis for its presence-absence relationship. Thus, it expresses the ratio of the common species to all species found in the vegetation (Muller-Dombois and Ellenberg, 1974). Ever since the publication of Jaccard's formula has undergone several quantitative and qualitative modifications. Sorenson's (1948) modification is the one, widely accepted. Sorenson's similarity index expresses the actually measured coinciding species occurrence against the theoretically possible ones. His formula for similarity index is:

$$\text{IS} = \frac{2C}{A+B} \times 100$$

where 'C' is the number of species common to two vegetations, 'A' is the total number of species in vegetation A and 'B' is the total number of species in vegetation B. In the present study Sorenson's formula was followed because it is mathematically more satisfactory in terms of statistical probability.

4.4. Biodiversity

Biodiversity indices are mathematical expressions of species importance relationships (Odum, 1971). The following indices were used for the present study to ascertain species richness, diversity and evenness of the permanent vegetation of the study area.

4.4.1. Species Richness

For species richness study the Margalef Index (RI) was used (Margalef, 1958).

$$RI = \frac{S-1}{\text{Log}(n)}$$

Where S = Total number of species and n = number of individuals

4.4.2. Species Diversity

Species diversity is one of the most important characteristics of a community. Species diversity of the tree species was determined as per Shannon and Wiener Index (H') (1949).

$$H' = - \sum \frac{n_i}{N} \times \log \frac{n_i}{N}$$

where n_i = total number of individual of species 'i', and N = total number of individuals of all species in the area.

4.4.3. Species Dominance

The species dominance was measured by Simpson's Index (1949). Simpson's index as:

$$D = \frac{S}{\sum_{i=1}^S (n_i/N)^2}$$

where n_i and N were the same as for the Shannon's index equation.

4.4.4. Evenness or Equitability

Abundance of the species is represented by evenness index. Pielou's evenness measure is the most commonly used method (Pielou, 1975). This is given by the formula;

$$E_3 = H'/\ln S$$

Where S = Total number of species in the plot.

H' = Shannon's Index

4.5. RET species and endemism

Rare, endangered, vulnerable and endemic tree species in the study area were identified and enlisted.

Results

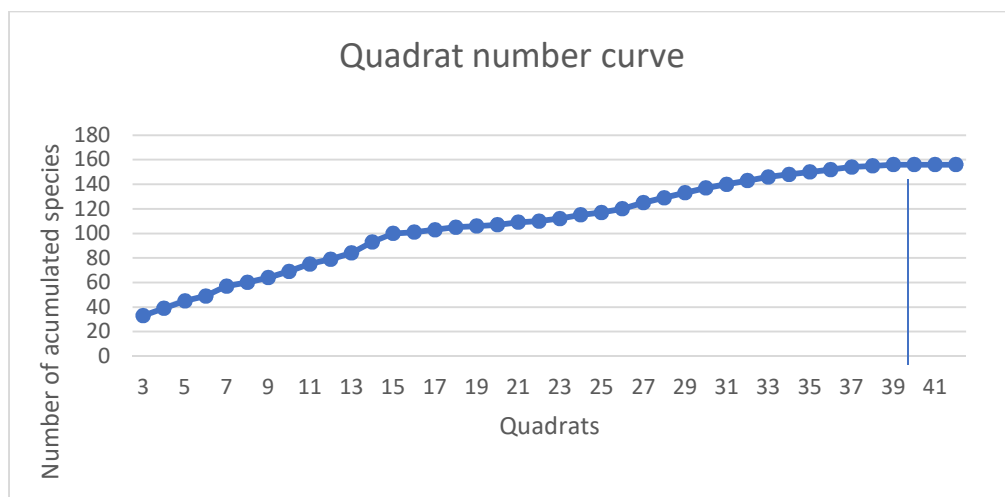
Chapter-5

RESULTS

For the convenience of the study, the entire study area is divided into two zones based on altitude and vegetation types. The area above 700m altitude is considered as medium elevation zone, and below 700m altitude is considered as low elevation zone. The medium elevation zone is characterized with a rainfall of more than 4000 mm per year and a 2-3 months period of dry climate. Rainfall in the low elevation zone is in between 3500mm and 4000mm. In order to find out the structural status of riparian vegetation in the study area, data on tree species in those areas were recorded separately.

The standardization of quadrat numbers was done according to Misra (2013). Fifty quadrats of 0.1ha were established in the study area. The number of species found within each quadrat was counted. Following the recording of the species number, the number of plots that needed to be laid out was progressively raised by 2, 3, 4, 5, and eventually 50. Only the new species that had not been found in the earlier plots were noted down. This was carried out until each new plot had no more new species. The data of the number of quadrats in the X-axis and the number of accumulating species in the Y-axis were plotted on a graph. The X-axis's number of plots coincided with the line graph's flattening point, and the graph's minimal number of plots needed for vegetation analysis was calculated. Quadrat number of 40 was found to be sufficient for sampling trees (Fig.6).

Fig. 6. Standardisation of quadrat numbers



5.1. Medium elevation zone

Primary analysis of the vegetation

A total of 109 species and 7375 individuals of trees having GBH 30cm and above were recorded from the 160 sample plots of 0.1ha size laid out in the sixteen study sites of medium elevation zone. The species with maximum number of individuals are viz. *Palaquium ellipticum*(673), *Cullenia exarillata* (657) and *Mesua ferrea* (556) etc.

As far as enumeration is concerned, a total of 53 species out of 407 individuals/ha from site 1, 41 species out of 430 individuals/ha from site 2, 36 species out of 481 individuals/ha from site 3, 43 species out of 341 individuals/ha from site 4, 32 species out of 489 individuals/ha from site 5, 29 species out of 540 individuals/ha from site 6, 42 species out of 423 individuals/ha from site 7, 38 species out of 473 individuals/ha from site 8, 31 species out of 443 individuals/ha from site 9, 51 species out of 548 individuals/ha from site 10, 36 species out of 531 individuals/ha from site 11, 30 species out of 407 individuals/ha from site 12, 41 species out of 464 individuals/ha from site 13, 34 species out of 456 individuals/ha from site 14, 35 species out of 511 individuals/ha from site 15, 28 species out of 431 individuals/ha from site 16 were recorded (Table 32-47).

Major associations derived, based on Importance Value Index are *Cullenia exarillata-Palaquium ellipticum-Agrostistachys borneensis* in site 1, *Palaquium ellipticum-Cullenia exarillata-Mesua ferrea* in site 2, site 3, site 5, site 6, site 8, site 9, site 12 and site 13, *Vateria indica-Palaquium ellipticum-Cullenia exarillata* in site 4, site 11, site 14 and site 15, *Vateria indica- Calophyllum polyanthum-Palaquium ellipticum* in site 7, *Vateria indica-Mesua ferrea-Palaquium ellipticum* in site 10, *Cullenia exarillata-Palaquium ellipticum-Drypetes venusta* in site 16 (Table 32-47).

5.1.1. Density

With respect to the density, the maximum density (number of individuals/ha) was shared by *Cullenia exarillata* (66 individuals/ha) in site 5 followed by *Palaquium ellipticum* (63 individuals/ha) in site 11, *Vateria indica* (59 individuals/ha) in site 4, *Agrostistachys borneensis* (57 individuals/ha) in site 5, *Mesua ferrea* (49 individuals/ha) in site 5, *Otonophelium stipulaceum* (45 individuals/ha) in site 5,

Aglaia barberi (44 individuals/ha) in site 6 and *Drypetes venusta* (44 individuals/ha) in site 3.

5.1.2. Percentage Frequency

Out of 109 species recorded from the study sites of medium elevation area, species showing high frequency are *Cullenia exarillata*(90), *Palaquium ellipticum*(70) and *Agrostistachys borneensis* (70) in site 1; *Cullenia exarillata* (90), *Aglaia barberi* (80) and *Palaquium ellipticum*(80) in site 2, *Cullenia exarillata*(100), *Diospyros paniculata*(80), *Drypetes venusta*(100), *Mesua ferrea*(100), *Palaquium ellipticum*(100), *Agrostistachys borneensis*(90), *Drypetes malabarica*(80), *Gomphandra coriacea* (80) and *Xanthophyllum arnottianum* (80) in site 3, *Palaquium ellipticum* (100), *Vateria indica* (100), *Diospyros paniculata*(90), *Cullenia exarillata* (80) and *Melicope lunu-ankenda*(80) in site 4, *Agrostistachys borneensis*(100), *Cullenia exarillata*(80), *Drypetes oblongifolia*(80), *Palaquium ellipticum*(100), *Mesua ferrea*(80) and *Otonophelium stipulaceum*(80)in site 5, *Cullenia exarillata*(100), *Diospyros paniculata*(80), *Mesua ferrea*(100), *Palaquium ellipticum*(100), *Holigarna arnottiana*(80), *Elaeocarpus tuberculatus*(90), *Xanthophyllum arnottianum* (80) in site 6, *Calophyllum polyanthum*(100), *Vateria indica* (100), *Palaquium ellipticum* (80) and *Cullenia exarillata*(80) in site 7, *Cullenia exarillata*(100), *Drypetes malabarica*(80), *Palaquium ellipticum* (80), *Mesua ferrea* (80) and *Agrostistachys borneensis*(90) in site 8, *Mesua ferrea*(100), *Palaquium ellipticum* (100), *Cullenia exarillata*(100), *Agrostistachys borneensis*(80), *Drypetes venusta*((90), *Cyathocalyx zeylanica*(80) and *Macaranga peltata*(80) in site 9, *Cullenia exarillata*(90), *Macaranga peltata*(100), *Mesua ferrea*(100), *Palaquium ellipticum* (100), *Vateria indica* (100) and *Hydnocarpus pentandra* (80) and *Actinodaphne malabarica*(80) in site 10, *Calophyllum polyanthum*(100), *Cullenia exarillata*(100), *Mesua ferrea*(100), *Palaquium ellipticum* (100), *Otonophelium stipulaceum*(90) *Macaranga peltata*(80), *Schefflera wallichiana*(80) and *Dysoxylum malabaricum*(80) in site 11, *Cullenia exarillata*(100), *Palaquium ellipticum*(100), *Agrostistachys borneensis*(80), *Chukrasia tabularis*(80), *Vateria indica*(80) in site 12, *Calophyllum polyanthum*(100), *Palaquium ellipticum*(100), *Mesua ferrea*(100), *Vateria indica*(100), *Bischofia javanica*(90), *Dysoxylum malabaricum*(80) in site 13, *Cullenia exarillata*(100), *Palaquium ellipticum* (100), *Vateria indica* (100), *Diospyros paniculata*(80), *Mesua ferrea*(80) and *Knema attenuata*(80) in site 14, *Diospyros*

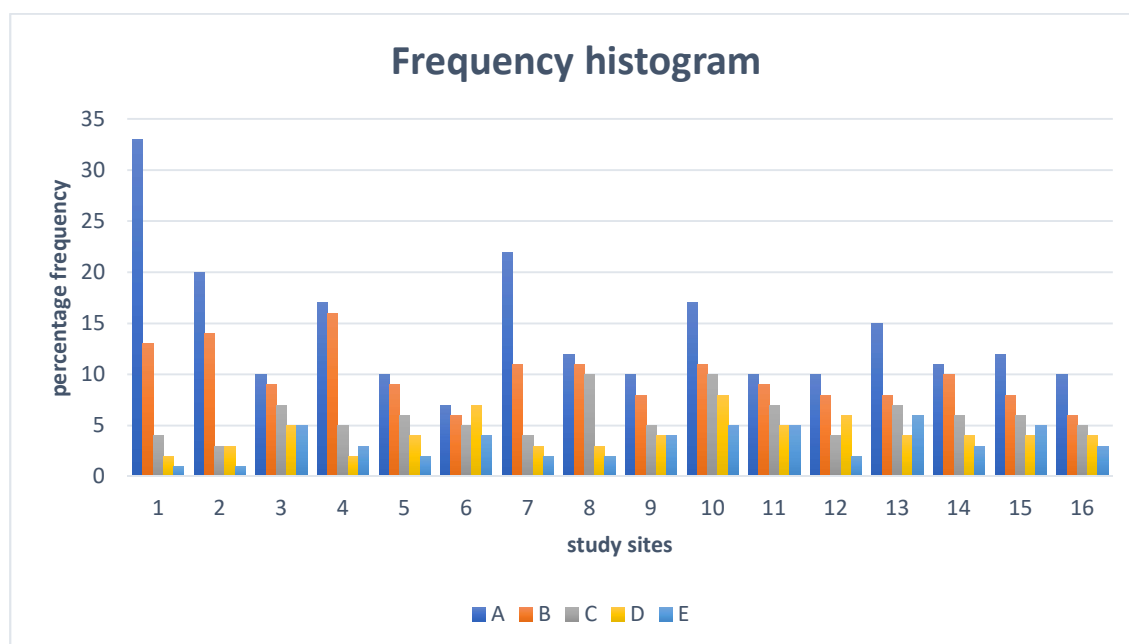
sylvatica(100), *Macaranga peltata*(100), *Mesua ferrea*(100) and *Calophyllum polyanthum*(80) in site 15, *Cullenia exarillata*(100), *Drypetes venusta*(100), *Palaquium ellipticum* (80), *Agrostistachys borneensis*(80), *Mesua ferrea*(80)and *Xanthophyllum arnottianum*(90) in site 16(Table 32-47).

Based on Raunkiaer’s Law of frequency, the vegetation of most of the study sites are of heterogeneous nature except in sites 4, 13 and 15(Fig. 7. and Table 1)

Table 1. Frequency classes

| Sl no | Study sites | Frequency classes | | | | | Nature |
|-------|---------------|-------------------|-------|-------|-------|--------|---------------|
| | | A | B | C | D | E | |
| | | 0-20 | 21-40 | 41-60 | 61-80 | 81-100 | |
| 1 | Study site 1 | 33 | 13 | 4 | 2 | 1 | Heterogeneous |
| 2 | Study site 2 | 20 | 14 | 3 | 3 | 1 | Heterogeneous |
| 3 | Study site 3 | 10 | 9 | 7 | 5 | 5 | Heterogeneous |
| 4 | Study site 4 | 17 | 16 | 5 | 2 | 3 | Homogeneous |
| 5 | Study site 5 | 10 | 9 | 6 | 4 | 2 | Heterogeneous |
| 6 | Study site 6 | 7 | 6 | 5 | 7 | 4 | Heterogeneous |
| 7 | Study site 7 | 22 | 11 | 4 | 3 | 2 | Heterogeneous |
| 8 | Study site 8 | 12 | 11 | 10 | 3 | 2 | Heterogeneous |
| 9 | Study site 9 | 10 | 8 | 5 | 4 | 4 | Heterogeneous |
| 10 | Study site 10 | 17 | 11 | 10 | 8 | 5 | Heterogeneous |
| 11 | Study site 11 | 10 | 9 | 7 | 5 | 5 | Heterogeneous |
| 12 | Study site 12 | 10 | 8 | 4 | 6 | 2 | Heterogeneous |
| 13 | Study site 13 | 15 | 8 | 7 | 4 | 6 | Homogeneous |
| 14 | Study site 14 | 11 | 10 | 6 | 4 | 3 | Heterogeneous |
| 15 | Study site 15 | 12 | 8 | 6 | 4 | 5 | Homogeneous |
| 16 | Study site 16 | 10 | 6 | 5 | 4 | 3 | Heterogeneous |

Fig.7. Frequency histogram of different study sites



5.1.3. Abundance

16 species are recorded with mean abundance value greater than 5. These are *Aglaia barberi* (11) in study site 12, *Canarium strictum*(13) in study area 7, *Cullenia exarillata* (8.3) in study area 5, *Dysoxylum malabaricum* (7.33) in study site 12, *Drypetes venusta* (5.5) in study site 16, *Callicarpa tomentosa* (6.7) in study site 11, *Drypetes malabarica* (6.4) in study site 6, *Palaquium ellipticum* (6.3)in study site 11, *Turpinia malabarica* (5.5) in study site 1, *Prunus ceylanica* (6) in study site 2, *Vateria indica* (5.9) in study site 4, *Agrostistachys borneensis* (5.7) in study site 5, *Mesua ferrea*(6.1) in study site 5, *Otonophelium stipulaceum*(5.6) in study site 5, *Calophyllum polyanthum*(5.75) in study site 10 and *Persea macrantha*(5.33) in study site 7.

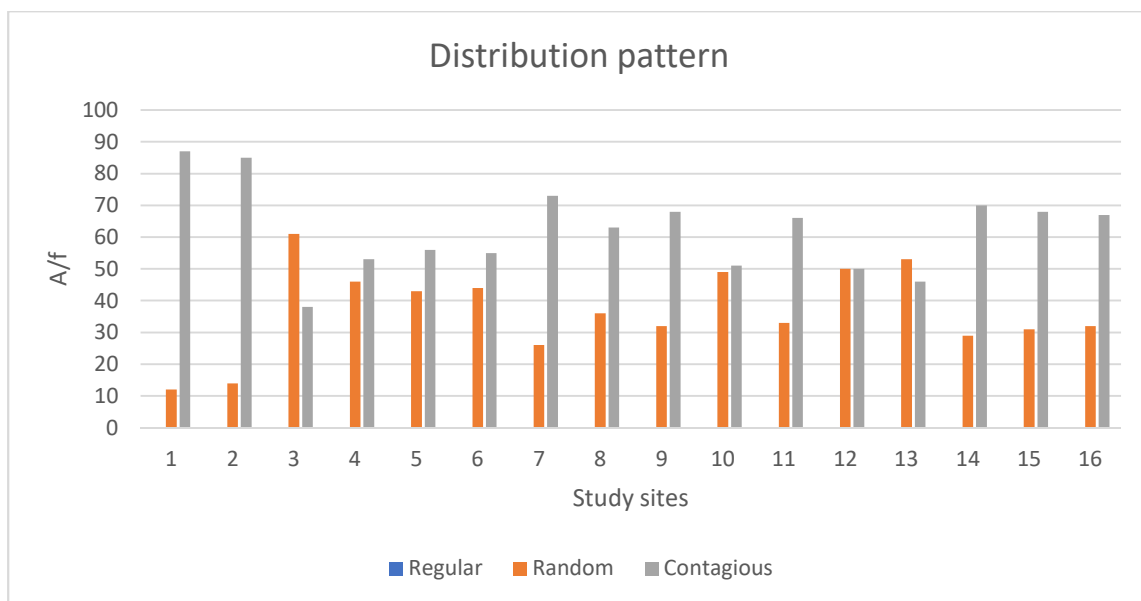
5.1.4. Distribution pattern

Distribution pattern studies indicate that contagious distribution pattern is prevalent in most of the sites except in sites 3 and 13; where most of the species showed random distribution. Out of the 109 species recorded, none of the species followed regular distribution. Percentage of species showing different distribution patterns in each study site is given in the table. (Fig.8 & Table 2)

Table 2. Distribution pattern of tree species in 16 study sites

| Study sites | Regular | Random | Contagious |
|-------------|---------|--------|------------|
| 1 | 0 | 12 | 87 |
| 2 | 0 | 14 | 85 |
| 3 | 0 | 61 | 38 |
| 4 | 0 | 46 | 53 |
| 5 | 0 | 43 | 56 |
| 6 | 0 | 44 | 55 |
| 7 | 0 | 26 | 73 |
| 8 | 0 | 36 | 63 |
| 9 | 0 | 32 | 68 |
| 10 | 0 | 49 | 51 |
| 11 | 0 | 33 | 66 |
| 12 | 0 | 50 | 50 |
| 13 | 0 | 53 | 46 |
| 14 | 0 | 29 | 70 |
| 15 | 0 | 31 | 68 |
| 16 | 0 | 32 | 67 |

Fig.8. Distribution pattern of species



5.1.5. Girth class distribution

More than fifty percentage of individuals belong to lower three classes. Girth class distribution shows an inverted 'J' shaped curve. Which is a feature of undisturbed forests. (Fig.9 & Table 3)

Table 3. Population structure of trees along girth classes

| Girth class | Number of individuals |
|-------------|-----------------------|
| 30-60 | 3908 |
| 61-90 | 1851 |
| 91-120 | 689 |
| 121-150 | 452 |
| 151-180 | 211 |
| >180 | 264 |
| | Total = 7375 |

Fig.9. Girth class distribution of trees plotted against the number of individuals



5.1.6. Basal area

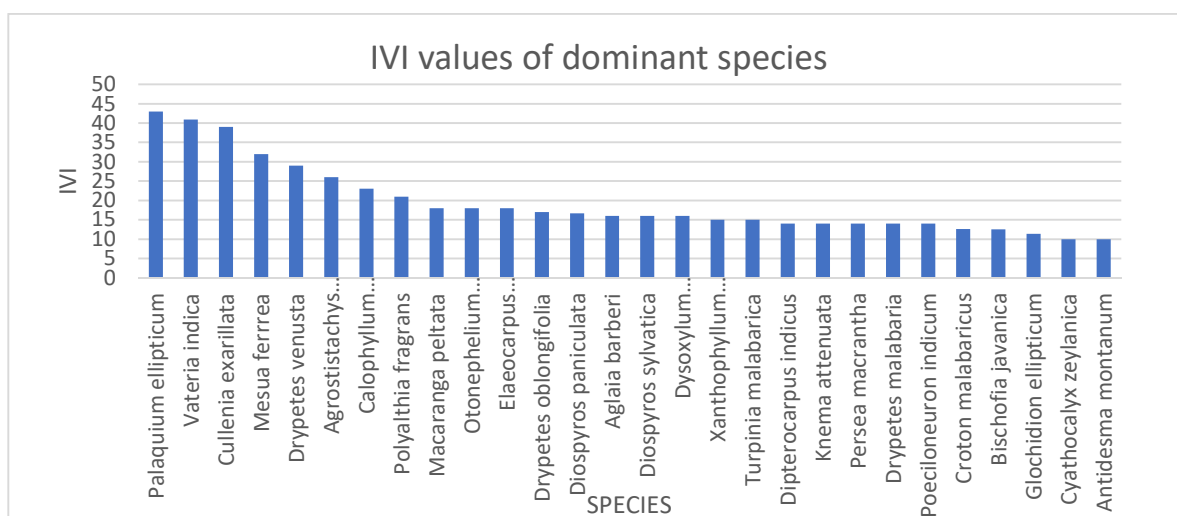
One of the key factors determining the dominance and character of a community is its basal area, which is the actual space that the stems occupy. High basal area typically denotes stronger dominance. Among the 16 study sites, species showing dominance with respect to the basal area in different study sites are *Aglaia barberi* (70.34sqm/h), *Cullenia exarillata* (105.9sqm/h), *Dysoxylum malabaricum*

(37.2sqm/h), *Drypetes venusta* (45.7sqm/h), *Palaquium ellipticum* (153.9sqm/h), *Vateria indica* (111.8sqm/h), *Mesua ferrea* (120.3sqm/h), *Calophyllum polyanthum* (30.1sqm/h), *Persea macrantha* (52.1sqm/h) , *Diospyros paniculata* (80sqm/h), *Poeciloneuron indicum* (52.6sqm/h) and *Chukrasia tabularis* (63.5sqm/h)(Table32-47).

5.1.7. Importance Value Index

A wide range of variation is observed in the mean IVI of species. The dominant species based on Importance Value Index are *Palaquium ellipticum*(23.4) and *Cullenia exarillata*(27.8) in site 1, *Palaquium ellipticum*(31) and *Cullenia exarillata*(29) in site 2, *Palaquium ellipticum*(31) and *Cullenia exarillata*(28) in site 3, *Vateria indica*(40.9) and *Palaquium ellipticum*(40.8) in site 4, *Palaquium ellipticum*(40) and *Cullenia exarillata*(39) in site 5, *Palaquium ellipticum*(38)and *Mesua ferrea*(32) in site 6, *Vateria indica*(31) and *Calophyllum polyanthum*(23) in site 7. *Cullenia exarillata*(32) and *Mesua ferrea*(23) in site 8, *Palaquium ellipticum*(43) and *Mesua ferrea*(30) in site 9, *Mesua ferrea*(25) and *Palaquium ellipticum*(24) in site 10, *Palaquium ellipticum*(32) and *Cullenia exarillata*(27) in site 11, *Cullenia exarillata*(34) and *Mesua ferrea*(30) in site 12, *Cullenia exarillata*(29) and *Mesua ferrea*(25) in site 13, *Vateria indica*(31) and *Cullenia exarillata*(29) in site 14, *Palaquium ellipticum*(36) and *Cullenia exarillata*(23) in site 15 and *Cullenia exarillata*(34) and *Drypetes venusta*(29) in site 16. Other dominant species which show IVI values more than 10 in different study sites are *Agrostistachys borneensis*, *Aglaia barberi*, *Macaranga peltata*, *Diospyros paniculata*, *Dysoxylum malabaricum*, *Persea macrantha*, *Poeciloneuron indicum*, *Diospyros assimilis*, *Holigarna arnottiana*, *Drypetes malabarica*, *Xanthophyllum arnottianum*, *Cyathocalyx zeylanica*, *Otonophelium stipulaceum*, *Antidesma montanum*, *Elaeocarpus tuberculatus*, *Knema attenuata*, *Turpinia malabarica*, *Syzygium cumini*, *Croton malabaricus*, *Glochidion ellipticum*, *Bischofia javanica*, *Dipterocarpus indicus* and *Polyalthia fragrans*(Fig.10 & Table 32-47)

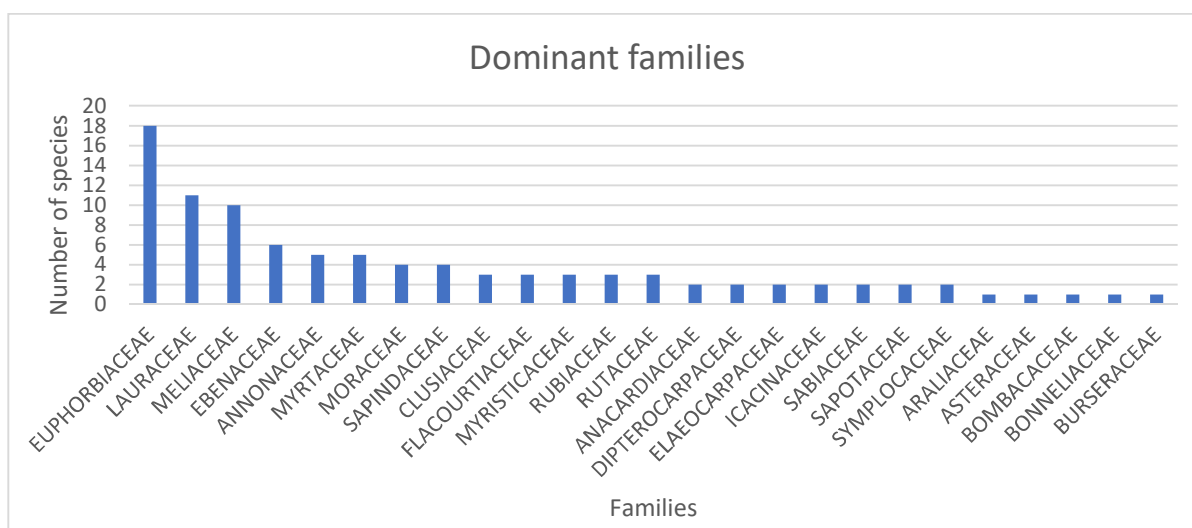
Fig. 10. IVI of dominant species



5.1.8. Family compositions

A total of 109 species belonging to 37 families were recorded from the 16 study sites. The family with maximum number of species is Euphorbiaceae (18) followed by Lauraceae (11), Meliaceae (10) and Ebenaceae (6). Other families are Annonaceae, Myrtaceae, Moraceae, Sapindaceae, Clusiaceae, Flacourtiaceae, Myristicaceae, Rubiaceae, Rutaceae, Anacardiaceae, Dipterocarpaceae, Elaeocarpaceae, Icacinaceae, Sabiaceae, Sapotaceae, Symplocaceae, Araliaceae, Asteraceae, Bombacaceae, Bonneliaceae, Bursesaceae, Caesalpiniaceae, Celastraceae, Combretaceae, Olacaceae, Oleaceae, Rosaceae, Simaroubaceae, Staphyleaceae, Sterculiaceae, Urticaceae, Verbenaceae and Xanthophyllaceae (Fig.11).

Fig.11. Dominant families



5.2. Secondary analysis of the vegetation:

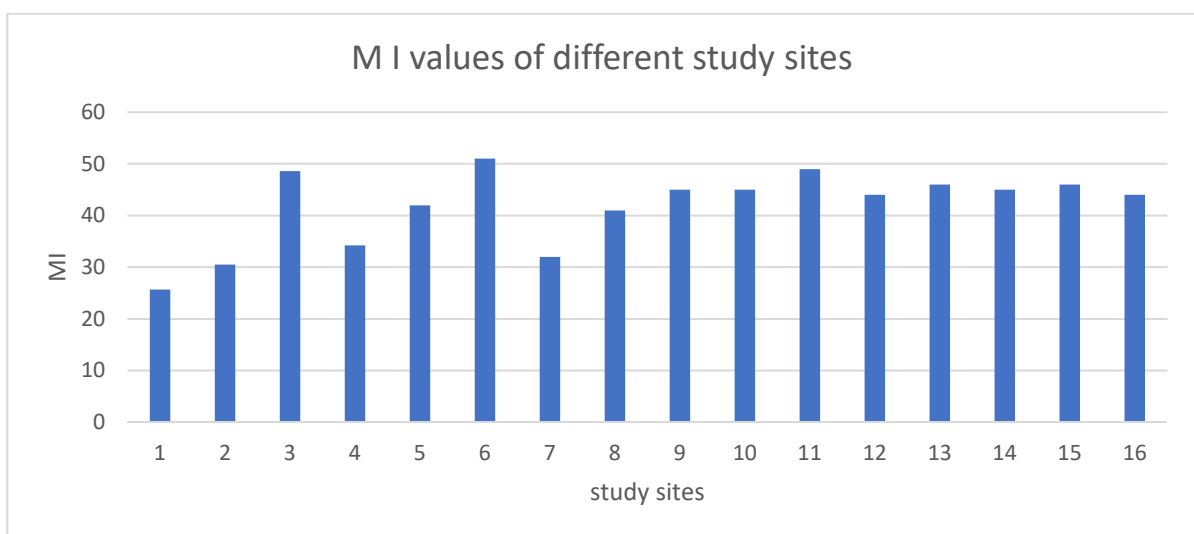
5.2.1. Maturity index

The mean maturity index value is 42. The maturity index values of various localities ranges from 25.7 to 51 (Fig.12 & Table 4.)

Table.4. Maturity Index (MI)

| Study sites | Maturity index |
|---------------|----------------|
| 1 | 25.7 |
| 2 | 30.5 |
| 3 | 48.6 |
| 4 | 34.2 |
| 5 | 42 |
| 6 | 51 |
| 7 | 32 |
| 8 | 41 |
| 9 | 45 |
| 10 | 45 |
| 11 | 49 |
| 12 | 44 |
| 13 | 46 |
| 14 | 45 |
| 15 | 46 |
| 16 | 44 |
| Average value | 42 |

Fig. 12. Maturity index of various study sites



5.3. Biodiversity indices

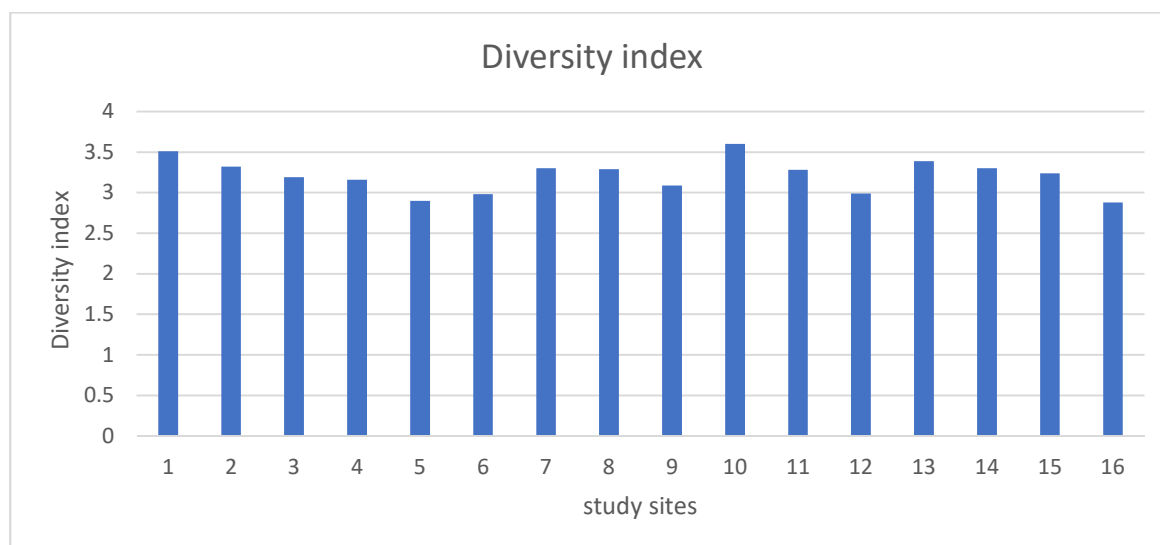
5.3.1. Shannon's diversity index (H')

The mean diversity index value is 3.21. H' values of various localities ranges from 3.6(study site 10) to 2.8(study site 16) (Fig.13 & Table 5).

Table 5. Shannon's Diversity Index of various study sites

| <u>Study sites</u> | <u>Shannon's diversity- (H')</u> |
|---------------------------|----------------------------------|
| 1 | 3.51 |
| 2 | 3.32 |
| 3 | 3.19 |
| 4 | 3.16 |
| 5 | 2.90 |
| 6 | 2.98 |
| 7 | 3.30 |
| 8 | 3.29 |
| 9 | 3.09 |
| 10 | 3.60 |
| 11 | 3.28 |
| 12 | 2.99 |
| 13 | 3.39 |
| 14 | 3.30 |
| 15 | 3.24 |
| 16 | 2.88 |
| Shannon's diversity- (H') | 3.21 |

Fig.13. Shannon's Diversity Index of various study sites.



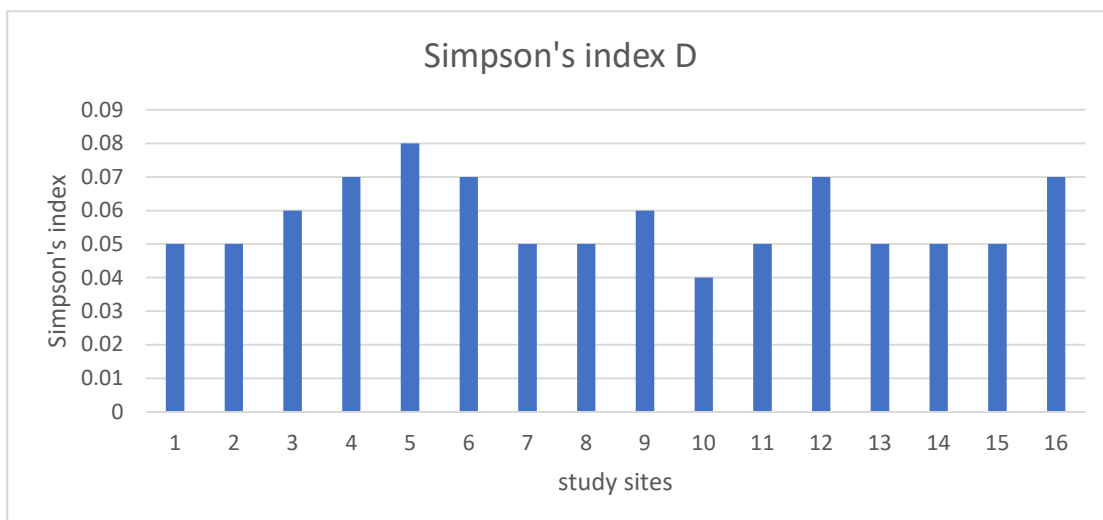
5.3.2. Simpson's index (D)

Simpson's index (D) value is 0.05. Values of 16 localities ranges from 0.04 to 0.08 (Fig.14 & Table 6)

Table 6. Simpson's index (D) values of various study sites

| Study sites | Simpson's dominance index (D) |
|---------------|-------------------------------|
| 1 | 0.05 |
| 2 | 0.05 |
| 3 | 0.06 |
| 4 | 0.07 |
| 5 | 0.08 |
| 6 | 0.07 |
| 7 | 0.05 |
| 8 | 0.05 |
| 9 | 0.06 |
| 10 | 0.04 |
| 11 | 0.05 |
| 12 | 0.07 |
| 13 | 0.05 |
| 14 | 0.05 |
| 15 | 0.05 |
| 16 | 0.07 |
| Simpson index | 0.05 |

Fig.14. Simpson's index (D) values of various study sites



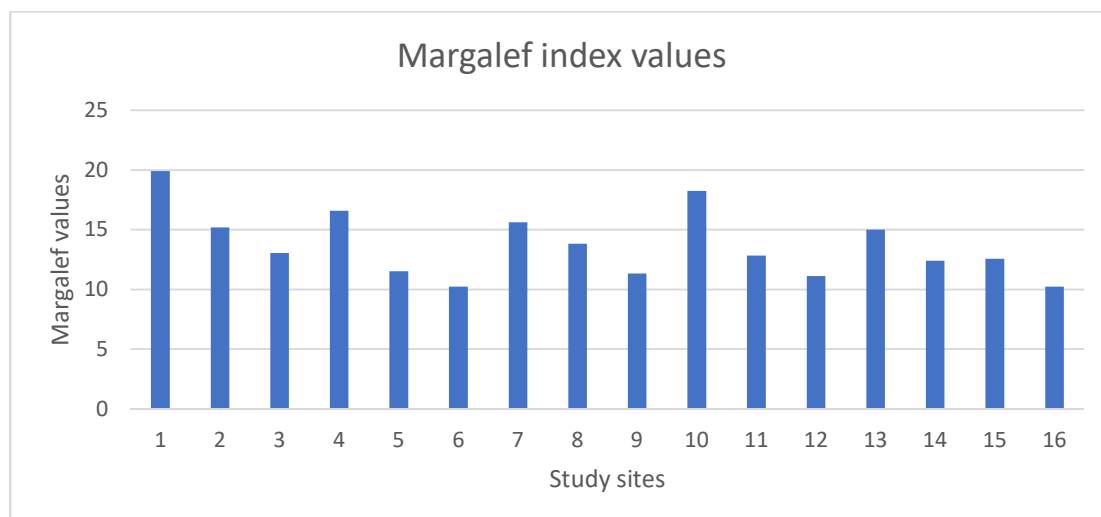
5.3.3. Margalef species richness index (RI)

Margalef species richness value is 13.72. In various study sites its value ranges from 10.24 to 19.9. (Fig.15 & Table 7)

Table 7. Margalef species Richness Index (RI) in various sites

| Study sites | Margalef index |
|----------------|----------------|
| 1 | 19.9 |
| 2 | 15.18 |
| 3 | 13.04 |
| 4 | 16.58 |
| 5 | 11.52 |
| 6 | 10.24 |
| 7 | 15.61 |
| 8 | 13.83 |
| 9 | 11.33 |
| 10 | 18.25 |
| 11 | 12.84 |
| 12 | 11.11 |
| 13 | 15 |
| 14 | 12.41 |
| 15 | 12.55 |
| 16 | 10.24 |
| Margalef index | 13.72 |

Fig.15. Margalef species richness index (RI) in various sites



5.3.4. Pielou's evenness index (E3)

Evenness value is 0.88. Its value ranges from 0.83 to 0.91.(Fig. 16 & Table 8)

Table 8. Pielou's evenness index (E3)

| Study sites | Pielou's evenness index |
|-------------------------|-------------------------|
| 1 | 0.88 |
| 2 | 0.89 |
| 3 | 0.89 |
| 4 | 0.84 |
| 5 | 0.83 |
| 6 | 0.88 |
| 7 | 0.88 |
| 8 | 0.90 |
| 9 | 0.89 |
| 10 | 0.91 |
| 11 | 0.91 |
| 12 | 0.87 |
| 13 | 0.91 |
| 14 | 0.93 |
| 15 | 0.91 |
| 16 | 0.86 |
| Pielou's evenness index | 0.88 |

Fig.16. Pielou's evenness index (E3) in different study sites.

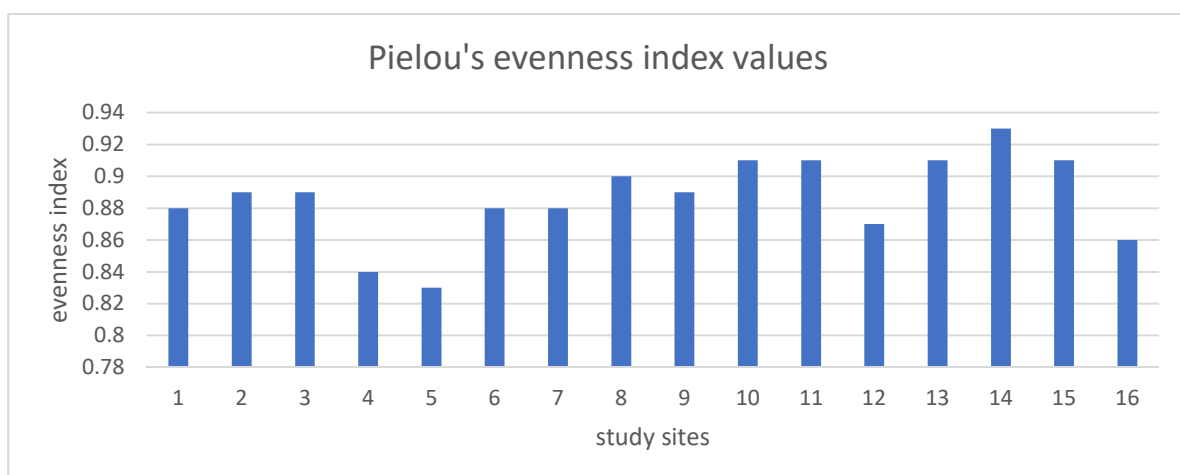


Table 9. Different indices of biodiversity in the medium elevation study sites.

| Shannon's index | Simpson index | Margalef index | Pielou's evenness index |
|-----------------|---------------|----------------|-------------------------|
| 3.21 | 0.05 | 13.72 | 0.88 |

5.4. Low elevation zone**Primary analysis of the vegetation**

A total of 74 species and 1977 individuals of trees having GBH 30cm and above were recorded from the 80 sample plots laid out in the 8 study sites. The species with maximum number of individuals are viz. *Terminalia paniculata* (166), *Grewia tiliifolia* (91), *Wrightia tinctoria* (87), *Pterocarpus marsupium* (83) and *Dipterocarpus indicus* (69) etc. As far as enumeration is concerned, a total of 21 species out of 239 individuals/ha from site 17, 22 species out of 197 individuals/ha from site 18, 27 species out of 144 individuals/ha from site 19, 21 species out of 255 individuals/ha from site 20, 22 species out of 176 individuals/ha from site 21, 30 species out of 195 individuals/ha from site 22, 32 species out of 470 individuals/ha from site 23 and 29 species out of 301 individuals/ha from site 24 were recorded. No significant association among tree species were observed in the low elevation study sites (Table 48–55).

5.4.1. Density

The maximum density (number of individuals/ha) was shared by *Terminalia paniculata* (70 individuals/ha) in site 20, *Vateria indica* (31 individuals/ha) in site 23 followed by *Agrostistachys borneensis* (29 individuals/ha) in site 23, *Dipterocarpus indicus* (29 individuals/ha) in site 23, *Tectona grandis* (28) in site 17, *Canarium strictum* (28 individuals/ha) in site 23, and *Drypetes venusta* (26 individuals/ha) in site 23.

5.4.2. Percentage frequency

Out of 74 species, 25 species showed high frequency. The species with high frequency are *Wrightia tinctoria* (100), *Tectona grandis* (90), *Tetrameles nudiflora* (80), *Phyllanthus emblica* (80), *Grewia tiliifolia* (80) in site 17, *Erythrina stricta* (90), *Lagerstroemia microcarpa* (80), *Pterocarpus marsupium* (80), *Wrightia tinctoria* (80) in site 18, *Terminalia paniculata* (100) in site 20, *Dalbergia latifolia* (80), *Grewia*

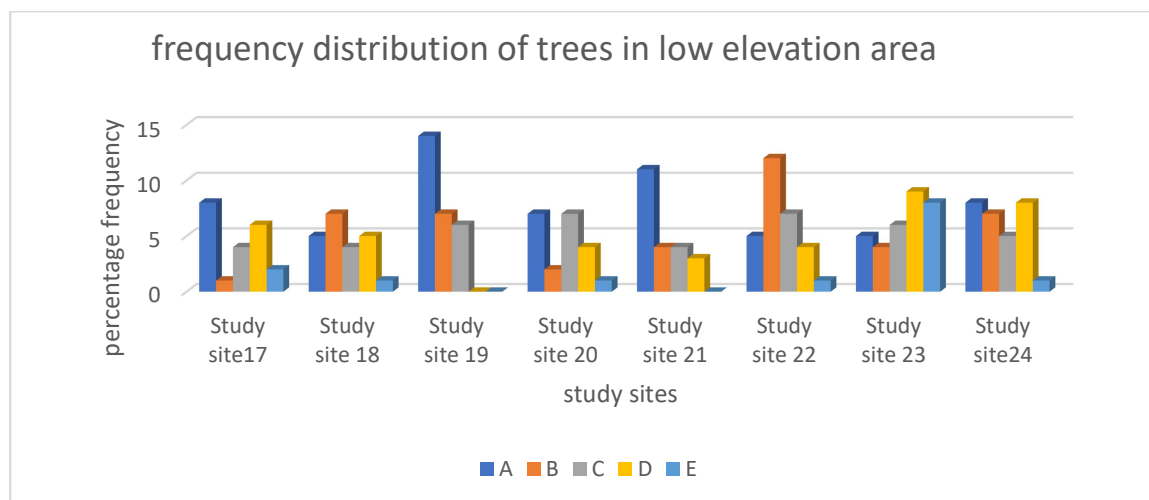
tiliifolia (80) in site 21, *Actinodaphne malabarica* (90), *Terminalia paniculata* (80) in site 22, *Agrostistachys borneensis* (100), *Vateria indica* (100), *Croton malabaricus* (100), *Aglaia lawii* (90), *Bischofia javanica* (90), *Canarium strictum* (90), *Cyathocalyx zeylanica* (90), *Dipterocarpus indicus* (90), *Alseodaphne malabarica* (80), *Antiaris toxicaria* (80), *Dysoxylum malabaricum* (80), *Otonephelium stipulaceum* (80), *Schleichera oleosa* (80) and *Turpinia malabarica* (80) in site 23, *Alseodaphne malabarica* (90), *Dipterocarpus indicus* (80), *Dysoxylum malabaricum* (80) and *Vateria indica* (80) in site 24 (Table 48-55).

Based on Raunkiaer’s Law of frequency, all the study sites are of heterogeneous. (Fig.17 & Table 10)

Table 10. Frequency distribution in various study sites.

| Sl no | Study sites | Frequency classes | | | | | Nature |
|-------|---------------|-------------------|-------|-------|-------|--------|---------------|
| | | A | B | C | D | E | |
| | | 0-20 | 21-40 | 41-60 | 61-80 | 81-100 | |
| 1 | Study site17 | 8 | 1 | 4 | 6 | 2 | Heterogeneous |
| 2 | Study site 18 | 5 | 7 | 4 | 5 | 1 | Heterogeneous |
| 3 | Study site 19 | 14 | 7 | 6 | 0 | 0 | Heterogeneous |
| 4 | Study site 20 | 7 | 2 | 7 | 4 | 1 | Heterogeneous |
| 5 | Study site 21 | 11 | 4 | 4 | 3 | 0 | Heterogeneous |
| 6 | Study site 22 | 5 | 12 | 7 | 4 | 1 | Heterogeneous |
| 7 | Study site 23 | 5 | 4 | 6 | 9 | 8 | Heterogeneous |
| 8 | Study site 24 | 8 | 7 | 5 | 8 | 1 | Heterogeneous |

Fig. 17. Frequency histogram of different study sites



5.4.3. Abundance

Among 74 species encountered, only 3 species recorded mean abundance value greater than 5. These are *Polyalthia fragrans* (12) and *Macaranga peltata* (8) in study site 21 and *Terminalia paniculata* (7) in site 20. Other species showing high abundance are *Canarium strictum* (4), *Cinnamomum malabattrum* (4) in study site 24, *Careya arborea* (4.3) in study site 21, *Terminalia bellirica* (4) in study sites 18 and 19, and *Tectona grandis* (4) in site 19 (Table 48-55).

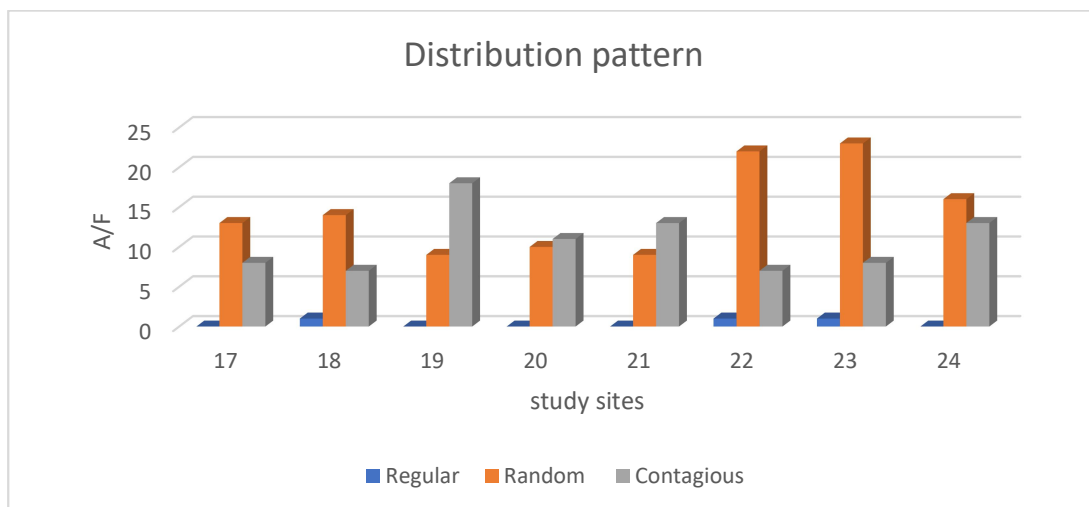
5.4.4. Distribution pattern

Regular, random and contagious distribution patterns were observed in different sites. Out of 74 species studied 3 species showed regular distribution. Number of species showing different distribution patterns in each study site is given in the table. Random distribution was more prevalent than contagious distribution in some sites. (Fig. 18 & Table 11).

Table 11. Distribution pattern of species in 8 study sites

| Study sites | Regular | Random | Contagious |
|-------------|---------|--------|------------|
| 17 | 0 | 13 | 8 |
| 18 | 1 | 14 | 7 |
| 19 | 0 | 9 | 18 |
| 20 | 0 | 10 | 11 |
| 21 | 0 | 9 | 13 |
| 22 | 1 | 22 | 7 |
| 23 | 1 | 23 | 8 |
| 24 | 0 | 16 | 13 |

Fig. 18. Distribution pattern of species



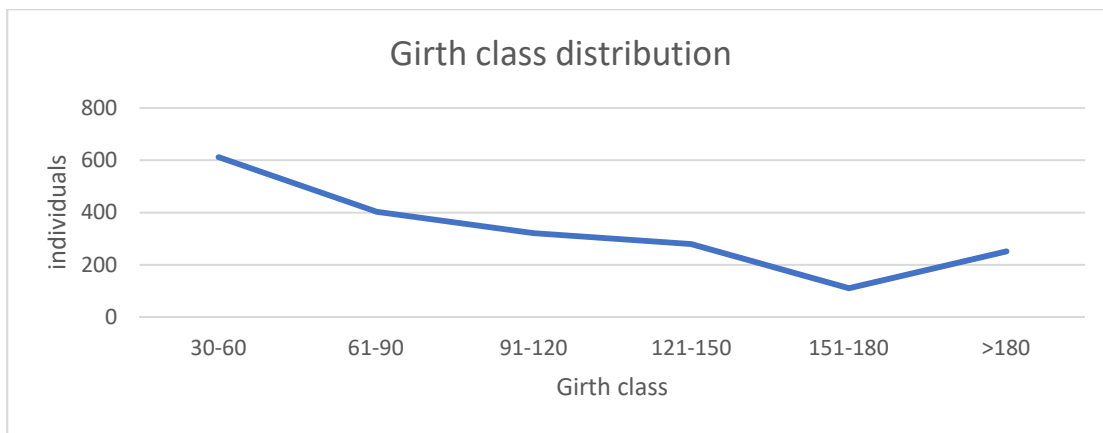
5.4.5. Girth class distribution

Girth class distribution showed almost an inverse “J” shaped curve. The modest bulged margins on the curve are caused by a progressive increase in tree individuals in the 91-120 and 121-150 classes, rather than a sudden decline. (Fig. 19 and Table 12).

Table 12. Population structure of trees along girth classes

| Girth class | Number of individuals |
|-------------|-----------------------|
| 30-60 | 612 |
| 61-90 | 403 |
| 91-120 | 321 |
| 121-150 | 280 |
| 151-180 | 110 |
| >180 | 251 |
| Total | 1977 |

Fig.19. Girth class distribution of trees plotted against the number of individuals



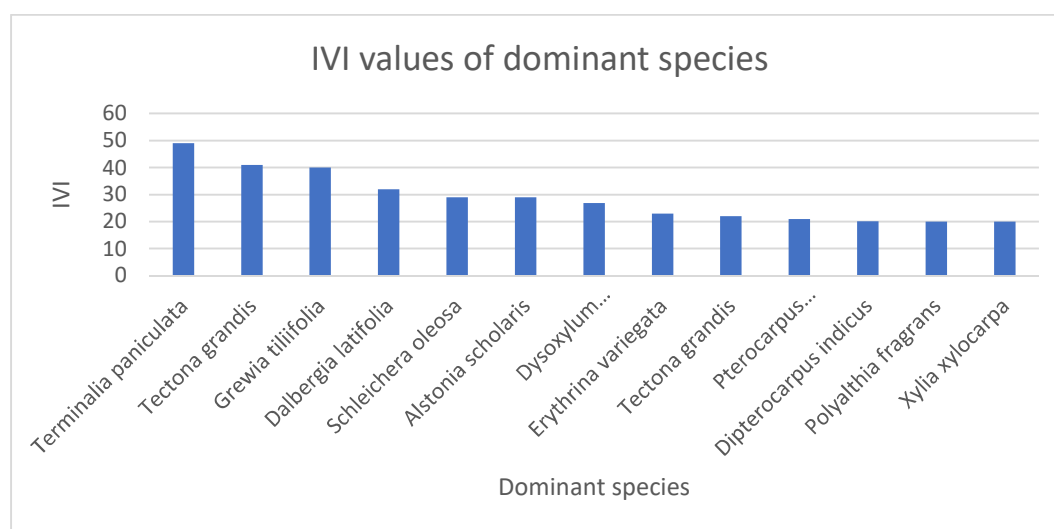
5.4.6. Basal area

Among 8 study sites, *Dalbergia latifolia* (49.2sqm/h), *Pterocarpus marsupium* (102.9sqm/h), *Tectona grandis* (171sqm/h), *Terminalia paniculata* (82.2sqm/h), *Alstonia scholaris* (46.3sqm/h), *Grewia tiliifolia* (20.1sqm/h), *Antiaris toxicaria* (67.4sqm/h), *Dysoxylum malabaricum* (44.5sqm/h) etc. have maximum basal area (Table 48-55).

5.4.7. Importance value index

High values of Importance Value Index are showed by *Tectona grandis* (41) in site 17, *Terminalia paniculata* (46) in site 18, *Dalbergia latifolia* (32) in site 19, *Terminalia paniculata* (49) in site 20, *Grewia tiliifolia* (40) in site 21, *Tectona grandis* (22) in site 22, *Dipterocarpus indicus* (20.1) in site 23 and *Dysoxylum malabaricum* (26.89) in site 24 (Table 48-55 and Fig. 20)

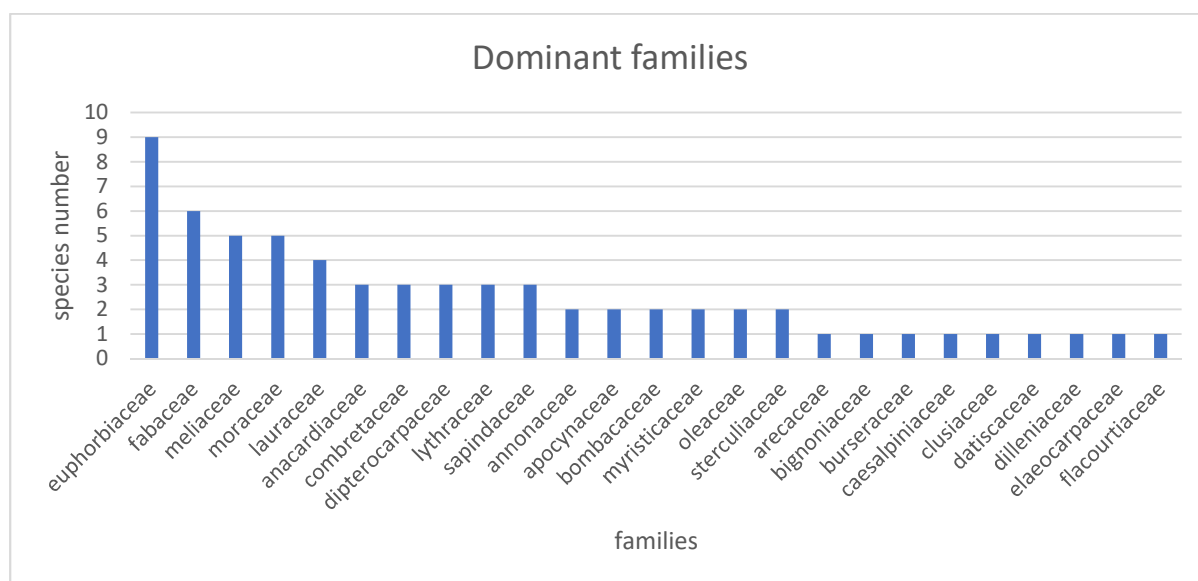
Fig.20. IVI of dominant species in low elevation



5.4.8. Family composition

A total of 74 species belonging to 34 families were present in the low elevation forest area. The family with maximum number of species is Euphorbiaceae (9) followed by Fabaceae (6), Meliaceae (5), Moraceae (5) and Lauraceae (4). Other families are Anacardiaceae, Combretaceae, Dipterocarpaceae, Lythraceae, Sapindaceae, Apocyanaceae, Annonaceae, Bombacaceae, Myristicaceae, Oleaceae, Sterculiaceae, Arecaceae, Bignoniaceae, Burseraceae, Caesalpiniaceae, Clusiaceae, Datisceae, Dilleniaceae, Elaeocarpaceae, Flacourtiaceae, Lecythidaceae, Leguminosae, Myrtaceae, Rhizophoraceae, Sapotaceae, Staphyleaceae, Tiliaceae, Verbenaceae and Xanthophyllaceae (Fig. 21).

Fig.21. Family composition.



5.5. Secondary analysis of the vegetation:

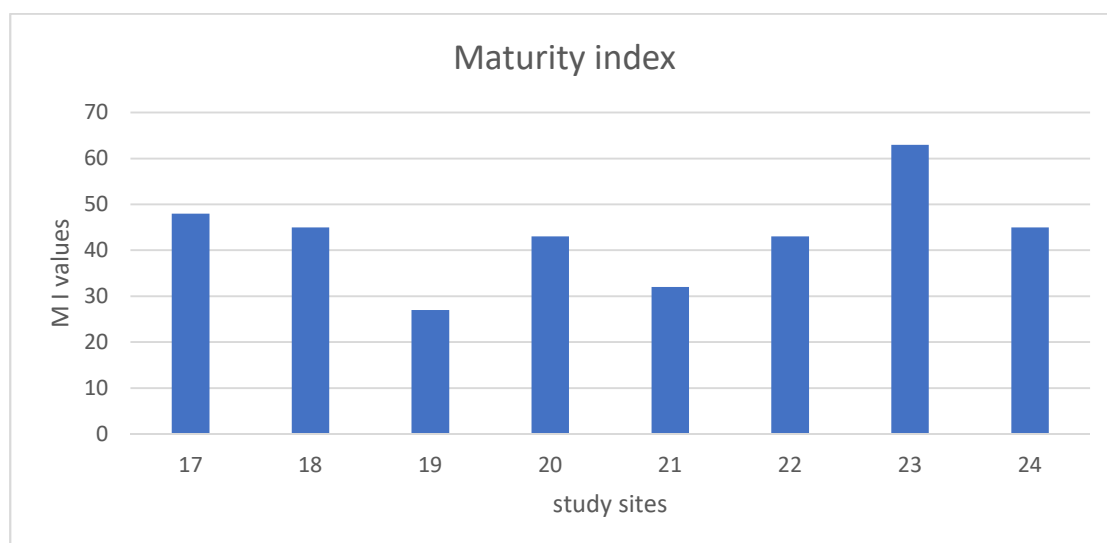
5.5.1. Maturity index

The mean maturity index value is 43. The maturity index values of various localities ranges from 27 (study site-19) to 63 (study site-23) (Table 13 and Fig.22).

Table 13. Maturity index

| Study sites | Maturity index |
|---------------|----------------|
| 17 | 48 |
| 18 | 45 |
| 19 | 27 |
| 20 | 43 |
| 21 | 32 |
| 22 | 43 |
| 23 | 63 |
| 24 | 45 |
| Average value | 43 |

Fig. 22. Maturity index



5.6. Biodiversity indices

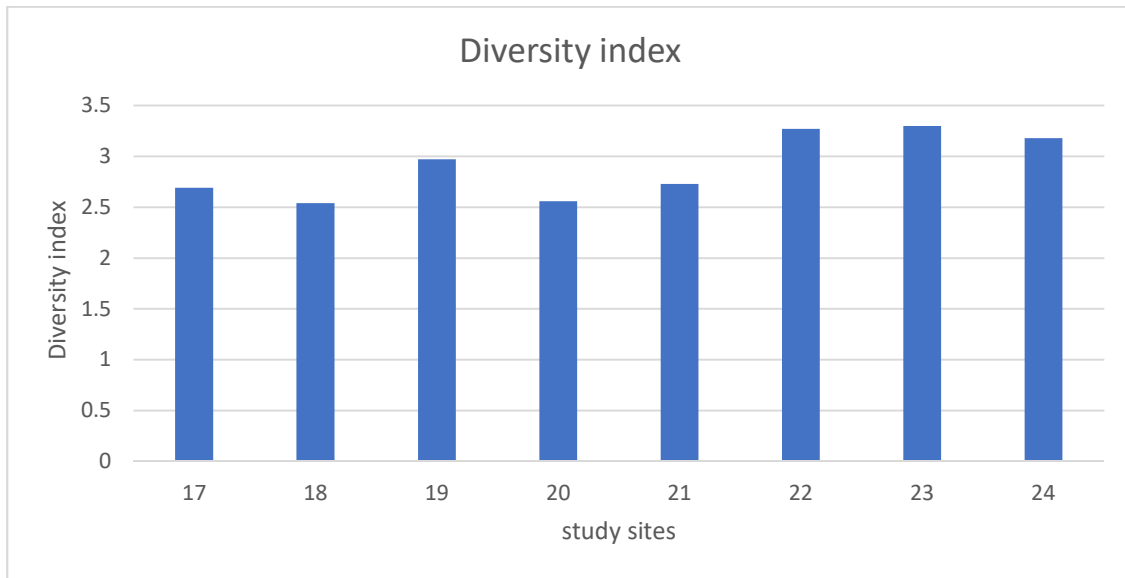
5.6.1. Shannon's diversity index (H')

The mean diversity index value is 2.9. H' values of various localities ranges from 2.5(study site 18) to 3.3(study site 23) (Table 14 and Fig.23).

Table 14. Shannon's Diversity Index of various study sites

| <u>Study sites</u> | <u>Shannon's diversity- (H')</u> |
|---------------------------|----------------------------------|
| 17 | 2.69 |
| 18 | 2.54 |
| 19 | 2.97 |
| 20 | 2.56 |
| 21 | 2.73 |
| 22 | 3.27 |
| 23 | 3.30 |
| 24 | 3.18 |
| Shannon's diversity- (H') | 2.90 |

Fig.23. Shannon’s Diversity Index of various study sites



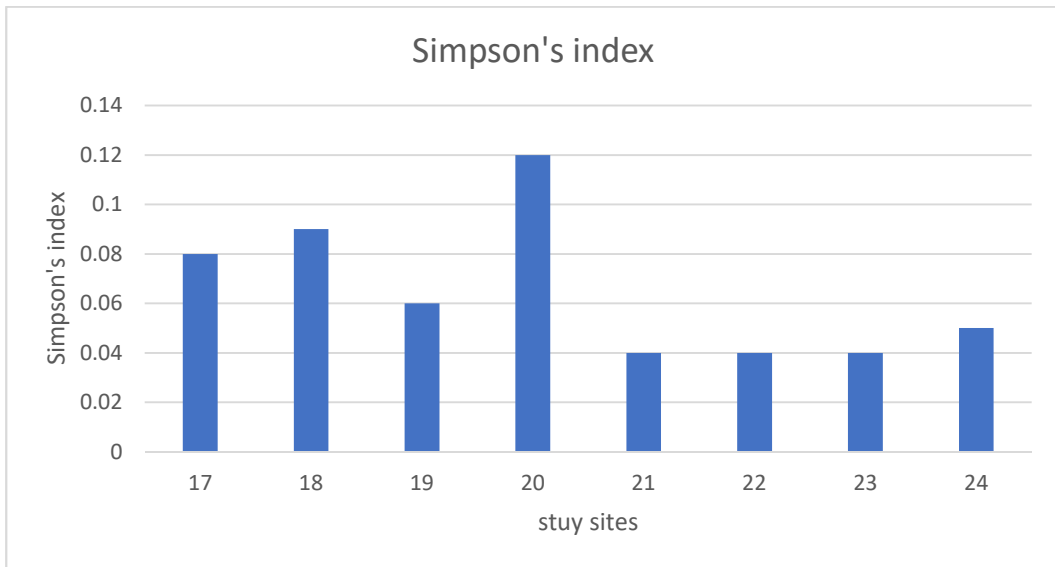
5.6.2. Simpson’s index (D)

Simpson’s index (D) value is 0.06. Values of 8 localities ranges from 0.04 to 0.12 (Table 15 and Fig.24).

Table 15. Simpson’s index (D) values of various study sites

| Study sites | Simpson’s index (D) |
|---------------|---------------------|
| 17 | 0.08 |
| 18 | 0.09 |
| 19 | 0.06 |
| 20 | 0.12 |
| 21 | 0.04 |
| 22 | 0.04 |
| 23 | 0.04 |
| 24 | 0.05 |
| Simpson index | 0.06 |

Fig.24.Simpson's index (D) values in different sites



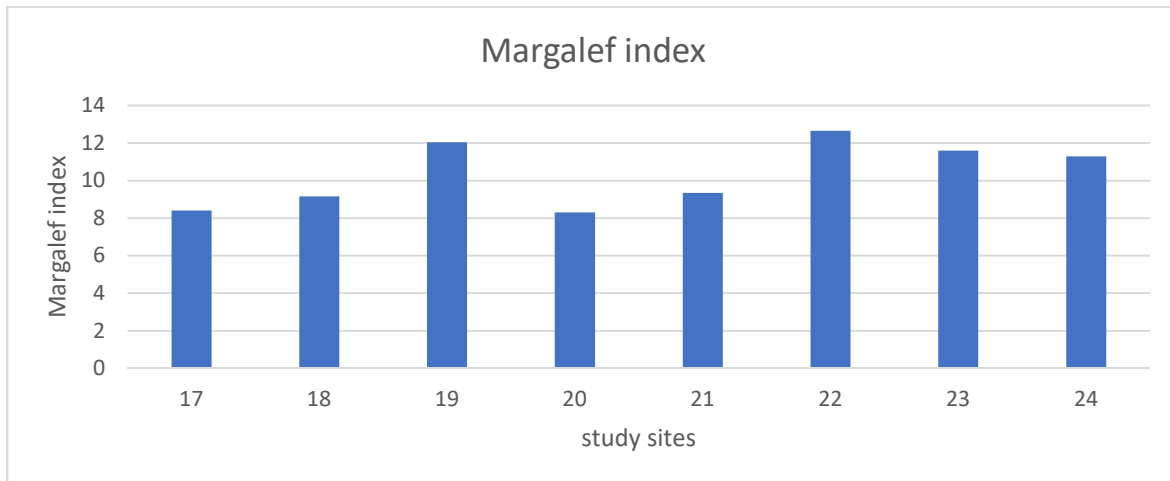
5.6.3. Margalef species richness index (RI)

Margalef species richness index value is 10.35. In various study sites its value ranges from 8.31 to 12.66. (Table 16 and Fig.25)

Table 16. Margalef species richness index (RI)

| Study sites | Margalef index |
|----------------|----------------|
| 17 | 8.40 |
| 18 | 9.15 |
| 19 | 12.04 |
| 20 | 8.31 |
| 21 | 9.35 |
| 22 | 12.66 |
| 23 | 11.6 |
| 24 | 11.29 |
| Margalef index | 10.35 |

Fig.25. Margalef Species Richness Index (RI)



5.6.4. Pielou’s evenness index (E3)

Evenness index value is 0.89. Its value ranges from 0.82 to 0.96 (Table 17 and Fig.26.)

Table 17. Evenness index values

| Study sites | Pielou’s evenness index (E3) |
|-------------------------|------------------------------|
| 17 | 0.88 |
| 18 | 0.82 |
| 19 | 0.90 |
| 20 | 0.84 |
| 21 | 0.88 |
| 22 | 0.96 |
| 23 | 0.95 |
| 24 | 0.94 |
| Pielou’s evenness index | 0.89 |

Fig.26. Pielou's evenness index (E3)

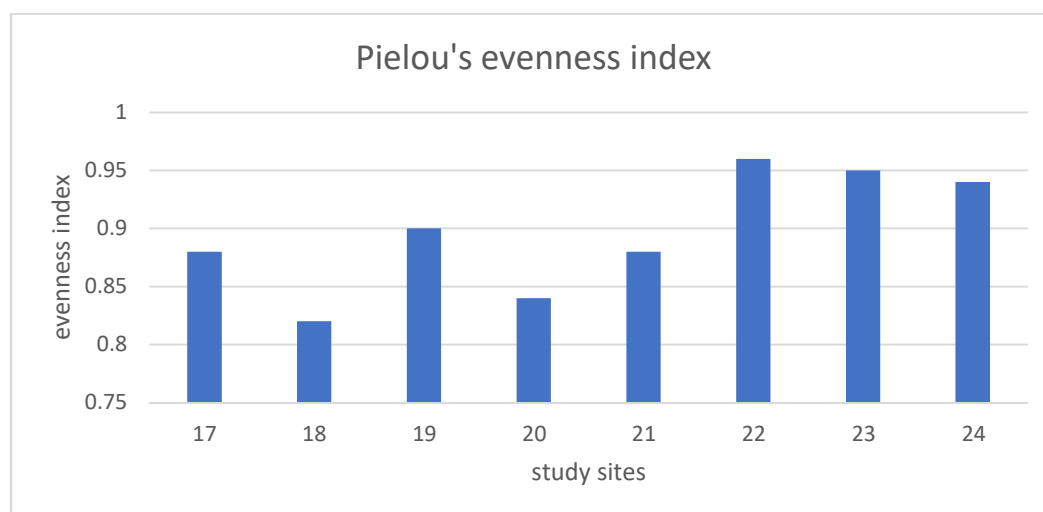


Table 18. Various indices of the medium elevation and low elevation forests.

| | Maturity index | Shannon's diversity index | Simpson's index | Margalef species richness index | Pielou's evenness index |
|------------------------------|----------------|---------------------------|-----------------|---------------------------------|-------------------------|
| Medium elevation zone | 42 | 3.21 | 0.05 | 13.72 | 0.88 |
| Low elevation zone | 43 | 2.90 | 0.06 | 10.35 | 0.89 |

5.7. Riparian forest ecosystem

Primary analysis of the vegetation.

87 species of trees having GBH 30cm and above were recorded from the 20 sample plots in the medium elevation riparian area and 54 species were recorded from the riparian forest of low elevation area. The species with maximum number of individuals are viz. *Vateria indica* (97), *Knema attenuata* (64), *Persea macrantha* (54), *Palaquium ellipticum* (51), *Chionanthus mala-elengi* (47), *Tetrameles nudiflora* (43), *Aglaia barberi* (42), *Canarium strictum* (42), *Otonophelium stipulaceum* (41), *Elaeocarpus tuberculatus* (41), *Cullenia exarillata* (40) and *Madhuca nerifolia* (39).

As far as enumeration is concerned, a total of 49 species out of 492 individuals/ha from site 25 and 47 species out of 454 individuals/ha from site 26 of

medium elevation riparian forest and 36 species out of 296 individuals/ha from site 27 and 34 species out of 352 individuals/ha from site 28 of low elevation riparian area were recorded. Major associations obtained, based on Importance Value Index are *Cullenia exarillata* - *Madhuca nerifolia* - *Elaeocarpus tuberculatus* - *Canarium strictum* in site 25, *Vateria indica* - *Palaquium ellipticum* - *Aglaia barberi* in site 26. No particular associations were observed in low elevation riparian sites (Table 56-59).

5.7.1. Density

The maximum density (number of individuals/ha) was shared by *Vateria indica* (38 individuals/ha) in site 26 followed by *Cullenia exarillata* (34 individuals/ha) in site 25, *Aglaia barberi*(33) in site 26, *Canarium strictum*(33) in site 25 and *Madhuca nerifolia*(31) and *Chionanthus mala-elengi* (29) in site 25(Table 56-59).

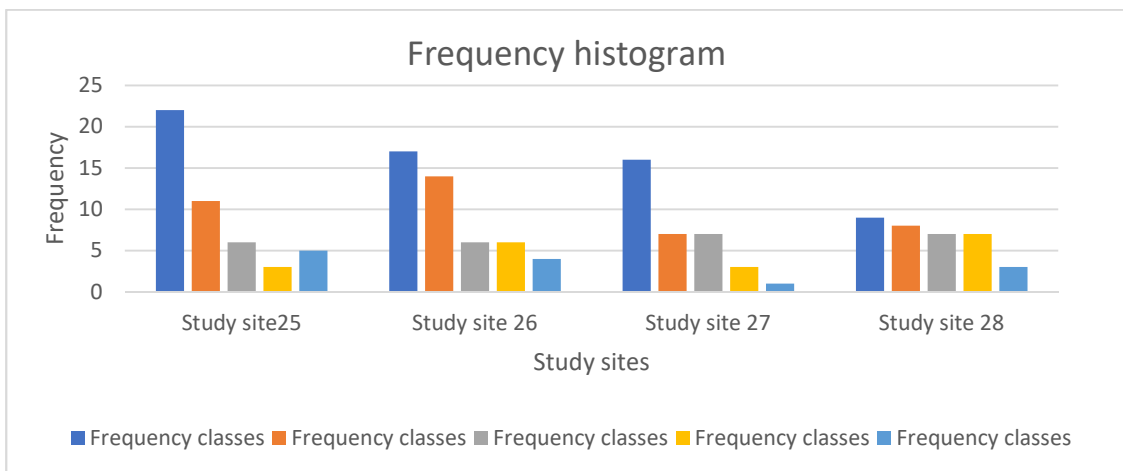
5.7.2. Percentage frequency

A total of 87 species were recorded from the total sample plots of riparian forest area, among them 10 species showed high frequency. The species with high frequency are *Canarium strictum* (100), *Chionanthus mala-elengi*(100), *Cullenia exarillata*(100), *Madhuca nerifolia*(100) and *Calophyllum polyanthum*(90) in site 25, *Aglaia barberi*(100), *Diospyros paniculata*(90), *Palaquium ellipticum*(100), *Vateria indica*(100) in site 26, *Vateria indica*(90) in site 27 and *Myristica beddomei*(100), *Tetrameles nudiflora*(100) and *Vateria indica*(100) in site 28. Based on Raunkiaer's law of frequency, all the study sites except site 25, are heterogeneous (Table 19 and Fig.27).

Table 19. Frequency classes in the riparian forest area.

| Sl no | Study sites | Frequency classes | | | | | Nature |
|-------|-------------|-------------------|-------|-------|-------|--------|---------------|
| | | A | B | C | D | E | |
| | | 0-20 | 21-40 | 41-60 | 61-80 | 81-100 | |
| 1 | site25 | 22 | 11 | 6 | 3 | 5 | Homogeneous |
| 2 | site 26 | 17 | 14 | 6 | 6 | 4 | Heterogeneous |
| 3 | site 27 | 16 | 7 | 7 | 3 | 1 | Heterogeneous |
| 4 | site 28 | 9 | 8 | 7 | 7 | 3 | Heterogeneous |

Fig.27. Frequency histogram of different study sites



5.7.3. Abundance

Only *Turpinia malabarica* (8) and *Alseodaphne semecarpifolia* (5) have high abundance values. Other species showing high abundance are *Actinodaphne malabarica* (4), *Agrostistachys borneensis* (4) and *Hydnocarpus pentandra* (4) in study site 25, *Myristica malabarica* (4) and *Vateria indica* (4) in study site 26, *Artocarpus hirsutus* (4) in study site 27, and *Strobocalyx arborea* (4) and *Lophopetalum wightianum* (4) in site 28 (Table 56-59).

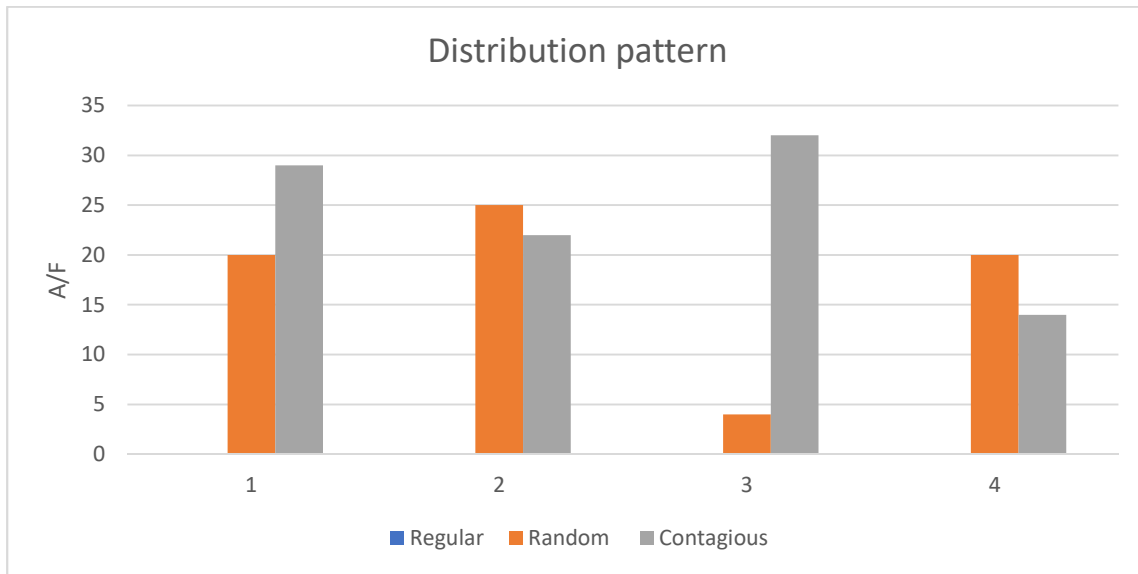
5.7.4. Distribution pattern

Distribution studies indicate that riparian forest in Sholayar follows random and contagious distribution patterns. Out of 87 species studied no species followed regular distribution. Number of species showing different distribution patterns in each study site is given in the table. (Table 20 and Fig.28)

Table 20. Distribution patterns of trees in the riparian forest

| Study sites | Regular | Random | Contagious |
|-------------|---------|--------|------------|
| 25 | 0 | 20 | 29 |
| 26 | 0 | 25 | 22 |
| 27 | 0 | 4 | 32 |
| 28 | 0 | 20 | 14 |

Fig.28.Distribution patterns of trees in the riparian forest



5.7.5. Girth class distribution

“J” shaped curves obtained for girth class distribution in the riparian forest. (Table 21 & 22 and Fig.29 & 30)

Table 21. Population structure of trees along girth classes in the medium elevation riparian forest

| Girth class | Number of individuals |
|-------------|-----------------------|
| 30-60 | 361 |
| 61-90 | 223 |
| 91-120 | 132 |
| 121-150 | 97 |
| 151-180 | 64 |
| >180 | 69 |
| Total | 946 |

Fig.29. Girth class distribution of trees plotted against the number of individuals

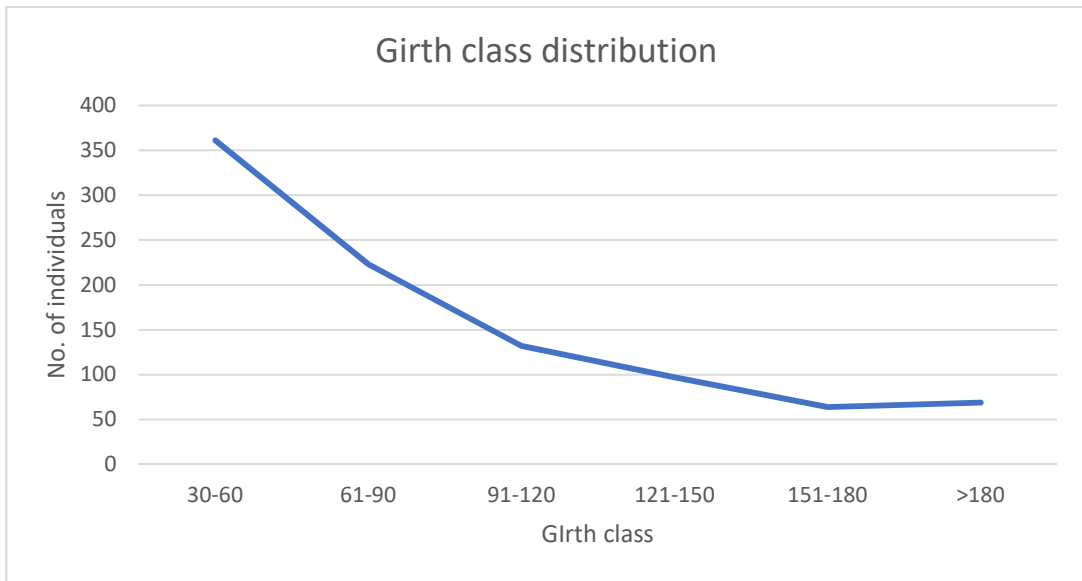
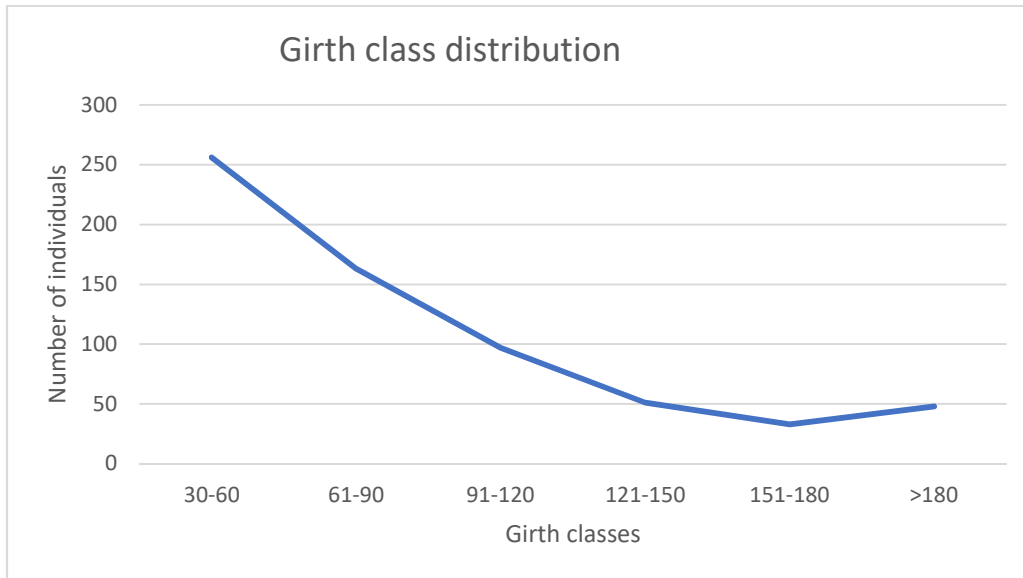


Table 22. Population structure of trees along girth classes in the low elevation riparian forest

| Girth class | Number of individuals |
|-------------|-----------------------|
| 30-60 | 256 |
| 61-90 | 163 |
| 91-120 | 97 |
| 121-150 | 51 |
| 151-180 | 33 |
| >180 | 48 |
| Total | 648 |

Fig.30. Population structure of trees along girth classes in the low elevation riparian forest



5.7.6. Basal area

Among riparian study sites *Cullenia exarillata* (79.6sqm/h), *Vateria indica* (63.7sqm/h), *Tetrameles nudiflora* (55sqm/h), *Cinnamomum malabattrum* (61.6sqm/h), *Elaeocarpus tuberculatus* (42sqm/h), *Dysoxylum malabattrum* (43.5) and *Ficus tsjahela* (77.8sqm/h) showed maximum basal area (Table 56-59).

5.7.7. Importance Value Index (IVI)

The dominant species based on the Importance Value Index are *Cullenia exarillata* (26), *Madhuca nerifolia* (18), *Vateria indica* (26) and *Palaquium ellipticum* (18) in the medium elevation riparian forest and in the low elevation, not much variations are observed among species in the IVI values (Table 56-59 and Fig. 31& Fig.32).

Fig.31.IVI of dominant species in medium elevation riparian forest ecosystem

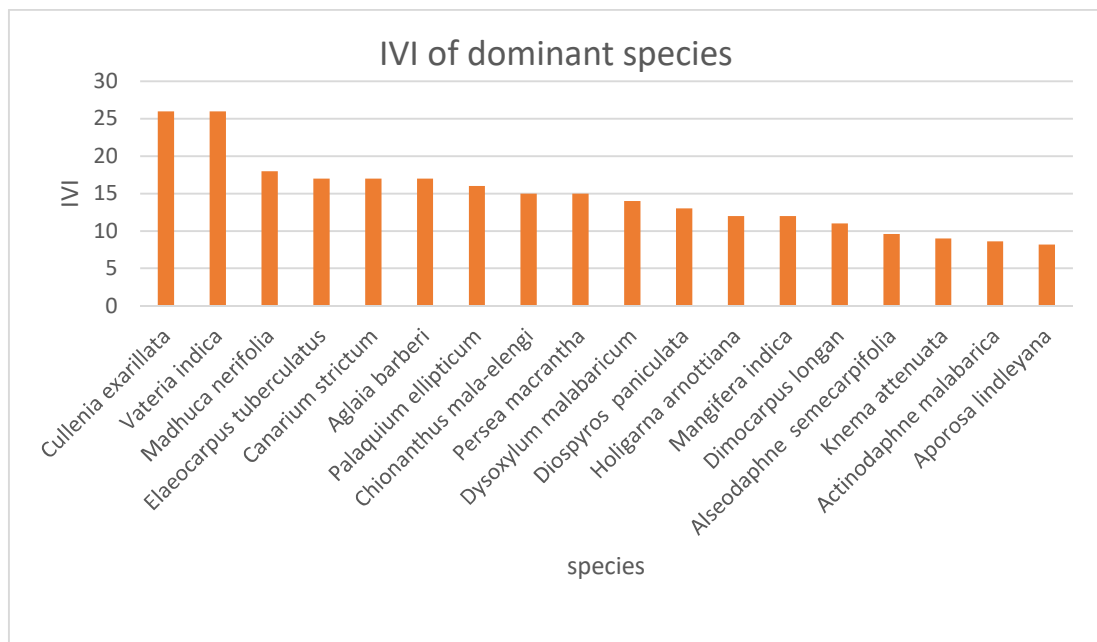
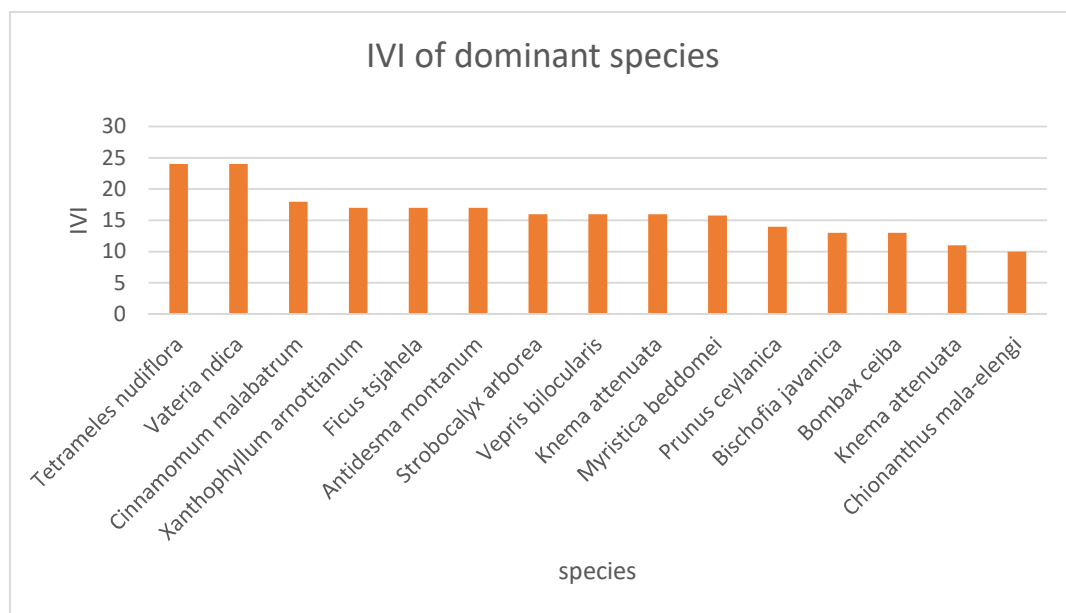


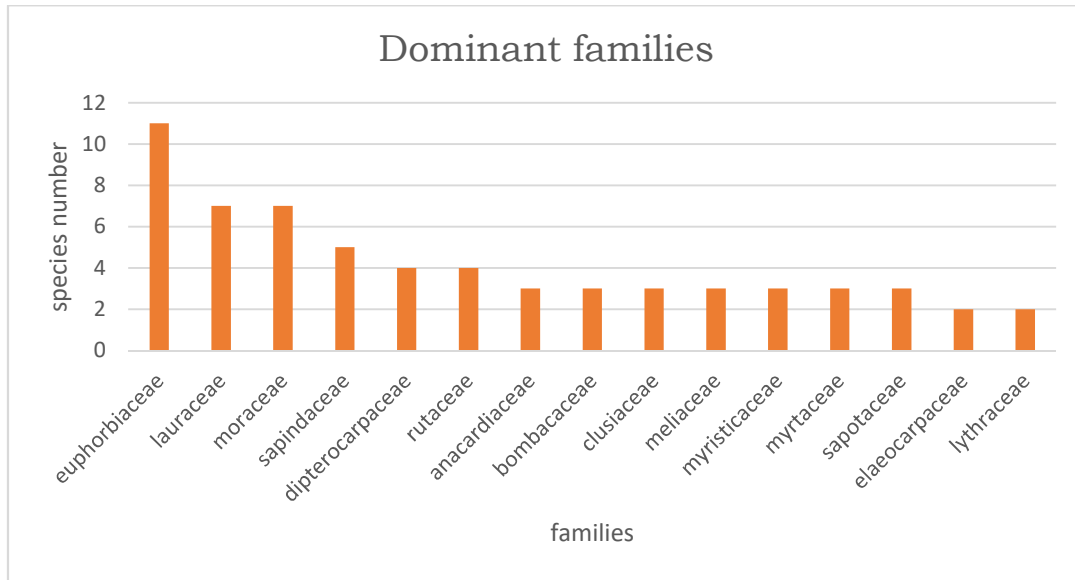
Fig.32. IVI of dominant species in low elevation riparian forest ecosystem



A total of 87 species belonging to 38 families were present in the riparian zone. The family with maximum number of species is Euphorbiaceae (11) followed by Moraceae (7), Lauraceae (7), Sapindaceae (5), Dipterocarpaceae (4) and Rutaceae (4). Other families are Anacardiaceae, Bombacaceae, Clusiaceae, Meliaceae, Myristicaceae, Myrtaceae, Sapotaceae, Elaeocarpaceae, Lythraceae, Oleaceae, Annonaceae, Apocyanaceae, Araliaceae, Asteraceae, Bignoniaceae, Burseraceae, Caesalpiniaceae, Celastraceae, Datisceae, Ebenaceae, Flacourtiaceae, Leeaceae,

Olacaceae, Rosaceae, Rubiaceae, Sabiaceae, Staphyleaceae, Sterculiaceae, Symplocaceae, Urticaceae Verbenaceae and Xanthopyllaceae(Fig.33).

Fig.33. Dominant families in riparian forest area



5.8. Secondary analysis of the vegetation

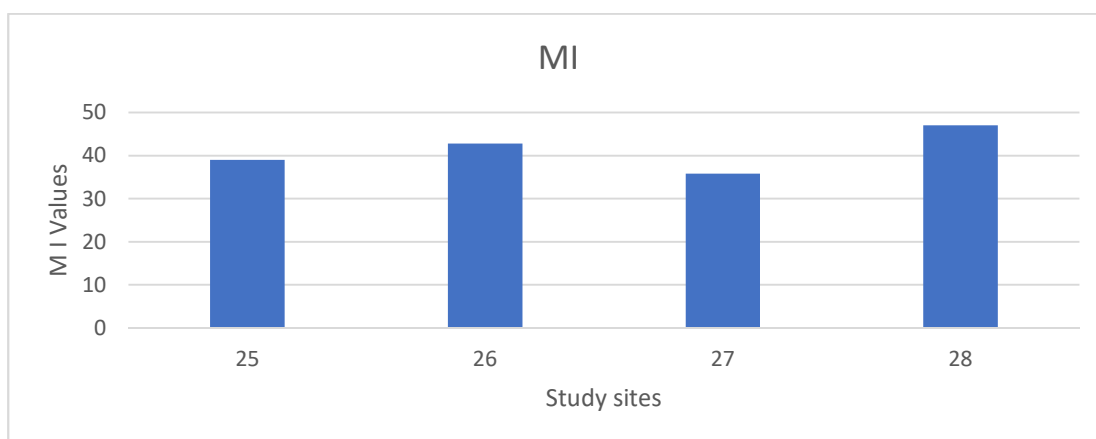
5.8.1. Maturity index (MI)

The average maturity index value of medium elevation riparian forest area is 40.9 and of the low elevation riparian forest is 41.4(Table 23 and Fig. 34)

Table 23. Maturity index (MI) of riparian study sites.

| Study sites | Maturity index |
|-------------|----------------|
| 25 | 39 |
| 26 | 42.8 |
| 27 | 35.8 |
| 28 | 47 |

Fig.34. Maturity index values of riparian forest areas



5.9. Biodiversity indices

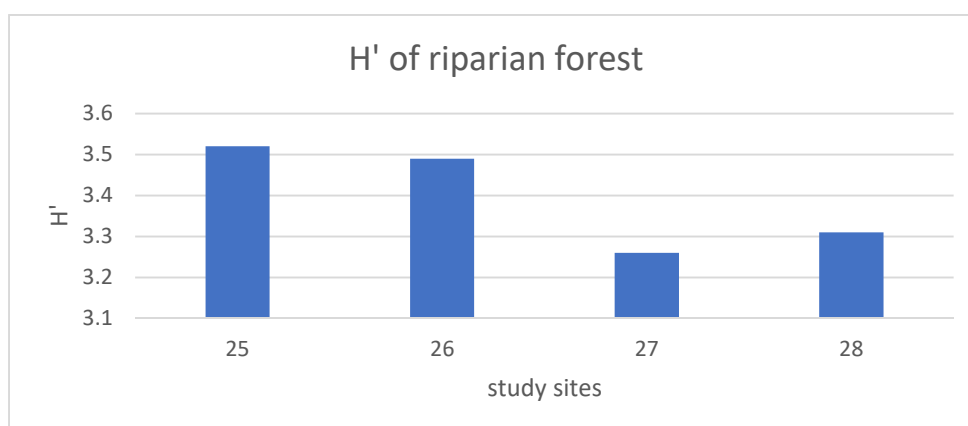
5.9.1. Shannon's diversity index (H')

The average diversity index value of the medium elevation riparian forest is 3.5 and that of the low elevation riparian forest is 3.28 (Table 24 and Fig.35).

Table 24. Shannon's Diversity Index of various riparian study sites

| Study sites | Shannon's diversity- (H') |
|-------------|---------------------------|
| 25 | 3.52 |
| 26 | 3.49 |
| 27 | 3.26 |
| 28 | 3.31 |

Fig.35. Diversity Index of various riparian sites



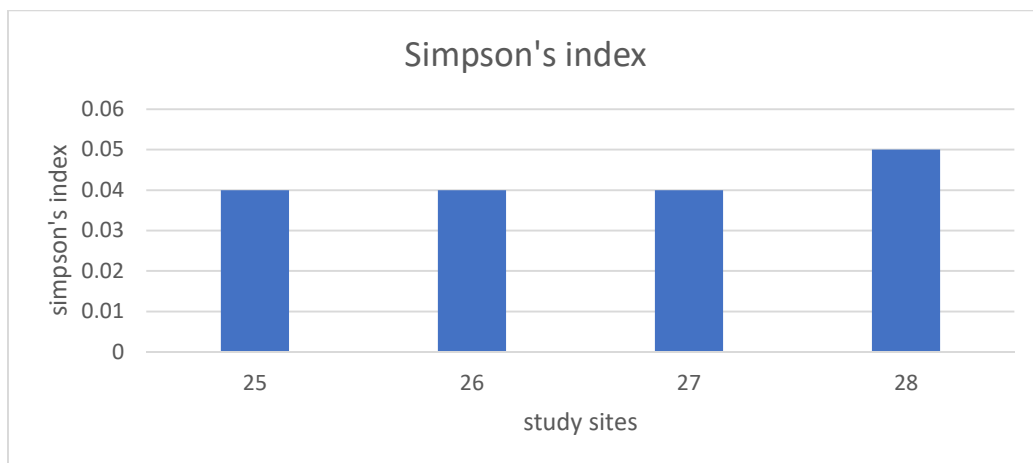
5.9.2. Simpson's index (D)

The mean Simpson's index (D) value of the medium elevation riparian forest is 0.04 and of the low elevation is 0.04 (Table 25 and Fig.36).

Table 25. Simpson's index (D) values of various study sites

| Study sites | Simpson's index (D) |
|-------------|---------------------|
| 25 | 0.04 |
| 26 | 0.04 |
| 27 | 0.04 |
| 28 | 0.05 |

Fig.36. Simpson's index (D) values of various study sites



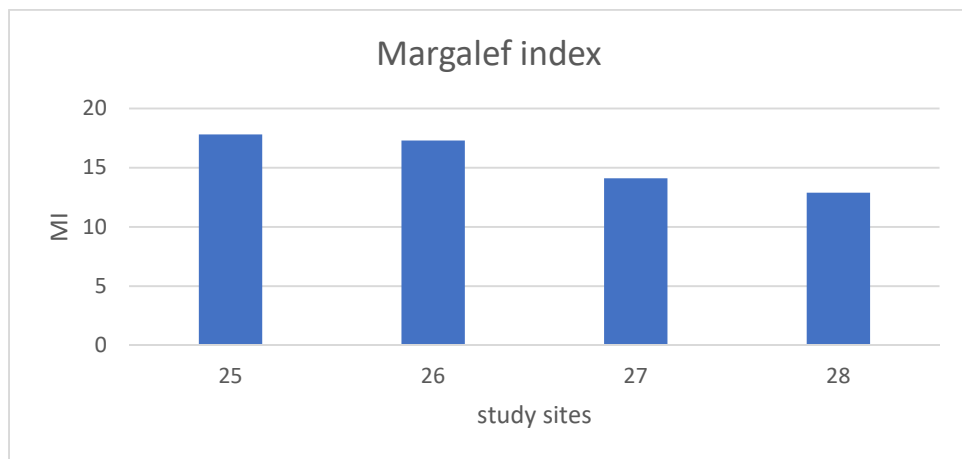
5.9.3. Margalef species richness index (RI)

The average Margalef species richness index value of the medium elevation riparian forest is 17.55 and that of the low elevation is 13.5 (Table 26 and Fig.37).

Table 26. Margalef species richness index (RI)

| Study sites | Margalef index |
|-------------|----------------|
| 25 | 17.8 |
| 26 | 17.3 |
| 27 | 14.1 |
| 28 | 12.9 |

Fig.37. Margalef species richness index (RI)



5.9.4. Pielou's evenness index (E3)

The average evenness index value is 0.90 for the medium riparian area and 0.92 for the low elevation riparian area (Table 27 and Fig.38).

Table 27. Pielou's evenness index (E3)

| Study sites | Pielou's evenness index |
|-------------|-------------------------|
| 25 | 0.90 |
| 26 | 0.90 |
| 27 | 0.90 |
| 28 | 0.93 |

Fig.38. Pielou's evenness index (E3)

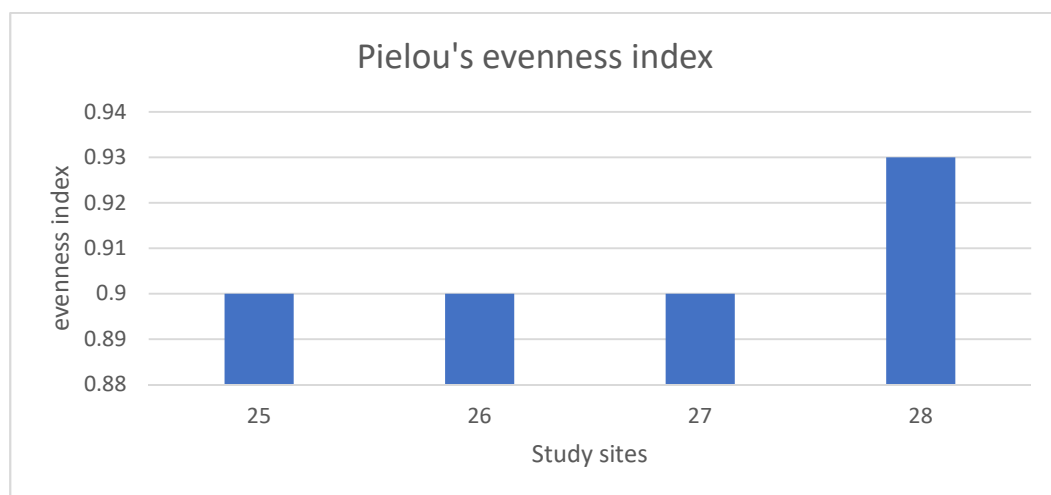


Table 28. Various indices of the medium elevation, low elevation and riparian forests

| | Maturity index | Shannon's diversity index | Simpson's index | Margalef species richness index | Pielou's evenness index |
|---------------------------------------|----------------|---------------------------|-----------------|---------------------------------|-------------------------|
| Medium elevation area | 42 | 3.21 | 0.05 | 13.72 | 0.88 |
| Medium elevation riparian forest area | 40.9 | 3.5 | 0.04 | 17.55 | 0.90 |
| Low elevation area | 43 | 2.90 | 0.06 | 10.35 | 0.89 |
| Low elevation riparian forest area | 41.4 | 3.2 | 0.04 | 13.5 | 0.91 |

5.10. Community Coefficient among different forest types

Similarity between medium elevation forest and low elevation forest is 38%. 63% similarity is observed between medium elevation forest and riparian forest. Low elevation forest and riparian forest show 54% similarity. Highest value of dissimilarity is in between medium elevation forest and low elevation forest. (Table 29)

Table 29. Community Coefficient among different forest types

| FOREST TYPE | Medium elevation | Low elevation | Riparian |
|------------------|------------------|---------------|----------|
| Medium elevation | | 38% | 63% |
| Low elevation | | | 54% |
| Riparian | | | |

Table 30&31: RET and Endemic species

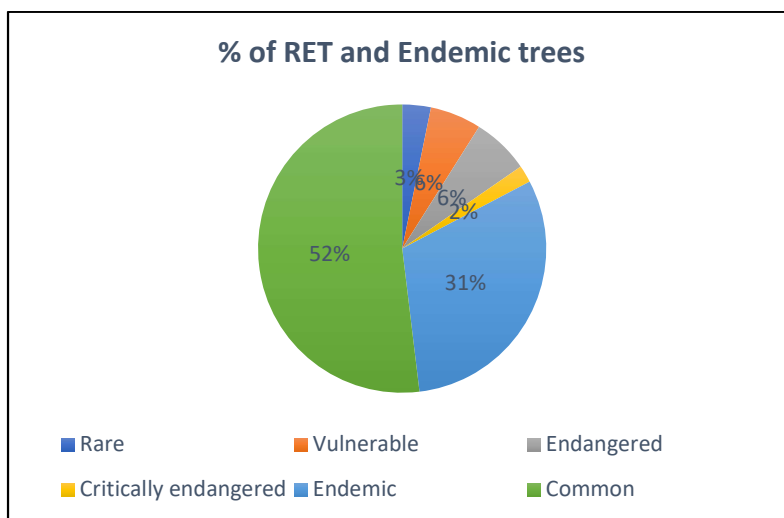
| Species name | RET status | Status of Endemism |
|--|-------------------|-------------------------------|
| <i>Actinodaphne malabarica</i> Balakr. | Least concern | <i>Southern Western Ghats</i> |
| <i>Aglaia barberi</i> Gamble | Nearly threatened | <i>Western Ghats</i> |
| <i>Aglaia lawii</i> (Wight) C.J.Saldanha | Least concern | |
| <i>Aglaia perviridis</i> Hiern | Vulnerable | |
| <i>Aglaia tomentosa</i> Teijsm. & Binn. | Least concern | |
| <i>Agrostistachys borneensis</i> Becc. | Least concern | |
| <i>Ailanthus triphysa</i> (Dennst.) Alston in Trimen | Least concern | |
| <i>Albizia lebbeck</i> (L.)Willd. | Least concern | |
| <i>Alseodaphne semecarpifolia</i> Nees | Least concern | <i>Southern Western Ghats</i> |
| <i>Alstonia scholaris</i> (L.) R.Br. | Least concern | |
| <i>Antiaris toxicaria</i> Lesch. | Least concern | |
| <i>Antidesma montanum</i> Blume. | Least concern | |
| <i>Aphanamixis polystachya</i> | Least concern | |
| <i>Aporosa acuminata</i> Thw. | Least concern | |
| <i>Aporosa bourdillonii</i> Stapf. | Endangered | <i>Southern Western Ghats</i> |
| <i>Aporosa lindleyana</i> (Wight)Baill. | Least concern | |
| <i>Artocarpus heterophyllus</i> Lam. | Least concern | |
| <i>Artocarpus hirsutus</i> Lam. | Least concern | |
| <i>Azadirachta indica</i> A.Juss. | Least concern | |
| <i>Baccaurea courtallensis</i> (Wight) Muell.-Arg. | Least concern | |
| <i>Bischofia javanica</i> Blume | Least concern | |
| <i>Blachia umbellata</i> (Willd.) Baill. | Least concern | |
| <i>Bombax ceiba</i> L. | Least concern | |
| <i>Bombax insigne</i> Wall. | Least concern | |
| <i>Callicarpa tomentosa</i> (L.) Murr. | Least concern | |
| <i>Calophyllum polyanthum</i> | Nearly threatened | |
| <i>Canarium strictum</i> Roxb. | Endangered | |
| <i>Carallia brachiata</i> (Lour.) Merr. | Least concern | |
| <i>Careya arborea</i> Roxb. | Least concern | |
| <i>Caryota urens</i> L. | Least concern | |
| <i>Cassia fistula</i> L. | Least concern | |
| <i>Chionanthus mala-elengi</i> (| Least concern | |
| <i>Chrysophyllum roxburghii</i> G.Don | Least concern | |
| <i>Chukrasia tabularis</i> A.Juss. | Least concern | |
| <i>Cinnamomum malabratrum</i> (Burm.f.) J.Presl | Least concern | <i>Southern Western Ghats</i> |
| <i>Cinnamomum sulphuratum</i> Nees | Vulnerable | <i>Western Ghats</i> |
| <i>Cinnamomum verum</i> Presl | Vulnerable | |
| <i>Clausena indica</i> (Dalz.) Oliver | Least concern | |
| <i>Croton malabaricus</i> Bedd. | Least concern | <i>Southern Western Ghats</i> |
| <i>Cryptocarya anamalayana</i> Gamble | Endangered | <i>Southern Western Ghats</i> |
| <i>Cryptocarya wightiana</i> Thw. | Least concern | <i>Southern Western Ghats</i> |

| | | |
|---|-----------------------|-------------------------------|
| <i>Cullenia exarillata</i> Robyns | Nearly threatened | <i>Southern Western Ghats</i> |
| <i>Cyathocalyx zeylanicus</i> | Least concern | |
| <i>Dalbergia latifolia</i> Roxb. | Vulnerable | |
| <i>Dendrocide sinuata</i> (Blume) Chew | Least concern | |
| <i>Dillenia pentagyna</i> Roxb. | Least concern | |
| <i>Dimocarpus longan</i> Lour. | Data deficient | |
| <i>Dimorphocalyx lawianus</i> (Muell.Arg.)Hook.f. | Least concern | <i>Western Ghats</i> |
| <i>Diospyros assimilis</i> Bedd., | Data deficient | <i>Western Ghats</i> |
| <i>Diospyros bourdillonii</i> Brandis | Least concern | <i>Southern Western Ghats</i> |
| <i>Diospyros buxifolia</i> (Blume) Hiern | Least concern | |
| <i>Diospyros crumenata</i> Thw. | Critically endangered | |
| <i>Diospyros paniculata</i> Dalz. | Vulnerable | |
| <i>Diospyros sylvatica</i> Roxb. | Least concern | |
| <i>Dipterocarpus indicus</i> Bedd. | Endangered | <i>Western Ghats</i> |
| <i>Drypetes oblongifolia</i> (Bedd.) Airy Shaw | Least concern | |
| <i>Drypetes malabarica</i> (Bedd.) Airy Shaw | Least concern | <i>Southern Western Ghats</i> |
| <i>Drypetes venusta</i> (Wight) Pax & Hoffm. | Least concern | <i>Southern Western Ghats</i> |
| <i>Dysoxylum beddomei</i> Hiern | Endangered | <i>Southern Western Ghats</i> |
| <i>Dysoxylum malabaricum</i> Bedd. ex C.DC. | Endangered | <i>Southern Western Ghats</i> |
| <i>Elaeocarpus serratus</i> L. | Endangered | |
| <i>Elaeocarpus tuberculatus</i> Roxb. | Least concern | |
| <i>Erythrina stricta</i> Roxb. | Least concern | |
| <i>Erythrina variegata</i> L. | Least concern | |
| <i>Ficus beddomei</i> King | Endangered | <i>Western Ghats</i> |
| <i>Ficus callosa</i> Willd. | Least concern | |
| <i>Ficus hispida</i> L.f. | Least concern | |
| <i>Ficus nervosa</i> B.Heyne ex Roth | Least concern | |
| <i>Ficus racemosa</i> L. | Least concern | |
| <i>Ficus tsjahela</i> Burm. f. | Least concern | |
| <i>Flacourtia montana</i> J. Graham | Least concern | |
| <i>Garcinia gummi-gutta</i> (L.) Robs. | Least concern | |
| <i>Glochidion ellipticum</i> Wight | Least concern | |
| <i>Glochidion zeylanicum</i> (Gaertn.) A. Juss. var. <i>zeylanicum</i> ; Hook. f. | Least concern | |
| <i>Gmelina arborea</i> Roxb. | Least concern | |
| <i>Gomphandra coriacea</i> Wight | Not evaluated | |
| <i>Gomphandra tetrandra</i> (Wall.)Sleumer. | Least concern | |
| <i>Grewia tiliifolia</i> Vahl | Least concern | |
| <i>Harpullia arborea</i> (Blanco) Radlk. | Least concern | |
| <i>Holigarna arnottiana</i> Hook.f. | Least concern | <i>Southern Western Ghats</i> |
| <i>Holigarna grahamii</i> (Wight) Kurz | Vulnerable | <i>Western Ghats</i> |
| <i>Hopea parviflora</i> Bedd. | Endangered | <i>Southern Western Ghats</i> |
| <i>Hopea ponga</i> (Dennst.)Mabb | Vulnerable | <i>Western Ghats</i> |
| <i>Hydnocarpus macrocarpa</i> (Bedd.)Warb. | Vulnerable | <i>Southern Western Ghats</i> |

| | | |
|--|-------------------|-------------------------------|
| <i>Hydnocarpus pentandra</i> (Buch.-Ham.) Oken | Vulnerable | <i>Western Ghats</i> |
| <i>Ixora brachyata</i> Roxb. | Least concern | <i>Western Ghats</i> |
| <i>Kingiodendron pinnatum</i> (Roxb ex.DC.)Harms | Vulnerable | <i>Southern Western Ghats</i> |
| <i>Knema attenuata</i> Warb. | Least concern | <i>Western Ghats</i> |
| <i>Lagerstroemia microcarpa</i> Wight | Least concern | <i>Western Ghats</i> |
| <i>Lagerstroemia speciosa</i> (L.) Pers. | Least concern | |
| <i>Leea indica</i> (Burm. f.) Merr. | Least concern | |
| <i>Lepisanthes tetraphylla</i> (Vahl) Radlk | Least concern | |
| <i>Litsea bourdillonii</i> Gamble | Nearly threatened | <i>Southern Western Ghats</i> |
| <i>Litsea coriacea</i> | Nearly threatened | |
| <i>Litsea floribunda</i> (Blume) Gamble | Nearly threatened | <i>Western Ghats</i> |
| <i>Lophopetalum wightianum</i> Arn. | Least concern | |
| <i>Macaranga peltata</i> (Roxb.) Muell.-Arg. | Least concern | |
| <i>Madhuca nerifolia</i> (Moon) H.J.Lam | Least concern | |
| <i>Mallotus philippensis</i> (Lam.) Muell.-Arg. | Least concern | |
| <i>Mallotus tetracoccus</i> (Roxb.) Kurz. | Least concern | |
| <i>Mangifera indica</i> L. | Least concern | |
| <i>Meiogyne pannosa</i> (Dalzell) J. Sinclair | Nearly threatened | <i>Western Ghats</i> |
| <i>Melicope lunu-ankenda</i> (Gaertn.) Hartley | Least concern | |
| <i>Meliosma pinnata</i> (Roxb.) | Least concern | |
| <i>Mesua ferrea</i> L. | Vulnerable | |
| <i>Mimusops elengi</i> L. | Least concern | |
| <i>Murraya paniculata</i> (L.) Jack. | Least concern | |
| <i>Myristica beddomei</i> King | Least concern | |
| <i>Myristica malabarica</i> Lam. | Vulnerable | <i>Western Ghats</i> |
| <i>Nothopogia colebrookeana</i> (Wight) Blume | Data deficient | |
| <i>Nothopogia travancorica</i> Bedd. Ex Hook f. | Vulnerable | <i>Southern Western Ghats</i> |
| <i>Olea dioica</i> Roxb. | Least concern | |
| <i>Orophea erythrocarpa</i> Bedd. | Vulnerable | |
| <i>Orophea uniflora</i> Hook. f. & Thoms. | Nearly threatened | <i>Southern Western Ghats</i> |
| <i>Otonophelium stipulaceum</i> (Bedd.) Radlk. | Least concern | <i>Southern Western Ghats</i> |
| <i>Palaquium ellipticum</i> (Dalz.) Baill. | Least concern | <i>Western Ghats</i> |
| <i>Paracroton pendulus</i> (Hassk.) Miq. ssp. zeylanicus (Thw.) Balakr. & Chakrab. | Least concern | |
| <i>Persea macrantha</i> (Nees) Kosterm. | Least concern | |
| <i>Phyllanthus emblica</i> L. | Least concern | |
| <i>Poeciloneuron indicum</i> Bedd. | Least concern | <i>Western Ghats</i> |
| <i>Polyalthia fragrans</i> (Dalz.) Bedd. | Least concern | |
| <i>Prunus ceylanica</i> (Wight) Miq. | Endangered | |
| <i>Psychotria anamalayana</i> Bedd. | Vulnerable | <i>Southern Western Ghats</i> |
| <i>Psychotria beddomei</i> Deb and Gangop. | Endangered | |
| <i>Pterocarpus marsupium</i> Roxb. | Nearly threatened | |
| <i>Pterospermum reticulatum</i> Wight & Arn. | Vulnerable | <i>Southern Western Ghats</i> |
| <i>Saraca asoka</i> | Vulnerable | |
| <i>Schefflera wallichiana</i> (Wight & Arn.) Harms | Least concern | |

| | | |
|---|----------------|-------------------------------|
| <i>Schleichera oleosa</i> (Lour.) Oken. | Least concern | |
| <i>Spondias pinnata</i> (L. f.) Kurz | Least concern | |
| <i>Sterculia guttata</i> Roxb. ex DC., | Least concern | |
| <i>Stereospermum colais</i> (Buch.-Ham. ex Dillw.) Mabb. | Least concern | |
| <i>Strobocalyx arborea</i> Buch.-Ham. | Least concern | |
| <i>Strombosia ceylanica</i> Gard. | Least concern | |
| <i>Symplocos cochinchinensis</i> (Lour.) Moore | Least concern | |
| <i>Symplocos macrophylla</i> Wall. ex A. DC ssp. <i>rosea</i> (Bedd.) Nooteb. | Least concern | <i>Southern Western Ghats</i> |
| <i>Syzygium cumini</i> (L.) Skeels var. <i>cumini</i> ; | Least concern | |
| <i>Syzygium laetum</i> (Buch.-Ham.) Gandhi | Not evaluated | <i>Southern Western Ghats</i> |
| <i>Syzygium lanceolatum</i> (Lam.) Wight & Arn. | Data deficient | |
| <i>Syzygium mundagam</i> (Bourd.) Chithra | Vulnerable | <i>Southern Western Ghats</i> |
| <i>Syzygium munronii</i> (Wight)Chandrab. | Not evaluated | |
| <i>Syzygium occidentale</i> (Bourd.)Gandhi | Endangered | <i>Southern Western Ghats</i> |
| <i>Tectona grandis</i> L. f. | Endangered | |
| <i>Terminalia bellirica</i> (Gaertn.) Roxb. | Least concern | |
| <i>Terminalia paniculata</i> Roth | Least concern | |
| <i>Terminalia travancorensis</i> Wight & Arn. | Vulnerable | <i>Western Ghats</i> |
| <i>Tetrameles nudiflora</i> R. Br. | Least concern | |
| <i>Toona ciliata</i> Roem., | Least concern | |
| <i>Trichilia connaroides</i> (Wight & Arn.) Benth. | Least concern | |
| <i>Turpinia malabarica</i> Gamble | Not evaluated | |
| <i>Vateria indica</i> L. | Vulnerable | <i>Western Ghats</i> |
| <i>Vepris bilocularis</i> (Wight & Arn.) Engl. | Endangered | <i>Southern Western Ghats</i> |
| <i>Vitex altissima</i> L. f. | Least concern | |
| <i>Wrightia tinctoria</i> R.Br. | Least concern | |
| <i>Xanthophyllum arnottianum</i> Wight | Least concern | <i>Western Ghats</i> |
| <i>Xylia xylocarpa</i> (Roxb.) Taub. | Least concern | |

Fig.39. Pie diagram showing % of RET and endemic tree species



Discussion

Chapter -6

DISCUSSION

The tropical evergreen forest of the Western Ghats is usually seen at elevations of 800–1200 metres, with an annual rainfall of at least 3000 mm. The vegetation of Sholayar consists of West Coast Tropical evergreen forests. Its subtypes are medium elevation evergreen or wet evergreen forests and low elevation evergreen forests and its degraded types (Rajesh,2018). The evergreen forests that were formerly classified as West Coast Tropical evergreen forests (Champion and Seth, 1968) and the potential vegetation within each region based on the bioclimate are replaced with either sub types, based on edaphic, microclimatic features, or secondary forest types due to extensive past anthropogenic interventions for plantations, hydroelectric projects, selection felling and other purposes.

Present study has shown that forest in the medium elevation zone of Sholayar reserve forest has shown typical wet evergreen vegetation; dominated with tree species such as *Palaquium ellipticum*, *Cullenia exarillata*, *Mesua ferrea*, *Calophyllum polyanthum*, *Artocarpus heterophyllus*, *Canarium strictum*, *Elaeocarpus tuberculatus*, *Dysoxylum malabaricum*, *Myristica beddomei*, *Diospyros sylvatica*, *Vateria indica* etc. in the top close canopy; *Actinodaphne malabarica*, *Aglaia barberi*, *Drypetes malabarica*, *Elaeocarpus serratus*, *Toona ciliata*, *Pararoton pendulus*, *Persea macrantha*, *Prunus ceylanica* etc. in the third tree layers; *Alstonia scholaris*, *Turpinia malabarica*, *Holigarna grahamii*, *Garcinia gummi-gutta* etc. in the medium layers; *Antidesma montanum*, *Aglaia tomentosa*, *Aglaia lawii*, *Syzygium laetum*, *Otonophelium stipulaceum*, *Diospyros paniculata*, *Cinnamomum malabattrum*, *Meiogyne pannosa*, *Chrysophyllum roxburghii* and *Symplocos cochinchinensis* among the small trees and *Aporosa auminata*, *Dimocarpus longan*, *Litsea floribunda*, *Baccaurea courtallensis* and *Dendrocnide sinuata* in the very small trees.

The percentage of secondary species is an indication of forest degradation (Basha, 1987). Number of secondary species is very less in the medium elevation evergreen forest. 109 species and 7375 individuals of trees have been recorded from different study sites of medium wet evergreen forest area. Indicators of canopy

disturbance are *Actinodaphne malabarica*, *Macaranga peltata*, *Polyalthia fragrans*, *Callicarpa tomentosa*, *Ailantus triphysa* and *Ixora brachiata* etc.

The percentage value of secondary species is less in medium evergreen forest. Maximum observed percentage is 0.11 in study site 10. No secondary species are present in site 3.

74 species and 1977 individuals of trees have been recorded from the different study sites of low elevation forest. Two sites comprise wet evergreen characteristic species; dominated with *Vateria indica*, *Dipterocarpus indicus*, *Kingiodendron pinnatum* in the close canopy; *Elaeocarpus tuberculatus*, *Myristica beddomei*, *Antiaris toxicaria*, *Canarium strictum*, *Dysoxylum malabaricum*, *Holigarna arnottiana* and *Caryota urens* etc. in the sub canopy; *Aglaia lawii*, *Bischofia javanica*, *Hopea parviflora*, *Otonophelium stipulaceum*, *Knema attenuata*, *Mangifera indica*, *Drypetes venusta* and *Pterospermum reticulatum* in the medium sized trees, *Agrostistachys borneensis*, *Xanthophyllum arnottianum*, *Lepisanthes tetraphylla*, *Aporosa bourdillounii* and *Turpinia malabarica* in the small trees.

Canopy opening in the wet evergreen forests leads to the community growth of secondary species in the low elevation area. This is the reason for the degenerating nature of the forest. The canopy opening promotes the regrowth of primary evergreen plants that prefer shade and promotes the growth of secondary species that require light. Six study sites showed degenerated nature and are dominated with deciduous trees such as *Terminalia paniculata*, *Xylia xylocarpa*, *Lagerstroemia microcarpa*, *Dalbergia latifolia*, *Bombax ceiba*, *Terminalia bellirica* and *Tectona grandis* in the top layer; *Wrightia tinctoria*, *Dillenia pentagyna*, *Phyllanthus emblica*, *Cassia fistula*, *Pterocarpus marsupium*, *Stereospermum colais* and *Schleichera oleosa* in the medium trees and *Grewia tiliifolia*, *Alstonia scholaris* and *Tetrameles nudiflora* among the small trees.

A total of 87 species and 1594 trees have been recorded from the riparian sites. Study sites near Sholayar river in the medium elevation constitute primary wet evergreen riparian vegetation. Dominated by *Cullenia exarillata*, *Canarium strictum*, *Elaeocarpus tuberculatus*, *Holigarna arnottiana*, *Madhuca nerifolia* and *Palaquium ellipticum* etc. Characteristic riparian species are *Madhuca nerifolia*, *Persea*

macrantha, *Garcinia gummi-gutta*, *Cinnamomum verum*, *Elaeocarpus tuberculatus*, *Myristica beddomei*, *Lophopetalum wightianum*, *Bischofia javanica* etc. *Palaquium ellipticum*, *Cullenia exarillata*, *Vateria indica*, *Lophopetalum wightianum* etc. seen in the top layer. *Otonophelium stipulaceum*, *Schleichera oleosa*, *Persea macrantha* etc. constitute the second layer. *Diospyros paniculata*, *Melicope lunu ankenda*, *Aglaia tomentosa*, *Garcinia gummi-gutta* etc. form the third layer. The lower layer includes *Madhuca nerifolia*, *Aglaia barberi*, *Agrostistachys borneensis* etc. *Ochlandra travancorica* is very common in the riparian area. *Ochlandra*, *Persea macrantha*, *Schleichera oleosa*, and *Vateria indica* show more secondary evergreen nature; and a slightly degraded nature is seen in the vegetation. Presence of *Macaranga peltata*, *Polyalthia fragrans* and *Olea dioica* etc. indicate canopy disturbances.

Study sites near Anakkayam stream in the low elevation area represent secondary semi evergreen riparian vegetation. The flow of the stream favours the growth of secondary species, and unnatural speed and fluctuation may prevent more moist evergreen species from reaching their climax. This is sustained by secondary regrowth of species such as *Artocarpus heterophyllus*, *Aglaia barberi*, *Cinnamomum malabattrum* and *Schleichera oleosa*. Other species include *Leea indica*, *Polyalthia fragrans*, *Hopea ponga*, *Ficus tsjahela*, *Myristica beddomei*, *Macaranga peltata* etc. Dominance of deciduous and secondary species could be due to biotic pressure and it also indicates the deteriorating status of evergreen forest (Abhilash, 2007).

6.1. Stand structure

Among study sites in the medium elevation dense evergreen forest area, including riparian vegetation the stand density of trees ranges from 341/ha to 540/ha. The overall stand density of all the study sites in the medium elevation evergreen forest is 462/ha. This is a higher value than 419/ha reported by Ghate et al. (1998) for Western Ghats closed canopy evergreen forest. The obtained values are very much comparable with the values observed in various studies. Magesh (2014) reported overall density of 448/ha. for Parambikulam wildlife sanctuary. Parthasarathy and Karthikeyan (1997) observed 482/ha in the tropical evergreen forest of Courtallum, Western Ghats. Stand density values ranging from 433 to 590 are reported by Abhilash (2007) in various localities of wet evergreen forest in the Goodrical forest range, Western Ghats. Pascal and Pelissier (1996) reported 635 trees in the tropical

wet evergreen forests of South-West India. Manoj (2019) reported a stand density of 842/ha in the evergreen forest of Karian Shola. The stand density values of some other evergreen forest of Western Ghats are as follows; Agasthyavanam Biological Park, 460 trees/ha and Peppara Wildlife Sanctuary 1110 trees/ha (Varghese, 1997); Idukki, 780 trees/ha; Nilambur, 908 trees/ha (Sanalkumar, 1997); Ranni, 892 trees/ha; Parambikulam, 881 trees/ha (Sankar and Sanal Kumar, 1997); Attappady, 1520 trees/ha (Pascal, 1988); Silent Valley, 1082 trees/ha (Basha, 1987).

The stand density of low elevation forest showed much variation. Degraded evergreen vegetation, dominated with deciduous trees are observed in most of the study sites in the low elevation area. High stand density value observed is 470/ha in site 23. Low elevation riparian area showed slight semievergreen nature, among low elevation riparian forest, high stand density observed is 352/ha. The other reported stand densities among Western Ghats are New Amarambalam (375/ha) by Jayakumar (2003); Planthodu (398 trees/ha) and Nilakkal (514 trees/ha) by Abhilash (2007); Kolli hills in Tamil Nadu (592 trees/ha) by Lakshmi (1995); Parambikkulam (536 trees/ha) by Magesh(2014); In the semi evergreen forests in Eastern Ghats, the values reported are in forest of Vellimalai, Kalrayans 397-667/ha and tropical semievergreen forest of Yercaud, Shevarayans 640-986/ha (Kadavul and Parthasarathy, 1999). The stand density of some secondary moist mixed forest type in other studies are as follows: New Amarambalam (132 trees/ha) by Jayakumar (2003); 226-314 by Abhilash (2007) in Goodrical; Agastyanam Biological park (430 trees/ha) and Peppara (650 trees/ha) by Varghese (1997). The stand density of southern secondary moist deciduous forest of Parambikulam Tiger Reserve is 314 trees/ha (Magesh,2014). In the present study the overall stand density value of low elevation zone is 262/ha.

The overall tree species density/ha area in the medium dense evergreen forest is 39/ha. And that of low elevation degraded forest is 27/ha. Ganesh et al. (1996) reported 45 species/ha (more than 10cm gbh), for evergreen forests of Kalakad-Mundanthurai Tiger Reserve, Western Ghats, India. In the wet evergreen forests across the tropics, tree diversity ranges from 20 species/ha (Chandrasekhara et al., 1998). He reported trees species 32, 37 and 30 from Attappadi, Silent Valley and Pothumala of Kerala respectively. Menon and Abhilash (2014) reported 27-55

species/ha. from Kottiyoor. Varghese (1997) recorded 36 species/0.1 ha from Peppara in Kerala, 64-82 species per ha (>30 cm) from Kalakad (Parthasarthy,1988). He also reported 29 species/0.1 ha from subtropical hill forest, 27species/0.1ha from West coast semievergreen forest and 16 tree species/0.1ha in Southern secondary moist mixed forest. In the study sites of stream side vegetation, species/ha is 36 and 34 respectively. Which is higher than the other study sites in the low elevation area.

Among 18 study sites in the medium elevation dense evergreen forest, highest values regarding density is shown by the following species viz, *Cullenia exarillata* (66/ha), *Palaquium ellipticum* (63/ha), *Vateria indica* (59/ha), *Agrostistachys borneensis* (57/ha) and *Mesua ferrea* (49/ha).

Secondary species are less than 0.1% in all the 18 sites in the wet evergreen forest. Presence of some secondary species like *Macaranga peltata*, *Polyalthia fragrans*, *Callicarpa tomentosa*, *Ailanthes triphysa* etc. indicates that some sort of disruption, such as tree falls and canopy gap or human activities, has occurred in the forest.

Among 10 study sites in the low elevation forest, highest values regarding density is shown by the following species viz, *Terminalia paniculata* (70/ha), *Vateria indica* (31/ha), *Agrostistachys borneensis* (29/ha), *Dipterocarpus indicus* (29/ha), *Tectona grandis* (28/ha), *Canarium strictum* (28/ha) and *Drypetes venusta* (26/ha). Dominance of moist deciduous and secondary species in the low elevation area reflects the degraded nature of the forest. In comparison to the higher elevation forests, low elevation forests are more vulnerable to damage due to an array of human activities, natural hazards, the effects of climate change, ecological sensitivity, and resource extraction operations. Which may be the reason for low stand density and low species density in the low-elevation forests.

Tree growth and stand density in evergreen forests can be negatively impacted by soil quality degradation brought on by erosion and other causes. More over temperature, precipitation, and other climatic variations can have an impact on the growth and productivity of forests, which may reduce the stand density in degraded evergreen forests. Areas with lower elevations are more susceptible to the effects of climate change, such as rising temperature and altered precipitation patterns.

Deciduous trees show more tolerance to disturbances than evergreen species and their rapid growth enables them to establish dominance in disturbed ecosystems. The light availability and less canopy in the disturbed forest support the growth of deciduous species.

Water levels in non-perennial streams fluctuate all year long, with periods of dryness interrupted by intervals of flood. These pools of water, especially in riparian zones, frequently keep the surrounding soil relatively moist with their intermittent flow. The growth of vegetation, particularly semi-evergreen species that are adapted to variations in water availability, can be sustained by this intermittent water supply. Semi-evergreen forests often emerge in riparian zones over time as a result of biological succession processes in areas of non-perennial streams.

6.2. Family composition

Among the families, Euphorbiaceae is the largest one with 20 species, followed by Lauraceae (11 species), Meliaceae (11 species), Moraceae (9 species), Fabaceae (6 species) and Ebenaceae (6 species). The highest number of species for Euphorbiaceae is also recorded in New Amarambalam Reserved Forest (Sharma et al.,2002); Attappady, Naravi, Suthanabi and Bhagavathy forests of Western Ghats (Pascal, 1988) and by Manoj (2019) in the unlogged evergreen forest of Karian Shola. Magesh (2014) reported dominance of same families in Parambikulam Tiger Reserve. Pascal (1988) also reported that the most dominated families in Uppangala forest of Western Ghats are Euphorbiaceae (20 species) and Anacardiaceae (7 species). In Peppara, one of the highest families is Euphorbiaceae (Varghese,1997). This indicates the wide distribution of Euphorbiaceae in the evergreen forests of Western Ghats.

In the low-elevation disturbed forests, Fabaceae is also a dominant family. Manoj (2014) reported dominance of Fabaceae in the logged deciduous forest area of Karian Shola. Fabaceae is an important family in the moist deciduous forest of New Amarambalam (Sharma et al., 2002)

6.3. Abundance and Frequency

The higher abundance values of secondary species like, *Polyalthia fragrans* and *Macaranga peltata* in the low elevation study sites indicate the degenerated nature of the forest. In the medium elevation tropical evergreen forest, typical evergreen species like *Cullenia exarillata*, *Palaquium ellipticum*, *Drypetes venusta*, *Mesua ferrea*, *Vateria indica*, *Agrostistachys borneensis*, *Calophyllum polyanthum*, *Canarium strictum*, *Aglaia barberi*, *Diospyros paniculata*, *Chionanthus mala-elengi* etc. showed higher frequency; indicating their wider ecological amplitude in the evergreen habitat. Riparian species like *Madhuca nerifolia*, *Myristica beddomei*, *Elaeocarpus tuberculatus* etc. showed high frequency in study sites along river banks. In the low elevation forest, *Wrightia tinctoria*, *Grewia tiliifolia*, *Tectona grandis*, *Erythrina stricta*, *Terminalia paniculata*, *Actinodaphne malabarica*, *Vateria indica*, *Agrostistachys borneensis* etc. showed high frequency values. Frequent appearance of deciduous species indicates the deteriorating status of evergreen forest and the ecological tolerance of that particular species to establish in a degraded forest. In the low elevation riparian area, *Myristica beddomei*, *Tetrameles nudiflora*, *Vateria indica*, *Antidesma montanum* etc. showed higher values.

Based on the Raunkiaer's frequency classes, in the dense evergreen forest among 18 study sites, 13 are heterogeneous and 5 are homogeneous. In the disturbed forest in the low elevation zone, all the forest types are heterogeneous in nature. In study site 19, class D and class E are absent. And in the site 21, class E is absent. Absence of such classes shows that characteristic species are absent or very few in number in that area.

In the dense evergreen forest, a greater number of species showed contagious distribution and at study site 13 and 26 more number of species expressed random distribution. In the disturbed forest in the low elevation area, in 3 study sites some species showed regular distribution, and 6 sites showed a greater number of randomly distributed species. Reddy et al. (2008) reported regular distribution of 107 species in the tropical forest of Eastern Ghats.

According to Odum (1971), random distribution happens in situations where there is intense competition between individuals, contagious distribution is most prevalent in nature, and regular distribution is only found in extremely uniform environments.

6.4. Vegetation communities

The formation of species groupings is influenced by biotic variables, climate, and ecology. Species with comparable ecological requirements usually form associations or communities. With regard to vegetation formations in the area, *Palaquium-Cullenia-Mesua* association is seen in the most of the evergreen sites. Same type of association is reported by Sharma et al. (2002) and Magesh and Menon (2011). In the riparian site an association of *Cullenia-Madhuca-Elaeocarpus* is obtained. Other species involved in associations are *Agrostistachys borneensis*, *Vateria indica*, *Calophyllum polyanthum*, *Drypetes venusta* and *Aglaiia barberi*.

No such characteristic associations are found in the low elevation zone. Below 700 meters in altitude, no particular tree group dominates the evergreen forest. The evergreen species found below 700 meters are primarily found in patches along the banks of water channels where the soil is relatively deep (Sasidharan, 2004).

6.5. Girth class distribution

Distribution of girth classes in the medium elevation forest gave a negative exponential inverse "J" curve, starting high in the lower girth class and progressively decreasing into the upper girth class. Which is an indication of good regenerating population (Richards, 1996) and evergreen forest (Pascal, 1988). Magesh (2014) in Parambikkulam, Abhilash (2007) in Goodrical, Ganesh et al., (1996) in Kakachi, Parthasarathy (2001) in Sengaltheri, and Pascal and Pelissier (1996) in Uppangala and Manoj (2019) in Karian Shola, reported similar results in their study areas. The girth class distribution pattern of low elevation disturbed forest was represented by a curve that nearly resembled an inverted "J" curve; rather than a precipitous decline, the curve's slightly bulging borders are caused by a progressive increase in the number of tree individuals in the 91–120 and 121–150 classes.

6.6. Succession

The overall maturity index obtained was slightly lower for the medium dense evergreen forest (41.7) than the degraded forest (42.88). Higher maturity index values indicate that vegetation has reached a more advanced level in comparison to earlier phases, whereas lower values suggest that succession is in its early stages

(Abhilash,2007). Tropical and subtropical regions, with stable environmental conditions are common habitats for evergreen forests. These areas experience fewer disturbances. Due to this factor, evergreen forests can endure for a long period of time without experiencing considerable changes in the species composition. Disturbances like logging, fires, flood or human activities can create canopy openings and lead to shifts in species composition, which may result in different age classes in disturbed forests. This results in a higher maturity index value in disturbed forests compared to evergreen forests. The maturity index value of evergreen forests of Kottiyoor Reserve Forest is 31.11(Menon and Abhilash,2014); Peppara Wildlife Sanctuary is 26.56 (Varghese 1997). For Andamans the value is 47.78 (Roy et al., 1993). In Goodricial range for the semi evergreen forests, the values range from 23.73 - 42.22, the maturity index values of Southern secondary moist deciduous forest range from 29.41 to 29.57 and in Southern subtropical hill forests, the maturity index (MI) was 32.54(Abhilash,2007). Varghese (1997) reported maturity index value of 21.76 for Podiakala, 26.20 for Podium and 26.36 for Agasthyavanam Biosphere Park; 24.67 for Chimmony area by Suraj (1997) and 17.22 for North Kerala by Menon (1999).

6.7. Species richness

A total of 10,946 trees of above 30 cm. gbh belonging to 156 species out of 89 genera and 49 families were enumerated from the total sampling area. From the dense evergreen medium elevation forest, 118 species of trees and from the low elevation degraded forest, 94 species were recorded. These values are greater than the number of species reported from Western Ghats *viz.*, 91 in tropical wet evergreen forest in Uppangala, Karnataka, (Pascal and Pelissier, 1996). 34 species from Silent Valley and 27 species from Attappady (Pascal ,1988). 90 tree species under 35 families from KMTR, Western Ghats (Ganesh et al.,1996). In Peppara Wildlife Sanctuary 151 tree species in 52 families were recorded by Varghese (1997). From Southern moist mixed deciduous forests of Agasthyamalai region of Kerala 49 species were recorded (Varghese and Balasubramanyan,1999). 214 species out of 55 families were recorded by Magesh (2014) from Parambikkulam Tiger Reserve. Among them 161 species of trees are recorded from evergreen forest. 97 species out of 48 families were recorded by Mohandas et al. (2016) from medium elevation tropical montane evergreen forest of Western Ghats. Rao et al. (2013) recorded a total of 129 tree

species, out of 46 families in a study conducted at tropical forest of Srikakulam district, Andhra Pradesh. Manoj (2019) recorded 270 tree species out of 64 families from Karian Shola and total of about 70 species of trees were recorded from the logged area. 132 tree species were recorded from evergreen forest of New Amarambalam (Sharma et al.,2002). 274 tree species among 45 families from tropical forest in Western Ghats was reported by Reddy et al. (2008). In another study at Kambalakonda Wildlife Sanctuary, Naidu et al. (2012) observed 319 species out of 73 families. Iqbal et al. (2012) reported 31 tree species around Khok river of Garhwal Himalaya, India. Dudipala et al. (2023) reported 102 tree species out of 44 families from Pench Tiger Reserve, Maharashtra. 189 tree species representing 51 families were reported from Mahendragiri hill forest, Eastern Ghats of Odisha (Khadanga et al.,2023)

According to the present study the species richness index value for medium elevation dense evergreen forest is 14.15 and that of low elevation degraded evergreen forest is 10.98. In the evergreen forest of Goodrical range the maximum richness index value observed is 11.94 (Abhilash,2007). Magesh (2014) recorded a richness index value 19.44 for the evergreen forest of Parambikulam Tiger Reserve. The richness value for similar habitat of new Amarambalam was 14.21 (Jaya Kumar, 2003) and that of Peppara was 6.3-8.29 (Varghese, 1997). Richness index of Semievergreen forest in Goodrical range is 15.96 (Abhilash,2007), and in New Amarambalam (15.11) by Jayakumar (2003). The maturity index value for dense evergreen forest is lower than disturbed forest. But the species richness value is higher for dense evergreen forest, degraded forests may have undergone disturbance or degradation due to human activities such as logging, agriculture, or urbanization. While these disturbances may reduce the overall biodiversity and ecological function of the forest, they can create conditions that favour the rapid growth and establishment of pioneer species, leading to a relatively high maturity index compared to undisturbed forests in early succession. More over species richness increases with increasing area (He and Legendre, 2002).

6.8. Species diversity

The species diversity value is 3.26 for dense evergreen forest and 2.98 for low elevation disturbed forest. In both zone riparian area shows comparatively high values

(3.52 in site 25 and 3.39 in site 28). Site 10 has higher value that is 3.6. The following values are reported for the evergreen forests of other regions of Kerala *viz.* The evergreen forests of Silent Valley showed 3.9 (Basha, 1987), Nelliampathy - 3-3.7 (Chandrasekhara, 1991), Achankoil - 1.5-2.2 (Sankar and Sanal Kumar, 1997), Agasthyavanam Biological Park - 2.8 (Varghese, 1997), New Amarambalam- 3.29 (Jayakumar, 2003). Pascal (1988) opined that the climax evergreen forests of Western Ghats points between 3.6 and 4.34 Shannon index. The climax evergreen forests of the Western Ghats showed diversity index between 3.6 and 4.3 (Rajendraprasad, 1995). Various regions of Bandhipur National Park showed Shannon Weiner values in a range of 2.06-2.94 (Prasad et al., 1998); Wayanad Wildlife Sanctuary showed 2.12 (Rajasekaran, 2000). Sanal Kumar et al. (2012) got values range from 3.2 to 3.8 at Konni reserve forest of Western Ghats. Varghese (1997) got a value of 3.3 for Westcoast tropical evergreen forest. Singh et al. (1984) got a value between 3 to 4 for Silent Valley. Magesh (2014) reported a value of 4.07 for evergreen forest in Parambikulam. Evergreen forest in Karian Shola has 4.001(Manoj,2019). 3.25 in Peppara (Varghese and Menon, 1998). Even though riparian area in the low elevation showed a moderate value ie.3.3, in the present study diversity index for degraded forest is comparatively less. Fast-growing pioneer species that speedily colonise disturbed regions, may predominate in degraded forests. While these species may contribute to the rapid advancement of successional stages, they may not necessarily contribute to high biodiversity as measured by the Shannon index. The following indices were reported for semi evergreen forests of Western Ghats *viz.* Idukki - 2.11 (Sankar and Sanal Kumar, 1997); Aralam - 2.71 [Menon, 1997]; Achankoil - 1.7-2.5 and Kasaragode; Parappa, 1.8-2.1 (Sankar and Sanal Kumar, 1997); Andaman Islands - 1.36 (Roy et al.1992 b); and that of Peppara 2.94 (Varghese, 1997). Due to variation in biogeography, habitat and disturbance, tree species diversity in tropical forests differs greatly from location to location (Neumann and Starlinger 2001).

According to similarity index, only 38% similarity is existing between medium elevation and low elevation forests. This indicates the species diversity of the study area.

6.9. Species dominance

Simpson's index of dominance of tree species in medium elevation dense evergreen forest is 0.05 and that of low elevation degraded forest is 0.06. It is very much comparable to the other values obtained for evergreen forests (Pascal and Pelissier, 1996). Manoj (2019) reported 0.03 for Karian Shola. The value reported for New Amarambalam by Sharma et al. (2002) is 0.06. Simpson's index of trees in the West coast evergreen forests in Goodrical is 0.02 (Abhilash, 2007). The lower value indicates that the dominance was shared among the total species (Varghese, 1997; Suraj, 1997; Menon, 1998; Jayakumar, 2003). Since the value is lower than 1, it is indicating that the study sites were not dominated by single species (Kumar, 2016). Simpson's index is inversely proportional to heterogeneity of species (Magurran, 1988). In the low elevation forest, it can be inferred that heterogeneity of species is lesser than medium elevation. When heterogeneity is high it means that Simpson's index will be less and Shannon's index will be high. In the present study, low value of Simpson's index for medium elevation evergreen forests (0.05) shows its higher heterogeneity of species.

6.10. Species evenness

In the current study for dense evergreen forest evenness index is 0.8 and for degraded forest the value is 0.9. Pielou's evenness index ranges from 0 to 1, with 1 indicating perfect evenness which means that all species have the same abundance and 0 indicating maximum unevenness which means one species dominates while others are rare or absent. Even though dense evergreen forest is more diverse, some species show slight dominance over other species in the present study. But in the degraded low elevation forest there is no such dominance. High Pielou's index value in the low elevation forest support this observation. Species evenness of the tree species in the West coast tropical evergreen forests in Goodrical was 0.81 (Abhilash, 2007), at Peppara it was 0.93 (Varghese, 1997); Nilambur (0.94) by Sankar and Sanalkumar (1997) and at New Amarambalam (0.67) by Sharma et al. (2002), the obtained index value is very much comparable with all the above values.

6.11. RET status and endemism

Among 156 tree species recorded, 3% of the species belongs to the rare category, 6% are endangered, 6% are vulnerable, 2% are critically endangered and 31% species belongs to the endemic category. Nayar (1997) recorded about 3800 species of flowering plants from Kerala and 1272 species show endemism to Southern Western Ghats. *Dysoxylum beddomei* is endemic to Southern Western Ghats of Kerala. The rare and threatened plants of Kerala is documented by Ahmedullah and Nayar, 1987; Nayar,1997; Nair and Sastry,1988; *Drypetes oblongifolia*, *Drypetes malabarica* and *Vateria indica* are critically endangered species and need special protection. And these forests portions have critical significance from a conservation perspective.

6.12. Vegetation Dynamics

Many tree species seem to have associations within their own habitats and individualistic dispersion patterns. Some species have uneven distribution; they are frequently represented in small numbers as rare species. The particular factors can be linked to this kind of dispersion. Thus, as noted above by Hubbel et al. (1983), the phenomenon of species associations can be linked to site-specific microclimatic variables. Different explanations exist for the observed differences in tree distribution. For species with essentially random distribution in the study sites, it makes sense to presume that every location is equally suitable for the successful establishment and growth of communities. Site quality, or microsite quality, can be partly responsible for the restricted distribution of species, which in turn leads to site-specific adaptations.

Summary and Conclusions

Chapter-7

SUMMARY AND CONCLUSIONS

Because of extensive past anthropogenic interventions for plantations, hydroelectric projects, selection felling and other purposes, the evergreen forests that were previously classified as West Coast Tropical evergreen forests (Champion and Seth, 1968) and the potential vegetation within each region based on the bioclimate are replaced with either sub types, based on edaphic, microclimatic features, or secondary forest types.

Sholayar range is situated in the Vazhachal forest division, which falls in Chalakkudy taluk of Thrissur district. A detailed understanding of forest composition reveals two different types of Tropical evergreen forests in the study area. i) the medium elevation tropical evergreen or the wet evergreen ii) the low elevation tropical evergreen and their degradation types. The medium elevation tropical evergreen or the wet evergreen or otherwise called the tropical rainforests account for a major portion and are more distributed in Sholayar range (Bachan, 2019). Sholayar comprises 31sq.km of medium elevation evergreen forest; 3.6 sq.km of medium elevation evergreen degraded forest, 25 sq.km of low elevation evergreen degraded forest, 6.2 sq. km of coffee and tea plantation, grass land and open rocky areas (Rajesh,2018)

A total of 280 sample plots of 0.1 ha. area was established in the study area. 28 study sites were selected, and 10 quadrats of 0.1ha was laid out in each study site. 10,946 trees belonging to 156 species out of 89 genera and 49 families were enumerated from the total sampling area. From the dense evergreen medium elevation forest 118 species of trees and from the low elevation degraded forest 94 species were recorded. Altitude and climatic variables have great role in the distribution and species richness pattern Kharkwal et al. (2005).

Among the families, Euphorbiaceae is the largest one with 20 species, followed by Lauraceae (11 species), Meliaceae (11 species), Moraceae (9 species), Fabaceae (6 species) and Ebenaceae (6 species).

Based on the Raunkiaer's frequency classes, among 28 study sites, 23 are heterogeneous and 5 are homogeneous.

Major associations derived, based on Importance Value Index are *Cullenia exarillata-Palaquium ellipticum-Agrostistachys borneensis*; *Palaquium ellipticum-Cullenia exarillata-Mesua ferrea*; *Vateria indica-Palaquium ellipticum-Cullenia exarillata*; *Vateria indica- Calophyllum polyanthum-Palaquium ellipticum*; *Vateria indica-Mesua ferrea-Palaquium ellipticum*; *Cullenia exarillata-Palaquium ellipticum-Drypetes venusta* and *Cullenia exarillata -Madhuca nerifolia-Elaeocarpus tuberculatus*.

Distribution of girth classes in the medium elevation forest gave a negative exponential inverse "J" curve, and of the low elevation disturbed forest was represented by a curve that nearly resembled an inverted "J" curve; rather than a precipitous decline, the curve's slightly bulging borders are caused by a progressive increase in the number of tree individuals in the 91–120 and 121–150 classes. A negative exponential "J" curve indicates a good regenerating vegetation dominated with young ones and also an indication of early stage of succession.

The overall maturity index value obtained was, lower for dense evergreen forest (41.7) and higher for degraded forest (42.88). Disturbances can lead to faster rates of succession, with species adapted to quick colonization and growth taking over gaps in the forest canopy. As a result, disturbed forests may go through succession stages more rapidly compared to the evergreen forests.

The species diversity value is 3.26 for dense evergreen forest and 2.98 for low elevation disturbed forest. In both zone riparian area shows comparatively high values. A higher Shannon index value indicates greater biodiversity within the community. According to similarity index only 38% similarity is existing between medium elevation and low elevation forests. This also indicates the species diversity of the study area.

Margalef richness index value for medium elevation dense evergreen forest is 14.15 and that of low elevation degraded evergreen forest is 10.98. The higher the Margalef index value, the higher the species richness in the sample.

Simpson's index of dominance of tree species in the medium elevation dense evergreen forest is 0.05 and that of the low elevation degraded forest is 0.06. It can be inferred that in the low elevation forest, heterogeneity of species is lesser than the medium elevation zone. Heterogeneity and Simpson's index value is inversely proportional to each other.

In the current study, the evenness index for the dense evergreen forest is 0.8 and for the degraded forest, the value is 0.9. This value indicates how evenly species are distributed. A higher evenness index value suggests a more even distribution of individuals among the species in the community, while a lower value indicates a more skewed distribution with one or a few dominant species. This supports the observation of some sort of associations and dominance of a few species in the study area of evergreen forest. Moreover, there are no specific associations and species dominance are observed in the low elevation forest.

Among 156 tree species recorded 3% of the species belongs to the rare category, 6% are endangered, 6% are vulnerable, 2% are critically endangered and 31% species belongs to the endemic category. A unique riparian vegetation is also observed in the study area. Riparian species such as *Madhuca nerifolia*, *Myristica beddomei*, *Elaeocarpus tuberculatus*, *Cinnamomum verum*, *Lophopetalum wightianum* etc. were recorded from the different study sites.

Very few investigations have been done in the Sholayar reserve forest. The area is hilly and covered mainly with dense evergreen forests. River Chalakkudy's numerous tributaries begin from Sholayar. Athirappally waterfall, is located in the river Chalakkudy and the Sholayar range is not far from the water fall. The location serves as both a recreational and ecotourism destination. The top of Malakappara hill is another tourist destination. The hydroelectric Sholayar dam is located in the Sholayar range.

Selective logging or felling of trees for timber extraction was a common practice in the Sholayar reserve forest (Menon and Balasubramanian, 2006). Even though selective logging, with good management, can be sustainable, it frequently results in habitat fragmentation, biodiversity loss, soil erosion, and disturbance of ecosystem processes. The composition and structure of forest communities can also

be changed by removing particular tree species, which increases their susceptibility to invading species and other disturbances.

The development of reservoirs and dams for the purpose of producing hydroelectric power may have a substantial effect on forest ecosystems. When vast tracts of land are flooded to build reservoirs, forests and other habitats may be submerged, which can cause habitat loss, fragmentation, and changes to the hydrological regimes. Water flow patterns can alter downstream ecosystems, such as riparian zones, which can impair ecosystem processes and habitat availability.

One of the main routes connecting Thrissur district with Tamil Nadu is the Chalakkudy–Pollachi road. This particular route goes through this forest that is set preserved. The majority of the travellers are tourists. This is the best example of forest fragmentation. The road contributes significantly to the destruction of the forests. The main cause of the threat to the several delicate ecosystems that are responsible for the Western Ghats's internationally renowned biodiversity is tourism. Even though ecotourism can boost the economy and aid in conservation efforts, improper management of the industry can have detrimental effects on forest ecosystems. Excessive tourist traffic can cause pollution, disruption of the ecosystem, and trampling of flora. Roads, paths, and accommodation facilities are examples of infrastructure developed for the tourism industry that can further fragment and damage forest habitats, increasing the risk of confrontations between humans and wildlife and upsetting sensitive species.

Some area in the forest reserve is utilized for tea and coffee plantations. This may lead to the direct loss of biodiversity and habitat for native flora and fauna. This can disrupt the ecological balance and threaten the survival of many species, including endangered ones.

Variations in temperature and precipitation patterns brought about by climate change have the potential to deteriorate the condition of forests by increasing the frequency and severity of extreme weather events like storms, floods, and droughts. These climate variations have the potential to stress forest ecosystems, resulting in altered species distributions.

The synergistic effects of these elements collectively may cause cumulative degradation and loss of ecosystem services in forest ecosystems. To meet these issues and ensure the long-term resilience and health of forest ecosystems, conservation efforts, climate change mitigation strategies, and sustainable forest management practices are necessary.

Recommendations

Chapter-8

RECOMMENDATIONS

- 1) Only ecotourism that doesn't harm the local flora and fauna should be permitted.
- 2) Using GIS and remote sensing methods, the region should be evaluated on a regular basis to track any changes in the vegetation.
- 3) Soil erosion and other risks from bordering forests sharing regions with habitations, agricultural fields, tea estates etc., should receive enough consideration.
- 4) There is forest fragmentation in the vegetation that surrounds built-up areas, plantations, agriculture, and other communities. Policies must evolve in order to repair fragmentations.
- 5) It is best to prohibit building permanent structures or built-up areas inside reserve forests. Alternately, environmentally acceptable temporary build-ups that don't disrupt the vegetation cover could be used.
- 6) Sholayar Reserve Forest is inhabiting to a number of endangered, endemic, and rare species of plants. To identify whether their regeneration is progressive or retrogressive in relation to global climate change, periodic systematic assessments of regeneration should be carried out. For the diminishing rare, endemic, and vulnerable plant species, assisted natural regeneration is the best course of action.
- 7) Conservation of biodiversity can only take place when human dependence on natural resources is reduced. Government financial aid should be provided to adjacent communities that directly depend on forests for their livelihood in order to provide them with other economic possibilities.
- 8) As the Western Ghats are considered as a key component in preserving the state's climate balance, substantial conservation measures are needed for the current situation. Therefore, this is the time to start implementing suitable conservation plans with an integrated strategy and public involvement for the Western Ghats's natural hotspots.

References

- Abhilash, E. S., (2007). Ecosystem analysis and vegetation mapping of Goodrical range (kerala) using remote sensing techniques. PhD thesis, Forest Research Institute, Dehradun, Uttaranchal, 163p.
- Abhilash, E. S., Menon, A.R.R., and Balasubramanyan, K. (2005). Regeneration status in natural habitats of *Nageia wallichiana* (Presl.) O. Ktz., Goodrical Reserved Forests of Western Ghats of India. *Indian Forester*, 131(2), 183-200.
- Agni, T., Pandit, A., Pant, K., & Tewari, A. (2000). Analysis of tree vegetation in the Tarai-Bhabhar tract of Kumaun Central Himalaya. *Indian Journal of Forestry*, 23, 252-261.
- Ahmedullah, M., and Nayar, M.P. (1987). Endemic Plants of the Indian Region. Botanical III. Botanical Survey of India, Calcutta.
- Akinyemi, O. D., Oyelowo, O. J., Oloketuyi, A. J. (2019). Population, diversity, and structure of trees in Omo Biosphere Reserve, Ogun state, Southwestern Nigeria. *Australian Journal of Science and Technology*, 3(4), 154-160.
- Anbarashan, M., and Parthasarathy, N. (2013). Tree diversity of tropical dry evergreen forests dominated by single or mixed species on the Coromandel coast of India. *Tropical Ecology*, 54(2), 179-190
- Anbarasu, C., and Balasubramanian, P. (2015). Tree Diversity of the Tropical Montane Evergreen forests (Shola) in the Nilgiri Mountains, Western Ghats, India. *Indian Forester*, 141 (5), 490-495.
- Anilkumar, K.A., (2015). Phytosociological and Plant Diversity of the Attappady Hills, Western Ghats, India, PhD Thesis, University of Kannur.
- Anita Kumari, (2005). Effect of *Lantana Camara* L. On Floristic Diversity in Chirpine Forests of Himachal Pradesh. PhD Thesis, Dr Y.S. Parmar University of horticulture and forestry, Solan.
- Anitha, K., Joseph, S., Chandran, R.J., Ramasamy, E.V. and Narendra Prasad, S. (2010). Tree Species Diversity and Community Composition in a Human Dominated Tropical Forest of Western Ghats Biodiversity Hotspot, India. *Ecological Complexity*, 7, 217-227.
- Arora, R. K., & Nayar, E.R. (1984). Wild relatives of crop plants in India. ICAR-National Bureau of Plant Genetic Resources, New Delhi, India, 90p.
- Ashby, R.M. (1961). Introduction to Plant Ecology. Mac Millan & Co Ltd, London. 456p.
- Bachan, A.K.H. (2005). Riparian vegetation along the middle and lower zones of the Chalakkudy River, Kerala, India. Project 26/2000. Sponsored by Kerala Research Programme on Local Level Development, CDS, Thiruvananthapuram.
- Bachan, A.K.H., and Pooja, S. (2017). Riparian Forest Vegetation - a Highly Endangered Wetland Plant Community: A Case study from Vazhachal, Chalakkudy River, Western Ghats. *Meridian*, 6(2), 30-40.
- Bachan, A.K.H. (2019). Assessment of impact of flood/landslide on biodiversity and developing methodology for long term monitoring and evaluation of changes in the ecosystem and biodiversity. Project report, Kerala state biodiversity board.
- Bajpai, O., Kumar, A., Ashish, K., Mishra, P. R Nayan Sahu, Pandey, J., Soumit, K. Behera, Lal Babu Chaudhary. (2012). Re congregation of tree species of katarniaghat Wildlife Sanctuary, Uttar Pradesh, India. *Journal of Biodiversity and Environmental Sciences*, 2(12), 24-40.

- Basha, S.C. (1987). Studies on the ecology of evergreen forests of Kerala with special reference to Silent valley and Attapady. Ph.D Thesis, University of Kerala, Trivandrum. 232 p.
- Battles, J.J., Shlisky, A., Barrett, R.H., Heald, R.C. (2001). *Forest Ecology and Management*. 146(1):211-222.
- Bawa, G. S., Damisa, M. A. (2007). The response of weaner pigs to the replacement value of cassava peel meal for maize. *Asian Journal of Animal and Veterinary Advances*, 2 (3), 162-165.
- Bohara, R., Chand, H.B., and Tewari, A. (2018). Biomass and Carbon Stock in Kharsu Oak (*Quercus semecarpifolia*) Dominated Forest in Nainital District of Kumaun, Himalaya. *Journal of Energy Research and Environmental Technology*, 5(2), 45-50.
- Bonan, G.B. (2008). Forests and Climate Change: Forcings, Feedbacks, and the Climate Benefits of Forests. *Science*, 320 (5882), 1444 - 449.
- Broun-Blanquet, J. (1932). *Plant Ecology*. Mc-Graw Hill Book Co. New York. 312 p.
- Cain, S.A. (1938). The species area-curve. *American Midland Naturalist*, 19, 578-581.
- Champion, H.G. & Seth, S.K. (1968). The forest types of India-A revised survey. Manager of Publication, Delhi. 185 p.
- Champion, H.G. (1936). A preliminary survey of the forest types of India and Burma. *Indian Forest Record*, 1, 1-286.
- Chandran, V., Gopakumar, M.S., and Mathews, A. (2020). Comparative phytosociological assessment of three terrestrial ecosystems of Wayanad Wildlife Sanctuary, Kerala, India. *Journal of Threatened Taxa*, 12(5), 15631-15645.
- Chandrasekaran, C. (1962 a). Ecological study of the forests of Kerala State. *Indian Forester*, 88 (7), 473-480.
- Chandrasekaran, C. (1962 b). Forest types of Kerala State, India Part I. *Indian Forester*, 88 (9), 660-674.
- Chandrasekaran, C. (1962 c). Forest types of Kerala State, India Part II. *Indian Forester*, 88 (10), 731-747.
- Chandrasekaran, C. (1962 d). Forest types of Kerala State, India Part III. *Indian Forester*, 88 (11), 837-847.
- Chandrasekhara, U.M., Menon, A.R.R., Nair, K.K.N., Sasidharan, N., and Swarupnandan, K. (1998). Evaluating plant diversity in different forest types of Kerala by laying out permanent sample plots. KFRI Research Report No. 156. Kerala Forest Research Institute, Peechi, Thrissur. 86 p.
- Clements, F.E. (1916). *Plant succession*. Carnegie Institute. Washington, 242, 1-512.
- Cole La, M.C. (1949). The measurement of interspecific association. *Ecology*, 30, 411-424.
- Condit, R.N., Pitman, E.G., Leigh, Jr., Chave, J., Terborgh, J., Foster, R.B., Nunez, P., Aguilar, S., Valencia, R., Villa, G., Muller-Landau, H.C., Losos, E., and Hubbel, S.P. (2002). Beta Diversity in Tropical Forest Trees. *Science*, 295(5555), 666-669.
- Curtis, J. T. (1959). *The Vegetation of Wisconsin. An Ordination of Plant Communities*. University of Wisconsin Press, Madison. 633p.
- Curtis, J. T. and Cottom. (1956). *Plant ecology workbook. Laboratory field reference manual*. Burgess Publication Co., Minnesota, 193 p.

- Curtis, J. T., and Mc-Intosh, R. (1951). An upland forest community in the prairie forest border region of Wisconsin. *Zoology*, 32, 476-496.
- Das, M., & Das, A. (2020). Assessing the impact of master plan on the dynamicity and resilience of forest cover change: a study on Adina Deer Park (Forest), West Bengal, India, <https://doi.org/10.1007/s10708-020-10213-4>
- Davidar, P., Puyravaud, J.P., and Leigh, E.G. (2005). Changes in rain forest tree diversity, dominance and rarity across a seasonality gradient in the Western Ghats, India. *Journal of Biogeography*, 32(3), 493-501.
- Devlal ,R., and Sharma, N.(2011).Quantitative analysis of the woody vegetation of some village forest of Mandakini catchment. *Indian Journal of Forestry*, 34(1),99-102.
- Devlin, L., and Maibam R. S. (2018). Tree Diversity, Distribution and Population Structure of a Riparian Forest from Certain Zones along the Dikhu River in Nagaland, India. *Journal of Forest and Environmental Science*,34(1),31-45.
- Dudipala, R., Kolagani, C., SreeLakshmi A., Shukla, P., Sahith Chepyala, Podishetti, V., Swamynath Shakati, Basai, N., and Bhargavi, C.H. (2023). Species Diversity, Phytosociological Attributes and Regeneration Status of Pench Tiger Reserve, Maharashtra, India. *International Journal of Environment and Climate Change*,13(10),1743-1757.
- Ellenberg, H. (1956). Aufgaben and Methoden der vegetation's Kunde. Eugen Ulmer, Stuttgart, 136 p.
- Farooquee, N.A., Saxena, K.G., (1996). Conservation and utilization of medicinal plants in high hills of the central Himalayas. *Environmental Conservation*,23,75-80.
- Forest, F., Grenyer, R., Rouget, M., Davies, T.J., Cowling, R.M., Faith,D.P., Balmford, A.,Manning,J.C., S. Proches, Van der Bank, M., Reeves, G., Hedderson, T.A.J., and Savolainen, V. (2007). Preserving the evolutionary potential of floras in biodiversity hotspots. *Nature*, 445(7129), 757-760.
- FSI (2021). State Forest Report. Forest Survey of India, Ministry of Environment.
- FSI (2011). State Forest Report. Forest Survey of India, Ministry of Environment.
- Galav, P. K., Katewa, S. S., Chaudhary, B. L., Jain, A. (2005). Phytosociological studies on the grassland community of southern Aravalli hill of Rajasthan. *Indian Forester Journal*, 137, 943 -952.
- Gallery, R.E. (2014). Ecology of Tropical Rain Forests and Ecology and the Environment. *The Plant Sciences*, 8,247–272.
- Gamble, J. S., and Fischer, C.E.C. (1936). The flora of the Presidency of Madras. Adlard and Son Ltd., London. 2017 p.
- Ganesh, T. R., Ganesan, Devi, M. S., Davidar, P., and Bawa, K. S. (1996). Assessment of plant biodiversity at a mid-elevation evergreen forest of Kalakad-Mundanthurai Tiger Reserve, Western Ghats, India. *Current Science*,71,379-392.
- Gaston, K, J., Jonathan, B., Thomas W, D., Hopkins. (2013). The ecological impacts of night time light pollution: a mechanistic appraisal. *Biological reviews*, 88(4),912-927.
- Ghate, U., Joshi, N.V., and Gadgil, M. (1998). On the patterns of tree diversity in the Western Ghats of India. *Current Science*, 75, 594-603.

- Ghosh, S.B. (2012). Biodiversity and Wild Fodder of Gorumara National Park in West Bengal, India Fodder Plants and Habitat of Gorumara National Park. *Journal of Environment & Ecology*,3(1),18-35.
- Giriraj, A., Murthy M.S.R., and Ramesh, B.R. (2008). Vegetation Composition, Structure and Diversity Pattern: A case study from Tropical Wet Evergreen Forests of Western Ghats, India. *Edinburgh Journal of Botany*, 65 (3), 447-468.
- Gleason, H.A. (1920). Some application of the Quadrat methods. *Bulletin Torrey Botanical Club*, 53, 1-30.
- Guptha, S.R., & Kumar, R. (2014). Biodiversity Conservation and Ecosystem Services of Forests in Siwaliks of Northern India. *International Journal of Ecology and Environmental Sciences*, 40 (1), 15-28.
- He,F., and Legendre, P.(2002). Species Diversity Patterns Derived from Species-Area Models. *Ecology*,83(5),1185-1198.
- Hubbel, S.P., and Foster, R.B. (1983). Diversity of canopy trees in a neotropical forest and implications for conservation, In *Tropical Rain Forest: Ecology and Management*, 25-42: Sutton, S.J., Whitmore, T.C. and Chadwick, A.C. (eds.) *Tropical Rain Forest: Ecology and Management*. Blackwell Scientific Publication,Oxford, U.K
- Hubbel, S.P. (1979). Tree dispersion, abundance and diversity in a tropical dry forest. *Science*,213,1299-1305.
- Hubbel, S.P., Foster,R.B., O'Brien,S.T., Harms,K.E., Condit,R., Wechsler,B., Wrightand,S.J.,de Lao,S.L. (1999). Light Gap disturbances, recruitment limitation and tree diversity in a Neotropical Forest. *Science*,283(5401), 554-557
- Iqbal, K., Bhat, J.A., Pala, N.A., & Negi, A.K. (2012). Structure and composition estimation of plant around Khok river of Garhwal Himalaya. *Indian Journal of biodiversity and Environmental sciences*, 2(9), 1-11.
- Jaccard, P. (1912). The distribution of the flora of Alpine zone. *New phytol*, 11, 37-50.
- Jayakumar, R. (2003). Studies on the Angiosperm flora and its diversity in New Amarambalam Reserve Forest of the Nilgiri bioreserve, Western Ghats of India. Ph.D thesis, FRI Deemed University, Dehra Dun. 596 p.
- Jayakumar, S., Arokiasamy, D.I., and John Britto, S. (2002). Vegetation Type Mapping and Vegetation Analysis in Part of Kolli Hills, Eastern Ghats of Tamil Nadu. *Tropical Ecology*, 43 (3),345-349.
- Joshi, N.K., and Tiwari S.C. (1990). Phytosociological analysis of woody vegetation along an altitudinal gradation in Garhwal Himalaya. *Indian Journal of Forestry*,13 (4),322-328.
- Kadavul, K., and Parthasarathy, N. (1999). Structure and composition of woody species in tropical semi evergreen forest of Kalrayan Hills, Eastern Ghats, India. *Tropical Ecology*, 40,247-260.
- Khadanga, S.S., Dar, A.A., Jaiswal, N., Dash, P.K., Jayakumar,S.(2023). Elevation patterns of tree diversity, composition and stand structure in Mahendragiri Hill Forest, Eastern Ghats of Odisha, India. *Journal of Asia-Pacific Biodiversity*,1-15. (in press)
- Khare. P. K, &Thakur, A.S. (2010). Vegetation changes during fifty years in the forest-complex of Patharia hills, Sagar, India. *Tropical Ecology* ,51(2), 161-171.
- Kharkwal, G., Mehrotra, P., Rawat, Y.S., Pangtey, Y.P.S. (2005). Phytodiversity and growth form in relation to altitudinal gradient in the Central Himalayan (Kumaun) region of India. *Current Science*,89(5), 873-878.

- Khatri, P.K. (2000). Study on biodiversity in tropical forest ecosystem of Satpura National Park, Madhya Pradesh. Ph.D. Thesis. Forest Research Institute, Dehra Dun.
- Khurana and Kalpana, P. (2008). Phytodiversity in natural forest of Hastinapur. *The Indian Forester*, 134 (4) ,554-562.
- Kidwai, Z. (2013). Vegetation structure and composition in core area of Sariska National Park, Rajasthan. *Indian Forester* ,139(7),636-644.
- Kimmins, J. P. (2004). Forest Ecology: a foundation for sustainable forest management and environmental ethics in forestry, 3rd Edit. Prentice Hall, 611p.
- Kishore kumar, K. (2004). Taxonomic and Ecological studies on the Shola Forests of Kerala. Ph.D Thesis, University of Calicut.
- Kraft, N.J.B., Valencia, R., and Ackerly,D. (2008).Functional Traits and Niche-Based Tree Community Assembly in an Amazonian Forest. *Science*,322 (5901), 580 – 582.
- Kumar, A., Marcot, B., Saxena, A. (2006). Tree species diversity and distribution patterns in tropical forests of Garo Hills. *Current Science*,91(10),1370-1381.
- Kumar, M., Bhatt, V. P., Rajwar, G. S. (2006). Plant and soil diversities in a sub-tropical forest of the Garhwal Himalaya. *Ghana Journal of Forestry*, 19 (20),1-19.
- Kumar, S., and Sharma,S. (2014). Diversity, Disturbance and Regeneration Status of forests along an Altitudinal Gradient in Paddar Valley, Northwest Himalayas. *Indian Forester*. 140(4),348-353.
- Kumar,S.A.(2016). Ecological Studies of Tree Vegetation of Ramshai Forest Range, Gorumara National Park, India. *International Research Journal of Biological Sciences*,5(7),53-59.
- Kumari, A., and Tripathy, K, P. (2007). Phytosociological studies of the pteridophytes in Tarai forest of North India. *Indian Journal of Forestry*, 30(4), 445-450.
- Kushwaha, S.P.S. (1990). Forest-type mapping and change detection from satellite imagery. ISPRS J. Photogramm. *Remote Sensing*, 45, 175-181.
- Lakshmi, G. (1995). Ecological studies on the vegetation of Kolli hills, Salem District, Tamil Nadu. Ph.D thesis. Bharatiyar University, Coimbatore. 150p
- Magesh, G. (2014). Ecological studies of the Parambikulam tiger reserve in the Western Ghats of India, using remote sensing and GIS. Ph. D thesis, Cochin University of Science and Techonology, Kerala.
- Magesh, G. and Menon, A.R.R. (2011). Vegetation Status, Species Diversity and Endemism of Sulimudi Forests in Southern Western Ghats of Kerala, India. *Indian Forester*, 137(3), 304- 311.
- Magurran, A.E. (1988). Ecological diversity and its measurement. Croom Helm Limited, London.179 p.
- Mani, S. and Parthasarathy,N. (2005). Biodiversity assessment of trees in five inland tropical dry evergreen forests of peninsular India. *Systematics-and-Biodiversity*,3(1), 1-12.
- Manoj, K. (2019). Ecological studies to evaluate the post climax status of Karian Shola in Parambikulam Wild life Sanctuary Palakkad dist. Kerala, PhD Thesis submitted to Mahathma Gandhi University.
- Margalef, D.R. (1958). Information theory in ecology. *General Systems*, 3,36-71.

- Mathews, E. (1983). Global vegetation and land use: new high – resolution data bases for climate studies. *Journal of Climatology and Applied Meteorology*, 22, 474-487.
- McNeely, J. A., Miller, K. R., Reid, W. V., Mittermeier, R. A., and Werner, T. B. (1990). Conserving the world Biological Diversity. IUCN, Gland, Switzerland. 215-218 p.
- Meher- Homji, V. M. (1984). A New classification of the phytogeographic zones of India, *Indian Journal of Botany*, 7, 224-233.
- Menon, A. R. R. (1981). Phytosociology of Saurashtra: Polygraphic representation of species characters. *Acta Ecology*, 3, 1-8.
- Menon, A. R. R. (1982). Impact of forest on environment. *Acta Ecology*, 4 (1), 23-29.
- Menon, A. R. R. (1999). Vegetation analysis and mapping of Aralam wildlife Sanctuary. KFRI Research Report No. 128. Kerala Forest Research Institute, Peechi, Thrissur. 29p.
- Menon, A. R. R. and Sasidharan, N. (2005). Biodiversity characterization at landscape level using remote sensing and GIS in Kerala. KFRI Research Report No. 274, Kerala Forest Research Institute, Peechi, Thrissur. 217 p.
- Menon, A. R. R., and Abhilash, E. S. (2014). Impact of selection felling on Ecosystem health of Kottiyoor Reserved Forest, Western Ghats of India. *Asia Pacific Journal of Environment Ecology and Sustainable Development*, 1(1), 29–31.
- Menon, A. R. R. and Balasubramanian, K. (1985). Species relation studies in Moist Deciduous Forests of Trichur Forest Division (Kerala). Research Report No. 32. Kerala Forest Research Institute, Peechi, Thrissur. 194p.
- Menon, A. R. R. and Balasubramanian, K. (2006). Evaluation of plant diversity in unlogged and logged stands of varying intensities. KFRI Research Report No. 281, Kerala Forest Research Institute, Peechi, Thrissur. 126p.
- Menon, A. R. R. (2006). Biodiversity characterization at landscape level using satellite remote sensing Phase II study. Project funded by DBT-DOS. KFRI Research Report No. 284.
- Menon, S. and Bava, K. S. (1997). Applications of geographic information systems, remote sensing, and landscape ecology approach to biodiversity conservation in the Western Ghats. *Current Science*, 73 (2), 134-144.
- Menon, A. R. R. (2001). Vegetation Mapping Analysis of Neyyar Wild Life Sanctuary Using Remote Sensing Techniques, KFRI Research Report No. 208, Thrissur.
- Menon, A. R. R., and Balasubramanian, K. (1985). Species Relation studies in Moist Deciduous Forests of Thrissur Forest Division (Kerala), KFRI Research Report 32, Thrissur.
- Mishra, D., Mishra, T. K., Banerje, S. K. (1997). Comparative phytosociological and soil physico-chemical aspects between managed and unmanaged lateritic land. *Annals of Forestry*, 5, 16-25.
- Misra, R. and Puri, G. S. (1954). *Indian manual of plant ecology*. English Book Depot; Dehradun, 360p.
- Misra, R. (1968). Ecology Work Book. New Delhi, India: Oxford and IBH. 31p.
- Misra, R. (2013). Ecology workbook. Scientific Publishers, Jodhpur, 244p.
- Mohandas, Alice, D., Hughes, C., Mackay, B., Davidar, P., and Chabra, T. (2016). Floristic species composition and structure of a mid-elevation tropical montane evergreen forests (sholas) of the Western Ghats, Southern India. *Tropical Ecology*, 57(3), 533-543.

- Muller-Dombois, D., and Ellenberg, H. (1974). Aims and Methods of vegetation Ecology. Wiley international edition, New York. 547 p.
- Murphy, P. G. and Lugo, A.E. (1986). Ecology of tropical dry forests. *Annual Review of Ecology and Systematics*, 17, 67-88.
- Myers, N., Mittermeier, R.A., Mittermeier, C.G., G. A. B. da Fonseca, and Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403, 853–858.
- Naidu, M. T., Rao, J.P., Rao, D.S., Murty, P.P., and Venkaiah, M. (2012). Plant wealth of Kambalakonda wildlife sanctuary, Visakhapatnam, Andhra Pradesh. *Indian forester*, 138(7), 593-699.
- Nair, N.C. and Daniel, P. (1986). The floristic diversity of the Western Ghats and its conservation: a review. *Proc. Indian Acad Sci. (Animal Sci./Plant Sci.) Suppl*, 127-163.
- Nair, R. (1991). *Podocarpus wallichiana* (Presl). *Proc. of the Rare, Endangered and Endemic plants of the Western Ghats* (ed. Karunakaran), Kerala Forest Department, Trivandrum. 70-71.
- Nair, K.K.N., and Jayakumar, R. (2008). Phytosociology, Endemism and Affinities of the Flora of New Amarambalam Reserve Forests in the Western Ghats of India. *Indian Journal of Forestry*, 31 (1), 85-94.
- Nath, T. K., Hussain, M.K., and Alam, M.K. (2000). Assessment of tree species diversity of the Sitaphar forest reserve, Chittagong hill tracts (South) Forest Division, Bangladesh. *Indian Forester*, 126(1), 16-21.
- Nayar, M. P. (1996). Hot Spots of Endemic Plants of India, Nepal and Bhutan. Tropical Botanical Garden and Research Institute, Trivandrum, 252p.
- Nayar, M.P., and Sastry, A.R.K. (1987, 1988, 1990). Red Data Book on Indian Plants, I140 III. Botanical Survey of India, Calcutta
- Nayar, M.P. (1997). Biodiversity challenges in Kerala and Science of Conservation biology, In *Biodiversity of Tropical Forests: the Kerala Scenario*, Puspangadan, P. and K.S.S.Nair (eds) STEC, Trivandrum, Kerala. 7-80.
- Nayar, M.P., and Sastry, A.R.K. (1987, 1988, 1990). Red Data Book on Indian Plants, vols. I140
- Negi, H.S. (2002). Studies on woody species diversity of Sangla valley (HP). Msc. Thesis. Dr Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, 29-30p.
- Neumann, M., Starlinger, F. (2001). The significance of different indices for stand structure and diversity in forests. *Forest Ecology and Management*, 145(1-2), 91-106.
- Nirmalkumar, J.I., Rita N. K., Rohit, K. B., & Sajish, P. R. (2010). Tree species diversity and soil nutrient status in three sites of tropical dry deciduous forest of western India. *Tropical Ecology*, 51(2), 273-279.
- Noss, R.F. (1990). Indicators for monitoring Biodiversity – A hierarchical approach. *Conservation biology*, 4, 355-364.
- Odum, E.P. (1971). *Fundamentals of Ecology*. W.B. Saunders. Co., Philadelphia, 574 p.
- Oosting, H.J. (1956). *The study of plant communities*. Freeman and Co, 2nd edition. San Francisco. 250p.

- Pandey, J., and Lodhiyal, L.S. (2015). Vegetation structure and regeneration of Van panchayat forests in Kumaun Himalaya, Uttarakhand. *International Journal of Environment*, 4(3),69-80.
- Pandey, P.K., Sharma, S.C., Banerjee, S.K. (2002). Biodiversity studies in a moist temperate Western Himalayan forest. *Indian Journal of Tropical Biodiversity*, 10(1/4),19-27.
- Pandey, S. K., and Shukla, R. P., (2005). Plant community and diversity patterns within the forested landscape of North-Eastern Uttar Pradesh. *The Indian Forester*, 131 (9). 1217-1226.
- Pant,S., and Samant, S.S.(2012). Diversity and regeneration status of tree species in Khokhan Wildlife Sanctuary, north-western Himalaya. *Tropical Ecology* ,53(3), 317-331.
- Parthasarathy,N. (1988).A phytogeographic analysis of the flora of Kalakad Reserve forest Western Ghats, south India. *Journal of Indian Botanical Society*,67,342-346.
- Parthasarathy, N. (1999). Tree Diversity and Distribution in Undisturbed and Human-Impacted Sites of Tropical Wet Evergreen Forest in Southern Western Ghats, India. *Biodiversity and Conservation*, 8, 1365-1381.
- Parthasarathy, N., and Karthikeyan, R. (1997). Biodiversity and population density of woody species in a tropical evergreen forest in Courtallum reserve forest, Western Ghats India. *Tropical ecology*, 38, 297-306.
- Parthasarathy, N. (2001). Changes in forest composition and structure in three sites of tropical evergreen forest around Sengaltheri, Western Ghats. *Current science*,80,389-393.
- Pascal, J. P., and Pelissier. (1996). Structure and floristic composition of a tropical evergreen forest in southwest India. *Journal of Tropical Ecology*, 12,191- 214.
- Pascal, J.P. (1988). Wet Evergreen Forests of the Western Ghats of India: ecology, structure, floristic composition and succession. French Institute of Pondicherry, Pondicherry. 345 p.
- Phillips, E. A. (1959). *Methods of Vegetation Study*. 1st Edn., Henri Holt Co., Inc., NewYork, USA. 107p.
- Phillips, J. (1935). Succession, development, the climax and the complex organism: an analysis of concept, Part III. The complex organism: conclusions. *Journal of Ecology*, 23, 488 – 508.
- Pichi-Sermolli, R. (1948). An index for establishing the degree of maturity in plant communities. *Journal of Ecology*,36, 85-90.
- Pileou, E. C. (1975). *Ecological Diversity*. Wiley International, Newyork.165p.
- Pimm, S.L., Gareth, J., Russell, John, L., Gittleman, and Brooks, T.M. (1995). The Future of Biodiversity. *Science*, 269(5222),347-350.
- Pooja, S., Sidhardh, A.S.K., and Bachan, A. K.H. (2020). Biodiversity Significance of Low-Elevation Riparian Forests in Vazhachal: Conservation and Restoration Implications. *Journal of Aquatic Biology & Fisheries*, 8, 77-82.
- Pound, R., and Clements, F.E. (1898). A method of determining the abundance of secondary species. *Minnesota Botanical Studies*, 2,19-24.
- Prasad, P.R.C., and Kumari, J, A. (2019). Structure, composition and diversity of trees within the dry evergreen reserve forest of Kondapalli (Eastern Ghats, southern India). *Biodiv. Res. Conserv*, 54,23-36.

- Prasad, S.N., Vijayan, L., Balachandran, S., Ramachandran, V.S., and Verghese, C.P.A. (1998). Conservation planning for the Western Ghats of Kerala: I. A GIS approach for location of biodiversity hotspots. *Current Science*, 75, 211-219.
- Raghubanshi, A. S., & Tripathi, A. (2009). Effect of disturbance, habitat fragmentation and a line invasive plant on floral diversity in dry tropical forest of Vindhyan highlands; A review. *Tropical Ecology*, 50, 57-69.
- Rajasekaran, A. (2000). Ecology and utilization of medicinal plants with special reference to select tribal groups in the Nilgiri Biosphere Reserve. Ph.D. Thesis, Bharathiar University, Coimbatore. <http://hdl.handle.net/10603/101239>
- Rajendraprasad, M. (1995). The Floristic, Structural and Functional analysis of Sacred Groves of Kerala. Ph.D. Thesis, University of Kerala, Thiruvananthapuram.
- Rajesh, N. (2018). Second working plan of Vazhachal forest division, Govt. of Kerala, 758p.
- Rakesh, R.R., Mathew, J., Roby, C.J, Soman, C.K. (2018), Ecology and Conservation of an Endangered tree species *Aporosa bourdillonii* Stapf. from Kerala. *Indian Forester*, 144(8), 716-722.
- Ramya, E.K., Sharmila, S., and Monika, S. (2020). Phytosociological Assessment of Tree Vegetation in Tropical Moist Deciduous Forest of Veerakkal area, Nilgiris, Western Ghats, India. *Indian Journal of Ecology*, 47(2), 480-484.
- Rao, D., Pragada, Prayaga, Kumar, O. (2015). Plant biodiversity and phytosociological studies on tree species diversity of Khammam district, Telangana state, India. *Journal of Pharmaceutical Sciences and Research*, 7(8), 518-522.
- Rao, D., S., Murthy, P.P., and Venkaiah, M. (2013). Phytosociological Observations on the Tree Species Diversity of Tropical Forests of Srikakulam District, Andhra Pradesh, India. *Indian Journal of Plant Science*, 2(4), 89-108.
- Raunkiaer, C. (1934). The life forms of plants and Statistical plant geography. Clarendon press. Oxford, 682p.
- Rawat, G. S., and Bhainsora, N.S. (1999). Woody vegetation of Shivaliks and outer Himalaya in north western India. *Tropical ecology*, 40(1), 119-128.
- Rawat, V.S., and Chandra, J. (2012). Tree layer Vegetational analysis in temperate forest of Uttarakhand. *Natural Science*, 10(10), 167-171.
- Rawat, V.R.S., and Kumar, P. (1989). Ecological studies of some *Cedrus deodara* forests in Western Himalayan, India. *Indian Journal of Forestry*, 12, 145-150
- Reddy, C. S., Ugle, P., & Sudhakar, S. (2008). Structure and composition of Tropical forest of Eastern Ghats: A case study in R.V. Nagar Range, Visakhapatnam district, Andhra Pradesh, India. https://www.researchgate.net/publication/259075597_
- Richards, P.W. (1996). The Tropical Rain Forest: An ecological study. Second edition. Cambridge University Press, Cambridge. 575 p.
- Rodgers, W. A., Panwar, H. S., and Mathur, V. B. (2000). Wildlife Protected Area Network in India: A review. Wildlife Institute of India, Dehradun.
- Roy, P. N. (1993). A study of the optimum size of sample plot for forest inventory. *Indian Forester*, 119(1), 1-10.
- Roy, P. S., Moharana, S.C., Prasad, S.N., and Singh, I.J. (1992 b). Vegetation analysis and study of its dynamics in Chandaka Wildlife Sanctuary (Orissa) using Aerospace Remote sensing. *Photonirvachak*, 20 (4), 223-235.

- Roy, P. S., Sarnam, S., and Porwal, M.C. (1993). Characteristic ecological parameters in tropical forest community- A remote sensing approach. *Photonirvachak*, 21 (3), 127-149.
- Sabine, C.L., Heimann, M., Artaxo, P., Bakker, D.C.E., Chen, C.T. A., Field, C.B., Gruber, N., C. Le Quere, R.G. Prinn, Richey, J.D., Lankao, P.R., Sathaye, J.A., Valentini, R. (2004). Current status and past trends of the global carbon cycle. In: *The Global Carbon Cycle: Integrating Humans, Climate, and the Natural World* (eds Field CB, Raupach MR), Island Press, Washington, 17-44.
- Sahu, S.C., Dhal, N.K., Reddy, C.S. (2007). Phytosociological study of Tropical Dry Deciduous Forest of Boudh District, Orissa, India. *Research Journal of Forestry*, 1 (2), 66-72.
- Sahu, S. C., Dhal. N. K., Lal, B., and Mohanty, R. (2012). Differences in tree species diversity and soil nutrient status in a tropical sacred forest ecosystem on Niyamgiri hill range, Eastern Ghats, India. *Journal of Mountain Science*, 9(4), 492-500.
- Sahu, S.C, Pani, A.K., Mohanta, M.R. (2019). Tree species diversity, distribution and soil nutrient status along altitudinal gradients in Saptasajya hill range, Eastern Ghats, India. *Taiwania*, 64 (1), 28p
- Sahu, P.K., Sagar, R., Singh, J.S. (2008). Tropical forest structure and diversity in relation to altitude and disturbance in a Biosphere Reserve in central India. *Applied Vegetation Science*, 11 (4), 461-470.
- Sanalkumar, M.G. (1997). Problems and Prospects of Biodiversity Conservation and Management in Some Forest areas of Kerala, Western Ghats. Ph.D. Thesis, Cochin University of Science and Technology, Cochin, Kerala.
- Sanalkumar, M.G., Jayalekshmy, V., and Balamurali, R.S. (2012). Vegetation study based on the soil properties of Konni Reserve forest of Western Ghats. *International Journal of Scientific and Research Publications*, 2(2), 1-5.
- Sankar, S., and Sanalkumar, M.G. (1997). Ecological and Environmental assessment of Forest Cover of Kerala with special reference to soil, vegetation and wildlife. KFRI Extension Report No.17. Kerala Forest Research Institute, Peechi, Thrissur. 84 p.
- Sarkar, A. (2015). Phytosociological studies of tree vegetation of Moraghat forest range, India. *Asian Journal of Biological and Life Sciences*, 4(3), 217-220.
- Sasidharan, N. (2004). Biodiversity Documentation for Kerala, Part 6: Flowering Plants. KFRI Handbook No. 17. Kerala Forest Research Institute, Peechi. 702 p.
- Schaefer, T, S. (1990). The Critical Success Index as an Indicator of Warning Skill. *Weather and Forecasting*, 5 (4), 570-575.
- Shahid, M., and Joshi, S.P. (2015). Biomass and Carbon Stock Assessment in Moist Deciduous Forests of Doon Valley, Western Himalaya, India. *Taiwania*, 60(2), 71-76.
- Shannon, C. E., and Weiner., W. (1949). The mathematical theory of communications. Urbana University Illinois press. 117 p.
- Sharma, C.M., Baduni, N.P., Gairola, S., Ghildiyal, S.K., and Suyal, S. (2010). Tree diversity and carbon stocks of some major forest types of Garhwal Himalaya, India. *Forest Ecology and Management*, 260, 2170-2179.
- Sharma, J. k., Nair, K.K.N., Mathew, J., Ramachandran, K.K. (2002). Studies on the Biodiversity of New Amarambalam Reserved Forest of Nilgiri Biosphere Reserve,

Report number: KFRI Res. Rep No 247, Affiliation: Kerala Forest Research Institute, Peechi, Kerala, India.

- Sharma, S.B., Pandey, S., Upadhyaya, S.D., Agarwal, R. (2006). Phyto-sociological Studies of Tree Species Outside Forest in Traditional Agroforestry of Chattisgarh. *Indian Journal of Agroforestry*, 8(1), 26-34.
- Shi, H., and Singh, A. (2002). An assessment of biodiversity hotspots using Remote Sensing and GIS. *Journal of the Indian Society of Remote Sensing*, 30(1 & 2), 105-112.
- Shukla, R.P., and Srivastava, S. (2017). Plant diversity of North-Eastern Uttar Pradesh, India: species distribution and depletion pattern during the last five decades. *International Journal of Ecology and Environmental Sciences*, 43 (2), 99-128.
- Simpson, E. H. (1949). Measurement of diversity. *Nature*, 163, 688-698.
- Simpson, G. G. (1964). Species diversity of north American mammals. *Systematic Zoology*, 13, 57-73.
- Singh, J.S., & Kushwaha, S.P.S. (2008). Forest Biodiversity and Its Conservation in India. *International Forestry Review*, 10(2), 292-304. doi:10.1505/ifor.10.2.292
- Singh, J.S., Singh, S.P., Saxena, A.K., Rawat, Y.S. (1984). India's Silent Valley and Its Threatened Rain-forest Ecosystems. *Environmental Conservation*, 11(03), 223 – 233.
- Singh, R. K., and Khan, S. (1984). The Forest vegetation of Silent Valley, India. Tropical rainforest. The Leeds Symposium. 25-52.
- Singh, R., Sood, U. K., Bhatia, M., and Thakur, G. C. (1991). Phytosociological Studies on Tree Vegetation around Shimla, Himanchal Pradesh. *Indian Journal of Forestry*, 14(3), 169-180.
- Singh, R.P., Gupta, M. K. (1992). Vegetation survey and ecological studies under silver fir and spruce forests of Himachal Pradesh. *Indian Forester*, 118(7), 460-465.
- Singh, S. K., and Rawat, G. S. (1999). Flora of Great Himalayan National Park, Himachal Pradesh. Dehra Dun, India: Bishen Singh Mahendra Pal Singh, 304 pp.
- Singh, S., Chand, H.B., Khatri, P.K., Kumar, D., Kewat, A.K., Kumar, A. and Singh, K.P. (2021). Phytosociology and Regeneration Status in Different Permanent Preservation Plots across Different Forest Types in Madhya Pradesh, Central India. *Grassroots Journal of Natural Resources*, 4(2), 179-198.
- Singh, T. P., Singh, S., Roy, P. S., Rao, B. S. P. (2002). Vegetation mapping and characterization in West Siang District of Arunachal Pradesh, India – a satellite remote sensing-based approach. *Current Science*, 83(10), 1221-1230.
- Sinha, M.K. and Sinha, D. (2013). Composition of Forest Vegetation of Korla District of Chhattisgarh (India). *Global Journal of Biology, Agriculture and Health Science*, 2(4), 160-168.
- Sneadaker, S. C. (1970). Ecological studies on tropical moist forest succession in eastern lowland Guatemala. Ph.D Thesis, University of Florida (Gainesville). 131p.
- Soni, A., and Namdeo, K.P. (2022). Plant biodiversity and phytosociological studies on tree species diversity of Ratanpur forest Bilaspur district (C.G.) India. *Journal of Medicinal Plants Studies*, 10(2), 139-142.
- Sophia, M., Behera, N., Gupta, A. (2018). Phytosociological studies of woody species in subtropical forest of Manipur, North-East India. *International Journal of scientific research*, 7(9), 56-59.

- Sorenson, T. (1948). A method of establishing group of equal amplitude in plant sociology based on similarity of the species. *Ecology*, 50, 278-296.
- Srivastava, V. K. (1986). Diversity and dominance in two manmade forests at Dehra Dun, India. *Indian Journal of Forestry*, 9 (4), 287-292.
- Subramanyam, K., and Nayar, M.P. (1974). Vegetation and Phytogeography of the Western Ghats. In: M.S Mani, (ed.) *Ecology and Biogeography of India*, Junk Publishers, Hauge, 178-196p.
- Suhs, R.B., Hoeltgebaum, M.P., Silva, A.N., Fiaschi, P., Oliveira, S.N., and Peroni, N. (2019). Species diversity, community structure and ecological traits of trees in an upper montane forest, Southern Brazil. *Acta Botanica Brasilica*, 33(1), 153-162.
- Suraj, M.A. (1997). Phytosociological and vegetation mapping of Chimmony wildlife sanctuary (Kerala) using remote sensing techniques., Ph.D Thesis submitted to Forest Research Institute, Dehradun, 123p.
- Suraj, M. A., Manoj, K., and Balasubramanian, K. (2014). Quantification of the Size of Quadrat for Sampling in Evergreen Forest of Parambikulam Wildlife Sanctuary; Kerala, South India. *Journal of Chemical, Biological and Physical Sciences*, 4(1), 351-35.
- Suresh Babu, P.K. (1998). Vegetation Mapping and Analysis of Eravikulam National Park of Kerala using Remote sensing techniques. Ph.D thesis. Cochin University, Cochin. 163 p.
- Suresh, H.S., and Sukumar, R. (1999). Phytogeographical affinities of flora of Nilgiri Biosphere Reserve. *Rheedea*, 9, 1-21.
- Tansley, A. G. (1935). The use and abuse of vegetational concepts and terms. *Ecology*, 16, 284-307.
- Thakur, P., Thapa, A., Verma, M., Shivani Tandon. (2021). Phytosociological Studies on Tree Vegetation of Jakhu Hill, Shimla, Himachal Pradesh. *Journal of Environmental Science, Toxicology and Food Technology*, 16(8), 46-52.
- Tripathi, O. P. (2011). Community Composition, Structure and Management of Subtropical Vegetation of Forests in Meghalaya State, Northeast India. *International Journal of Biodiversity Science and Management*, 6(3-4), 157-163.
- Varghese, A. O. (1997). Ecological studies of the forests of the Peppara Wildlife Sanctuary using remote sensing techniques. Ph.D thesis, Forest Research Institute, Dehradun, 279 p.
- Varghese, A.O., and Balasubramanian, K. (1999). Structure, Composition and Diversity of the Tropical Wet Evergreen Forest of the Agasthyamalai Region of Kerala, Western Ghats. *Journal of South Asian Natural History*, 1, 87-98.
- Varghese, A.O., and Menon, A.R.R. (1998). Assessment of Biodiversity of Peppara Wildlife Sanctuary, Trivandrum District, Kerala. *Journal of Economic and Taxonomic Botany*, 22(3), 1-7.
- Varghese, A.O., Menon, A.R.R. (1999). Floristic composition, dynamics and diversity of *Myristica* swamp forests of Southern-Western Ghats, Kerala. *Indian Forester*, 125(8), 775-783.
- Varma, R. K., Totey, N.G., and Gupta, B.N. (1997). Analysis of forest vegetation in the permanent preservation plot of Tamna in Orisa. *Indian Forester*, 123 (11), 1007-1016.

- Vijayan, L., Prasad S.N., and Balasubramanian, P. (1999). Impact of human interference on the plant and bird communities in the Nilgiri Biosphere Reserve. Salim Ali Centre for Ornithology and Natural History, Final Report.
- Vincy, M.V. (2014). A watershed approach for sustainable ecosystem management of Meenachil river basin with emphasis on remote sensing and GIS. Ph. D. Thesis, Mahatma Gandhi University, Kottayam, Kerala.
- Viraj, M. R. K., Verma, N. S. Chauhan, K. S. Kapoor. (2007). Assessment of floristic diversity in Phulang valley of Lippa-Asrang Wildlife Sanctuary of district Kinnaur, Himachal Pradesh. *Environment and Ecology*,30(1),226-233.
- Virkar, Preeti, S., Uniyal, V. P., Banarjee, A. K. (2012). Baseline Information of Floral and Faunal Diversity for Long Term Ecological Monitoring of Dhanolti Eco Park - Mussoorie forest Division, Uttarakhand. *Indian Forester*,138(6),513-517.
- Whitford, P.B. (1948). Distribution of woodland plants in relation to succession and clonal growth. *Ecology*, 30, 199-208.
- Wilson, E. O. (1988). Biodiversity, Washington, D.C, National Academy Press,538 p.

Phytosociological analysis of medium elevation study sites

Table 32 - Site 1

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|-----------------------------------|-----|----|-----|------|-----|------|--------|------|-----|
| 1 | <i>Actinodaphne malabarica</i> | 0.2 | 10 | 2 | 0.2 | 0.5 | 0.74 | 3630.9 | 0.9 | 2.1 |
| 2 | <i>Agalia lawii</i> | 0.2 | 10 | 2 | 0.2 | 0.5 | 0.74 | 1601.7 | 0.4 | 1.6 |
| 3 | <i>Aglaia perviridis</i> | 0.5 | 40 | 1.3 | 0.03 | 1.2 | 2.94 | 3785.6 | 0.94 | 5.1 |
| 4 | <i>Aglaia tomentosa</i> | 0.4 | 20 | 2 | 0.1 | 1 | 1.47 | 2067.3 | 0.51 | 3 |
| 5 | <i>Agrostistachys borneensis</i> | 3.2 | 70 | 4.6 | 0.07 | 7.9 | 5.15 | 22866 | 5.68 | 19 |
| 6 | <i>Alseodaphne semecarpifolia</i> | 0.2 | 20 | 1 | 0.05 | 0.5 | 1.47 | 892.75 | 0.22 | 2.2 |
| 7 | <i>Antidesma montanum</i> | 0.6 | 30 | 2 | 0.07 | 1.5 | 2.21 | 2651.9 | 0.66 | 4.3 |
| 8 | <i>Aporosa bourdillonii</i> | 0.7 | 40 | 1.8 | 0.04 | 1.7 | 2.94 | 5423.6 | 1.35 | 6 |
| 9 | <i>Aporosa acuminate</i> | 0.2 | 20 | 1 | 0.05 | 0.5 | 1.47 | 896.34 | 0.22 | 2.2 |
| 10 | <i>Artocarpus heterophyllus</i> | 0.5 | 30 | 1.7 | 0.06 | 1.2 | 2.21 | 4505.5 | 1.12 | 4.6 |
| 11 | <i>Calophyllum polyanthum</i> | 1.6 | 40 | 4 | 0.1 | 3.9 | 2.94 | 10355 | 2.57 | 9.4 |
| 12 | <i>Canarium strictum</i> | 0.3 | 10 | 3 | 0.3 | 0.7 | 0.74 | 4777.2 | 1.19 | 2.7 |
| 13 | <i>Croton malabaricus</i> | 0.7 | 30 | 2.3 | 0.08 | 1.7 | 2.21 | 5974.2 | 1.48 | 5.4 |
| 14 | <i>Cullenia exarillata</i> | 3.8 | 90 | 4.2 | 0.05 | 9.3 | 6.62 | 47730 | 11.9 | 28 |
| 15 | <i>Cyathocalyx zeylanicus</i> | 0.3 | 20 | 1.5 | 0.08 | 0.7 | 1.47 | 1363.3 | 0.34 | 2.5 |
| 16 | <i>Dendrocnide sinuata</i> | 0.3 | 10 | 3 | 0.3 | 0.7 | 0.74 | 745.54 | 0.19 | 1.7 |
| 17 | <i>Dimorphocalyx lawianus</i> | 0.3 | 10 | 3 | 0.3 | 0.7 | 0.74 | 1349.5 | 0.34 | 1.8 |
| 18 | <i>Diospyros paniculata</i> | 1.6 | 40 | 4 | 0.1 | 3.9 | 2.94 | 19767 | 4.91 | 12 |
| 19 | <i>Dipterocarpus indicus</i> | 0.4 | 10 | 4 | 0.4 | 1 | 0.74 | 22313 | 5.55 | 7.3 |
| 20 | <i>Drypetes oblongifolia</i> | 0.2 | 10 | 2 | 0.2 | 0.5 | 0.74 | 1676.6 | 0.42 | 1.6 |
| 21 | <i>Drypetes malabarica</i> | 1.7 | 60 | 2.8 | 0.05 | 4.2 | 4.41 | 19938 | 4.96 | 14 |
| 22 | <i>Drypetes venusta</i> | 1 | 30 | 3.3 | 0.11 | 2.5 | 2.21 | 6890.7 | 1.71 | 6.4 |
| 23 | <i>Dysoxylum malabaricum</i> | 0.7 | 20 | 3.5 | 0.18 | 1.7 | 1.47 | 5115.8 | 1.27 | 4.5 |
| 24 | <i>Elaeocarpus serratus</i> | 0.1 | 10 | 1 | 0.1 | 0.2 | 0.74 | 764.65 | 0.19 | 1.2 |

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|----|----------------------------------|-----|----|-----|------|-----|------|--------|------|-----|
| 25 | <i>Elaeocarpus tuberculatus</i> | 0.4 | 20 | 2 | 0.1 | 1 | 1.47 | 12711 | 3.16 | 5.6 |
| 26 | <i>Flacourtia montana</i> | 0.2 | 10 | 2 | 0.2 | 0.5 | 0.74 | 1174 | 0.29 | 1.5 |
| 27 | <i>Garcinia gummi-gutta</i> | 0.8 | 30 | 2.7 | 0.09 | 2 | 2.21 | 5457.4 | 1.36 | 5.5 |
| 28 | <i>Glochidion zeylanicum</i> | 0.3 | 20 | 1.5 | 0.08 | 0.7 | 1.47 | 2074.5 | 0.52 | 2.7 |
| 29 | <i>Gomphandra coriacea</i> | 0.2 | 10 | 2 | 0.2 | 0.5 | 0.74 | 933.84 | 0.23 | 1.5 |
| 30 | <i>Gomphandra tetrandra</i> | 0.3 | 10 | 3 | 0.3 | 0.7 | 0.74 | 6027 | 1.5 | 3 |
| 31 | <i>Holigarna grahamii(rare)</i> | 0.1 | 10 | 1 | 0.1 | 0.2 | 0.74 | 1538.3 | 0.38 | 1.4 |
| 32 | <i>Hydnocarpus pentandra</i> | 0.2 | 10 | 2 | 0.2 | 0.5 | 0.74 | 3985.4 | 0.99 | 2.2 |
| 33 | <i>Diospyros sylvatica</i> | 2.8 | 60 | 4.7 | 0.08 | 6.9 | 4.41 | 13516 | 3.36 | 15 |
| 34 | <i>Litsea bourdillonii</i> | 0.2 | 10 | 2 | 0.2 | 0.5 | 0.74 | 354.3 | 0.09 | 1.3 |
| 35 | <i>Litsea floribunda</i> | 0.3 | 20 | 1.5 | 0.08 | 0.7 | 1.47 | 2193.2 | 0.55 | 2.8 |
| 36 | <i>Meiogyne pannosa</i> | 0.9 | 40 | 2.3 | 0.06 | 2.2 | 2.94 | 6386 | 1.59 | 6.7 |
| 37 | <i>Melicope lunu ankenda</i> | 0.1 | 10 | 1 | 0.1 | 0.2 | 0.74 | 447.85 | 0.11 | 1.1 |
| 38 | <i>Mesua ferrea</i> | 1.7 | 50 | 3.4 | 0.07 | 4.2 | 3.68 | 24675 | 6.13 | 14 |
| 39 | <i>Myristica beddomei</i> | 0.5 | 10 | 5 | 0.5 | 1.2 | 0.74 | 2664.8 | 0.66 | 2.6 |
| 40 | <i>Nothopegia colebrookeana</i> | 0.7 | 40 | 1.8 | 0.04 | 1.7 | 2.94 | 4497.3 | 1.12 | 5.8 |
| 41 | <i>Otonophelium stipulaceum</i> | 0.6 | 20 | 3 | 0.15 | 1.5 | 1.47 | 4221.7 | 1.05 | 4 |
| 42 | <i>Palaquium ellipticum</i> | 3.1 | 70 | 4.4 | 0.06 | 7.6 | 5.15 | 42694 | 10.6 | 23 |
| 43 | <i>Persea macrantha</i> | 1 | 30 | 3.3 | 0.11 | 2.5 | 2.21 | 10423 | 2.59 | 7.3 |
| 44 | <i>Prunus ceylanica</i> | 0.4 | 20 | 2 | 0.1 | 1 | 1.47 | 18372 | 4.57 | 7 |
| 45 | <i>Psychotria anamalayana</i> | 0.4 | 10 | 4 | 0.4 | 1 | 0.74 | 3434.9 | 0.85 | 2.6 |
| 46 | <i>Symplocos cochinchinensis</i> | 0.5 | 20 | 2.5 | 0.13 | 1.2 | 1.47 | 3192.2 | 0.79 | 3.5 |
| 47 | <i>Syzygium laetum</i> | 0.2 | 10 | 2 | 0.2 | 0.5 | 0.74 | 924.92 | 0.23 | 1.5 |
| 48 | <i>Syzygium mundagam</i> | 0.4 | 20 | 2 | 0.1 | 1 | 1.47 | 1673.6 | 0.42 | 2.9 |
| 49 | <i>Toona ciliata</i> | 0.8 | 30 | 2.7 | 0.09 | 2 | 2.21 | 5675.2 | 1.41 | 5.6 |
| 50 | <i>Turpinia malabarica</i> | 1.1 | 20 | 5.5 | 0.28 | 2.7 | 1.47 | 6593.1 | 1.64 | 5.8 |
| 51 | <i>Vateria indica</i> | 2.3 | 50 | 4.6 | 0.09 | 5.7 | 3.68 | 15977 | 3.97 | 13 |
| 52 | <i>Strobocalyx arborea</i> | 0.3 | 10 | 3 | 0.3 | 0.7 | 0.74 | 1673.1 | 0.42 | 1.9 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|---|-----|-----|------|--------|------|-----|
| 53 | <i>Xanthophyllum arnottianum</i> | 0.2 | 10 | 2 | 0.2 | 0.5 | 0.74 | 1743.7 | 0.43 | 1.7 |
| | | 40.7 | 1360 | | | 100 | 100 | 402315 | 100 | 300 |

Table 33 - Site 2

| SL No. | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|--------|----------------------------------|-----|----|------|------|------|-----|--------|--------|-----|
| 1 | <i>Actinodaphne malabarica</i> | 0.6 | 20 | 3 | 0.15 | 1.4 | 1.6 | 15904 | 2.1585 | 5.2 |
| 2 | <i>Aglaia barberi</i> | 3 | 80 | 3.75 | 0.05 | 6.98 | 6.4 | 22247 | 3.0194 | 16 |
| 3 | <i>Aglaia tomentosa</i> | 1.5 | 50 | 3 | 0.06 | 3.49 | 4 | 8096.1 | 1.0988 | 8.6 |
| 4 | <i>Agrostistachys borneensis</i> | 0.1 | 10 | 1 | 0.1 | 0.23 | 0.8 | 764.65 | 0.1038 | 1.1 |
| 5 | <i>Aporosa bourdillonii</i> | 0.8 | 40 | 2 | 0.05 | 1.86 | 3.2 | 4449.1 | 0.6038 | 5.7 |
| 6 | <i>Artocarpus heterophyllus</i> | 0.1 | 10 | 1 | 0.1 | 0.23 | 0.8 | 1516.2 | 0.2058 | 1.2 |
| 7 | <i>Calophyllum polyanthum</i> | 1.1 | 40 | 2.75 | 0.07 | 2.56 | 3.2 | 30436 | 4.1309 | 9.9 |
| 8 | <i>Chrysophyllum roxburghii</i> | 0.5 | 20 | 2.5 | 0.13 | 1.16 | 1.6 | 23646 | 3.2093 | 6 |
| 9 | <i>Cinnamomum malabattrum</i> | 0.6 | 20 | 3 | 0.15 | 1.4 | 1.6 | 24146 | 3.2772 | 6.3 |
| 10 | <i>Croton malabaricus</i> | 0.4 | 20 | 2 | 0.1 | 0.93 | 1.6 | 2644.2 | 0.3589 | 2.9 |
| 11 | <i>Cullenia exarillata</i> | 3.7 | 90 | 4.11 | 0.05 | 8.6 | 7.2 | 99817 | 13.547 | 29 |
| 12 | <i>Cyathocalyx zeylanica</i> | 1.2 | 30 | 4 | 0.13 | 2.79 | 2.4 | 8249.4 | 1.1196 | 6.3 |
| 13 | <i>Dimocarpus longan</i> | 0.2 | 10 | 2 | 0.2 | 0.47 | 0.8 | 1408.4 | 0.1912 | 1.5 |
| 14 | <i>Dimorphocalyx lawianus</i> | 0.3 | 10 | 3 | 0.3 | 0.7 | 0.8 | 1015.4 | 0.1378 | 1.6 |
| 15 | <i>Diospyros paniculata</i> | 2.1 | 50 | 4.2 | 0.21 | 4.88 | 4 | 15771 | 2.1405 | 11 |
| 16 | <i>Drypetes malabarica</i> | 1.5 | 30 | 5 | 0.25 | 3.49 | 2.4 | 8128.8 | 1.1033 | 7 |
| 17 | <i>Drypetes venusta</i> | 0.8 | 20 | 4 | 0.2 | 1.86 | 1.6 | 3486.2 | 0.4732 | 3.9 |
| 18 | <i>Dysoxylum malabaricum</i> | 1.1 | 40 | 2.75 | 0.14 | 2.56 | 3.2 | 41456 | 5.6266 | 11 |
| 19 | <i>Elaeocarpus tuberculatus</i> | 0.1 | 10 | 1 | 0.05 | 0.23 | 0.8 | 472.05 | 0.0641 | 1.1 |
| 20 | <i>Garcinia gummi-gutta</i> | 0.3 | 20 | 1.5 | 0.08 | 0.7 | 1.6 | 2383.6 | 0.3235 | 2.6 |
| 21 | <i>Glochidion zeylanicum</i> | 1.3 | 30 | 4.33 | 0.22 | 3.02 | 2.4 | 191.16 | 0.0259 | 5.4 |
| 22 | <i>Gomphandra tetrandra</i> | 1.3 | 30 | 4.33 | 0.22 | 3.02 | 2.4 | 5436.5 | 0.7379 | 6.2 |
| 23 | <i>Holigarna arnottiana</i> | 0.2 | 10 | 2 | 0.1 | 0.47 | 0.8 | 11435 | 1.552 | 2.8 |
| 24 | <i>Hydnocarpus pentandra</i> | 0.2 | 10 | 2 | 0.1 | 0.47 | 0.8 | 781.69 | 0.1061 | 1.4 |
| 25 | <i>Litsea coriacea</i> | 1.1 | 30 | 3.67 | 0.18 | 2.56 | 2.4 | 4380.6 | 0.5945 | 5.6 |

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|----|------------------------------|-----|------|------|------|------|-----|--------|--------|-----|
| 26 | <i>Litsea floribunda</i> | 0.1 | 10 | 1 | 0.05 | 0.23 | 0.8 | 718.55 | 0.0975 | 1.1 |
| 27 | <i>Meiogyne pannosa</i> | 1.1 | 40 | 2.75 | 0.14 | 2.56 | 3.2 | 6926.2 | 0.94 | 6.7 |
| 28 | <i>Melicope lunu ankenda</i> | 0.4 | 10 | 4 | 0.2 | 0.93 | 0.8 | 3018.6 | 0.4097 | 2.1 |
| 29 | <i>Mesua ferrea</i> | 3.5 | 70 | 5 | 0.25 | 8.14 | 5.6 | 71127 | 9.6536 | 23 |
| 30 | <i>Palaquium ellipticum</i> | 4.1 | 80 | 5.13 | 0.26 | 9.53 | 6.4 | 107432 | 14.581 | 31 |
| 31 | <i>Paracroton pendulus</i> | 0.3 | 20 | 1.5 | 0.08 | 0.7 | 1.6 | 3268.4 | 0.4436 | 2.7 |
| 32 | <i>Persea macrantha</i> | 1.5 | 40 | 3.75 | 0.19 | 3.49 | 3.2 | 43517 | 5.9062 | 13 |
| 33 | <i>Poeciloneuron indicum</i> | 1 | 30 | 3.33 | 0.17 | 2.33 | 2.4 | 41841 | 5.6788 | 10 |
| 34 | <i>Prunus ceylanica</i> | 1.2 | 20 | 6 | 0.3 | 2.79 | 1.6 | 23747 | 3.223 | 7.6 |
| 35 | <i>Syzygium cumini</i> | 0.2 | 10 | 2 | 0.1 | 0.47 | 0.8 | 2049.2 | 0.2781 | 1.5 |
| 36 | <i>Syzygium laetum</i> | 0.1 | 10 | 1 | 0.05 | 0.23 | 0.8 | 336.39 | 0.0457 | 1.1 |
| 37 | <i>Syzygium mundagam</i> | 1.3 | 30 | 4.33 | 0.22 | 3.02 | 2.4 | 9708.7 | 1.3177 | 6.7 |
| 38 | <i>Terminalia bellirica</i> | 0.4 | 20 | 2 | 0.1 | 0.93 | 1.6 | 2181.8 | 0.2961 | 2.8 |
| 39 | <i>Toona ciliata</i> | 0.7 | 30 | 2.33 | 0.12 | 1.63 | 2.4 | 24034 | 3.2619 | 7.3 |
| 40 | <i>Turpinia malabarica</i> | 1.8 | 40 | 4.5 | 0.23 | 4.19 | 3.2 | 22154 | 3.0069 | 10 |
| 41 | <i>Vateria indica</i> | 1.2 | 60 | 2 | 0.1 | 2.79 | 4.8 | 36471 | 4.95 | 13 |
| | | 43 | 1250 | 217 | | 100 | 100 | 736794 | 100 | 300 |

Table 34 - Site 3

| SL No | Species | D | F | A | A/F | RD | RF | BA | R B A | IVI |
|-------|----------------------------------|-----|-----|------|------|------|------|--------|-------|-----|
| 1 | <i>Aglaia tomentosa</i> | 1.1 | 60 | 1.83 | 0.03 | 2.29 | 3.43 | 7904.9 | 1.06 | 6.8 |
| 2 | <i>Agrostistachys borneensis</i> | 3.7 | 90 | 4.11 | 0.05 | 7.69 | 5.14 | 25527 | 3.43 | 16 |
| 3 | <i>Artocarpus heterophyllus</i> | 0.4 | 40 | 1 | 0.03 | 0.83 | 2.29 | 6042.2 | 0.81 | 3.9 |
| 4 | <i>Bischofia javanica</i> | 0.7 | 30 | 2.33 | 0.08 | 1.46 | 1.71 | 17982 | 2.42 | 5.6 |
| 5 | <i>Calophyllum polyanthum</i> | 0.3 | 30 | 1 | 0.03 | 0.62 | 1.71 | 18000 | 2.42 | 4.8 |
| 6 | <i>Chrysophyllum roxburghii</i> | 0.4 | 20 | 2 | 0.1 | 0.83 | 1.14 | 16950 | 2.28 | 4.3 |
| 7 | <i>Cinnamomum sulphuratum</i> | 1.2 | 40 | 3 | 0.08 | 2.49 | 2.29 | 26790 | 3.6 | 8.4 |
| 8 | <i>Croton malabaricus</i> | 0.3 | 30 | 1 | 0.03 | 0.62 | 1.71 | 2013.5 | 0.27 | 2.6 |
| 9 | <i>Cullenia exarillata</i> | 4.3 | 100 | 4.3 | 0.04 | 8.94 | 5.71 | 99747 | 13.4 | 28 |
| 10 | <i>Diospyros paniculata</i> | 2.2 | 80 | 2.75 | 0.03 | 4.57 | 4.57 | 15022 | 2.02 | 11 |
| 11 | <i>Drypetes malabarica</i> | 2.3 | 80 | 2.88 | 0.04 | 4.78 | 4.57 | 10394 | 1.4 | 11 |
| 12 | <i>Drypetes venusta</i> | 4.4 | 100 | 4.4 | 0.04 | 9.15 | 5.71 | 45737 | 6.15 | 21 |
| 13 | <i>Dysoxylum malabaricum</i> | 1.2 | 70 | 1.71 | 0.02 | 2.49 | 4 | 37566 | 5.05 | 12 |
| 14 | <i>Elaeocarpus tuberculatus</i> | 0.4 | 20 | 2 | 0.1 | 0.83 | 1.14 | 1114.1 | 0.15 | 2.1 |
| 15 | <i>Garcinia gummi-gutta</i> | 0.6 | 20 | 3 | 0.15 | 1.25 | 1.14 | 3569.2 | 0.48 | 2.9 |
| 16 | <i>Glochidion ellipticum</i> | 0.1 | 10 | 1 | 0.1 | 0.21 | 0.57 | 191.16 | 0.03 | 0.8 |
| 17 | <i>Gomphandra coriacea</i> | 1.6 | 80 | 2 | 0.03 | 3.33 | 4.57 | 8270.2 | 1.11 | 9 |
| 18 | <i>Holigarna arnottiana</i> | 0.2 | 20 | 1 | 0.05 | 0.42 | 1.14 | 8173.6 | 1.1 | 2.7 |
| 19 | <i>Hydnocarpus macrocarpa</i> | 0.2 | 10 | 2 | 0.2 | 0.42 | 0.57 | 889.33 | 0.12 | 1.1 |
| 20 | <i>Litsea floribunda</i> | 0.5 | 20 | 2.5 | 0.13 | 1.04 | 1.14 | 2357.3 | 0.32 | 2.5 |
| 21 | <i>Mallotus tetracoccus</i> | 0.7 | 40 | 1.75 | 0.04 | 1.46 | 2.29 | 1888.5 | 0.25 | 4 |
| 22 | <i>Meiogyne pannosa</i> | 0.7 | 50 | 1.4 | 0.03 | 1.46 | 2.86 | 3841.9 | 0.52 | 4.8 |
| 23 | <i>Meliosma pinnata</i> | 0.4 | 20 | 2 | 0.1 | 0.83 | 1.14 | 4463 | 0.6 | 2.6 |
| 24 | <i>Mesua ferrea</i> | 3.6 | 100 | 3.6 | 0.04 | 7.48 | 5.71 | 67438 | 9.06 | 22 |
| 25 | <i>Myristica beddomei</i> | 1.7 | 60 | 2.83 | 0.05 | 3.53 | 3.43 | 8360.2 | 1.12 | 8.1 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|------|------|------|------|--------|------|-----|
| 26 | <i>Myristica malabarica</i> | 0.2 | 20 | 1 | 0.05 | 0.42 | 1.14 | 1090 | 0.15 | 1.7 |
| 27 | <i>Otonophelium stipulaceum</i> | 0.3 | 20 | 1.5 | 0.08 | 0.62 | 1.14 | 2358.8 | 0.32 | 2.1 |
| 28 | <i>Palaquium ellipticum</i> | 4.6 | 100 | 4.6 | 0.05 | 9.56 | 5.71 | 115100 | 15.5 | 31 |
| 29 | <i>Persea macrantha</i> | 1.2 | 60 | 2 | 0.03 | 2.49 | 3.43 | 39514 | 5.31 | 11 |
| 30 | <i>Poeciloneuron indicum</i> | 1.1 | 50 | 2.2 | 0.04 | 2.29 | 2.86 | 43250 | 5.81 | 11 |
| 31 | <i>Prunus ceylanica</i> | 1 | 40 | 2.5 | 0.06 | 2.08 | 2.29 | 22805 | 3.06 | 7.4 |
| 32 | <i>Psychotria anamalayana</i> | 0.5 | 30 | 1.67 | 0.06 | 1.04 | 1.71 | 2525.3 | 0.34 | 3.1 |
| 33 | <i>Toona ciliata</i> | 0.8 | 30 | 2.67 | 0.09 | 1.66 | 1.71 | 17997 | 2.42 | 5.8 |
| 34 | <i>Turpinia malabarica</i> | 1.6 | 50 | 3.2 | 0.06 | 3.33 | 2.86 | 20707 | 2.78 | 9 |
| 35 | <i>Vateria indica</i> | 1.2 | 50 | 2.4 | 0.05 | 2.49 | 2.86 | 26647 | 3.58 | 8.9 |
| 36 | <i>Xanthophyllum arnottianum</i> | 2.4 | 80 | 3 | 0.04 | 4.99 | 4.57 | 12037 | 1.62 | 11 |
| | | 48.1 | 1750 | 79.7 | | 100 | 100 | 744262 | 100 | 300 |

Table 35 - Site 4

| SL No. | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|--------|----------------------------------|-----|----|------|-----|------|------|---------|------|-----|
| 1 | <i>Actinodaphne malabarica</i> | 0.3 | 30 | 1 | 0 | 0.88 | 2.04 | 12062.4 | 2.42 | 5.3 |
| 2 | <i>Aglaiia tomentosa</i> | 0.9 | 40 | 2.25 | 0.1 | 2.64 | 2.72 | 7022.77 | 1.41 | 6.8 |
| 3 | <i>Agrostistachys borneensis</i> | 0.6 | 30 | 2 | 0.1 | 1.76 | 2.04 | 5989.41 | 1.2 | 5 |
| 4 | <i>Antiaris toxicaria</i> | 0.8 | 40 | 2 | 0.1 | 2.35 | 2.72 | 10749.4 | 2.16 | 7.2 |
| 5 | <i>Antidesma montanum</i> | 0.1 | 10 | 1 | 0.1 | 0.29 | 0.68 | 424.283 | 0.09 | 1.1 |
| 6 | <i>Aporosa lindleyana</i> | 0.6 | 40 | 1.5 | 0 | 1.76 | 2.72 | 2553.5 | 0.51 | 5 |
| 7 | <i>Artocarpus heterophyllus</i> | 0.7 | 30 | 2.33 | 0.1 | 2.05 | 2.04 | 5113.46 | 1.03 | 5.1 |
| 8 | <i>Artocarpus hirsutus</i> | 0.2 | 20 | 1 | 0.1 | 0.59 | 1.36 | 3669.19 | 0.74 | 2.7 |
| 9 | <i>Baccaurea courtallensis</i> | 0.7 | 60 | 1.17 | 0 | 2.05 | 4.08 | 18532.8 | 3.72 | 9.9 |
| 10 | <i>Bischofia javanica</i> | 1.1 | 50 | 2.2 | 0 | 3.23 | 3.4 | 7787.42 | 1.56 | 8.2 |
| 11 | <i>Calophyllum polyanthum</i> | 0.3 | 30 | 1 | 0 | 0.88 | 2.04 | 9754.54 | 1.96 | 4.9 |
| 12 | <i>Canarium strictum</i> | 0.3 | 20 | 1.5 | 0.1 | 0.88 | 1.36 | 3287.74 | 0.66 | 2.9 |
| 13 | <i>Cinnamomum verum</i> | 0.1 | 10 | 1 | 0.1 | 0.29 | 0.68 | 688.615 | 0.14 | 1.1 |
| 14 | <i>Croton malabaricus</i> | 0.9 | 30 | 3 | 0.1 | 2.64 | 2.04 | 5525.96 | 1.11 | 5.8 |
| 15 | <i>Cryptocarya anamalayana</i> | 0.2 | 20 | 1 | 0.1 | 0.59 | 1.36 | 1673.01 | 0.34 | 2.3 |
| 16 | <i>Cullenia exarillata</i> | 2.6 | 80 | 3.25 | 0 | 7.62 | 5.44 | 51132.2 | 10.3 | 23 |
| 17 | <i>Dimocarpus longan</i> | 0.1 | 10 | 1 | 0.1 | 0.29 | 0.68 | 1408.36 | 0.28 | 1.3 |
| 18 | <i>Diospyros paniculata</i> | 2.5 | 90 | 2.78 | 0 | 7.33 | 6.12 | 16407.6 | 3.29 | 17 |
| 19 | <i>Dysoxylum malabaricum</i> | 1.3 | 50 | 2.6 | 0.1 | 3.81 | 3.4 | 37239.6 | 7.47 | 15 |
| 20 | <i>Elaeocarpus tuberculatus</i> | 0.2 | 20 | 1 | 0.1 | 0.59 | 1.36 | 1160.67 | 0.23 | 2.2 |
| 21 | <i>Garcinia gummi-gutta</i> | 0.5 | 30 | 1.67 | 0.1 | 1.47 | 2.04 | 3097.13 | 0.62 | 4.1 |
| 22 | <i>Glochidion zeylanicum</i> | 0.1 | 10 | 1 | 0.1 | 0.29 | 0.68 | 191.162 | 0.04 | 1 |
| 23 | <i>Holigarna arnottiana</i> | 0.8 | 40 | 2 | 0.1 | 2.35 | 2.72 | 10586.5 | 2.12 | 7.2 |
| 24 | <i>Hydnocarpus pentandra</i> | 0.3 | 30 | 1 | 0 | 0.88 | 2.04 | 1441 | 0.29 | 3.2 |
| 25 | <i>Kingiodendron pinnatum</i> | 0.6 | 30 | 2 | 0.1 | 1.76 | 2.04 | 5453.11 | 1.09 | 4.9 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|------|-----|------|------|---------|------|-----|
| 26 | <i>Lepisanthes tetraphylla</i> | 0.1 | 10 | 1 | 0.1 | 0.29 | 0.68 | 764.65 | 0.15 | 1.1 |
| 27 | <i>Litsea floribunda</i> | 0.4 | 30 | 1.33 | 0 | 1.17 | 2.04 | 2300.96 | 0.46 | 3.7 |
| 28 | <i>Lophopetalum wightianum</i> | 0.1 | 10 | 1 | 0.1 | 0.29 | 0.68 | 7651.27 | 1.54 | 2.5 |
| 29 | <i>Mallotus tetracoccus</i> | 0.5 | 50 | 1 | 0 | 1.47 | 3.4 | 1655.65 | 0.33 | 5.2 |
| 30 | <i>Melicope lunu-ankenda</i> | 1.2 | 80 | 1.5 | 0 | 3.52 | 5.44 | 3541 | 0.71 | 9.7 |
| 31 | <i>Mesua ferrea</i> | 0.5 | 30 | 1.67 | 0.1 | 1.47 | 2.04 | 12196.4 | 2.45 | 6 |
| 32 | <i>Nothopegia colebrookeana</i> | 0.2 | 10 | 2 | 0.2 | 0.59 | 0.68 | 635.032 | 0.13 | 1.4 |
| 33 | <i>Otonephelium stipulaceum</i> | 1.6 | 50 | 3.2 | 0.1 | 4.69 | 3.4 | 14120.9 | 2.83 | 11 |
| 34 | <i>Palaquium ellipticum</i> | 4.1 | 100 | 4.1 | 0 | 12 | 6.8 | 109464 | 22 | 41 |
| 35 | <i>Psychotria beddomei</i> | 0.2 | 10 | 2 | 0.2 | 0.59 | 0.68 | 468.312 | 0.09 | 1.4 |
| 36 | <i>Pterospermum reticulatum</i> | 0.3 | 20 | 1.5 | 0.1 | 0.88 | 1.36 | 13040 | 2.62 | 4.9 |
| 37 | <i>Strobocalyx arborea</i> | 0.4 | 10 | 4 | 0.4 | 1.17 | 0.68 | 11667.4 | 2.34 | 4.2 |
| 38 | <i>Symplocos cochinchinensis</i> | 0.1 | 10 | 1 | 0.1 | 0.29 | 0.68 | 630.653 | 0.13 | 1.1 |
| 39 | <i>Syzygium cumini</i> | 0.6 | 20 | 3 | 0.2 | 1.76 | 1.36 | 4442.99 | 0.89 | 4 |
| 40 | <i>Trichilla connaroides</i> | 0.3 | 10 | 3 | 0.3 | 0.88 | 0.68 | 4002.71 | 0.8 | 2.4 |
| 41 | <i>Turpinia malabarica</i> | 0.3 | 30 | 1 | 0 | 0.88 | 2.04 | 3286.78 | 0.66 | 3.6 |
| 42 | <i>Vateria indica</i> | 5.9 | 100 | 5.9 | 0.1 | 17.3 | 6.8 | 83840.6 | 16.8 | 41 |
| 43 | <i>Xanthophyllum arnottianum</i> | 0.5 | 40 | 1.25 | 0 | 1.47 | 2.72 | 1543.15 | 0.31 | 4.5 |
| | | 34.1 | 1470 | 81.7 | | 100 | 100 | 498205 | 100 | 300 |

Table 36 - Site 5

| SL No | Species | D | F | A | A/F | R D | R F | B A | RBA | IVI |
|-------|----------------------------------|-----|-----|------|------|------|------|--------|-------|-----|
| 1 | <i>Aglaiia tomentosa</i> | 0.5 | 40 | 1.25 | 0.03 | 1.02 | 2.99 | 1543.2 | 0.23 | 4.2 |
| 2 | <i>Agrostistachys borneensis</i> | 5.7 | 100 | 5.7 | 0.06 | 11.7 | 7.46 | 47326 | 7.038 | 26 |
| 3 | <i>Artocarpus heterophyllus</i> | 0.1 | 10 | 1 | 0.1 | 0.2 | 0.75 | 454.63 | 0.068 | 1 |
| 4 | <i>Calophyllum polyanthum</i> | 1.3 | 40 | 3.25 | 0.03 | 2.66 | 2.99 | 32569 | 4.844 | 10 |
| 5 | <i>Canarium strictum</i> | 0.1 | 10 | 1 | 0.1 | 0.2 | 0.75 | 223.44 | 0.033 | 1 |
| 6 | <i>Cinnamomum malabatrum</i> | 0.3 | 10 | 3 | 0.3 | 0.61 | 0.75 | 2197 | 0.327 | 1.7 |
| 7 | <i>Croton malabaricus</i> | 0.3 | 20 | 1.5 | 0.08 | 0.61 | 1.49 | 2376.5 | 0.353 | 2.5 |
| 8 | <i>Cullenia exarillata</i> | 6.6 | 80 | 8.25 | 0.07 | 13.5 | 5.97 | 129623 | 19.28 | 39 |
| 9 | <i>Cyathocalyx zeylanica</i> | 1.9 | 60 | 3.17 | 0.03 | 3.89 | 4.48 | 12416 | 1.847 | 10 |
| 10 | <i>Diospyros paniculata</i> | 1.3 | 60 | 2.17 | 0.04 | 2.66 | 4.48 | 9020.2 | 1.342 | 8.5 |
| 11 | <i>Drypetes oblongifolia</i> | 3.5 | 80 | 4.38 | 0.04 | 7.16 | 5.97 | 26426 | 3.93 | 17 |
| 12 | <i>Dysoxylum malabaricum</i> | 0.9 | 40 | 2.25 | 0.03 | 1.84 | 2.99 | 32924 | 4.897 | 9.7 |
| 13 | <i>Elaeocarpus tuberculatus</i> | 0.7 | 30 | 2.33 | 0.08 | 1.43 | 2.24 | 3569.2 | 0.531 | 4.2 |
| 14 | <i>Garcinia gummi-gutta</i> | 0.7 | 40 | 1.75 | 0.02 | 1.43 | 2.99 | 3700 | 0.55 | 5 |
| 15 | <i>Gomphandra coriacea</i> | 0.8 | 60 | 1.33 | 0.02 | 1.64 | 4.48 | 2866.3 | 0.426 | 6.5 |
| 16 | <i>Knema attenuata</i> | 0.4 | 20 | 2 | 0.1 | 0.82 | 1.49 | 2525.3 | 0.376 | 2.7 |
| 17 | <i>Lepisanthes tetraphylla</i> | 0.2 | 10 | 2 | 0.2 | 0.41 | 0.75 | 440.84 | 0.066 | 1.2 |
| 18 | <i>Litsea floribunda</i> | 0.6 | 20 | 3 | 0.15 | 1.23 | 1.49 | 2741.8 | 0.408 | 3.1 |
| 19 | <i>Lophopetalum wightianum</i> | 0.8 | 30 | 2.67 | 0.09 | 1.64 | 2.24 | 22538 | 3.352 | 7.2 |
| 20 | <i>Macaranga peltata</i> | 0.8 | 40 | 2 | 0.05 | 1.64 | 2.99 | 1098.2 | 0.163 | 4.8 |
| 21 | <i>Mallotus tetracoccus</i> | 0.5 | 20 | 2.5 | 0.13 | 1.02 | 1.49 | 4243.1 | 0.631 | 3.1 |
| 22 | <i>Melicope lunu-ankenda</i> | 0.3 | 10 | 3 | 0.3 | 0.61 | 0.75 | 3541 | 0.527 | 1.9 |
| 23 | <i>Meliosma pinnata</i> | 1.5 | 60 | 2.5 | 0.02 | 3.07 | 4.48 | 10195 | 1.516 | 9.1 |
| 24 | <i>Mesua ferrea</i> | 4.9 | 80 | 6.13 | 0.06 | 10 | 5.97 | 88831 | 13.21 | 29 |
| 26 | <i>Myristica beddomei</i> | 0.8 | 40 | 2 | 0.03 | 1.64 | 2.99 | 3395.9 | 0.505 | 5.1 |

| | | | | | | | | | | |
|----|---------------------------------|------|------|------|------|------|------|--------|-------|-----|
| 27 | <i>Nothopegia colebrookeana</i> | 0.2 | 10 | 2 | 0.2 | 0.41 | 0.75 | 2736.7 | 0.407 | 1.6 |
| 28 | <i>Otonophelium stipulaceum</i> | 4.5 | 80 | 5.63 | 0.06 | 9.2 | 5.97 | 18280 | 2.719 | 18 |
| 29 | <i>Palaquium ellipticum</i> | 5.1 | 100 | 5.1 | 0.05 | 10.4 | 7.46 | 149143 | 22.18 | 40 |
| 30 | <i>Syzygium cumini</i> | 0.6 | 40 | 1.5 | 0.04 | 1.23 | 2.99 | 6087.6 | 0.905 | 5.1 |
| 31 | <i>Syzygium munronii</i> | 1.3 | 50 | 2.6 | 0.05 | 2.66 | 3.73 | 12000 | 1.785 | 8.2 |
| 32 | <i>Vateria indica</i> | 1.7 | 50 | 3.4 | 0.07 | 3.48 | 3.73 | 37357 | 5.556 | 13 |
| | | 48.9 | 1340 | | | 100 | 100 | 672391 | 100 | 300 |

Table 37 - Site 6

| SL No | Species | D | F | A | A/F | R D | R F | B A | RBA | IVI |
|-------|----------------------------------|-----|-----|------|------|-----|------|--------|------|-----|
| 1 | <i>Aglaia tomentosa</i> | 0.3 | 10 | 3 | 0.3 | 0.6 | 0.68 | 918.87 | 0.13 | 1.4 |
| 2 | <i>Aglaia barberi</i> | 4.4 | 70 | 6.29 | 0.09 | 8.1 | 4.73 | 36543 | 5.1 | 18 |
| 3 | <i>Antidesma montanum</i> | 2.1 | 70 | 3 | 0.04 | 3.9 | 4.73 | 13312 | 1.86 | 10 |
| 4 | <i>Aporosa lindleyana</i> | 0.6 | 30 | 2 | 0.07 | 1.1 | 2.03 | 2853 | 0.4 | 3.5 |
| 5 | <i>Calophyllum polyanthum</i> | 1.1 | 50 | 2.2 | 0.04 | 2 | 3.38 | 16245 | 2.27 | 7.7 |
| 6 | <i>Canarium strictum</i> | 0.1 | 10 | 1 | 0.1 | 0.2 | 0.68 | 3783.8 | 0.53 | 1.4 |
| 7 | <i>Cullenia exarillata</i> | 6.1 | 100 | 6.1 | 0.06 | 11 | 6.76 | 66825 | 9.33 | 27 |
| 8 | <i>Cyathocalyx zeylanica</i> | 0.3 | 20 | 1.5 | 0.08 | 0.6 | 1.35 | 7319.2 | 1.02 | 2.9 |
| 9 | <i>Diospyros paniculata</i> | 2.8 | 80 | 3.5 | 0.04 | 5.2 | 5.41 | 21403 | 2.99 | 14 |
| 10 | <i>Drypetes malabarica</i> | 3.2 | 50 | 6.4 | 0.13 | 5.9 | 3.38 | 34532 | 4.82 | 14 |
| 11 | <i>Dysoxylum malabaricum</i> | 1.8 | 70 | 2.57 | 0.04 | 3.3 | 4.73 | 26092 | 3.64 | 12 |
| 12 | <i>Macaranga peltata</i> | 0.7 | 30 | 2.33 | 0.08 | 1.3 | 2.03 | 6530.3 | 0.91 | 4.2 |
| 13 | <i>Glochidion ellipticum</i> | 0.4 | 20 | 2 | 0.1 | 0.7 | 1.35 | 315.68 | 0.04 | 2.1 |
| 14 | <i>Holigarna arnottiana</i> | 1.3 | 80 | 1.63 | 0.02 | 2.4 | 5.41 | 10492 | 1.46 | 9.3 |
| 15 | <i>Hydnocarpus pentandra</i> | 0.9 | 40 | 2.25 | 0.06 | 1.7 | 2.7 | 5786.5 | 0.81 | 5.2 |
| 16 | <i>Elaeocarpus tuberculatus</i> | 3.9 | 90 | 4.33 | 0.05 | 7.2 | 6.08 | 30344 | 4.24 | 18 |
| 17 | <i>Litsea coriacea</i> | 0.1 | 10 | 1 | 0.1 | 0.2 | 0.68 | 588.85 | 0.08 | 0.9 |
| 18 | <i>Myristica beddomei</i> | 1.8 | 50 | 3.6 | 0.07 | 3.3 | 3.38 | 6459.7 | 0.9 | 7.6 |
| 19 | <i>Meiogyne pannosa</i> | 0.6 | 20 | 3 | 0.15 | 1.1 | 1.35 | 1605.3 | 0.22 | 2.7 |
| 20 | <i>Mesua ferrea</i> | 4.8 | 100 | 4.8 | 0.05 | 8.9 | 6.76 | 120373 | 16.8 | 32 |
| 21 | <i>Palaquium ellipticum</i> | 5.3 | 100 | 5.3 | 0.05 | 9.8 | 6.76 | 153957 | 21.5 | 38 |
| 22 | <i>Persea macrantha</i> | 1.7 | 60 | 2.83 | 0.05 | 3.1 | 4.05 | 39461 | 5.51 | 13 |
| 23 | <i>Symplocos cochinchinensis</i> | 0.3 | 10 | 3 | 0.3 | 0.6 | 0.68 | 720.86 | 0.1 | 1.3 |
| 24 | <i>Syzygium cumini</i> | 0.8 | 50 | 1.6 | 0.03 | 1.5 | 3.38 | 8474.3 | 1.18 | 6 |
| 25 | <i>Syzygium laetum</i> | 1.1 | 30 | 3.67 | 0.12 | 2 | 2.03 | 5318.1 | 0.74 | 4.8 |

| | | | | | | | | | | |
|----|----------------------------------|-----|------|------|------|-----|------|--------|------|-----|
| 26 | <i>Syzygium mundagam</i> | 0.6 | 40 | 1.5 | 0.04 | 1.1 | 2.7 | 3547.1 | 0.5 | 4.3 |
| 27 | <i>Toona ciliata</i> | 0.9 | 40 | 2.25 | 0.06 | 1.7 | 2.7 | 22036 | 3.08 | 7.4 |
| 28 | <i>Vateria indica</i> | 2.5 | 70 | 3.57 | 0.05 | 4.6 | 4.73 | 45707 | 6.38 | 16 |
| 29 | <i>Xanthophyllum arnottianum</i> | 3.5 | 80 | 4.38 | 0.05 | 6.5 | 5.41 | 24775 | 3.46 | 15 |
| | | 54 | 1480 | | | 100 | 100 | 716319 | 100 | 300 |

Table 38 - Site 7

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|-----------------------------------|-----|-----|-----|------|------|------|--------|------|-----|
| 1 | <i>Aglaia tomentosa</i> | 0.8 | 20 | 4 | 0.2 | 1.89 | 1.5 | 4223.6 | 1.04 | 4.4 |
| 2 | <i>Agrostistachys borneensis</i> | 3.8 | 70 | 5.4 | 0.08 | 8.98 | 5.26 | 23916 | 5.87 | 20 |
| 3 | <i>Alseodaphne semecarpifolia</i> | 0.2 | 20 | 1 | 0.05 | 0.47 | 1.5 | 902.65 | 0.22 | 2.2 |
| 4 | <i>Antidesma montanum</i> | 0.6 | 30 | 2 | 0.07 | 1.42 | 2.26 | 2781.9 | 0.68 | 4.4 |
| 5 | <i>Aporosa bourdillonii</i> | 0.7 | 40 | 1.8 | 0.04 | 1.65 | 3.01 | 6103.6 | 1.5 | 6.2 |
| 6 | <i>Aporosa lindleyana</i> | 0.2 | 20 | 1 | 0.05 | 0.47 | 1.5 | 888.31 | 0.22 | 2.2 |
| 7 | <i>Calophyllum polyanthum</i> | 3.5 | 100 | 3.5 | 0.04 | 8.27 | 7.52 | 30161 | 7.4 | 23 |
| 8 | <i>Canarium strictum</i> | 1.3 | 10 | 13 | 1.3 | 3.07 | 0.75 | 24002 | 5.89 | 9.7 |
| 9 | <i>Croton malabaricus</i> | 0.7 | 30 | 2.3 | 0.08 | 1.65 | 2.26 | 6234.2 | 1.53 | 5.4 |
| 10 | <i>Cullenia exarillata</i> | 1.9 | 80 | 2.4 | 0.03 | 4.49 | 6.02 | 27543 | 6.76 | 17 |
| 11 | <i>Cyathocalyx zeylanica</i> | 0.3 | 20 | 1.5 | 0.08 | 0.71 | 1.5 | 1633.7 | 0.4 | 2.6 |
| 12 | <i>Dendrocnide sinuata</i> | 0.3 | 10 | 3 | 0.3 | 0.71 | 0.75 | 812.54 | 0.2 | 1.7 |
| 13 | <i>Dimorphocalyx lawianus</i> | 0.3 | 10 | 3 | 0.3 | 0.71 | 0.75 | 1849.5 | 0.45 | 1.9 |
| 14 | <i>Diospyros paniculata</i> | 1.6 | 40 | 4 | 0.1 | 3.78 | 3.01 | 21067 | 5.17 | 12 |
| 15 | <i>Drypetes venusta</i> | 1 | 30 | 3.3 | 0.11 | 2.36 | 2.26 | 6890.7 | 1.69 | 6.3 |
| 16 | <i>Dysoxylum malabaricum</i> | 0.7 | 20 | 3.5 | 0.18 | 1.65 | 1.5 | 5115.8 | 1.26 | 4.4 |
| 17 | <i>Elaeocarpus serratus</i> | 0.1 | 10 | 1 | 0.1 | 0.24 | 0.75 | 764.65 | 0.19 | 1.2 |
| 18 | <i>Flacourtia montana</i> | 0.2 | 10 | 2 | 0.2 | 0.47 | 0.75 | 1214 | 0.3 | 1.5 |
| 19 | <i>Glochidion zeylanicum</i> | 0.3 | 20 | 1.5 | 0.08 | 0.71 | 1.5 | 2032.5 | 0.5 | 2.7 |
| 20 | <i>Gomphandra coriacea</i> | 0.2 | 10 | 2 | 0.2 | 0.47 | 0.75 | 947.84 | 0.23 | 1.5 |
| 21 | <i>Gomphandra tetrandra</i> | 0.3 | 10 | 3 | 0.3 | 0.71 | 0.75 | 6125 | 1.5 | 3 |
| 22 | <i>Holigarna grahamii</i> | 0.1 | 10 | 1 | 0.1 | 0.24 | 0.75 | 1742.3 | 0.43 | 1.4 |
| 23 | <i>Hydnocarpus pentandra</i> | 0.2 | 10 | 2 | 0.2 | 0.47 | 0.75 | 4085.4 | 1 | 2.2 |
| 24 | <i>Knema attenuata</i> | 2.8 | 60 | 4.7 | 0.08 | 6.62 | 4.51 | 13516 | 3.32 | 14 |
| 25 | <i>Litsea bourdillonii</i> | 0.2 | 10 | 2 | 0.2 | 0.47 | 0.75 | 551.3 | 0.14 | 1.4 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|-----|------|------|------|--------|------|-----|
| 26 | <i>Litsea floribunda</i> | 0.3 | 20 | 1.5 | 0.08 | 0.71 | 1.5 | 2103.2 | 0.52 | 2.7 |
| 27 | <i>Macaranga peltata</i> | 1 | 40 | 2.5 | 0.06 | 2.36 | 3.01 | 8986.9 | 2.21 | 7.6 |
| 28 | <i>Meiogyne pannosa</i> | 0.9 | 40 | 2.3 | 0.06 | 2.13 | 3.01 | 6456 | 1.58 | 6.7 |
| 29 | <i>Mesua ferrea</i> | 2.2 | 50 | 4.4 | 0.09 | 5.2 | 3.76 | 25482 | 6.25 | 15 |
| 30 | <i>Myristica beddomei</i> | 0.5 | 10 | 5 | 0.5 | 1.18 | 0.75 | 2954.8 | 0.73 | 2.7 |
| 31 | <i>Nothopegia colebrookeana</i> | 0.8 | 40 | 2 | 0.05 | 1.89 | 3.01 | 4997.1 | 1.23 | 6.1 |
| 32 | <i>Otonephelium stipulaceum</i> | 0.8 | 20 | 4 | 0.2 | 1.89 | 1.5 | 5281.7 | 1.3 | 4.7 |
| 33 | <i>Palaquium ellipticum</i> | 2.9 | 80 | 3.6 | 0.05 | 6.86 | 6.02 | 37242 | 9.14 | 22 |
| 34 | <i>Persea macrantha</i> | 1.6 | 30 | 5.3 | 0.18 | 3.78 | 2.26 | 14057 | 3.45 | 9.5 |
| 35 | <i>Polyalthia fragrans</i> | 0.3 | 10 | 3 | 0.3 | 0.71 | 0.75 | 5277.9 | 1.3 | 2.8 |
| 36 | <i>Prunus ceylanica</i> | 0.4 | 30 | 1.3 | 0.04 | 0.95 | 2.26 | 19001 | 4.66 | 7.9 |
| 37 | <i>Psychotria anamalayana</i> | 0.4 | 10 | 4 | 0.4 | 0.95 | 0.75 | 3510.9 | 0.86 | 2.6 |
| 38 | <i>Strobocalyx arborea</i> | 0.3 | 10 | 3 | 0.3 | 0.71 | 0.75 | 1771.1 | 0.43 | 1.9 |
| 39 | <i>Symplocos cochinchinensis</i> | 1 | 40 | 2.5 | 0.06 | 2.36 | 3.01 | 5987.2 | 1.47 | 6.8 |
| 40 | <i>Turpinia malabarica</i> | 1.3 | 50 | 2.6 | 0.05 | 3.07 | 3.76 | 6989 | 1.72 | 8.5 |
| 41 | <i>Vateria indica</i> | 4.1 | 100 | 4.1 | 0.04 | 9.69 | 7.52 | 54854 | 13.5 | 31 |
| 42 | <i>Xanthophyllum arnottianum</i> | 1.2 | 50 | 2.4 | 0.05 | 2.84 | 3.76 | 7387.3 | 1.81 | 8.4 |
| | | 42.3 | 1330 | | | 100 | 100 | 407445 | 100 | 300 |

Table 39 - Site 8

| SL No | Species | D | F | A | A/F | RD | RF | BA | R B A | IVI |
|-------|----------------------------------|-----|-----|-----|------|------|------|--------|-------|-----|
| 1 | <i>Aglaia perviridis</i> | 1.3 | 60 | 2.2 | 0.04 | 2.75 | 3.9 | 8304.9 | 1.07 | 7.7 |
| 2 | <i>Agrostistachys borneensis</i> | 2.6 | 90 | 2.9 | 0.03 | 5.5 | 5.84 | 18522 | 2.39 | 14 |
| 3 | <i>Artocarpus heterophyllus</i> | 0.1 | 10 | 1 | 0.1 | 0.21 | 0.65 | 842.19 | 0.11 | 1 |
| 4 | <i>Bischofia javanica</i> | 1.1 | 30 | 3.7 | 0.12 | 2.33 | 1.95 | 23912 | 3.09 | 7.4 |
| 5 | <i>Calophyllum polyanthum</i> | 0.7 | 30 | 2.3 | 0.08 | 1.48 | 1.95 | 29020 | 3.75 | 7.2 |
| 6 | <i>Chrysophyllum roxburghii</i> | 0.4 | 20 | 2 | 0.1 | 0.85 | 1.3 | 16950 | 2.19 | 4.3 |
| 7 | <i>Chukrasia tabularis</i> | 0.3 | 20 | 1.5 | 0.08 | 0.63 | 1.3 | 6790.1 | 0.88 | 2.8 |
| 8 | <i>Croton malabaricus</i> | 0.3 | 20 | 1.5 | 0.08 | 0.63 | 1.3 | 2110.1 | 0.27 | 2.2 |
| 9 | <i>Cullenia exarillata</i> | 5.1 | 100 | 5.1 | 0.05 | 10.8 | 6.49 | 110747 | 14.3 | 32 |
| 10 | <i>Dimocarpus longan</i> | 0.7 | 40 | 1.8 | 0.04 | 1.48 | 2.6 | 3869.1 | 0.5 | 4.6 |
| 11 | <i>Diospyros paniculata</i> | 1.2 | 50 | 2.4 | 0.05 | 2.54 | 3.25 | 80022 | 10.3 | 16 |
| 12 | <i>Drypetes malabarica</i> | 2.4 | 80 | 3 | 0.04 | 5.07 | 5.19 | 10996 | 1.42 | 12 |
| 13 | <i>Drypetes venusta</i> | 1.3 | 40 | 3.3 | 0.08 | 2.75 | 2.6 | 9856.5 | 1.27 | 6.6 |
| 14 | <i>Dysoxylum malabaricum</i> | 1.2 | 30 | 4 | 0.13 | 2.54 | 1.95 | 37566 | 4.85 | 9.3 |
| 15 | <i>Elaeocarpus tuberculatus</i> | 0.4 | 20 | 2 | 0.1 | 0.85 | 1.3 | 1114.1 | 0.14 | 2.3 |
| 16 | <i>Glochidion ellipticum</i> | 0.1 | 10 | 1 | 0.1 | 0.21 | 0.65 | 198.16 | 0.03 | 0.9 |
| 17 | <i>Gomphandra coriacea</i> | 1.5 | 40 | 3.8 | 0.09 | 3.17 | 2.6 | 7990.2 | 1.03 | 6.8 |
| 18 | <i>Holigarna arnottiana</i> | 0.2 | 10 | 2 | 0.2 | 0.42 | 0.65 | 7973.6 | 1.03 | 2.1 |
| 19 | <i>Hydnocarpus macrocarpa</i> | 0.2 | 10 | 2 | 0.2 | 0.42 | 0.65 | 889.33 | 0.11 | 1.2 |
| 20 | <i>Knema attenuata</i> | 2 | 50 | 4 | 0.08 | 4.23 | 3.25 | 19960 | 2.58 | 10 |
| 21 | <i>Litsea floribunda</i> | 0.9 | 30 | 3 | 0.1 | 1.9 | 1.95 | 3357.3 | 0.43 | 4.3 |
| 22 | <i>Macaranga peltata</i> | 0.6 | 20 | 3 | 0.15 | 1.27 | 1.3 | 6189.2 | 0.8 | 3.4 |
| 23 | <i>Mallotus tetracoccus</i> | 0.7 | 40 | 1.8 | 0.04 | 1.48 | 2.6 | 1888.5 | 0.24 | 4.3 |
| 24 | <i>Meiogyne pannosa</i> | 1.8 | 50 | 3.6 | 0.07 | 3.81 | 3.25 | 9672.2 | 1.25 | 8.3 |
| 25 | <i>Meliosma pinnata</i> | 0.4 | 20 | 2 | 0.1 | 0.85 | 1.3 | 4463 | 0.58 | 2.7 |

| | | | | | | | | | | |
|----|----------------------------------|-----|------|-----|------|------|------|--------|------|-----|
| 26 | <i>Mesua ferrea</i> | 4.1 | 80 | 5.1 | 0.06 | 8.67 | 5.19 | 70422 | 9.09 | 23 |
| 27 | <i>Myristica beddomei</i> | 0.4 | 20 | 2 | 0.1 | 0.85 | 1.3 | 4365.4 | 0.56 | 2.7 |
| 28 | <i>Myristica malabarica</i> | 0.2 | 20 | 1 | 0.05 | 0.42 | 1.3 | 1093.7 | 0.14 | 1.9 |
| 29 | <i>Nothopegia colebrookeana</i> | 0.8 | 50 | 1.6 | 0.03 | 1.69 | 3.25 | 3156.1 | 0.41 | 5.3 |
| 30 | <i>Palaquium ellipticum</i> | 3.3 | 80 | 4.1 | 0.05 | 6.98 | 5.19 | 72021 | 9.3 | 21 |
| 31 | <i>Persea macrantha</i> | 1.2 | 60 | 2 | 0.03 | 2.54 | 3.9 | 41514 | 5.36 | 12 |
| 32 | <i>Poeciloneuron indicum</i> | 0.9 | 40 | 2.3 | 0.06 | 1.9 | 2.6 | 41462 | 5.35 | 9.9 |
| 33 | <i>Prunus ceylanica</i> | 1 | 50 | 2 | 0.04 | 2.11 | 3.25 | 23905 | 3.09 | 8.4 |
| 34 | <i>Psychotria anamalayana</i> | 0.5 | 30 | 1.7 | 0.06 | 1.06 | 1.95 | 2790.3 | 0.36 | 3.4 |
| 35 | <i>Toona ciliata</i> | 0.9 | 30 | 3 | 0.1 | 1.9 | 1.95 | 19998 | 2.58 | 6.4 |
| 36 | <i>Turpinia malabarica</i> | 1.9 | 50 | 3.8 | 0.08 | 4.02 | 3.25 | 22817 | 2.95 | 10 |
| 37 | <i>Vateria indica</i> | 2.2 | 50 | 4.4 | 0.09 | 4.65 | 3.25 | 32643 | 4.22 | 12 |
| 38 | <i>Xanthophyllum arnottianum</i> | 2.4 | 60 | 4 | 0.07 | 5.07 | 3.9 | 15038 | 1.94 | 11 |
| | | 47 | 1540 | | | 100 | 100 | 774428 | 100 | 300 |

Table 40 - Site 9

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|-----------------------------------|-----|-----|------|------|-------|------|--------|------|-----|
| 1 | <i>Aglaia tomentosa</i> | 1.2 | 30 | 4 | 0.13 | 2.709 | 2.13 | 8631.1 | 1.38 | 6.2 |
| 2 | <i>Agrostistachys borneensis</i> | 2.3 | 80 | 2.88 | 0.04 | 5.192 | 5.67 | 14592 | 2.34 | 13 |
| 3 | <i>Alseodaphne semecarpifolia</i> | 0.9 | 40 | 2.25 | 0.06 | 2.032 | 2.84 | 3172.3 | 0.51 | 5.4 |
| 4 | <i>Aporosa lindleyana</i> | 0.4 | 20 | 2 | 0.1 | 0.903 | 1.42 | 1182.6 | 0.19 | 2.5 |
| 5 | <i>Calophyllum polyanthum</i> | 0.9 | 30 | 3 | 0.1 | 2.032 | 2.13 | 28665 | 4.59 | 8.8 |
| 6 | <i>Canarium strictum</i> | 0.4 | 20 | 2 | 0.1 | 0.903 | 1.42 | 26595 | 4.26 | 6.6 |
| 7 | <i>Dendrocnide sinuata</i> | 2.1 | 60 | 3.5 | 0.06 | 4.74 | 4.26 | 3597.7 | 0.58 | 9.6 |
| 8 | <i>Cullenia exarillata</i> | 3.8 | 100 | 3.8 | 0.04 | 8.578 | 7.09 | 49233 | 7.89 | 24 |
| 9 | <i>Cyathocalyx zeylanica</i> | 1.6 | 80 | 2 | 0.03 | 3.612 | 5.67 | 9902 | 1.59 | 11 |
| 10 | <i>Diospyros paniculata</i> | 1.2 | 60 | 2 | 0.03 | 2.709 | 4.26 | 9281 | 1.49 | 8.5 |
| 11 | <i>Drypetes malabarica</i> | 1.1 | 40 | 2.75 | 0.07 | 2.483 | 2.84 | 6340.6 | 1.02 | 6.3 |
| 12 | <i>Drypetes venusta</i> | 1.9 | 90 | 2.11 | 0.02 | 4.289 | 6.38 | 6639.6 | 1.06 | 12 |
| 13 | <i>Dysoxylum malabaricum</i> | 0.2 | 10 | 2 | 0.2 | 0.451 | 0.71 | 12817 | 2.05 | 3.2 |
| 14 | <i>Elaeocarpus tuberculatus</i> | 0.4 | 20 | 2 | 0.1 | 0.903 | 1.42 | 2855.7 | 0.46 | 2.8 |
| 15 | <i>Litsea bourdillonii</i> | 0.8 | 30 | 2.67 | 0.09 | 1.806 | 2.13 | 3241.2 | 0.52 | 4.5 |
| 16 | <i>Garcinia gummi-gutta</i> | 0.3 | 10 | 3 | 0.3 | 0.677 | 0.71 | 1262 | 0.2 | 1.6 |
| 17 | <i>Knema attenuata</i> | 0.2 | 10 | 2 | 0.2 | 0.451 | 0.71 | 1637.7 | 0.26 | 1.4 |
| 18 | <i>Litsea floribunda</i> | 1.9 | 60 | 3.17 | 0.05 | 4.289 | 4.26 | 6829.2 | 1.09 | 9.6 |
| 19 | <i>Macaranga peltata</i> | 2.4 | 80 | 3 | 0.04 | 5.418 | 5.67 | 13932 | 2.23 | 13 |
| 20 | <i>Meiogyne pannosa</i> | 1.1 | 40 | 2.75 | 0.07 | 2.483 | 2.84 | 4313.9 | 0.69 | 6 |
| 21 | <i>Mesua ferrea</i> | 4.2 | 100 | 4.2 | 0.04 | 9.481 | 7.09 | 87989 | 14.1 | 31 |
| 22 | <i>Otonophelium stipulaceum</i> | 1 | 40 | 2.5 | 0.06 | 2.257 | 2.84 | 7387.3 | 1.18 | 6.3 |
| 23 | <i>Palaquium ellipticum</i> | 5.6 | 100 | 5.6 | 0.06 | 12.64 | 7.09 | 149514 | 24 | 44 |
| 24 | <i>Meliosma pinnata</i> | 0.8 | 20 | 4 | 0.2 | 1.806 | 1.42 | 21549 | 3.45 | 6.7 |
| 25 | <i>Toona ciliata</i> | 0.9 | 30 | 3 | 0.1 | 2.032 | 2.13 | 25093 | 4.02 | 8.2 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|------|------|-------|------|--------|------|-----|
| 26 | <i>Syzygium cumini</i> | 1.3 | 50 | 2.6 | 0.05 | 2.935 | 3.55 | 36712 | 5.88 | 12 |
| 27 | <i>Syzygium laetum</i> | 0.1 | 10 | 1 | 0.1 | 0.226 | 0.71 | 240.84 | 0.04 | 1 |
| 28 | <i>Syzygium mundagam</i> | 0.5 | 20 | 2.5 | 0.13 | 1.129 | 1.42 | 3459.3 | 0.55 | 3.1 |
| 29 | <i>Turpinia malabarica</i> | 2.4 | 70 | 3.43 | 0.05 | 5.418 | 4.96 | 30595 | 4.9 | 15 |
| 30 | <i>Vateria indica</i> | 2.3 | 50 | 4.6 | 0.09 | 5.192 | 3.55 | 46441 | 7.44 | 16 |
| 31 | <i>Xanthophyllum arnottianum</i> | 0.1 | 10 | 1 | 0.1 | 0.226 | 0.71 | 149.23 | 0.02 | 1 |
| | | 44.3 | 1410 | | | 100 | 100 | 623850 | 100 | 300 |

Table 41 - Site 10

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|-----------------------------------|-----|----|-------|------|------|------|--------|------|-----|
| 1 | <i>Actinodaphne malabarica</i> | 1.1 | 80 | 1.375 | 0.02 | 2.01 | 3.52 | 21474 | 2.92 | 8.5 |
| 2 | <i>Aglaia perviridis</i> | 0.7 | 40 | 1.75 | 0.04 | 1.28 | 1.76 | 4369.4 | 0.59 | 3.6 |
| 3 | <i>Aglaia tomentosa</i> | 0.4 | 20 | 2 | 0.1 | 0.73 | 0.88 | 2088.3 | 0.28 | 1.9 |
| 4 | <i>Agrostistachys borneensis</i> | 2.9 | 70 | 4.143 | 0.06 | 5.29 | 3.08 | 20835 | 2.84 | 11 |
| 5 | <i>Alseodaphne semecarpifolia</i> | 1 | 50 | 2 | 0.04 | 1.82 | 2.2 | 6417 | 0.87 | 4.9 |
| 6 | <i>Antidesma montanum</i> | 0.5 | 20 | 2.5 | 0.13 | 0.91 | 0.88 | 2031.8 | 0.28 | 2.1 |
| 7 | <i>Aporosa bourdillonii</i> | 0.8 | 40 | 2 | 0.05 | 1.46 | 1.76 | 2758.3 | 0.38 | 3.6 |
| 8 | <i>Aporosa lindleyana</i> | 0.2 | 10 | 2 | 0.2 | 0.36 | 0.44 | 3034.7 | 0.41 | 1.2 |
| 9 | <i>Blachia umbellata</i> | 0.8 | 30 | 2.667 | 0.09 | 1.46 | 1.32 | 2420.1 | 0.33 | 3.1 |
| 10 | <i>Calophyllum polyanthum</i> | 2.3 | 40 | 5.75 | 0.14 | 4.2 | 1.76 | 27518 | 3.75 | 9.7 |
| 11 | <i>Canarium strictum</i> | 0.5 | 20 | 2.5 | 0.13 | 0.91 | 0.88 | 10623 | 1.45 | 3.2 |
| 12 | <i>Croton malabaricus</i> | 0.7 | 30 | 2.333 | 0.08 | 1.28 | 1.32 | 4698.1 | 0.64 | 3.2 |
| 13 | <i>Cullenia exarillata</i> | 2.6 | 90 | 2.889 | 0.03 | 4.74 | 3.96 | 41263 | 5.62 | 14 |
| 14 | <i>Cyathocalyx zeylanica</i> | 1.3 | 70 | 1.857 | 0.03 | 2.37 | 3.08 | 8930.4 | 1.22 | 6.7 |
| 15 | <i>Dendrocnide sinuata</i> | 0.3 | 20 | 1.5 | 0.08 | 0.55 | 0.88 | 878.11 | 0.12 | 1.5 |
| 16 | <i>Diospyros crumenata</i> | 0.9 | 60 | 1.5 | 0.03 | 1.64 | 2.64 | 7898.9 | 1.08 | 5.4 |
| 17 | <i>Diospyros paniculata</i> | 1.4 | 50 | 2.8 | 0.06 | 2.55 | 2.2 | 10053 | 1.37 | 6.1 |
| 18 | <i>Dipterocarpus indicus</i> | 0.7 | 30 | 2.333 | 0.08 | 1.28 | 1.32 | 26902 | 3.66 | 6.3 |
| 19 | <i>Drypetes malabarica</i> | 0.8 | 50 | 1.6 | 0.03 | 1.46 | 2.2 | 9844.8 | 1.34 | 5 |
| 20 | <i>Drypetes venusta</i> | 1.9 | 80 | 2.375 | 0.03 | 3.47 | 3.52 | 11006 | 1.5 | 8.5 |
| 21 | <i>Dysoxylum malabaricum</i> | 1 | 50 | 2 | 0.04 | 1.82 | 2.2 | 38971 | 5.3 | 9.3 |
| 22 | <i>Elaeocarpus serratus</i> | 0.2 | 20 | 1 | 0.05 | 0.36 | 0.88 | 876.12 | 0.12 | 1.4 |
| 23 | <i>Flacourtia montana</i> | 0.1 | 10 | 1 | 0.1 | 0.18 | 0.44 | 541.23 | 0.07 | 0.7 |
| 24 | <i>Garcinia gummi-gutta</i> | 0.2 | 10 | 2 | 0.2 | 0.36 | 0.44 | 912.02 | 0.12 | 0.9 |
| 25 | <i>Glochidion zeylanicum</i> | 0.4 | 20 | 2 | 0.1 | 0.73 | 0.88 | 2584.1 | 0.35 | 2 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|-------|------|------|------|--------|------|-----|
| 26 | <i>Gomphandra tetrandra</i> | 0.6 | 40 | 1.5 | 0.04 | 1.09 | 1.76 | 10184 | 1.39 | 4.2 |
| 27 | <i>Harpullia arborea</i> | 1.5 | 70 | 2.143 | 0.03 | 2.74 | 3.08 | 9770.9 | 1.33 | 7.2 |
| 28 | <i>Hydnocarpus pentandra</i> | 1.3 | 80 | 1.625 | 0.02 | 2.37 | 3.52 | 6338.5 | 0.86 | 6.8 |
| 29 | <i>Ixora brachyata</i> | 0.5 | 50 | 1 | 0.02 | 0.91 | 2.2 | 2148.3 | 0.29 | 3.4 |
| 30 | <i>Knema attenuata</i> | 1 | 60 | 1.667 | 0.03 | 1.82 | 2.64 | 4231.7 | 0.58 | 5 |
| 31 | <i>Litsea floribunda</i> | 0.1 | 10 | 1 | 0.1 | 0.18 | 0.44 | 589.65 | 0.08 | 0.7 |
| 32 | <i>Macaranga peltata</i> | 2.2 | 100 | 2.2 | 0.02 | 4.01 | 4.41 | 17518 | 2.38 | 11 |
| 33 | <i>Meiogyne pannosa</i> | 0.1 | 10 | 1 | 0.1 | 0.18 | 0.44 | 912.12 | 0.12 | 0.7 |
| 34 | <i>Melicope lunu ankenda</i> | 0.2 | 10 | 2 | 0.2 | 0.36 | 0.44 | 1021.2 | 0.14 | 0.9 |
| 35 | <i>Mesua ferrea</i> | 4.3 | 100 | 4.3 | 0.04 | 7.85 | 4.41 | 94985 | 12.9 | 25 |
| 36 | <i>Murraya paniculata</i> | 0.2 | 10 | 2 | 0.2 | 0.36 | 0.44 | 782.72 | 0.11 | 0.9 |
| 37 | <i>Myristica beddomei</i> | 1 | 40 | 2.5 | 0.06 | 1.82 | 1.76 | 19088 | 2.6 | 6.2 |
| 38 | <i>Nothopegia colebrookeana</i> | 0.5 | 40 | 1.25 | 0.03 | 0.91 | 1.76 | 2044.6 | 0.28 | 3 |
| 39 | <i>Orophea uniflora</i> | 0.7 | 50 | 1.4 | 0.03 | 1.28 | 2.2 | 2524.4 | 0.34 | 3.8 |
| 40 | <i>Otonophelium stipulaceum</i> | 1.9 | 40 | 4.75 | 0.12 | 3.47 | 1.76 | 9424.4 | 1.28 | 6.5 |
| 41 | <i>Palaquium ellipticum</i> | 3.6 | 100 | 3.6 | 0.04 | 6.57 | 4.41 | 102102 | 13.9 | 25 |
| 42 | <i>Persea macrantha</i> | 0.5 | 20 | 2.5 | 0.13 | 0.91 | 0.88 | 14821 | 2.02 | 3.8 |
| 43 | <i>Polyalthia fragrans</i> | 1.7 | 40 | 4.25 | 0.11 | 3.1 | 1.76 | 30984 | 4.22 | 9.1 |
| 44 | <i>Prunus ceylanica</i> | 1.6 | 70 | 2.286 | 0.03 | 2.92 | 3.08 | 26133 | 3.56 | 9.6 |
| 45 | <i>Strobocalyx arborea</i> | 0.2 | 10 | 2 | 0.2 | 0.36 | 0.44 | 865.74 | 0.12 | 0.9 |
| 46 | <i>Symplocos cochinchinensis</i> | 0.5 | 20 | 2.5 | 0.13 | 0.91 | 0.88 | 3258.1 | 0.44 | 2.2 |
| 47 | <i>Syzygium mundagam</i> | 0.3 | 10 | 3 | 0.3 | 0.55 | 0.44 | 1609.2 | 0.22 | 1.2 |
| 48 | <i>Toona ciliata</i> | 1.4 | 70 | 2 | 0.03 | 2.55 | 3.08 | 30528 | 4.16 | 9.8 |
| 49 | <i>Turpinia malabarica</i> | 0.9 | 60 | 1.5 | 0.03 | 1.64 | 2.64 | 11256 | 1.53 | 5.8 |
| 50 | <i>Vateria indica</i> | 2.9 | 100 | 2.9 | 0.03 | 5.29 | 4.41 | 51682 | 7.03 | 17 |
| 51 | <i>Xanthophyllum arnottianum</i> | 1.4 | 50 | 2.8 | 0.06 | 2.55 | 2.2 | 10984 | 1.49 | 6.3 |
| | | 54.8 | 2270 | | | 100 | 100 | 734714 | 100 | 300 |

Table 42 - Site 11

| SL No | species | D | F | A | A/F | R D | R F | B A | RBA | IVI |
|-------|----------------------------------|-----|-----|------|------|------|------|--------|------|------|
| 1 | <i>Aglaiia barberi</i> | 1.7 | 50 | 3.4 | 0.07 | 3.2 | 2.82 | 3999.6 | 0.56 | 6.59 |
| 2 | <i>Agrostistachys borneensis</i> | 1.3 | 60 | 2.17 | 0.04 | 2.45 | 3.39 | 4703.8 | 0.66 | 6.5 |
| 3 | <i>Ailanthus triphysa</i> | 1.2 | 40 | 3 | 0.08 | 2.26 | 2.26 | 8372.4 | 1.18 | 5.7 |
| 4 | <i>Antidesma montanum</i> | 0.5 | 20 | 2.5 | 0.13 | 0.94 | 1.13 | 981.06 | 0.14 | 2.21 |
| 5 | <i>Artocarpus heterophyllus</i> | 0.5 | 20 | 2.5 | 0.13 | 0.94 | 1.13 | 1581.6 | 0.22 | 2.29 |
| 6 | <i>Callicarpa tomentosa</i> | 2 | 30 | 6.67 | 0.22 | 3.77 | 1.69 | 11082 | 1.56 | 7.02 |
| 7 | <i>Calophyllum polyanthum</i> | 3.4 | 100 | 3.4 | 0.03 | 6.4 | 5.65 | 38168 | 5.38 | 17.4 |
| 8 | <i>Chukrasia tabularis</i> | 0.7 | 30 | 2.33 | 0.08 | 1.32 | 1.69 | 20862 | 2.94 | 5.95 |
| 9 | <i>Croton malabaricus</i> | 0.7 | 30 | 2.33 | 0.08 | 1.32 | 1.69 | 4288.8 | 0.6 | 3.62 |
| 10 | <i>Cryptocarya anamalayana</i> | 1 | 40 | 2.5 | 0.06 | 1.88 | 2.26 | 5319.3 | 0.75 | 4.89 |
| 11 | <i>Cullenia exarillata</i> | 4.9 | 100 | 4.9 | 0.05 | 9.23 | 5.65 | 88973 | 12.5 | 27.4 |
| 12 | <i>Cyathocalyx zeylanica</i> | 0.5 | 20 | 2.5 | 0.13 | 0.94 | 1.13 | 1678.9 | 0.24 | 2.31 |
| 13 | <i>Diospyros buxifolia</i> | 0.8 | 30 | 2.67 | 0.09 | 1.51 | 1.69 | 17827 | 2.51 | 5.71 |
| 14 | <i>Diosypros assimilis</i> | 1.6 | 70 | 2.29 | 0.03 | 3.01 | 3.95 | 24318 | 3.43 | 10.4 |
| 15 | <i>Drypetes venusta</i> | 1.1 | 40 | 2.75 | 0.07 | 2.07 | 2.26 | 8621.9 | 1.21 | 5.55 |
| 16 | <i>Dysoxylum malabaricum</i> | 1.4 | 80 | 1.75 | 0.02 | 2.64 | 4.52 | 42690 | 6.02 | 13.2 |
| 17 | <i>Ficus nervosa</i> | 0.3 | 20 | 1.5 | 0.08 | 0.56 | 1.13 | 1163.5 | 0.16 | 1.86 |
| 18 | <i>Garcinia gummi-gutta</i> | 0.1 | 10 | 1 | 0.1 | 0.19 | 0.56 | 9074.2 | 1.28 | 2.03 |
| 19 | <i>Glochidion ellipticum</i> | 1.3 | 60 | 2.17 | 0.04 | 2.45 | 3.39 | 39631 | 5.58 | 11.4 |
| 20 | <i>Holigarna arnottiana</i> | 2.1 | 60 | 3.5 | 0.06 | 3.95 | 3.39 | 35763 | 5.04 | 12.4 |
| 21 | <i>Hydnocarpus macrocarpa</i> | 0.1 | 10 | 1 | 0.1 | 0.19 | 0.56 | 723.25 | 0.1 | 0.86 |
| 22 | <i>Knema attenuata</i> | 0.8 | 20 | 4 | 0.2 | 1.51 | 1.13 | 3349.5 | 0.47 | 3.11 |
| 23 | <i>Macaranga peltata</i> | 1 | 80 | 1.25 | 0.02 | 1.88 | 4.52 | 5989.2 | 0.84 | 7.25 |
| 24 | <i>Mesua ferrea</i> | 3.5 | 100 | 3.5 | 0.04 | 6.59 | 5.65 | 33711 | 4.75 | 17 |
| 25 | <i>Orophea erythrocarpa</i> | 0.9 | 40 | 2.25 | 0.06 | 1.69 | 2.26 | 4018.5 | 0.57 | 4.52 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|------|------|------|------|--------|------|------|
| 26 | <i>Otonephelium stipulaceum</i> | 2 | 90 | 2.22 | 0.02 | 3.77 | 5.08 | 10921 | 1.54 | 10.4 |
| 27 | <i>Palaquium ellipticum</i> | 6.3 | 100 | 6.3 | 0.06 | 11.9 | 5.65 | 105800 | 14.9 | 32.4 |
| 28 | <i>Persea macrantha</i> | 1.6 | 50 | 3.2 | 0.06 | 3.01 | 2.82 | 52190 | 7.35 | 13.2 |
| 29 | <i>Poeciloneuron indicum</i> | 1.2 | 60 | 2 | 0.03 | 2.26 | 3.39 | 45181 | 6.37 | 12 |
| 30 | <i>Schefflera wallichiana</i> | 1.9 | 80 | 2.38 | 0.03 | 3.58 | 4.52 | 9328 | 1.31 | 9.41 |
| 31 | <i>Symplocos macrophylla</i> | 0.7 | 20 | 3.5 | 0.18 | 1.32 | 1.13 | 2839.3 | 0.4 | 2.85 |
| 32 | <i>Syzygium laetum</i> | 0.6 | 20 | 3 | 0.15 | 1.13 | 1.13 | 2914.8 | 0.41 | 2.67 |
| 33 | <i>Syzygium lanceolatum</i> | 0.5 | 20 | 2.5 | 0.13 | 0.94 | 1.13 | 2447.5 | 0.34 | 2.42 |
| 34 | <i>Syzygium mundagam</i> | 0.9 | 40 | 2.25 | 0.06 | 1.69 | 2.26 | 3096.9 | 0.44 | 4.39 |
| 35 | <i>Vateria indica</i> | 2.2 | 80 | 2.75 | 0.03 | 4.14 | 4.52 | 44723 | 6.3 | 15 |
| 36 | <i>Xanthophyllum arnottianum</i> | 1.8 | 50 | 3.6 | 0.07 | 3.39 | 2.82 | 13325 | 1.88 | 8.09 |
| | | 53.1 | 1770 | | | 100 | 100 | 709660 | 100 | 300 |

Table 43 - Site 12

| SL No | Species | D | F | A | A/F | R D | R F | B A | RBA | IVI |
|-------|----------------------------------|-----|-----|-------|------|-------|-------|--------|-------|------|
| 1 | <i>Actinodaphne malabarica</i> | 0.9 | 30 | 3 | 0.1 | 2.211 | 2.29 | 26960 | 3.751 | 8.25 |
| 2 | <i>Agrostistachys borneensis</i> | 2.4 | 80 | 3 | 0.04 | 5.897 | 6.107 | 19081 | 2.655 | 14.7 |
| 3 | <i>Aglaia barberi</i> | 1.1 | 10 | 11 | 1.1 | 2.703 | 0.763 | 18607 | 2.589 | 6.05 |
| 4 | <i>Antidesma montanum</i> | 0.7 | 40 | 1.75 | 0.04 | 1.72 | 3.053 | 3094 | 0.43 | 5.2 |
| 5 | <i>Aphanamixis polystachya</i> | 1.7 | 60 | 2.833 | 0.05 | 4.177 | 4.58 | 5273.1 | 0.734 | 9.49 |
| 6 | <i>Artocarpus heterophyllus</i> | 0.3 | 20 | 1.5 | 0.08 | 0.737 | 1.527 | 1566.4 | 0.218 | 2.48 |
| 7 | <i>Callicarpa tomentosa</i> | 0.1 | 10 | 1 | 0.1 | 0.246 | 0.763 | 365.86 | 0.051 | 1.06 |
| 8 | <i>Calophyllum polyanthum</i> | 0.6 | 60 | 1 | 0.02 | 1.474 | 4.58 | 19415 | 2.701 | 8.76 |
| 9 | <i>Chukrasia tabularis</i> | 3.2 | 80 | 4 | 0.05 | 7.862 | 6.107 | 63560 | 8.843 | 22.8 |
| 10 | <i>Cinnamomum verum</i> | 0.2 | 20 | 1 | 0.05 | 0.491 | 1.527 | 1305.4 | 0.182 | 2.2 |
| 11 | <i>Croton malabaricus</i> | 0.4 | 10 | 4 | 0.4 | 0.983 | 0.763 | 2641 | 0.367 | 2.11 |
| 12 | <i>Cullenia exarillata</i> | 5.1 | 100 | 5.1 | 0.05 | 12.53 | 7.634 | 101323 | 14.1 | 34.3 |
| 13 | <i>Cyathocalyx zeylanica</i> | 0.1 | 10 | 1 | 0.1 | 0.246 | 0.763 | 554.04 | 0.077 | 1.09 |
| 14 | <i>Diospyros sylvatica</i> | 0.6 | 30 | 2 | 0.07 | 1.474 | 2.29 | 2387.8 | 0.332 | 4.1 |
| 15 | <i>Drypetes venusta</i> | 1.6 | 40 | 4 | 0.1 | 3.931 | 3.053 | 16840 | 2.343 | 9.33 |
| 16 | <i>Dysoxylum malabaricum</i> | 2.2 | 30 | 7.333 | 0.24 | 5.405 | 2.29 | 45594 | 6.343 | 14 |
| 17 | <i>Garcinia gummi-gutta</i> | 0.4 | 20 | 2 | 0.1 | 0.983 | 1.527 | 2734.9 | 0.38 | 2.89 |
| 18 | <i>Holigarna arnottiana</i> | 0.4 | 30 | 1.333 | 0.04 | 0.983 | 2.29 | 13625 | 1.896 | 5.17 |
| 19 | <i>Knema attenuata</i> | 0.9 | 70 | 1.286 | 0.02 | 2.211 | 5.344 | 5004.5 | 0.696 | 8.25 |
| 20 | <i>Macaranga peltata</i> | 0.2 | 10 | 2 | 0.2 | 0.491 | 0.763 | 2539.6 | 0.353 | 1.61 |
| 21 | <i>Mesua ferrea</i> | 4.3 | 80 | 5.375 | 0.07 | 10.57 | 6.107 | 97850 | 13.61 | 30.3 |
| 22 | <i>Otonophelium stipulaceum</i> | 2 | 40 | 5 | 0.13 | 4.914 | 3.053 | 12589 | 1.751 | 9.72 |
| 23 | <i>Palaquium ellipticum</i> | 3.2 | 100 | 3.2 | 0.03 | 7.862 | 7.634 | 97762 | 13.6 | 29.1 |
| 24 | <i>Persea macrantha</i> | 1.8 | 60 | 3 | 0.05 | 4.423 | 4.58 | 53674 | 7.467 | 16.5 |
| 25 | <i>Poeciloneuron indicum</i> | 0.6 | 40 | 1.5 | 0.04 | 1.474 | 3.053 | 38453 | 5.35 | 9.88 |
| 26 | <i>Syzygium laetum</i> | 0.4 | 20 | 2 | 0.1 | 0.983 | 1.527 | 2765.8 | 0.385 | 2.89 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|-------|------|-------|-------|--------|-------|------|
| 27 | <i>Syzygium lanceolatum</i> | 0.1 | 10 | 1 | 0.1 | 0.246 | 0.763 | 650.02 | 0.09 | 1.1 |
| 28 | <i>Vateria indica</i> | 1.9 | 80 | 2.375 | 0.03 | 4.668 | 6.107 | 37357 | 5.197 | 16 |
| 29 | <i>Vepris bilocularis</i> | 0.8 | 50 | 1.6 | 0.03 | 1.966 | 3.817 | 6865.5 | 0.955 | 6.74 |
| 30 | <i>Xanthophyllum arnottianum</i> | 2.5 | 70 | 3.571 | 0.05 | 6.143 | 5.344 | 18345 | 2.552 | 14 |
| | | 40.7 | 1310 | | | 100 | 100 | 718783 | 100 | 300 |

Table 44 - Site 13

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|-----------------------------------|-----|-----|------|------|-------|------|--------|------|-----|
| 1 | <i>Actinodaphne malabarica</i> | 0.9 | 40 | 2.25 | 0.06 | 1.94 | 2.13 | 16027 | 2.95 | 7 |
| 2 | <i>Aglaiia perviridis</i> | 0.7 | 20 | 3.5 | 0.18 | 1.509 | 1.06 | 2623.8 | 0.48 | 3.1 |
| 3 | <i>Aglaiia tomentosa</i> | 0.2 | 20 | 1 | 0.05 | 0.431 | 1.06 | 3518.9 | 0.65 | 2.1 |
| 4 | <i>Agrostistachys borneensis</i> | 1.1 | 60 | 1.83 | 0.03 | 2.371 | 3.19 | 8417.9 | 1.55 | 7.1 |
| 5 | <i>Ailanthus triphysa</i> | 0.9 | 40 | 2.25 | 0.06 | 1.94 | 2.13 | 7330.8 | 1.35 | 5.4 |
| 6 | <i>Alseodaphne semecarpifolia</i> | 1.9 | 70 | 2.71 | 0.04 | 4.095 | 3.72 | 9100.8 | 1.68 | 9.5 |
| 7 | <i>Antidesma montanum</i> | 0.2 | 10 | 2 | 0.2 | 0.431 | 0.53 | 559.83 | 0.1 | 1.1 |
| 8 | <i>Aporosa lindleyana</i> | 0.7 | 30 | 2.33 | 0.08 | 1.509 | 1.6 | 5118.4 | 0.94 | 4 |
| 9 | <i>Artocarpus hirsutus</i> | 0.3 | 20 | 1.5 | 0.08 | 0.647 | 1.06 | 3595.6 | 0.66 | 2.4 |
| 10 | <i>Baccaurea courtallensis</i> | 1.7 | 60 | 2.83 | 0.05 | 3.664 | 3.19 | 4918.4 | 0.91 | 7.8 |
| 11 | <i>Bischofia javanica</i> | 1.6 | 90 | 1.78 | 0.02 | 3.448 | 4.79 | 22982 | 4.24 | 12 |
| 12 | <i>Calophyllum polyanthum</i> | 2.3 | 100 | 2.3 | 0.02 | 4.957 | 5.32 | 10701 | 1.97 | 12 |
| 13 | <i>Canarium strictum</i> | 0.7 | 40 | 1.75 | 0.04 | 1.509 | 2.13 | 5471 | 1.01 | 4.6 |
| 14 | <i>Chionanthus mala-elengi</i> | 0.5 | 20 | 2.5 | 0.13 | 1.078 | 1.06 | 7868.8 | 1.45 | 3.6 |
| 15 | <i>Cinnamomum verum</i> | 1 | 70 | 1.43 | 0.02 | 2.155 | 3.72 | 5909.4 | 1.09 | 7 |
| 16 | <i>Croton malabaricus</i> | 0.3 | 20 | 1.5 | 0.08 | 0.647 | 1.06 | 3880.3 | 0.72 | 2.4 |
| 17 | <i>Cullenia exarillata</i> | 3.5 | 100 | 3.5 | 0.04 | 7.543 | 5.32 | 88343 | 16.3 | 29 |
| 18 | <i>Dimocarpus longan</i> | 0.7 | 40 | 1.75 | 0.04 | 1.509 | 2.13 | 2155.7 | 0.4 | 4 |
| 19 | <i>Diospyros bourdillonii</i> | 0.1 | 10 | 1 | 0.1 | 0.216 | 0.53 | 662.62 | 0.12 | 0.9 |
| 20 | <i>Dipterocarpus indicus</i> | 1.6 | 70 | 2.29 | 0.03 | 3.448 | 3.72 | 19110 | 3.52 | 11 |
| 21 | <i>Dysoxylum beddomei</i> | 0.2 | 10 | 2 | 0.2 | 0.431 | 0.53 | 510.13 | 0.09 | 1.1 |
| 22 | <i>Dysoxylum malabaricum</i> | 1.9 | 80 | 2.38 | 0.03 | 4.095 | 4.26 | 42273 | 7.79 | 16 |
| 23 | <i>Glochidion zeylanicum</i> | 0.9 | 50 | 1.8 | 0.04 | 1.94 | 2.66 | 10113 | 1.86 | 6.5 |
| 24 | <i>Holigarna arnottiana</i> | 0.8 | 40 | 2 | 0.05 | 1.724 | 2.13 | 7182.3 | 1.32 | 5.2 |
| 25 | <i>Lophopetalum wightianum</i> | 0.3 | 20 | 1.5 | 0.08 | 0.647 | 1.06 | 4548.7 | 0.84 | 2.5 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|------|------|-------|------|--------|------|-----|
| 26 | <i>Macaranga peltata</i> | 0.4 | 10 | 4 | 0.4 | 0.862 | 0.53 | 10145 | 1.87 | 3.3 |
| 27 | <i>Mallotus tetracoccus</i> | 1.2 | 50 | 2.4 | 0.05 | 2.586 | 2.66 | 5110.3 | 0.94 | 6.2 |
| 28 | <i>Melicope lunu-ankenda</i> | 0.2 | 10 | 2 | 0.2 | 0.431 | 0.53 | 1632.7 | 0.3 | 1.3 |
| 29 | <i>Mesua ferrea</i> | 4.4 | 100 | 4.4 | 0.04 | 9.483 | 5.32 | 59517 | 11 | 26 |
| 30 | <i>Otonophelium stipulaceum</i> | 1.7 | 60 | 2.83 | 0.05 | 3.664 | 3.19 | 20676 | 3.81 | 11 |
| 31 | <i>Palaquium ellipticum</i> | 3.7 | 100 | 3.7 | 0.04 | 7.974 | 5.32 | 36142 | 6.66 | 20 |
| 32 | <i>Persea macrantha</i> | 1.5 | 70 | 2.14 | 0.03 | 3.233 | 3.72 | 4386.9 | 0.81 | 7.8 |
| 33 | <i>Polyalthia fragrans</i> | 1.4 | 60 | 2.33 | 0.04 | 3.017 | 3.19 | 21650 | 3.99 | 10 |
| 34 | <i>Prunus ceylanica</i> | 0.8 | 20 | 4 | 0.2 | 1.724 | 1.06 | 9875.8 | 1.82 | 4.6 |
| 35 | <i>Psychotria anamalayana</i> | 0.3 | 10 | 3 | 0.3 | 0.647 | 0.53 | 2462.9 | 0.45 | 1.6 |
| 36 | <i>Pterospermum reticulatum</i> | 0.4 | 20 | 2 | 0.1 | 0.862 | 1.06 | 5400.2 | 1 | 2.9 |
| 37 | <i>Strobocalyx arborea</i> | 1.3 | 60 | 2.17 | 0.04 | 2.802 | 3.19 | 10910 | 2.01 | 8 |
| 38 | <i>Symplocos cochinchinensis</i> | 0.2 | 10 | 2 | 0.2 | 0.431 | 0.53 | 3869.5 | 0.71 | 1.7 |
| 39 | <i>Trichilia connaroides</i> | 0.7 | 30 | 2.33 | 0.08 | 1.509 | 1.6 | 8081.3 | 1.49 | 4.6 |
| 40 | <i>Turpinia malabarica</i> | 1 | 40 | 2.5 | 0.06 | 2.155 | 2.13 | 19261 | 3.55 | 7.8 |
| 41 | <i>Vateria indica</i> | 2.2 | 100 | 2.2 | 0.02 | 4.741 | 5.32 | 30412 | 5.61 | 16 |
| | | 46.4 | 1880 | | | 100 | 100 | 542456 | 100 | 300 |

Table 45 - Site 14

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|----------------------------------|-----|-----|------|------|------|------|--------|-------|-----|
| 1 | <i>Actinodaphne malabarica</i> | 0.7 | 20 | 3.5 | 0.18 | 1.54 | 1.31 | 3172.3 | 0.489 | 3.3 |
| 2 | <i>Aglaia tomentosa</i> | 0.9 | 40 | 2.25 | 0.06 | 1.97 | 2.61 | 5947.2 | 0.916 | 5.5 |
| 3 | <i>Agrostistachys borneensis</i> | 1.2 | 40 | 3 | 0.08 | 2.63 | 2.61 | 9578.2 | 1.475 | 6.7 |
| 4 | <i>Artocarpus heterophyllus</i> | 0.6 | 20 | 3 | 0.15 | 1.32 | 1.31 | 7025.1 | 1.082 | 3.7 |
| 5 | <i>Bischofia javanica</i> | 0.3 | 20 | 1.5 | 0.08 | 0.66 | 1.31 | 2791.5 | 0.43 | 2.4 |
| 6 | <i>Calophyllum polyanthum</i> | 1.4 | 60 | 2.33 | 0.04 | 3.07 | 3.92 | 1500.2 | 0.231 | 7.2 |
| 7 | <i>Chrysophyllum roxburghii</i> | 0.7 | 20 | 3.5 | 0.18 | 1.54 | 1.31 | 20238 | 3.116 | 6 |
| 8 | <i>Cullenia exarillata</i> | 3.8 | 100 | 3.8 | 0.04 | 8.33 | 6.54 | 93150 | 14.34 | 29 |
| 9 | <i>Croton malabaricus</i> | 2.1 | 60 | 3.5 | 0.06 | 4.61 | 3.92 | 26243 | 4.041 | 13 |
| 10 | <i>Chukrasia tabularis</i> | 1.1 | 40 | 2.75 | 0.07 | 2.41 | 2.61 | 8213.3 | 1.265 | 6.3 |
| 11 | <i>Dendrocnide sinuata</i> | 0.5 | 20 | 2.5 | 0.13 | 1.1 | 1.31 | 2927.3 | 0.451 | 2.9 |
| 12 | <i>Diospyros paniculata</i> | 1.6 | 80 | 2 | 0.03 | 3.51 | 5.23 | 8797.1 | 1.355 | 10 |
| 13 | <i>Dipterocarpus indicus</i> | 1.4 | 60 | 2.33 | 0.04 | 3.07 | 3.92 | 31443 | 4.842 | 12 |
| 14 | <i>Drypetes venusta</i> | 1.6 | 50 | 3.2 | 0.06 | 3.51 | 3.27 | 9791.5 | 1.508 | 8.3 |
| 15 | <i>Elaeocarpus tuberculatus</i> | 0.8 | 20 | 4 | 0.2 | 1.75 | 1.31 | 3049.8 | 0.47 | 3.5 |
| 16 | <i>Gomphandra coriacea</i> | 0.3 | 20 | 1.5 | 0.08 | 0.66 | 1.31 | 1651.2 | 0.254 | 2.2 |
| 17 | <i>Holigarna arnottiana</i> | 1.6 | 40 | 4 | 0.1 | 3.51 | 2.61 | 27120 | 4.176 | 10 |
| 18 | <i>Hydnocarpus macrocarpa</i> | 0.9 | 40 | 2.25 | 0.06 | 1.97 | 2.61 | 4011.2 | 0.618 | 5.2 |
| 19 | <i>Knema attenuata</i> | 1.9 | 80 | 2.38 | 0.03 | 4.17 | 5.23 | 10237 | 1.576 | 11 |
| 20 | <i>Litsea floribunda</i> | 1.1 | 30 | 3.67 | 0.12 | 2.41 | 1.96 | 5315.4 | 0.819 | 5.2 |
| 21 | <i>Macaranga peltata</i> | 1.7 | 50 | 3.4 | 0.07 | 3.73 | 3.27 | 11679 | 1.799 | 8.8 |
| 22 | <i>Mesua ferrea</i> | 2.9 | 80 | 3.63 | 0.05 | 6.36 | 5.23 | 26770 | 4.122 | 16 |
| 23 | <i>Myristica malabarica</i> | 0.4 | 20 | 2 | 0.1 | 0.88 | 1.31 | 1978.3 | 0.305 | 2.5 |
| 24 | <i>Otonophelium stipulaceum</i> | 0.9 | 40 | 2.25 | 0.06 | 1.97 | 2.61 | 7282.7 | 1.121 | 5.7 |
| 25 | <i>Palaquium ellipticum</i> | 3.9 | 100 | 3.9 | 0.04 | 8.55 | 6.54 | 64555 | 9.941 | 25 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|------|------|------|------|--------|-------|-----|
| 26 | <i>Persea macrantha</i> | 1.2 | 30 | 4 | 0.13 | 2.63 | 1.96 | 39461 | 6.077 | 11 |
| 27 | <i>Poeciloneuron indicum</i> | 0.2 | 10 | 2 | 0.2 | 0.44 | 0.65 | 9797.5 | 1.509 | 2.6 |
| 28 | <i>Prunus ceylanica</i> | 1.1 | 60 | 1.83 | 0.03 | 2.41 | 3.92 | 23218 | 3.575 | 9.9 |
| 29 | <i>Psychotria anamalayana</i> | 0.7 | 20 | 3.5 | 0.18 | 1.54 | 1.31 | 14090 | 2.17 | 5 |
| 30 | <i>Symplocos cochinchinensis</i> | 0.3 | 10 | 3 | 0.3 | 0.66 | 0.65 | 1574.9 | 0.243 | 1.6 |
| 31 | <i>Toona ciliata</i> | 1.1 | 40 | 2.75 | 0.07 | 2.41 | 2.61 | 28034 | 4.317 | 9.3 |
| 32 | <i>Turpinia malabarica</i> | 1.4 | 40 | 3.5 | 0.09 | 3.07 | 2.61 | 16552 | 2.549 | 8.2 |
| 33 | <i>Vateria indica</i> | 3.5 | 100 | 3.5 | 0.04 | 7.68 | 6.54 | 111800 | 17.22 | 31 |
| 34 | <i>Xanthophyllum arnottianum</i> | 1.8 | 70 | 2.57 | 0.04 | 3.95 | 4.58 | 10388 | 1.6 | 10 |
| | | 45.6 | 1530 | | | 100 | 100 | 649382 | 100 | 300 |

Table 46 - Site 15

| SL No | species | D | F | A | A/F | R D | R F | B A | RBA | IVI |
|-------|----------------------------------|-----|-----|------|------|------|-------|---------|------|-----|
| 1 | <i>Agrostistachys borneensis</i> | 2.3 | 80 | 2.88 | 0.04 | 4.5 | 5 | 16534.2 | 2.25 | 12 |
| 2 | <i>Ailanthus triphysa</i> | 0.8 | 40 | 2 | 0.05 | 1.57 | 2.5 | 7412.34 | 1.01 | 5.1 |
| 3 | <i>Antidesma montanum</i> | 0.3 | 20 | 1.5 | 0.08 | 0.59 | 1.25 | 755.255 | 0.1 | 1.9 |
| 4 | <i>Artocarpus heterophyllus</i> | 0.4 | 20 | 2 | 0.1 | 0.78 | 1.25 | 1389.26 | 0.19 | 2.2 |
| 5 | <i>Callicarpa tomentosa</i> | 1.6 | 40 | 4 | 0.1 | 3.13 | 2.5 | 7486.78 | 1.02 | 6.6 |
| 6 | <i>Calophyllum polyanthum</i> | 2.6 | 80 | 3.25 | 0.04 | 5.09 | 5 | 26160.3 | 3.55 | 14 |
| 7 | <i>Chukrasia tabularis</i> | 0.3 | 20 | 1.5 | 0.08 | 0.59 | 1.25 | 15891.8 | 2.16 | 4 |
| 8 | <i>Cinnamomum verum</i> | 1.9 | 60 | 3.17 | 0.05 | 3.72 | 3.75 | 6846.66 | 0.93 | 8.4 |
| 9 | <i>Croton malabaricus</i> | 0.7 | 20 | 3.5 | 0.18 | 1.37 | 1.25 | 4239.71 | 0.58 | 3.2 |
| 10 | <i>Cryptocarya wightiana</i> | 1 | 30 | 3.33 | 0.11 | 1.96 | 1.875 | 5319.27 | 0.72 | 4.6 |
| 11 | <i>Cullenia exarillata</i> | 3.1 | 100 | 3.1 | 0.03 | 6.07 | 6.25 | 79961.2 | 10.9 | 23 |
| 12 | <i>Cyathocalyx zeylanica</i> | 1.2 | 30 | 4 | 0.13 | 2.35 | 1.875 | 8058.2 | 1.09 | 5.3 |
| 13 | <i>Diospyros buxifolia</i> | 0.9 | 30 | 3 | 0.1 | 1.76 | 1.875 | 19827.9 | 2.69 | 6.3 |
| 14 | <i>Diospyros sylvatica</i> | 1.8 | 100 | 1.8 | 0.02 | 3.52 | 6.25 | 42606 | 5.79 | 16 |
| 15 | <i>Diospyros assimilis</i> | 2 | 50 | 4 | 0.08 | 3.91 | 3.125 | 29985.1 | 4.07 | 11 |
| 16 | <i>Drypetes venusta</i> | 0.9 | 30 | 3 | 0.1 | 1.76 | 1.875 | 3551.27 | 0.48 | 4.1 |
| 17 | <i>Dysoxylum malabaricum</i> | 0.4 | 20 | 2 | 0.1 | 0.78 | 1.25 | 25491.6 | 3.46 | 5.5 |
| 18 | <i>Garcinia gummi-gutta</i> | 0.2 | 10 | 2 | 0.2 | 0.39 | 0.625 | 12674.9 | 1.72 | 2.7 |
| 19 | <i>Holigarna arnottiana</i> | 1.9 | 50 | 3.8 | 0.08 | 3.72 | 3.125 | 31482.7 | 4.28 | 11 |
| 20 | <i>Knema attenuata</i> | 1.5 | 50 | 3 | 0.06 | 2.94 | 3.125 | 8147.85 | 1.11 | 7.2 |
| 21 | <i>Macaranga peltata</i> | 3.7 | 100 | 3.7 | 0.04 | 7.24 | 6.25 | 36259.5 | 4.92 | 18 |
| 22 | <i>Mesua ferrea</i> | 3.1 | 100 | 3.1 | 0.03 | 6.07 | 6.25 | 31836.9 | 4.32 | 17 |
| 23 | <i>Orophea erythrocarpa</i> | 1.1 | 60 | 1.83 | 0.03 | 2.15 | 3.75 | 4276.27 | 0.58 | 6.5 |
| 24 | <i>Otonophelium stipulaceum</i> | 1.4 | 30 | 4.67 | 0.16 | 2.74 | 1.875 | 9640.13 | 1.31 | 5.9 |
| 25 | <i>Palaquium ellipticum</i> | 5.8 | 100 | 5.8 | 0.06 | 11.4 | 6.25 | 135801 | 18.4 | 36 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|------|------|------|-------|---------|------|-----|
| 26 | <i>Paracroton pendulus</i> | 0.5 | 20 | 2.5 | 0.13 | 0.98 | 1.25 | 7827.07 | 1.06 | 3.3 |
| 27 | <i>Persea macrantha</i> | 0.5 | 20 | 2.5 | 0.13 | 0.98 | 1.25 | 21688.5 | 2.95 | 5.2 |
| 28 | <i>Poeciloneuron indicum</i> | 1.7 | 50 | 3.4 | 0.07 | 3.33 | 3.125 | 52586.9 | 7.14 | 14 |
| 29 | <i>Strombosia ceylanica</i> | 0.1 | 10 | 1 | 0.1 | 0.2 | 0.625 | 612.98 | 0.08 | 0.9 |
| 30 | <i>Symplocos macrophylla</i> | 0.5 | 20 | 2.5 | 0.13 | 0.98 | 1.25 | 2499.84 | 0.34 | 2.6 |
| 31 | <i>Syzygium laetum</i> | 0.6 | 20 | 3 | 0.15 | 1.17 | 1.25 | 2874.76 | 0.39 | 2.8 |
| 32 | <i>Syzygium lanceolatum</i> | 0.3 | 10 | 3 | 0.3 | 0.59 | 0.625 | 2057.8 | 0.28 | 1.5 |
| 33 | <i>Syzygium mundagam</i> | 0.6 | 30 | 2 | 0.07 | 1.17 | 1.875 | 2598.57 | 0.35 | 3.4 |
| 34 | <i>Vateria indica</i> | 2.9 | 80 | 3.63 | 0.05 | 5.68 | 5 | 56718.1 | 7.7 | 18 |
| 35 | <i>Xanthophyllum arnottianum</i> | 2.5 | 70 | 3.57 | 0.05 | 4.89 | 4.375 | 15136.5 | 2.06 | 11 |
| | | 51.1 | 1600 | | | 100 | 100 | 736237 | 100 | 300 |

Table 47 - Site 16

| SL No | Species | D | F | A | A/F | R D | R F | B A | RBA | IVI |
|-------|----------------------------------|-----|-----|------|------|------|------|--------|------|------|
| 1 | <i>Aglaia barberi</i> | 2.9 | 70 | 4.14 | 0.06 | 6.73 | 5.65 | 70344 | 9.93 | 22.3 |
| 2 | <i>Agrostistachys borneensis</i> | 3.3 | 80 | 4.13 | 0.05 | 7.66 | 6.45 | 23320 | 3.29 | 17.4 |
| 3 | <i>Ailanthus triphysa</i> | 0.4 | 10 | 4 | 0.4 | 0.93 | 0.81 | 16683 | 2.35 | 4.09 |
| 4 | <i>Antidesma montanum</i> | 0.7 | 40 | 1.75 | 0.04 | 1.62 | 3.23 | 2316.3 | 0.33 | 5.18 |
| 5 | <i>Artocarpus heterophyllus</i> | 0.2 | 20 | 1 | 0.05 | 0.46 | 1.61 | 835.72 | 0.12 | 2.19 |
| 6 | <i>Callicarpa tomentosa</i> | 0.1 | 10 | 1 | 0.1 | 0.23 | 0.81 | 300.86 | 0.04 | 1.08 |
| 7 | <i>Calophyllum polyanthum</i> | 0.6 | 30 | 2 | 0.07 | 1.39 | 2.42 | 18910 | 2.67 | 6.48 |
| 8 | <i>Cinnamomum verum</i> | 0.2 | 20 | 1 | 0.05 | 0.46 | 1.61 | 1205.4 | 0.17 | 2.25 |
| 9 | <i>Croton malabaricus</i> | 0.1 | 10 | 1 | 0.1 | 0.23 | 0.81 | 198.86 | 0.03 | 1.07 |
| 10 | <i>Cullenia exarillata</i> | 4.8 | 100 | 4.8 | 0.05 | 11.1 | 8.06 | 105999 | 15 | 34.2 |
| 11 | <i>Cyathocalyx zeylanica</i> | 0.1 | 10 | 1 | 0.1 | 0.23 | 0.81 | 864.04 | 0.12 | 1.16 |
| 12 | <i>Diospyros sylvatica</i> | 1.1 | 50 | 2.2 | 0.04 | 2.55 | 4.03 | 21275 | 3 | 9.59 |
| 13 | <i>Drypetes venusta</i> | 5.5 | 100 | 5.5 | 0.06 | 12.8 | 8.06 | 60223 | 8.5 | 29.3 |
| 14 | <i>Dysoxylum malabaricum</i> | 0.8 | 40 | 2 | 0.05 | 1.86 | 3.23 | 36332 | 5.13 | 10.2 |
| 15 | <i>Garcinia gummi-gutta</i> | 0.7 | 30 | 2.33 | 0.08 | 1.62 | 2.42 | 4734.9 | 0.67 | 4.71 |
| 16 | <i>Holigarna arnottiana</i> | 0.4 | 20 | 2 | 0.1 | 0.93 | 1.61 | 13682 | 1.93 | 4.47 |
| 17 | <i>Knema attenuata</i> | 2.3 | 60 | 3.83 | 0.06 | 5.34 | 4.84 | 22515 | 3.18 | 13.4 |
| 18 | <i>Macaranga peltata</i> | 0.4 | 20 | 2 | 0.1 | 0.93 | 1.61 | 4179.9 | 0.59 | 3.13 |
| 19 | <i>Mesua ferrea</i> | 3.6 | 80 | 4.5 | 0.06 | 8.35 | 6.45 | 61544 | 8.69 | 23.5 |
| 20 | <i>Otonophelium stipulaceum</i> | 1.1 | 40 | 2.75 | 0.07 | 2.55 | 3.23 | 4438.5 | 0.63 | 6.4 |
| 21 | <i>Palaquium ellipticum</i> | 2.7 | 80 | 3.38 | 0.04 | 6.26 | 6.45 | 89363 | 12.6 | 25.3 |
| 22 | <i>Persea macrantha</i> | 1.8 | 50 | 3.6 | 0.07 | 4.18 | 4.03 | 43740 | 6.17 | 14.4 |
| 23 | <i>Poeciloneuron indicum</i> | 1.3 | 40 | 3.25 | 0.08 | 3.02 | 3.23 | 44557 | 6.29 | 12.5 |
| 24 | <i>Syzygium laetum</i> | 1.5 | 50 | 3 | 0.06 | 3.48 | 4.03 | 4191.4 | 0.59 | 8.1 |
| 25 | <i>Syzygium lanceolatum</i> | 0.4 | 20 | 2 | 0.1 | 0.93 | 1.61 | 2450 | 0.35 | 2.89 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|------|------|------|------|--------|------|------|
| 26 | <i>Syzygium mundagam</i> | 0.4 | 20 | 2 | 0.1 | 0.93 | 1.61 | 2614.7 | 0.37 | 2.91 |
| 27 | <i>Vateria indica</i> | 1.6 | 50 | 3.2 | 0.06 | 3.71 | 4.03 | 3710 | 0.52 | 8.27 |
| 28 | <i>Xanthophyllum arnottianum</i> | 4.1 | 90 | 4.56 | 0.05 | 9.51 | 7.26 | 48000 | 6.77 | 23.5 |
| | | 43.1 | 1240 | | | 100 | 100 | 708528 | 100 | 300 |

Phytosociological analysis of low elevation study sites

Table 48 - Site 17

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|---------------------------------|------|------|------|-------|------|-------|--------|------|------|
| 1 | <i>Albizia lebeck</i> | 1.5 | 70 | 2.14 | 0.031 | 6.28 | 6.931 | 84480 | 12 | 25.2 |
| 2 | <i>Alstonia scholaris</i> | 0.7 | 50 | 1.4 | 0.028 | 2.93 | 4.95 | 36930 | 5.23 | 13.1 |
| 3 | <i>Artocarpus hirsutus</i> | 0.1 | 10 | 1 | 0.1 | 0.42 | 0.99 | 7643.5 | 1.08 | 2.49 |
| 4 | <i>Bombax ceiba</i> | 0.1 | 10 | 1 | 0.1 | 0.42 | 0.99 | 7206.2 | 1.02 | 2.43 |
| 5 | <i>Bombax insigne</i> | 0.2 | 10 | 2 | 0.2 | 0.84 | 0.99 | 5925.4 | 0.84 | 2.67 |
| 6 | <i>Cassia fistula</i> | 0.5 | 40 | 1.25 | 0.031 | 2.09 | 3.96 | 3478.6 | 0.49 | 6.55 |
| 7 | <i>Dalbergia latifolia</i> | 1.3 | 60 | 2.17 | 0.03 | 5.44 | 5.941 | 80024 | 11.3 | 22.7 |
| 8 | <i>Dillenia pentagyna</i> | 0.2 | 20 | 1 | 0.05 | 0.84 | 1.98 | 12921 | 1.83 | 4.65 |
| 9 | <i>Erythrina stricta</i> | 0.2 | 10 | 2 | 0.2 | 0.84 | 0.99 | 1720.6 | 0.24 | 2.07 |
| 10 | <i>Grewia tiliifolia</i> | 2.3 | 80 | 2.88 | 0.028 | 9.62 | 7.921 | 34449 | 4.88 | 22.4 |
| 11 | <i>Hydnocarpus pentandra</i> | 0.2 | 10 | 2 | 0.2 | 0.84 | 0.99 | 1384.3 | 0.2 | 2.02 |
| 12 | <i>Lagerstroemia microcarpa</i> | 1.4 | 60 | 2.33 | 0.1 | 5.86 | 5.941 | 78313 | 11.1 | 22.9 |
| 13 | <i>Mallotus tetracoccus</i> | 0.2 | 10 | 2 | 0.2 | 0.84 | 0.99 | 1940.7 | 0.28 | 2.1 |
| 14 | <i>Phyllanthus emblica</i> | 1.3 | 80 | 1.63 | 0.02 | 5.44 | 7.921 | 7755.8 | 1.1 | 14.5 |
| 15 | <i>Pterocarpus marsupium</i> | 2.5 | 70 | 3.57 | 0.051 | 10.5 | 6.931 | 102936 | 14.6 | 32 |
| 16 | <i>Spondias pinnata</i> | 2 | 70 | 2.86 | 0.041 | 8.37 | 6.931 | 13384 | 1.9 | 17.2 |
| 17 | <i>Tectona grandis</i> | 2.8 | 90 | 3.11 | 0.035 | 11.7 | 8.911 | 147165 | 20.9 | 41.5 |
| 18 | <i>Terminalia bellerica</i> | 0.4 | 20 | 2 | 0.1 | 1.67 | 1.98 | 9836.7 | 1.39 | 5.05 |
| 19 | <i>Terminalia paniculata</i> | 1.5 | 60 | 2.5 | 0.042 | 6.28 | 5.941 | 45610 | 6.46 | 18.7 |
| 20 | <i>Tetrameles nudiflora</i> | 2.3 | 80 | 2.88 | 0.035 | 9.62 | 7.921 | 9665.6 | 1.37 | 18.9 |
| 21 | <i>Wrightia tinctoria</i> | 2.2 | 100 | 2.2 | 0.022 | 9.21 | 9.901 | 12830 | 1.82 | 20.9 |
| | | 23.9 | 1010 | | | 100 | 100 | 705599 | 100 | 300 |

Table 49 - Site 18

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|---------------------------------|------|------|-----|-------|------|------|--------|------|------|
| 1 | <i>Albizia lebbbeck</i> | 0.2 | 20 | 1 | 0.05 | 1.02 | 1.98 | 5663.1 | 1.42 | 4.42 |
| 2 | <i>Artocarpus hirsutus</i> | 0.3 | 20 | 1.5 | 0.075 | 1.52 | 1.98 | 15581 | 3.92 | 7.42 |
| 3 | <i>Bombax ceiba</i> | 0.3 | 30 | 1 | 0.033 | 1.52 | 2.97 | 8700.3 | 2.19 | 6.68 |
| 4 | <i>Bombax insigne</i> | 0.5 | 50 | 1 | 0.02 | 2.54 | 4.95 | 11045 | 2.78 | 10.3 |
| 5 | <i>Cassia fistula</i> | 1.3 | 50 | 2.6 | 0.052 | 6.6 | 4.95 | 7556.2 | 1.9 | 13.5 |
| 6 | <i>Chionanthus mala-elengi</i> | 0.5 | 40 | 1.3 | 0.031 | 2.54 | 3.96 | 1376.2 | 0.35 | 6.84 |
| 7 | <i>Dalbergia latifolia</i> | 0.2 | 10 | 2 | 0.2 | 1.02 | 0.99 | 681.87 | 0.17 | 2.18 |
| 8 | <i>Dillenia pentagyna</i> | 0.7 | 70 | 1 | 0.014 | 3.55 | 6.93 | 10519 | 2.65 | 13.1 |
| 9 | <i>Erythrina stricta</i> | 1.4 | 90 | 1.6 | 0.017 | 7.11 | 8.91 | 16026 | 4.03 | 20 |
| 10 | <i>Gmelina arborea</i> | 0.3 | 30 | 1 | 0.033 | 1.52 | 2.97 | 17311 | 4.36 | 8.85 |
| 11 | <i>Grewia tiliifolia</i> | 1 | 60 | 1.7 | 0.028 | 5.08 | 5.94 | 22177 | 5.58 | 16.6 |
| 12 | <i>Hydnocarpus pentandra</i> | 0.4 | 40 | 1 | 0.025 | 2.03 | 3.96 | 2673.5 | 0.67 | 6.66 |
| 13 | <i>Lagerstroemia microcarpa</i> | 1.4 | 80 | 1.8 | 0.022 | 7.11 | 7.92 | 33444 | 8.41 | 23.4 |
| 14 | <i>Mallotus tetracoccus</i> | 0.2 | 10 | 2 | 0.2 | 1.02 | 0.99 | 1940.7 | 0.49 | 2.49 |
| 15 | <i>Phyllanthus emblica</i> | 0.8 | 40 | 2 | 0.05 | 4.06 | 3.96 | 5354.4 | 1.35 | 9.37 |
| 16 | <i>Pterocarpus marsupium</i> | 1.9 | 80 | 2.4 | 0.03 | 9.64 | 7.92 | 75479 | 19 | 36.6 |
| 17 | <i>Spondias pinnata</i> | 0.8 | 70 | 1.1 | 0.016 | 4.06 | 6.93 | 10749 | 2.7 | 13.7 |
| 18 | <i>Tectona grandis</i> | 0.5 | 30 | 1.7 | 0.056 | 2.54 | 2.97 | 28515 | 7.17 | 12.7 |
| 19 | <i>Terminalia bellerica</i> | 0.4 | 10 | 4 | 0.4 | 2.03 | 0.99 | 19673 | 4.95 | 7.97 |
| 20 | <i>Terminalia paniculata</i> | 3.8 | 60 | 6.3 | 0.106 | 19.3 | 5.94 | 82253 | 20.7 | 45.9 |
| 21 | <i>Tetrameles nudiflora</i> | 1 | 40 | 2.5 | 0.063 | 5.08 | 3.96 | 7130.2 | 1.79 | 10.8 |
| 22 | <i>Wrightia tinctoria</i> | 1.8 | 80 | 2.3 | 0.028 | 9.14 | 7.92 | 13614 | 3.43 | 20.5 |
| | | 19.7 | 1010 | | | 100 | 100 | 397463 | 100 | 300 |

Table 50 - Site 19

| SL No | Species | D | F | A | A/F | RF | RD | BA | RBA | IVI |
|-------|---------------------------------|-----|----|------|-------|------|------|--------|-------|-----|
| 1 | <i>Actinodaphne malabarica</i> | 0.1 | 10 | 1 | 0.1 | 1.35 | 0.69 | 1839.5 | 0.621 | 2.7 |
| 2 | <i>Alstonia scholaris</i> | 0.9 | 50 | 1.8 | 0.036 | 6.76 | 6.25 | 46386 | 15.65 | 29 |
| 3 | <i>Bombax ceiba</i> | 0.4 | 20 | 2 | 0.1 | 2.7 | 2.78 | 6143.9 | 2.073 | 7.6 |
| 4 | <i>Chionanthus mala-elengi</i> | 0.1 | 10 | 1 | 0.1 | 1.35 | 0.69 | 258.68 | 0.087 | 2.1 |
| 5 | <i>Cinnamomum malabratrum</i> | 0.1 | 10 | 1 | 0.1 | 1.35 | 0.69 | 277.15 | 0.094 | 2.1 |
| 6 | <i>Dalbergia latifolia</i> | 1.4 | 40 | 3.5 | 0.088 | 5.41 | 9.72 | 49286 | 16.63 | 32 |
| 7 | <i>Dillenia pentagyna</i> | 0.5 | 40 | 1.25 | 0.031 | 5.41 | 3.47 | 8329 | 2.811 | 12 |
| 8 | <i>Erythrina stricta</i> | 0.1 | 10 | 1 | 0.1 | 1.35 | 0.69 | 861.15 | 0.291 | 2.3 |
| 9 | <i>Erythrina variegata</i> | 0.8 | 30 | 2.67 | 0.089 | 4.05 | 5.56 | 4206.8 | 1.42 | 11 |
| 10 | <i>Ficus tsjahela</i> | 0.1 | 10 | 1 | 0.1 | 1.35 | 0.69 | 2844 | 0.96 | 3 |
| 11 | <i>Grewia tiliifolia</i> | 1 | 40 | 2.5 | 0.063 | 5.41 | 6.94 | 16069 | 5.422 | 18 |
| 12 | <i>Hydnocarpus pentandra</i> | 0.3 | 30 | 1 | 0.033 | 4.05 | 2.08 | 1882.6 | 0.635 | 6.8 |
| 13 | <i>Lagerstroemia microcarpa</i> | 0.8 | 50 | 1.6 | 0.032 | 6.76 | 5.56 | 35121 | 11.85 | 24 |
| 14 | <i>Lagerstroemia speciosa</i> | 0.1 | 10 | 1 | 0.1 | 1.35 | 0.69 | 424.28 | 0.143 | 2.2 |
| 15 | <i>Olea dioica</i> | 0.2 | 20 | 1 | 0.05 | 2.7 | 1.39 | 537.1 | 0.181 | 4.3 |
| 16 | <i>Persea macrantha</i> | 0.1 | 10 | 1 | 0.1 | 1.35 | 0.69 | 688.6 | 0.232 | 2.3 |
| 17 | <i>Phyllanthus emblica</i> | 0.3 | 20 | 1.5 | 0.075 | 2.7 | 2.08 | 1697 | 0.573 | 5.4 |
| 18 | <i>Polyalthea fragrans</i> | 0.6 | 20 | 3 | 0.15 | 2.7 | 4.17 | 6171 | 2.082 | 9 |
| 19 | <i>Pterocarpus marsupium</i> | 0.7 | 50 | 1.4 | 0.028 | 6.76 | 4.86 | 27126 | 9.153 | 21 |
| 20 | <i>Spondias pinnata</i> | 0.4 | 30 | 1.33 | 0.044 | 4.05 | 2.78 | 2010.4 | 0.678 | 7.5 |
| 21 | <i>Stereospermum colais</i> | 0.1 | 10 | 1 | 0.1 | 1.35 | 0.69 | 412.73 | 0.139 | 2.2 |
| 22 | <i>Tectona grandis</i> | 0.4 | 10 | 4 | 0.4 | 1.35 | 2.78 | 20225 | 6.825 | 11 |
| 23 | <i>Terminalia bellerica</i> | 0.4 | 10 | 4 | 0.4 | 1.35 | 2.78 | 9846.7 | 3.323 | 7.5 |
| 24 | <i>Terminalia paniculata</i> | 1.6 | 60 | 2.67 | 0.044 | 8.11 | 11.1 | 19923 | 6.723 | 26 |

| | | | | | | | | | | |
|----|-----------------------------|------|-----|------|-------|------|------|--------|-------|-----|
| 25 | <i>Tetrameles nudiflora</i> | 0.7 | 50 | 1.4 | 0.028 | 6.76 | 4.86 | 5998.3 | 2.024 | 14 |
| 26 | <i>Wrightia tinctoria</i> | 1.3 | 60 | 2.17 | 0.036 | 8.11 | 9.03 | 4112.2 | 1.388 | 19 |
| 27 | <i>Xylia xylocarpa</i> | 0.9 | 30 | 3 | 0.1 | 4.05 | 6.25 | 23671 | 7.988 | 18 |
| | | 14.4 | 740 | | | 100 | 100 | 296347 | 100 | 300 |

Table 51- Site 20

| SL No | species | D | F | A | A/F | R D | R F | BA | RBA | IVI |
|-------|---------------------------------|------|-----|------|------|------|------|---------|-------|-----|
| 1 | <i>Albizia lebbeck</i> | 0.1 | 10 | 1 | 0.1 | 0.39 | 1.09 | 238.334 | 0.08 | 1.6 |
| 2 | <i>Azadirachta indica</i> | 0.2 | 10 | 2 | 0.2 | 0.78 | 1.09 | 611.2 | 0.204 | 2.1 |
| 3 | <i>Bischofia javanica</i> | 0.2 | 10 | 2 | 0.2 | 0.78 | 1.09 | 7008 | 2.339 | 4.2 |
| 4 | <i>Bombax ceiba</i> | 0.1 | 10 | 1 | 0.1 | 0.39 | 1.09 | 957.715 | 0.32 | 1.8 |
| 5 | <i>Cassia fistula</i> | 0.6 | 20 | 3 | 0.15 | 2.35 | 2.17 | 3943.67 | 1.316 | 5.8 |
| 6 | <i>Chionanthus mala-elengi</i> | 0.7 | 40 | 1.75 | 0.04 | 2.75 | 4.35 | 2186.65 | 0.73 | 7.8 |
| 7 | <i>Dalbergia latifolia</i> | 1.3 | 70 | 1.86 | 0.03 | 5.1 | 7.61 | 33118.5 | 11.06 | 24 |
| 8 | <i>Dillenia pentagyna</i> | 0.2 | 20 | 1 | 0.05 | 0.78 | 2.17 | 7567.89 | 2.526 | 5.5 |
| 9 | <i>Dipterocarpus indicus</i> | 2.1 | 70 | 3 | 0.04 | 8.24 | 7.61 | 14214.6 | 4.745 | 21 |
| 10 | <i>Erythrina stricta</i> | 0.9 | 50 | 1.8 | 0.04 | 3.53 | 5.43 | 11149.5 | 3.722 | 13 |
| 11 | <i>Grewia tiliifolia</i> | 1.6 | 60 | 2.67 | 0.04 | 6.27 | 6.52 | 26775.6 | 8.938 | 22 |
| 12 | <i>Hydnocarpus pentandra</i> | 0.1 | 10 | 1 | 0.1 | 0.39 | 1.09 | 615.937 | 0.206 | 1.7 |
| 13 | <i>Knema attenuata</i> | 1.1 | 50 | 2.2 | 0.04 | 4.31 | 5.43 | 13760.1 | 4.593 | 14 |
| 14 | <i>Lagerstroemia microcarpa</i> | 1.2 | 70 | 1.71 | 0.02 | 4.71 | 7.61 | 16288.4 | 5.437 | 18 |
| 15 | <i>Phyllanthus emblica</i> | 0.6 | 30 | 2 | 0.07 | 2.35 | 3.26 | 3390.51 | 1.132 | 6.7 |
| 16 | <i>Polyalthia fragrans</i> | 2 | 60 | 3.33 | 0.06 | 7.84 | 6.52 | 18365.1 | 6.13 | 20 |
| 17 | <i>Pterocarpus marsupium</i> | 1.7 | 70 | 2.43 | 0.03 | 6.67 | 7.61 | 56225.9 | 18.77 | 33 |
| 18 | <i>Schleichera oleosa</i> | 1.4 | 50 | 2.8 | 0.06 | 5.49 | 5.43 | 20113.1 | 6.714 | 18 |
| 19 | <i>Spondias pinnata</i> | 1 | 60 | 1.67 | 0.03 | 3.92 | 6.52 | 21000 | 7.01 | 17 |
| 20 | <i>Terminalia paniculata</i> | 7 | 100 | 7 | 0.07 | 27.5 | 10.9 | 32495.8 | 10.85 | 49 |
| 21 | <i>Wrightia tinctoria</i> | 1.4 | 50 | 2.8 | 0.06 | 5.49 | 5.43 | 9546.14 | 3.187 | 14 |
| | | 25.5 | 920 | | | 100 | 100 | 299573 | 100 | 300 |

Table 52 - Site 21

| SL No | Species | D | F | A | A/F | R D | R F | B A | RBA | IVI |
|-------|---------------------------------|------|-----|------|------|------|------|----------|------|-----|
| 1 | <i>Bombax ceiba</i> | 1.4 | 40 | 3.5 | 0.09 | 7.95 | 5.56 | 6339.537 | 5.04 | 19 |
| 2 | <i>Careya arborea</i> | 1.3 | 30 | 4.33 | 0.14 | 7.39 | 4.17 | 4579.676 | 3.64 | 15 |
| 3 | <i>Dalbergia latifolia</i> | 1.6 | 80 | 2 | 0.03 | 9.09 | 11.1 | 11664.94 | 9.28 | 29 |
| 4 | <i>Dillenia pentagyna</i> | 0.2 | 10 | 2 | 0.2 | 1.14 | 1.39 | 1891.237 | 1.5 | 4 |
| 5 | <i>Erythrina variegata</i> | 1.5 | 60 | 2.5 | 0.04 | 8.52 | 8.33 | 7654.905 | 6.09 | 23 |
| 6 | <i>Ficus hispida</i> | 0.2 | 10 | 2 | 0.2 | 1.14 | 1.39 | 537.6719 | 0.43 | 3 |
| 7 | <i>Ficus racemosa</i> | 0.2 | 10 | 2 | 0.2 | 1.14 | 1.39 | 5797.71 | 4.61 | 7.1 |
| 8 | <i>Gmelina arborea</i> | 0.5 | 50 | 1 | 0.02 | 2.84 | 6.94 | 4803.176 | 3.82 | 14 |
| 9 | <i>Grewia tiliifolia</i> | 2.3 | 80 | 2.88 | 0.04 | 13.1 | 11.1 | 20127.5 | 16 | 40 |
| 10 | <i>Hydnocarpus pentandra</i> | 0.1 | 10 | 1 | 0.1 | 0.57 | 1.39 | 91.94508 | 0.07 | 2 |
| 11 | <i>Lagerstroemia speciosa</i> | 0.7 | 50 | 1.4 | 0.03 | 3.98 | 6.94 | 3318.692 | 2.64 | 14 |
| 12 | <i>Macaranga peltata</i> | 0.8 | 10 | 8 | 0.8 | 4.55 | 1.39 | 3802.597 | 3.02 | 9 |
| 13 | <i>Olea dioica</i> | 0.1 | 10 | 1 | 0.1 | 0.57 | 1.39 | 547.9322 | 0.44 | 2.4 |
| 14 | <i>Otonephelium stipulaceum</i> | 0.1 | 10 | 1 | 0.1 | 0.57 | 1.39 | 644.2518 | 0.51 | 2.5 |
| 15 | <i>Polyalthea fragrans</i> | 1.2 | 10 | 12 | 1.2 | 6.82 | 1.39 | 7062.75 | 5.62 | 14 |
| 16 | <i>Pterocarpus marsupium</i> | 0.4 | 40 | 1 | 0.03 | 2.27 | 5.56 | 4138.244 | 3.29 | 11 |
| 17 | <i>Schleichera oleosa</i> | 1.8 | 60 | 3 | 0.05 | 10.2 | 8.33 | 13202.38 | 10.5 | 29 |
| 18 | <i>Spondias pinnata</i> | 0.2 | 10 | 2 | 0.2 | 1.14 | 1.39 | 1240.543 | 0.99 | 3.5 |
| 19 | <i>Stereospermum colais</i> | 0.1 | 10 | 1 | 0.1 | 0.57 | 1.39 | 140.3037 | 0.11 | 2.1 |
| 20 | <i>Terminalia paniculata</i> | 1.5 | 70 | 2.14 | 0.03 | 8.52 | 9.72 | 21511.33 | 17.1 | 35 |
| 21 | <i>Tetrameles nudiflora</i> | 0.3 | 20 | 1.5 | 0.08 | 1.7 | 2.78 | 3319.249 | 2.64 | 7.1 |
| 22 | <i>Wrightia tinctoria</i> | 1.1 | 40 | 2.75 | 0.07 | 6.25 | 5.56 | 3331.18 | 2.65 | 14 |
| | | 17.6 | 720 | | | 100 | 100 | 125747.8 | 100 | 300 |

Table 53 - Site 22

| SL No | Species | D | F | A | A/F | R D | R F | B A | RBA | IVI |
|-------|---------------------------------|-----|----|-----|------|-------|------|---------|-------|-----|
| 1 | <i>Actinodaphne malabarica</i> | 1.2 | 90 | 1.3 | 0.01 | 6.154 | 6.92 | 6000.53 | 3.453 | 17 |
| 2 | <i>Alstonia scholaris</i> | 0.8 | 70 | 1.1 | 0.02 | 4.103 | 5.38 | 10446.3 | 6.01 | 15 |
| 3 | <i>Bombax ceiba</i> | 0.6 | 40 | 1.5 | 0.04 | 3.077 | 3.08 | 4293.58 | 2.47 | 8.6 |
| 4 | <i>Carallia brachiata</i> | 0.6 | 40 | 1.5 | 0.04 | 3.077 | 3.08 | 9309.28 | 5.356 | 12 |
| 5 | <i>Caryota urens</i> | 0.2 | 10 | 2 | 0.2 | 1.026 | 0.77 | 1358.32 | 0.782 | 2.6 |
| 6 | <i>Chionanthus mala-elengi</i> | 0.4 | 20 | 2 | 0.1 | 2.051 | 1.54 | 3054.95 | 1.758 | 5.3 |
| 7 | <i>Chukrasia tabularis</i> | 1.1 | 70 | 1.6 | 0.02 | 5.641 | 5.38 | 5249.3 | 3.02 | 14 |
| 8 | <i>Cinnamomum malabatrum</i> | 0.4 | 30 | 1.3 | 0.04 | 2.051 | 2.31 | 3006.51 | 1.73 | 6.1 |
| 9 | <i>Dalbergia latifolia</i> | 0.6 | 40 | 1.5 | 0.04 | 3.077 | 3.08 | 4461.4 | 2.567 | 8.7 |
| 10 | <i>Dillenia pentagyna</i> | 0.8 | 50 | 1.6 | 0.03 | 4.103 | 3.85 | 3118.97 | 1.795 | 9.7 |
| 11 | <i>Erythrina stricta</i> | 0.5 | 30 | 1.7 | 0.06 | 2.564 | 2.31 | 2185 | 1.257 | 6.1 |
| 12 | <i>Erythrina variegata</i> | 0.2 | 10 | 2 | 0.2 | 1.026 | 0.77 | 406.674 | 0.234 | 2 |
| 13 | <i>Ficus tsjahela</i> | 0.1 | 10 | 1 | 0.1 | 0.513 | 0.77 | 2520.06 | 1.45 | 2.7 |
| 14 | <i>Grewia tiliifolia</i> | 0.9 | 50 | 1.8 | 0.04 | 4.615 | 3.85 | 12050.1 | 6.933 | 15 |
| 15 | <i>Hydnocarpus pentandra</i> | 0.3 | 20 | 1.5 | 0.08 | 1.538 | 1.54 | 1097.06 | 0.631 | 3.7 |
| 16 | <i>Lagerstroemia microcarpa</i> | 0.3 | 30 | 1 | 0.03 | 1.538 | 2.31 | 3904.4 | 2.246 | 6.1 |
| 17 | <i>Lagerstroemia speciosa</i> | 0.3 | 30 | 1 | 0.03 | 1.538 | 2.31 | 1339.57 | 0.771 | 4.6 |
| 18 | <i>Olea dioica</i> | 0.7 | 40 | 1.8 | 0.04 | 3.59 | 3.08 | 3531.14 | 2.032 | 8.7 |
| 19 | <i>Persea macrantha</i> | 0.6 | 40 | 1.5 | 0.04 | 3.077 | 3.08 | 10219.9 | 5.88 | 12 |
| 20 | <i>Phyllanthus emblica</i> | 0.5 | 30 | 1.7 | 0.06 | 2.564 | 2.31 | 1106.36 | 0.637 | 5.5 |
| 21 | <i>Polyalthea fragrans</i> | 0.3 | 30 | 1 | 0.03 | 1.538 | 2.31 | 2470.75 | 1.422 | 5.3 |
| 22 | <i>Pterocarpus marsupium</i> | 0.7 | 50 | 1.4 | 0.03 | 3.59 | 3.85 | 7375.09 | 4.243 | 12 |
| 23 | <i>Sterculia guttata</i> | 0.8 | 60 | 1.3 | 0.02 | 4.103 | 4.62 | 9446.16 | 5.435 | 14 |
| 24 | <i>Stereospermum colais</i> | 0.5 | 40 | 1.3 | 0.03 | 2.564 | 3.08 | 5697.17 | 3.278 | 8.9 |

| | | | | | | | | | | |
|----|------------------------------|------|------|-----|------|-------|------|---------|-------|-----|
| 25 | <i>Tectona grandis</i> | 1.3 | 70 | 1.9 | 0.03 | 6.667 | 5.38 | 17197.1 | 9.895 | 22 |
| 26 | <i>Terminalia bellerica</i> | 0.8 | 50 | 1.6 | 0.03 | 4.103 | 3.85 | 6622.51 | 3.81 | 12 |
| 27 | <i>Terminalia paniculata</i> | 1.2 | 80 | 1.5 | 0.02 | 6.154 | 6.15 | 16021.5 | 9.218 | 22 |
| 28 | <i>Tetrameles nudiflora</i> | 0.7 | 50 | 1.4 | 0.03 | 3.59 | 3.85 | 3994.52 | 2.298 | 9.7 |
| 29 | <i>Wrightia tinctoria</i> | 0.9 | 50 | 1.8 | 0.04 | 4.615 | 3.85 | 1687.62 | 0.971 | 9.4 |
| 30 | <i>Xylia xylocarpa</i> | 1.2 | 70 | 1.7 | 0.02 | 6.154 | 5.38 | 14630.6 | 8.418 | 20 |
| | | 19.5 | 1300 | 45 | | 100 | 100 | 173802 | 100 | 300 |

Table 54 - Site 23

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|-----------------------------------|-----|-----|------|-------|-------|-------|--------|-------|------|
| 1 | <i>Aglaia lawii</i> | 1.2 | 90 | 1.33 | 0.015 | 2.553 | 4.455 | 6343.7 | 1.14 | 8.15 |
| 2 | <i>Agrostistachys borneensis</i> | 2.9 | 100 | 2.9 | 0.029 | 6.17 | 4.95 | 21151 | 3.799 | 14.9 |
| 3 | <i>Alseodaphne semecarpifolia</i> | 1.8 | 80 | 2.25 | 0.028 | 3.83 | 3.96 | 3395 | 0.61 | 8.4 |
| 4 | <i>Antiaris toxicaria</i> | 1.4 | 80 | 1.75 | 0.022 | 2.979 | 3.96 | 67500 | 12.13 | 19.1 |
| 5 | <i>Aporosa bourdillonii</i> | 0.9 | 60 | 1.5 | 0.025 | 1.915 | 2.97 | 6450.6 | 1.159 | 6.04 |
| 6 | <i>Baccaurea courtallensis</i> | 1.7 | 60 | 2.83 | 0.047 | 3.617 | 2.97 | 10554 | 1.896 | 8.48 |
| 7 | <i>Bischofia javanica</i> | 2.1 | 90 | 2.33 | 0.026 | 4.468 | 4.455 | 12370 | 2.222 | 11.1 |
| 8 | <i>Canarium strictum</i> | 2.8 | 90 | 3.11 | 0.035 | 5.957 | 4.455 | 27146 | 4.876 | 15.3 |
| 9 | <i>Caryota urens</i> | 0.4 | 20 | 2 | 0.1 | 0.851 | 0.99 | 1710.1 | 0.307 | 2.15 |
| 10 | <i>Chrysophyllum roxburghii</i> | 1.8 | 50 | 3.6 | 0.072 | 3.83 | 2.475 | 54750 | 9.835 | 16.1 |
| 11 | <i>Croton malabaricus</i> | 1.5 | 100 | 1.5 | 0.015 | 3.191 | 4.95 | 18996 | 3.412 | 11.6 |
| 12 | <i>Cyathocalyx zeylanicus</i> | 1.5 | 90 | 1.67 | 0.019 | 3.191 | 4.455 | 8249.4 | 1.482 | 9.13 |
| 13 | <i>Dipterocarpus indicus</i> | 2.9 | 90 | 3.22 | 0.036 | 6.17 | 4.455 | 53005 | 9.521 | 20.1 |
| 14 | <i>Drypetes venusta</i> | 2.6 | 70 | 3.71 | 0.053 | 5.532 | 3.465 | 38721 | 6.956 | 16 |
| 15 | <i>Dysoxylum beddomei</i> | 1.5 | 40 | 3.75 | 0.094 | 3.191 | 1.98 | 19065 | 3.425 | 8.6 |
| 16 | <i>Dysoxylum malabaricum</i> | 1.3 | 80 | 1.63 | 0.02 | 2.766 | 3.96 | 42617 | 7.655 | 14.4 |
| 17 | <i>Elaeocarpus serratus</i> | 1 | 70 | 1.43 | 0.02 | 2.128 | 3.465 | 8397.5 | 1.508 | 7.1 |
| 18 | <i>Garcinia gummi-gutta</i> | 0.7 | 20 | 3.5 | 0.175 | 1.489 | 0.99 | 4089.3 | 0.735 | 3.21 |
| 19 | <i>Holigarna arnottiana</i> | 1.2 | 60 | 2 | 0.033 | 2.553 | 2.97 | 27890 | 5.01 | 10.5 |
| 20 | <i>Hopea parviflora</i> | 0.7 | 30 | 2.33 | 0.078 | 1.489 | 1.485 | 12820 | 2.303 | 5.28 |
| 21 | <i>Hydnocarpus pentandra</i> | 1.8 | 70 | 2.57 | 0.037 | 3.83 | 3.465 | 4931.9 | 0.886 | 8.18 |
| 22 | <i>Kingiodendron pinnatum</i> | 0.4 | 20 | 2 | 0.1 | 0.851 | 0.99 | 4887.5 | 0.878 | 2.72 |
| 23 | <i>Knema attenuata</i> | 1.7 | 60 | 2.83 | 0.047 | 3.617 | 2.97 | 10558 | 1.897 | 8.48 |
| 24 | <i>Lepisanthes tetraphylla</i> | 0.2 | 30 | 0.67 | 0.022 | 0.426 | 1.485 | 398.73 | 0.072 | 1.98 |
| 25 | <i>Myristica beddomei</i> | 0.7 | 30 | 2.33 | 0.078 | 1.489 | 1.485 | 6394.7 | 1.149 | 4.12 |

| | | | | | | | | | | |
|----|----------------------------------|-----|------|------|-------|-------|------|--------|-------|------|
| 26 | <i>Otonephelium stipulaceum</i> | 1.6 | 80 | 2 | 0.025 | 3.404 | 3.96 | 8273.8 | 1.486 | 8.85 |
| 27 | <i>Pterospermum reticulatum</i> | 0.4 | 20 | 2 | 0.1 | 0.851 | 0.99 | 6792.8 | 1.22 | 3.06 |
| 28 | <i>Schleichera oleosa</i> | 1.9 | 80 | 2.38 | 0.03 | 4.043 | 3.96 | 28316 | 5.087 | 13.1 |
| 29 | <i>Syzygium lanceolatum</i> | 0.2 | 20 | 1 | 0.05 | 0.426 | 0.99 | 998.81 | 0.179 | 1.6 |
| 30 | <i>Turpinia malabarica</i> | 1.3 | 80 | 1.63 | 0.02 | 2.766 | 3.96 | 7521.2 | 1.351 | 8.08 |
| 31 | <i>Vateria indica</i> | 3.1 | 100 | 3.1 | 0.031 | 6.596 | 4.95 | 18765 | 3.371 | 14.9 |
| 32 | <i>Xanthophyllum arnottianum</i> | 1.8 | 60 | 3 | 0.05 | 3.83 | 2.97 | 13628 | 2.448 | 9.25 |
| | | 47 | 2020 | | | 100 | 100 | 556687 | 100 | 300 |

Table 55 - Site 24

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|-----------------------------------|-----|----|-----|------|------|------|--------|-------|------|
| 1 | <i>Aglaia lawii</i> | 0.7 | 50 | 1.4 | 0.03 | 2.33 | 3.76 | 5620.9 | 1.839 | 7.92 |
| 2 | <i>Agrostistachys borneensis</i> | 1.6 | 70 | 2.3 | 0.03 | 5.32 | 5.26 | 8798.2 | 2.878 | 13.5 |
| 3 | <i>Alseodaphne semecarpifolia</i> | 1.8 | 90 | 2 | 0.02 | 5.98 | 6.77 | 7058.9 | 2.309 | 15.1 |
| 4 | <i>Antiaris toxicaria</i> | 0.9 | 50 | 1.8 | 0.04 | 2.99 | 3.76 | 16037 | 5.246 | 12 |
| 5 | <i>Aporosa bourdillonii</i> | 1.1 | 60 | 1.8 | 0.03 | 3.65 | 4.51 | 7234.1 | 2.366 | 10.5 |
| 6 | <i>Baccaurea courtallensis</i> | 1.4 | 60 | 2.3 | 0.04 | 4.65 | 4.51 | 10881 | 3.559 | 12.7 |
| 7 | <i>Bischofia javanica</i> | 1.5 | 70 | 2.1 | 0.03 | 4.98 | 5.26 | 18594 | 6.083 | 16.3 |
| 8 | <i>Canarium strictum</i> | 0.8 | 20 | 4 | 0.2 | 2.66 | 1.5 | 10244 | 3.351 | 7.51 |
| 9 | <i>Chrysophyllum roxburghii</i> | 0.5 | 40 | 1.3 | 0.03 | 1.66 | 3.01 | 11220 | 3.67 | 8.34 |
| 10 | <i>Cinnamomum malabatrum</i> | 1.2 | 30 | 4 | 0.13 | 3.99 | 2.26 | 5182.6 | 1.695 | 7.94 |
| 11 | <i>Dipterocarpus indicus</i> | 1.9 | 80 | 2.4 | 0.03 | 6.31 | 6.02 | 18745 | 6.132 | 18.5 |
| 12 | <i>Drypetes venusta</i> | 1.4 | 40 | 3.5 | 0.09 | 4.65 | 3.01 | 9856.5 | 3.224 | 10.9 |
| 13 | <i>Dysoxylum malabaricum</i> | 1.9 | 80 | 2.4 | 0.03 | 6.31 | 6.02 | 44503 | 14.56 | 26.9 |
| 14 | <i>Elaeocarpus serratus</i> | 0.6 | 20 | 3 | 0.15 | 1.99 | 1.5 | 3569.2 | 1.168 | 4.66 |
| 15 | <i>Garcinia gummi-gutta</i> | 0.5 | 30 | 1.7 | 0.06 | 1.66 | 2.26 | 3046.8 | 0.997 | 4.91 |
| 16 | <i>Holigarna arnottiana</i> | 1.3 | 60 | 2.2 | 0.04 | 4.32 | 4.51 | 23661 | 7.74 | 16.6 |
| 17 | <i>Hopea parviflora</i> | 0.8 | 30 | 2.7 | 0.09 | 2.66 | 2.26 | 20936 | 6.849 | 11.8 |
| 18 | <i>Hydnocarpus pentandra</i> | 0.2 | 10 | 2 | 0.2 | 0.66 | 0.75 | 1016.7 | 0.333 | 1.75 |
| 19 | <i>Kingiodendron pinnatum</i> | 0.3 | 20 | 1.5 | 0.08 | 1 | 1.5 | 3722.7 | 1.218 | 3.72 |
| 20 | <i>Knema attenuata</i> | 1.6 | 70 | 2.3 | 0.03 | 5.32 | 5.26 | 9701.9 | 3.174 | 13.8 |
| 21 | <i>Lepisanthes tetraphylla</i> | 0.1 | 10 | 1 | 0.1 | 0.33 | 0.75 | 424.28 | 0.139 | 1.22 |
| 22 | <i>Mangifera indica</i> | 0.4 | 20 | 2 | 0.1 | 1.33 | 1.5 | 7291 | 2.385 | 5.22 |
| 23 | <i>Myristica beddomei</i> | 0.7 | 40 | 1.8 | 0.04 | 2.33 | 3.01 | 3515.9 | 1.15 | 6.48 |
| 24 | <i>Otonophelium stipulaceum</i> | 0.6 | 30 | 2 | 0.07 | 1.99 | 2.26 | 5110.3 | 1.672 | 5.92 |
| 25 | <i>Syzygium lanceolatum</i> | 0.2 | 10 | 2 | 0.2 | 0.66 | 0.75 | 642.44 | 0.21 | 1.63 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|-----|------|------|------|--------|-------|------|
| 26 | <i>Terminalia travancorensis</i> | 0.4 | 20 | 2 | 0.1 | 1.33 | 1.5 | 3459.3 | 1.132 | 3.96 |
| 27 | <i>Turpinia malabarica</i> | 1.6 | 70 | 2.3 | 0.03 | 5.32 | 5.26 | 19020 | 6.222 | 16.8 |
| 28 | <i>Vateria indica</i> | 2.2 | 80 | 2.8 | 0.03 | 7.31 | 6.02 | 13829 | 4.524 | 17.8 |
| 29 | <i>Xanthophyllum arnottianum</i> | 1.9 | 70 | 2.7 | 0.04 | 6.31 | 5.26 | 12770 | 4.178 | 15.8 |
| | | 30.1 | 1330 | | | 100 | 100 | 305693 | 100 | 300 |

Phytosociological analysis of riparian study sites

Table 56 - Site 25

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|----------------------------------|-----|-----|-------|-------|------|------|---------|-------|-----|
| 1 | <i>Actinodaphne malabarica</i> | 1.3 | 30 | 4.333 | 0.144 | 2.64 | 1.55 | 24990.9 | 4.413 | 8.6 |
| 2 | <i>Aglaia tomentosa</i> | 1.1 | 50 | 2.2 | 0.044 | 2.24 | 2.59 | 5186.94 | 0.916 | 5.7 |
| 3 | <i>Agrostistachys borneensis</i> | 1.4 | 40 | 3.5 | 0.088 | 2.85 | 2.07 | 13667.4 | 2.413 | 7.3 |
| 4 | <i>Antiaris toxicaria</i> | 0.8 | 50 | 1.6 | 0.032 | 1.63 | 2.59 | 12964 | 2.289 | 6.5 |
| 5 | <i>Antidesma montanum</i> | 0.4 | 30 | 1.333 | 0.044 | 0.81 | 1.55 | 1086.86 | 0.192 | 2.6 |
| 6 | <i>Aporosa acuminata</i> | 0.6 | 30 | 2 | 0.067 | 1.22 | 1.55 | 4477.71 | 0.791 | 3.6 |
| 7 | <i>Aporosa lindleyana</i> | 1.6 | 70 | 2.286 | 0.033 | 3.25 | 3.63 | 7585.35 | 1.339 | 8.2 |
| 8 | <i>Artocarpus heterophyllus</i> | 0.3 | 20 | 1.5 | 0.075 | 0.61 | 1.04 | 2308.04 | 0.408 | 2.1 |
| 9 | <i>Artocarpus hirsutus</i> | 0.1 | 10 | 1 | 0.1 | 0.2 | 0.52 | 867.54 | 0.153 | 0.9 |
| 10 | <i>Baccaurea courtallensis</i> | 1 | 40 | 2.5 | 0.063 | 2.03 | 2.07 | 15441.6 | 2.727 | 6.8 |
| 11 | <i>Bischofia javanica</i> | 0.5 | 20 | 2.5 | 0.125 | 1.02 | 1.04 | 16240 | 2.868 | 4.9 |
| 12 | <i>Calophyllum polyanthum</i> | 2.5 | 90 | 2.778 | 0.031 | 5.08 | 4.66 | 9655.1 | 1.705 | 11 |
| 13 | <i>Canarium strictum</i> | 3.3 | 100 | 3.3 | 0.033 | 6.71 | 5.18 | 27969.8 | 4.939 | 17 |
| 14 | <i>Chionanthus-mala-elengi</i> | 2.9 | 100 | 2.9 | 0.029 | 5.89 | 5.18 | 21501 | 3.797 | 15 |
| 15 | <i>Cinnamomum verum</i> | 0.6 | 30 | 2 | 0.067 | 1.22 | 1.55 | 1828.82 | 0.323 | 3.1 |
| 16 | <i>Clausena indica</i> | 0.4 | 20 | 2 | 0.1 | 0.81 | 1.04 | 1423.12 | 0.251 | 2.1 |
| 17 | <i>Cryptocarya anamalayana</i> | 0.3 | 20 | 1.5 | 0.075 | 0.61 | 1.04 | 1682.37 | 0.297 | 1.9 |
| 18 | <i>Cullenia exarillata</i> | 3.4 | 100 | 3.4 | 0.034 | 6.91 | 5.18 | 79698.9 | 14.07 | 26 |
| 19 | <i>Dimocarpus longan</i> | 0.6 | 40 | 1.5 | 0.038 | 1.22 | 2.07 | 2784.08 | 0.492 | 3.8 |
| 20 | <i>Diospyros paniculata</i> | 1.1 | 60 | 1.833 | 0.031 | 2.24 | 3.11 | 8452.63 | 1.493 | 6.8 |
| 21 | <i>Dysoxylum malabaricum</i> | 1.5 | 60 | 2.5 | 0.042 | 3.05 | 3.11 | 43524.9 | 7.685 | 14 |
| 22 | <i>Elaeocarpus tuberculatus</i> | 2.3 | 90 | 2.556 | 0.028 | 4.67 | 4.66 | 42073.6 | 7.429 | 17 |
| 23 | <i>Ficus beddomei</i> | 0.2 | 20 | 1 | 0.05 | 0.41 | 1.04 | 2307.17 | 0.407 | 1.9 |
| 24 | <i>Garcinia gummi-gutta</i> | 0.2 | 10 | 2 | 0.2 | 0.41 | 0.52 | 1845.11 | 0.326 | 1.3 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|-------|-------|------|------|---------|-------|-----|
| 25 | <i>Glochidion zeylanicum</i> | 0.5 | 20 | 2.5 | 0.125 | 1.02 | 1.04 | 3008.36 | 0.531 | 2.6 |
| 26 | <i>Holigarna arnottiana</i> | 1.9 | 80 | 2.375 | 0.03 | 3.86 | 4.15 | 21480.9 | 3.793 | 12 |
| 27 | <i>Hopea parviflora</i> | 0.2 | 10 | 2 | 0.2 | 0.41 | 0.52 | 4693.79 | 0.829 | 1.8 |
| 28 | <i>Hydnocarpus pentandra</i> | 0.8 | 20 | 4 | 0.2 | 1.63 | 1.04 | 10862 | 1.918 | 4.6 |
| 29 | <i>Kingiodendron pinnatum</i> | 0.2 | 10 | 2 | 0.2 | 0.41 | 0.52 | 1010.2 | 0.178 | 1.1 |
| 30 | <i>Knema attenuata</i> | 1.6 | 70 | 2.286 | 0.033 | 3.25 | 3.63 | 11974.6 | 2.114 | 9 |
| 31 | <i>Lepisanthes tetraphylla</i> | 0.3 | 20 | 1.5 | 0.075 | 0.61 | 1.04 | 826.354 | 0.146 | 1.8 |
| 32 | <i>Litsea floribunda</i> | 0.1 | 10 | 1 | 0.1 | 0.2 | 0.52 | 472.054 | 0.083 | 0.8 |
| 33 | <i>Lophopetalum wightianum</i> | 0.3 | 10 | 3 | 0.3 | 0.61 | 0.52 | 9930.81 | 1.754 | 2.9 |
| 34 | <i>Madhuca nerifolia</i> | 3.1 | 100 | 3.1 | 0.031 | 6.3 | 5.18 | 38234.2 | 6.751 | 18 |
| 35 | <i>Mallotus tetracoccus</i> | 1.3 | 40 | 3.25 | 0.081 | 2.64 | 2.07 | 4682.25 | 0.827 | 5.5 |
| 36 | <i>Melicope lunu-ankenda</i> | 0.9 | 40 | 2.25 | 0.056 | 1.83 | 2.07 | 11978.2 | 2.115 | 6 |
| 37 | <i>Mesua ferrea</i> | 0.5 | 30 | 1.667 | 0.056 | 1.02 | 1.55 | 1676.59 | 0.296 | 2.9 |
| 38 | <i>Mimusops elengi</i> | 0.3 | 10 | 3 | 0.3 | 0.61 | 0.52 | 1758.76 | 0.311 | 1.4 |
| 39 | <i>Murraya paniculata</i> | 0.3 | 10 | 3 | 0.3 | 0.61 | 0.52 | 1210.23 | 0.214 | 1.3 |
| 40 | <i>Nothopogia travancorica</i> | 0.1 | 10 | 1 | 0.1 | 0.2 | 0.52 | 623.45 | 0.11 | 0.8 |
| 41 | <i>Palaquium ellipticum</i> | 2.6 | 80 | 3.25 | 0.041 | 5.28 | 4.15 | 37419.3 | 6.607 | 16 |
| 42 | <i>Persea macrantha</i> | 1.2 | 40 | 3 | 0.075 | 2.44 | 2.07 | 7282.72 | 1.286 | 5.8 |
| 43 | <i>Psychotria beddomei</i> | 0.7 | 50 | 1.4 | 0.028 | 1.42 | 2.59 | 2525.08 | 0.446 | 4.5 |
| 44 | <i>Pterospermum reticulatum</i> | 1.2 | 60 | 2 | 0.033 | 2.44 | 3.11 | 15012.4 | 2.651 | 8.2 |
| 45 | <i>Symplocos cochinchinensis</i> | 0.3 | 10 | 3 | 0.3 | 0.61 | 0.52 | 1830.12 | 0.323 | 1.5 |
| 46 | <i>Syzygium cumini</i> | 0.1 | 10 | 1 | 0.1 | 0.2 | 0.52 | 591.34 | 0.104 | 0.8 |
| 47 | <i>Turpinia malabarica</i> | 1.6 | 20 | 8 | 0.4 | 3.25 | 1.04 | 20706.8 | 3.656 | 7.9 |
| 48 | <i>Vateria indica</i> | 0.5 | 20 | 2.5 | 0.125 | 1.02 | 1.04 | 3046.82 | 0.538 | 2.6 |
| 49 | <i>Xanthophyllum arnottianum</i> | 0.2 | 20 | 1 | 0.05 | 0.41 | 1.04 | 3932.56 | 0.694 | 2.1 |
| | | 49.2 | 1930 | | | 100 | 100 | 566333 | 100 | 300 |

Table 57 - Site 26

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|-----------------------------------|-----|-----|-------|-------|------|------|--------|-------|------|
| 1 | <i>Actinodaphne malabarica</i> | 0.7 | 40 | 1.75 | 0.044 | 1.54 | 2.07 | 15428 | 3.046 | 6.66 |
| 2 | <i>Aglaiia barberi</i> | 3.3 | 100 | 3.3 | 0.033 | 7.27 | 5.18 | 23343 | 4.61 | 17.1 |
| 3 | <i>Aglaiia tomentosa</i> | 0.2 | 20 | 1 | 0.05 | 0.44 | 1.04 | 3328.8 | 0.657 | 2.13 |
| 4 | <i>Agrostistachys borneensis</i> | 1.3 | 40 | 3.25 | 0.081 | 2.86 | 2.07 | 9017.8 | 1.781 | 6.72 |
| 5 | <i>Alseodaphne semecarpifolia</i> | 2.3 | 50 | 4.6 | 0.092 | 5.07 | 2.59 | 9849.1 | 1.945 | 9.6 |
| 6 | <i>Antidesma montanum</i> | 0.2 | 10 | 2 | 0.2 | 0.44 | 0.52 | 369.43 | 0.073 | 1.03 |
| 7 | <i>Artocarpus heterophyllus</i> | 0.1 | 10 | 1 | 0.1 | 0.22 | 0.52 | 1071.3 | 0.212 | 0.95 |
| 8 | <i>Artocarpus hirsutus</i> | 0.3 | 20 | 1.5 | 0.075 | 0.66 | 1.04 | 1661.3 | 0.328 | 2.03 |
| 9 | <i>Baccaurea courtallensis</i> | 1.6 | 80 | 2 | 0.025 | 3.52 | 4.15 | 4838.3 | 0.955 | 8.62 |
| 10 | <i>Bischofia javanica</i> | 1.4 | 70 | 2 | 0.029 | 3.08 | 3.63 | 19882 | 3.926 | 10.6 |
| 11 | <i>Calophyllum polyanthum</i> | 0.3 | 20 | 1.5 | 0.075 | 0.66 | 1.04 | 7309.6 | 1.443 | 3.14 |
| 12 | <i>Canarium strictum</i> | 0.9 | 40 | 2.25 | 0.056 | 1.98 | 2.07 | 9284.7 | 1.833 | 5.89 |
| 13 | <i>Chionanthus mala-elengi</i> | 0.4 | 30 | 1.333 | 0.044 | 0.88 | 1.55 | 6928.7 | 1.368 | 3.8 |
| 14 | <i>Cinnamomum verum</i> | 1.2 | 80 | 1.5 | 0.019 | 2.64 | 4.15 | 6792.6 | 1.341 | 8.13 |
| 15 | <i>Croton malabaricus</i> | 0.3 | 30 | 1 | 0.033 | 0.66 | 1.55 | 3473.4 | 0.686 | 2.9 |
| 16 | <i>Cullenia exarillata</i> | 0.6 | 20 | 3 | 0.15 | 1.32 | 1.04 | 12548 | 2.478 | 4.84 |
| 17 | <i>Dimocarpus longan</i> | 1.2 | 50 | 2.4 | 0.048 | 2.64 | 2.59 | 28873 | 5.701 | 10.9 |
| 18 | <i>Diospyros paniculata</i> | 2.6 | 90 | 2.889 | 0.032 | 5.73 | 4.66 | 12533 | 2.475 | 12.9 |
| 19 | <i>Dipterocarpus indicus</i> | 0.5 | 20 | 2.5 | 0.125 | 1.1 | 1.04 | 1655.7 | 0.327 | 2.46 |
| 20 | <i>Dysoxylum malabaricum</i> | 1.7 | 60 | 2.833 | 0.047 | 3.74 | 3.11 | 20503 | 4.049 | 10.9 |
| 21 | <i>Elaeocarpus serratus</i> | 0.6 | 40 | 1.5 | 0.038 | 1.32 | 2.07 | 14135 | 2.791 | 6.19 |
| 22 | <i>Elaeocarpus tuberculatus</i> | 0.6 | 30 | 2 | 0.067 | 1.32 | 1.55 | 2741.8 | 0.541 | 3.42 |
| 23 | <i>Garcinia gummi-gutta</i> | 0.2 | 10 | 2 | 0.2 | 0.44 | 0.52 | 614 | 0.121 | 1.08 |
| 24 | <i>Glochidion zeylanicum</i> | 0.6 | 30 | 2 | 0.067 | 1.32 | 1.55 | 3285.5 | 0.649 | 3.52 |
| 25 | <i>Harpullia arborea</i> | 0.1 | 10 | 1 | 0.1 | 0.22 | 0.52 | 518.23 | 0.102 | 0.84 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|-------|-------|------|------|--------|-------|------|
| 26 | <i>Holigarna arnottiana</i> | 0.9 | 40 | 2.25 | 0.056 | 1.98 | 2.07 | 7882.6 | 1.557 | 5.61 |
| 27 | <i>Hydnocarpus pentandra</i> | 0.3 | 10 | 3 | 0.3 | 0.66 | 0.52 | 4520.7 | 0.893 | 2.07 |
| 28 | <i>Kingiodendron pinnatum</i> | 0.2 | 20 | 1 | 0.05 | 0.44 | 1.04 | 8845.4 | 1.747 | 3.22 |
| 29 | <i>Knema attenuata</i> | 1.7 | 60 | 2.833 | 0.047 | 3.74 | 3.11 | 10210 | 2.016 | 8.87 |
| 30 | <i>Lepisanthes tetraphylla</i> | 0.2 | 20 | 1 | 0.05 | 0.44 | 1.04 | 1039.8 | 0.205 | 1.68 |
| 31 | <i>Lophopetalum wightianum</i> | 0.2 | 20 | 1 | 0.05 | 0.44 | 1.04 | 2676 | 0.528 | 2.01 |
| 32 | <i>Macaranga peltata</i> | 1.3 | 60 | 2.167 | 0.036 | 2.86 | 3.11 | 11142 | 2.2 | 8.17 |
| 33 | <i>Madhuca nerifolia</i> | 0.8 | 70 | 1.143 | 0.016 | 1.76 | 3.63 | 2086.9 | 0.412 | 5.8 |
| 34 | <i>Mangifera indica</i> | 1.7 | 60 | 2.833 | 0.047 | 3.74 | 3.11 | 27084 | 5.348 | 12.2 |
| 35 | <i>Melicope lunu-ankenda</i> | 0.3 | 30 | 1 | 0.033 | 0.66 | 1.55 | 2650.5 | 0.523 | 2.74 |
| 36 | <i>Mesua ferrea</i> | 0.9 | 30 | 3 | 0.1 | 1.98 | 1.55 | 9875.8 | 1.95 | 5.49 |
| 37 | <i>Myristica malabarica</i> | 1.1 | 30 | 3.667 | 0.122 | 2.42 | 1.55 | 7620.9 | 1.505 | 5.48 |
| 38 | <i>Otonephelium stipulaceum</i> | 1.9 | 70 | 2.714 | 0.039 | 4.19 | 3.63 | 16463 | 3.251 | 11.1 |
| 39 | <i>Palaquium ellipticum</i> | 2.5 | 100 | 2.5 | 0.025 | 5.51 | 5.18 | 36401 | 7.188 | 17.9 |
| 40 | <i>Persea macrantha</i> | 1.5 | 70 | 2.143 | 0.031 | 3.3 | 3.63 | 41869 | 8.268 | 15.2 |
| 41 | <i>Prunus ceylanica</i> | 0.8 | 40 | 2 | 0.05 | 1.76 | 2.07 | 15261 | 3.014 | 6.85 |
| 42 | <i>Schefflera wallichiana</i> | 0.1 | 10 | 1 | 0.1 | 0.22 | 0.52 | 286.7 | 0.057 | 0.8 |
| 43 | <i>Schleichera oleosa</i> | 0.4 | 20 | 2 | 0.1 | 0.88 | 1.04 | 1800.4 | 0.356 | 2.27 |
| 44 | <i>Syzygium occidentale</i> | 0.1 | 10 | 1 | 0.1 | 0.22 | 0.52 | 412 | 0.081 | 0.82 |
| 45 | <i>Turpinia malabarica</i> | 0.3 | 20 | 1.5 | 0.075 | 0.66 | 1.04 | 1907.4 | 0.377 | 2.07 |
| 46 | <i>Vateria indica</i> | 3.8 | 100 | 3.8 | 0.038 | 8.37 | 5.18 | 63760 | 12.59 | 26.1 |
| 47 | <i>Xanthophyllum arnottianum</i> | 1.2 | 40 | 3 | 0.075 | 2.64 | 2.07 | 12629 | 2.494 | 7.21 |
| | | 45.4 | 1930 | | | 100 | 100 | 506409 | 100 | 300 |

Table 58 - Site 27

| SL No | species | D | F | A | A/F | R D | R F | B A | RBA | IVI |
|-------|---------------------------------|-----|----|------|-------|------|------|--------|--------|-----|
| 1 | <i>Aglaia barberi</i> | 0.9 | 30 | 3 | 0.1 | 3.04 | 2.33 | 2371.3 | 0.5556 | 5.9 |
| 2 | <i>Alstonia scholaris</i> | 0.2 | 10 | 2 | 0.2 | 0.68 | 0.78 | 375.56 | 0.088 | 1.5 |
| 3 | <i>Antidesma montanum</i> | 0.9 | 40 | 2.25 | 0.056 | 3.04 | 3.1 | 48031 | 11.254 | 17 |
| 4 | <i>Aporosa lindleyana</i> | 0.4 | 20 | 2 | 0.1 | 1.35 | 1.55 | 1162 | 0.2723 | 3.2 |
| 5 | <i>Artocarpus heterophyllus</i> | 0.1 | 10 | 1 | 0.1 | 0.34 | 0.78 | 207.09 | 0.0485 | 1.2 |
| 6 | <i>Artocarpus hirsutus</i> | 0.4 | 10 | 4 | 0.4 | 1.35 | 0.78 | 8206.5 | 1.9228 | 4 |
| 7 | <i>Baccaurea courtallensis</i> | 0.5 | 30 | 1.67 | 0.056 | 1.69 | 2.33 | 617.99 | 0.1448 | 4.2 |
| 8 | <i>Bischofia javanica</i> | 0.8 | 50 | 1.6 | 0.032 | 2.7 | 3.88 | 28137 | 6.5926 | 13 |
| 9 | <i>Bombax ceiba</i> | 0.9 | 50 | 1.8 | 0.036 | 3.04 | 3.88 | 28031 | 6.5677 | 13 |
| 10 | <i>Chionanthus mala-elengi</i> | 1.4 | 50 | 2.8 | 0.056 | 4.73 | 3.88 | 5958.8 | 1.3962 | 10 |
| 11 | <i>Cinnamomum malabattrum</i> | 0.4 | 20 | 2 | 0.1 | 1.35 | 1.55 | 975.72 | 0.2286 | 3.1 |
| 12 | <i>Croton malabaricus</i> | 0.8 | 40 | 2 | 0.05 | 2.7 | 3.1 | 4895.5 | 1.147 | 7 |
| 13 | <i>Dimocarpus longan</i> | 0.3 | 10 | 3 | 0.3 | 1.01 | 0.78 | 942.99 | 0.2209 | 2 |
| 14 | <i>Elaeocarpus serratus</i> | 0.9 | 30 | 3 | 0.1 | 3.04 | 2.33 | 1997.8 | 0.4681 | 5.8 |
| 15 | <i>Elaeocarpus tuberculatus</i> | 0.5 | 30 | 1.67 | 0.056 | 1.69 | 2.33 | 1025 | 0.2402 | 4.3 |
| 16 | <i>Ficus callosa</i> | 0.2 | 10 | 2 | 0.2 | 0.68 | 0.78 | 2660 | 0.6232 | 2.1 |
| 17 | <i>Garcinia gummi-gutta</i> | 0.3 | 20 | 1.5 | 0.075 | 1.01 | 1.55 | 3708.4 | 0.8689 | 3.4 |
| 18 | <i>Hopea ponga</i> | 0.2 | 20 | 1 | 0.05 | 0.68 | 1.55 | 2673.6 | 0.6264 | 2.9 |
| 19 | <i>Knema attenuata</i> | 1.2 | 70 | 1.71 | 0.024 | 4.05 | 5.43 | 4391.3 | 1.0289 | 11 |
| 20 | <i>Lagerstroemia microcarpa</i> | 0.4 | 20 | 2 | 0.1 | 1.35 | 1.55 | 1147 | 0.2687 | 3.2 |
| 21 | <i>Leea indica</i> | 0.8 | 30 | 2.67 | 0.089 | 2.7 | 2.33 | 1218.2 | 0.2854 | 5.3 |
| 22 | <i>Olea dioica</i> | 0.1 | 10 | 1 | 0.1 | 0.34 | 0.78 | 447.85 | 0.1049 | 1.2 |
| 23 | <i>Otonophelium stipulaceum</i> | 2.2 | 80 | 2.75 | 0.034 | 7.43 | 6.2 | 22701 | 5.3188 | 19 |
| 24 | <i>Persea macrantha</i> | 1.9 | 70 | 2.71 | 0.039 | 6.42 | 5.43 | 8161.5 | 1.9123 | 14 |
| 25 | <i>Polyalthia fragrans</i> | 1.2 | 70 | 1.71 | 0.024 | 4.05 | 5.43 | 5338.5 | 1.2508 | 11 |

| | | | | | | | | | | |
|----|----------------------------------|------|------|------|-------|------|------|--------|--------|-----|
| 26 | <i>Prunus ceylanica</i> | 1.1 | 50 | 2.2 | 0.044 | 3.72 | 3.88 | 28019 | 6.5651 | 14 |
| 27 | <i>Saraca asoka</i> | 0.1 | 10 | 1 | 0.1 | 0.34 | 0.78 | 14517 | 3.4013 | 4.5 |
| 28 | <i>Schleichera oleosa</i> | 0.4 | 20 | 2 | 0.1 | 1.35 | 1.55 | 6807.5 | 1.595 | 4.5 |
| 29 | <i>Spondias pinnata</i> | 0.1 | 10 | 1 | 0.1 | 0.34 | 0.78 | 1264 | 0.2962 | 1.4 |
| 30 | <i>Stereospermum colais</i> | 0.2 | 20 | 1 | 0.05 | 0.68 | 1.55 | 555.49 | 0.1302 | 2.4 |
| 31 | <i>Strobocalyx arborea</i> | 2 | 60 | 3.33 | 0.056 | 6.76 | 4.65 | 18553 | 4.3471 | 16 |
| 32 | <i>Tetrameles nudiflora</i> | 1.8 | 60 | 3 | 0.05 | 6.08 | 4.65 | 55050 | 12.899 | 24 |
| 33 | <i>Turpinia malabarica</i> | 0.3 | 20 | 1.5 | 0.075 | 1.01 | 1.55 | 464.41 | 0.1088 | 2.7 |
| 34 | <i>Vateria indica</i> | 2.8 | 90 | 3.11 | 0.035 | 9.46 | 6.98 | 55779 | 13.069 | 30 |
| 35 | <i>Vepris bilocularis</i> | 1.4 | 50 | 2.8 | 0.056 | 4.73 | 3.88 | 30989 | 7.261 | 16 |
| 36 | <i>Xanthophyllum arnottianum</i> | 1.5 | 70 | 2.14 | 0.031 | 5.07 | 5.43 | 29414 | 6.8919 | 17 |
| | | 29.6 | 1290 | | | 100 | 100 | 426795 | 100 | 300 |

Table 59 - Site 28

| SL No | species | D | F | A | A/F | RD | RF | BA | RBA | IVI |
|-------|---------------------------------|-----|-----|------|------|------|-----|--------|--------|------|
| 1 | <i>Actinodaphne malabarica</i> | 1.1 | 40 | 2.75 | 0.07 | 3.13 | 2.5 | 3123.3 | 0.6133 | 6.24 |
| 2 | <i>Alstonia scholaris</i> | 0.4 | 20 | 2 | 0.1 | 1.14 | 1.3 | 729.86 | 0.1433 | 2.53 |
| 3 | <i>Antidesma montanum</i> | 1.3 | 80 | 1.63 | 0.02 | 3.69 | 5 | 1640.5 | 0.3221 | 9.02 |
| 4 | <i>Aporosa lindleyana</i> | 0.4 | 20 | 2 | 0.1 | 1.14 | 1.3 | 925 | 0.1816 | 2.57 |
| 5 | <i>Baccaurea courtallensis</i> | 0.8 | 40 | 2 | 0.05 | 2.27 | 2.5 | 28122 | 5.522 | 10.3 |
| 6 | <i>Bombax ceiba</i> | 0.3 | 20 | 1.5 | 0.08 | 0.85 | 1.3 | 20694 | 4.0635 | 6.17 |
| 7 | <i>Cinnamomum malabattrum</i> | 1 | 60 | 1.67 | 0.03 | 2.84 | 3.8 | 61693 | 12.114 | 18.7 |
| 8 | <i>Dendrocide sinuata</i> | 0.4 | 30 | 1.33 | 0.04 | 1.14 | 1.9 | 499.2 | 0.098 | 3.11 |
| 9 | <i>Dimocarpus longan</i> | 0.9 | 50 | 1.8 | 0.04 | 2.56 | 3.1 | 2763.5 | 0.5426 | 6.22 |
| 10 | <i>Elaeocarpus serratus</i> | 0.4 | 20 | 2 | 0.1 | 1.14 | 1.3 | 21305 | 4.1833 | 6.57 |
| 11 | <i>Elaeocarpus tuberculatus</i> | 0.7 | 50 | 1.4 | 0.03 | 1.99 | 3.1 | 2376.9 | 0.4667 | 5.58 |
| 12 | <i>Ficus hispida</i> | 0.6 | 50 | 1.2 | 0.02 | 1.7 | 3.1 | 3934.9 | 0.7726 | 5.6 |
| 13 | <i>Ficus tsjahela</i> | 0.2 | 20 | 1 | 0.05 | 0.57 | 1.3 | 77809 | 15.279 | 17.1 |
| 14 | <i>Garcinia gummi-gutta</i> | 0.3 | 10 | 3 | 0.3 | 0.85 | 0.6 | 7658 | 1.5037 | 2.98 |
| 15 | <i>Hopea parviflora</i> | 1.2 | 50 | 2.4 | 0.05 | 3.41 | 3.1 | 9235 | 1.8134 | 8.35 |
| 16 | <i>Hydnocarpus pentandra</i> | 1.4 | 50 | 2.8 | 0.06 | 3.98 | 3.1 | 23412 | 4.5971 | 11.7 |
| 17 | <i>Knema attenuata</i> | 1.9 | 70 | 2.71 | 0.04 | 5.4 | 4.4 | 32990 | 6.4779 | 16.3 |
| 18 | <i>Lagerstroemia microcarpa</i> | 0.9 | 30 | 3 | 0.1 | 2.56 | 1.9 | 2386.6 | 0.4686 | 4.9 |
| 19 | <i>Lagerstroemia speciosa</i> | 0.4 | 30 | 1.33 | 0.04 | 1.14 | 1.9 | 1237.1 | 0.2429 | 3.25 |
| 20 | <i>Litsea floribunda</i> | 1.7 | 60 | 2.83 | 0.05 | 4.83 | 3.8 | 6500.4 | 1.2764 | 9.86 |
| 21 | <i>Lophopetalum wightianum</i> | 1.2 | 30 | 4 | 0.13 | 3.41 | 1.9 | 16830 | 3.3047 | 8.59 |
| 22 | <i>Macaranga peltata</i> | 1.8 | 70 | 2.57 | 0.04 | 5.11 | 4.4 | 11756 | 2.3084 | 11.8 |
| 23 | <i>Mallotus philippensis</i> | 1.6 | 80 | 2 | 0.03 | 4.55 | 5 | 16999 | 3.338 | 12.9 |
| 24 | <i>Melicope lunu-ankenda</i> | 0.4 | 20 | 2 | 0.1 | 1.14 | 1.3 | 4899.1 | 0.962 | 3.35 |
| 25 | <i>Myristica beddomei</i> | 2 | 100 | 2 | 0.02 | 5.68 | 6.3 | 19532 | 3.8353 | 15.8 |

| | | | | | | | | | | |
|----|-----------------------------|------|------|------|------|------|-----|--------|--------|------|
| 26 | <i>Olea dioica</i> | 1.2 | 70 | 1.71 | 0.02 | 3.41 | 4.4 | 6806 | 1.3364 | 9.12 |
| 27 | <i>Persea macrantha</i> | 0.8 | 30 | 2.67 | 0.09 | 2.27 | 1.9 | 3365 | 0.6607 | 4.81 |
| 28 | <i>Schleichera oleosa</i> | 0.3 | 20 | 1.5 | 0.08 | 0.85 | 1.3 | 6583 | 1.2926 | 3.39 |
| 29 | <i>Strobocalyx arborea</i> | 1.2 | 30 | 4 | 0.13 | 3.41 | 1.9 | 6171.9 | 1.2119 | 6.5 |
| 30 | <i>Strombosia ceylanica</i> | 1.3 | 70 | 1.86 | 0.03 | 3.69 | 4.4 | 3442.3 | 0.6759 | 8.74 |
| 31 | <i>Syzygium lanceolatum</i> | 1.9 | 70 | 2.71 | 0.04 | 5.4 | 4.4 | 6447.7 | 1.2661 | 11 |
| 32 | <i>Tetrameles nudiflora</i> | 2.5 | 100 | 2.5 | 0.03 | 7.1 | 6.3 | 41203 | 8.0906 | 21.4 |
| 33 | <i>Vateria indica</i> | 2.6 | 100 | 2.6 | 0.03 | 7.39 | 6.3 | 55779 | 10.953 | 24.6 |
| 34 | <i>Vitex altissima</i> | 0.1 | 10 | 1 | 0.1 | 0.28 | 0.6 | 420 | 0.0825 | 0.99 |
| | | 35.2 | 1600 | | | 100 | 100 | 509270 | 100 | 300 |

D=Density, F=Frequency, A=Abundance, A/F=Abundance/ Frequency, RD= Relative Density, RF=Relative Frequency, RBA=Relative Basel Area, BA= Basel Area, IVI = Importance value Index

Table 60: Details of the study sites with the altitude and coordinate values

| Study site number | Latitude | Longitude | Altitude in meter |
|--------------------------|-----------------|------------------|--------------------------|
| 1 | 10'17'56N | 76'44'56E | 730 |
| 2 | 10'18'03N | 76'45'11E | 802 |
| 3 | 10'18'03N | 76'45'15E | 820 |
| 4 | 10'18'04N | 76'45'02E | 832 |
| 5 | 10'18'16 N | 76'46'27 E | 865 |
| 6 | 10'18'18N | 76'46'26E | 866 |
| 7 | 10'18'00N | 76'46'51E | 873 |
| 8 | 10'17'52N | 76'47'51E | 876 |
| 9 | 10'18'07N | 76'48'26E | 857 |
| 10 | 10'17'53N | 76'49'36E | 949 |
| 11 | 10'19'12N | 76'43'50E | 815 |
| 12 | 10'17'31N | 76'49'09E | 922 |
| 13 | 10'17'41N | 76'48'08E | 938 |
| 14 | 10'17'45N | 76'45'35E | 918 |
| 15 | 10'17'45N | 76'45'32E | 917 |
| 16 | 10'16'36N | 76'46'10E | 892 |
| 17 | 10'18'16'N | 76'42'33E | 579 |
| 18 | 10'18'14N | 76'42'59E | 516 |
| 19 | 10'18'08N | 76'43'41E | 503 |
| 20 | 10'18'41N | 76'43'17E | 605 |
| 21 | 10'18'25N | 76'43'26E | 569 |
| 22 | 10'16'53N | 76'41'20E | 575 |
| 23 | 10'16'34N | 76'43'05E | 556 |
| 24 | 10'16'19N | 76'41'45E | 640 |
| 25 | 10'17'24N | 76'50'28E | 880 |
| 26 | 10'17'23N | 76'50'28E | 881 |
| 27 | 10'17'45N | 76'41'21E | 475 |
| 28 | 10'17'50N | 76'41'49E | 483 |

Table 61 : Tree species recorded from Sholayar Reserve forest

| Name | Family |
|--|----------------|
| <i>Actinodaphne malabarica</i> Balakr. | LAURACEAE |
| <i>Aglaia barberi</i> Gamble | MELIACEAE |
| <i>Aglaia lawii</i> (Wight) C.J.Saldanha | MELIACEAE |
| <i>Aglaia perviridis</i> Hiern | MELIACEAE |
| <i>Aglaia tomentosa</i> Teijsm. & Binn. | MELIACEAE |
| <i>Agrostistachys borneensis</i> Becc. | EUPHORBIACEAE |
| <i>Ailanthus triphysa</i> (Dennst.) Alston in Trimen | SIMAROUBACEAE |
| <i>Albizia lebbeck</i> (L.)Willd. | FABACEAE |
| <i>Alseodaphne semecarpifolia</i> Nees | LAURACEAE |
| <i>Alstonia scholaris</i> (L.) R.Br. | APOCYANACEAE |
| <i>Antiaris toxicaria</i> Lesch. | MORACEAE |
| <i>Antidesma montanum</i> Blume. | EUPHORBIACEAE |
| <i>Aphanamixis polystachya</i> (Wall.)R.Parker | MELIACEAE |
| <i>Aporosa acuminata</i> Thw. | EUPHORBIACEAE |
| <i>Aporosa bourdillonii</i> Stapf. | EUPHORBIACEAE |
| <i>Aporosa lindleyana</i> (Wight)Baill. | EUPHORBIACEAE |
| <i>Artocarpus heterophyllus</i> Lam. | MORACEAE |
| <i>Artocarpus hirsutus</i> Lam. | MORACEAE |
| <i>Azadirachta indica</i> A.Juss. | MELIACEAE |
| <i>Baccaurea courtallensis</i> (Wight) Muell.-Arg. | EUPHORBIACEAE |
| <i>Bischofia javanica</i> Blume | EUPHORBIACEAE |
| <i>Blachia umbellata</i> (Willd.) Baill. | EUPHORBIACEAE |
| <i>Bombax ceiba</i> L. | BOMBACACEAE |
| <i>Bombax insigne</i> Wall. | BOMBACACEAE |
| <i>Callicarpa tomentosa</i> (L.) Murr. | VERBENACEAE |
| <i>Calophyllum polyanthum</i> Wall. ex Planch.& Triana | CLUSIACEAE |
| <i>Canarium strictum</i> Roxb. | BURSERACEAE |
| <i>Carallia brachiata</i> (Lour.) Merr. | RHIZOPHORACEAE |
| <i>Careya arborea</i> Roxb. | LECYTHIDACEAE |
| <i>Caryota urens</i> L. | ARECACEAE |
| <i>Cassia fistula</i> L. | LEGUMINOSAE |
| <i>Chionanthus mala-elengi</i> (Dennst.) P. S.Green | OLEACEAE |
| <i>Chrysophyllum roxburghii</i> G.Don | SAPOTACEAE |
| <i>Chukrasia tabularis</i> A.Juss. | MELIACEAE |
| <i>Cinnamomum malabattrum</i> (Burm.f.) J.Presl | LAURACEAE |
| <i>Cinnamomum sulphuratum</i> Nees | LAURACEAE |
| <i>Cinnamomum verum</i> Presl | LAURACEAE |
| <i>Clausena indica</i> (Dalz.) Oliver | RUTACEAE |
| <i>Croton malabaricus</i> Bedd. | EUPHORBIACEAE |
| <i>Cryptocarya anamalayana</i> Gamble | LAURACEAE |

| | |
|---|------------------|
| <i>Cryptocarya wightiana</i> Thw. | LAURACEAE |
| <i>Cullenia exarillata</i> Robyns | BOMBACACEAE |
| <i>Cyathocalyx zeylanicus</i> Champ. ex Hook.f. & Thomson | ANNONACEAE |
| <i>Dalbergia latifolia</i> Roxb. | FABACEAE |
| <i>Dendrocnide sinuata</i> (Blume) Chew | URTICACEAE |
| <i>Dillenia pentagyna</i> Roxb. | DILLENACEAE |
| <i>Dimocarpus longan</i> Lour. | SAPINDACEAE |
| <i>Dimorphocalyx lawianus</i> (Muell.Arg.)Hook.f. | EUPHORBIACEAE |
| <i>Diospyros assimilis</i> Bedd., | EBENACEAE |
| <i>Diospyros bourdillonii</i> Brandis | EBENACEAE |
| <i>Diospyros buxifolia</i> (Blume) Hiern | EBENACEAE |
| <i>Diospyros crumenata</i> Thw. | EBENACEAE |
| <i>Diospyros paniculata</i> Dalz. | EBENACEAE |
| <i>Diospyros sylvatica</i> Roxb. | EBENACEAE |
| <i>Dipterocarpus indicus</i> Bedd. | DIPTEROCARPACEAE |
| <i>Drypetes oblongifolia</i> (Bedd.) Airy Shaw | EUPHORBIACEAE |
| <i>Drypetes malabarica</i> (Bedd.) Airy Shaw | EUPHORBIACEAE |
| <i>Drypetes venusta</i> (Wight) Pax & Hoffm. | EUPHORBIACEAE |
| <i>Dysoxylum beddomei</i> Hiern | MELIACEAE |
| <i>Dysoxylum malabaricum</i> Bedd. ex C.DC. | MELIACEAE |
| <i>Elaeocarpus serratus</i> L. | ELAEOCARPACEAE |
| <i>Elaeocarpus tuberculatus</i> Roxb. | ELAEOCARPACEAE |
| <i>Erythrina stricta</i> Roxb. | FABACEAE |
| <i>Erythrina variegata</i> L. | FABACEAE |
| <i>Ficus beddomei</i> King | MORACEAE |
| <i>Ficus callosa</i> Willd. | MORACEAE |
| <i>Ficus hispida</i> L.f. | MORACEAE |
| <i>Ficus nervosa</i> B.Heyne ex Roth | MORACEAE |
| <i>Ficus racemosa</i> L. | MORACEAE |
| <i>Ficus tsjahela</i> Burm. f. | MORACEAE |
| <i>Flacourtia montana</i> J. Graham | FLACOURTIACEAE |
| <i>Garcinia gummi-gutta</i> (L.) Robs. | CLUSIACEAE |
| <i>Glochidion ellipticum</i> Wight | EUPHORBIACEAE |
| <i>Glochidion zeylanicum</i> (Gaertn.) A. Juss.var. <i>zeylanicum</i> ; Hook. f. | EUPHORBIACEAE |
| <i>Gmelina arborea</i> Roxb. | VERBENACEAE |
| <i>Gomphandra coriacea</i> Wight | ICACINACEAE |
| <i>Gomphandra tetrandra</i> (Wall.)Sleumer. | ICACINACEAE |
| <i>Grewia tiliifolia</i> Vahl | TILIACEAE |
| <i>Harpullia arborea</i> (Blanco) Radlk. | SAPINDACEAE |
| <i>Holigarna arnottiana</i> Hook.f. | ANACARDIACEAE |
| <i>Holigarna grahamii</i> (Wight) Kurz | ANACARDIACEAE |

| | |
|---|------------------|
| <i>Hopea parviflora</i> Bedd. | DIPTEROCARPACEAE |
| <i>Hopea ponga</i> (Dennst.)Mabb | DIPTEROCARPACEAE |
| <i>Hydnocarpus macrocarpa</i> (Bedd.)Warb. | FLACOURTIACEAE |
| <i>Hydnocarpus pentandra</i> (Buch.-Ham.) Oken | FLACOURTIACEAE |
| <i>Ixora brachyata</i> Roxb. | RUBIACEAE |
| <i>Kingiodendron pinnatum</i> (Roxb ex.DC.)Harms | CAESALPINIACEAE |
| <i>Knema attenuata</i> Warb. | MYRISTICACEAE |
| <i>Lagerstroemia microcarpa</i> Wight | LYTHRACEAE |
| <i>Lagerstroemia speciosa</i> (L.) Pers. | LYTHRACEAE |
| <i>Leea indica</i> (Burm. f.) Merr. | LEEACEAE |
| <i>Lepisanthes tetraphylla</i> (Vahl) Radlk | SAPINDACEAE |
| <i>Litsea bourdillonii</i> Gamble | LAURACEAE |
| <i>Litsea coriacea</i> (B.Heyne ex Nees)Hook.f. | LAURACEAE |
| <i>Litsea floribunda</i> (Blume) Gamble | LAURACEAE |
| <i>Lophopetalum wightianum</i> Arn. | CELASTRACEAE |
| <i>Macaranga peltata</i> (Roxb.) Muell.-Arg. | EUPHORBIACEAE |
| <i>Madhuca nerifolia</i> (Moon) H.J.Lam | SAPOTACEAE |
| <i>Mallotus philippensis</i> (Lam.) Muell.-Arg. | EUPHORBIACEAE |
| <i>Mallotus tetracoccus</i> (Roxb.) Kurz. | EUPHORBIACEAE |
| <i>Mangifera indica</i> L. | ANACARDIACEAE |
| <i>Meiogyne pannosa</i> (Dalzell) J. Sinclair | ANNONACEAE |
| <i>Melicope lunu-ankenda</i> (Gaertn.) Hartley | RUTACEAE |
| <i>Meliosma pinnata</i> (Roxb.) | SABIACEAE |
| <i>Mesua ferrea</i> L. | CLUSIACEAE |
| <i>Mimusops elengi</i> L. | SAPOTACEAE |
| <i>Murraya paniculata</i> (L.) Jack. | RUTACEAE |
| <i>Myristica beddomei</i> King | MYRISTICACEAE |
| <i>Myristica malabarica</i> Lam. | MYRISTICACEAE |
| <i>Nothopegia colebrookeana</i> (Wight) Blume | ANACARDIACEAE |
| <i>Nothopegia travancorica</i> Bedd. Ex Hook f. | ANACARDIACEAE |
| <i>Olea dioica</i> Roxb. | OLEACEAE |
| <i>Orophea erythrocarpa</i> Bedd. | ANNONACEAE |
| <i>Orophea uniflora</i> Hook. f. & Thoms. | ANNONACEAE |
| <i>Otonophelium stipulaceum</i> (Bedd.) Radlk. | SAPINDACEAE |
| <i>Palaquium ellipticum</i> (Dalz.) Baill. | SAPOTACEAE |
| <i>Paracroton pendulus</i> (Hassk.) Miq. ssp. zeylanicus (Thw.) Balakr. & Chakrab. | EUPHORBIACEAE |
| <i>Persea macrantha</i> (Nees) Kosterm. | LAURACEAE |
| <i>Phyllanthus emblica</i> L. | EUPHORBIACEAE |
| <i>Poeciloneuron indicum</i> Bedd. | BONNETIACEAE |
| <i>Polyalthia fragrans</i> (Dalz.) Bedd. | ANNONACEAE |
| <i>Prunus ceylanica</i> (Wight) Miq. | ROSACEAE |

| | |
|---|------------------|
| <i>Psychotria anamalayana</i> Bedd. | RUBIACEAE |
| <i>Psychotria beddomei</i> Deb and Gangop. | RUBIACEAE |
| <i>Pterocarpus marsupium</i> Roxb. | FABACEAE |
| <i>Pterospermum reticulatum</i> Wight & Arn. | STERCULIACEAE |
| <i>Saraca asoka</i> (Roxb.) de wilde. | CAESALPINIACEAE |
| <i>Schefflera wallichiana</i> (Wight & Arn.) Harms | ARALIACEAE |
| <i>Schleichera oleosa</i> (Lour.) Oken. | SAPINDACEAE |
| <i>Spondias pinnata</i> (L. f.) Kurz | ANACARDIACEAE |
| <i>Sterculia guttata</i> Roxb. ex DC., | STERCULIACEAE |
| <i>Stereospermum colais</i> (Buch.-Ham. ex Dillw.) Mabb. | BIGNONIACEAE |
| <i>Strobocalyx arborea</i> Buch.-Ham. | ASTERACEAE |
| <i>Strombosia ceylanica</i> Gard. | OLACACEAE |
| <i>Symplocos cochinchinensis</i> (Lour.) Moore | SYMPLOCACEAE |
| <i>Symplocos macrophylla</i> Wall. ex A. DC ssp. rosea (Bedd.) Nooteb. | SYMPLOCACEAE |
| <i>Syzygium cumini</i> (L.) Skeels var. cumini; | MYRTACEAE |
| <i>Syzygium laetum</i> (Buch.-Ham.) Gandhi | MYRTACEAE |
| <i>Syzygium lanceolatum</i> (Lam.) Wight & Arn. | MYRTACEAE |
| <i>Syzygium mundagam</i> (Bourd.) Chithra | MYRTACEAE |
| <i>Syzygium munronii</i> (Wight) Chandrab. | MYRTACEAE |
| <i>Syzygium occidentale</i> (Bourd.) Gandhi | MYRTACEAE |
| <i>Tectona grandis</i> L. f. | VERBENACEAE |
| <i>Terminalia bellirica</i> (Gaertn.) Roxb. | COMBRETACEAE |
| <i>Terminalia paniculata</i> Roth | COMBRETACEAE |
| <i>Terminalia travancorensis</i> Wight & Arn. | COMBRETACEAE |
| <i>Tetrameles nudiflora</i> R. Br. | DATISCAEAE |
| <i>Toona ciliata</i> Roem., | MELIACEAE |
| <i>Trichilia connaroides</i> (Wight & Arn.) Bentv. | MELIACEAE |
| <i>Turpinia malabarica</i> Gamble | STAPHYLIACEAE |
| <i>Vateria indica</i> L. | DIPTEROCARPACEAE |
| <i>Vepris bilocularis</i> (Wight & Arn.) Engl. | RUTACEAE |
| <i>Vitex altissima</i> L. f. | VERBENACEAE |
| <i>Wrightia tinctoria</i> R.Br. | APOCYANACEAE |
| <i>Xanthophyllum arnottianum</i> Wight | XANTHOPHYLLACEAE |
| <i>Xylia xylocarpa</i> (Roxb.) Taub. | FABACEAE |

PLATE 1



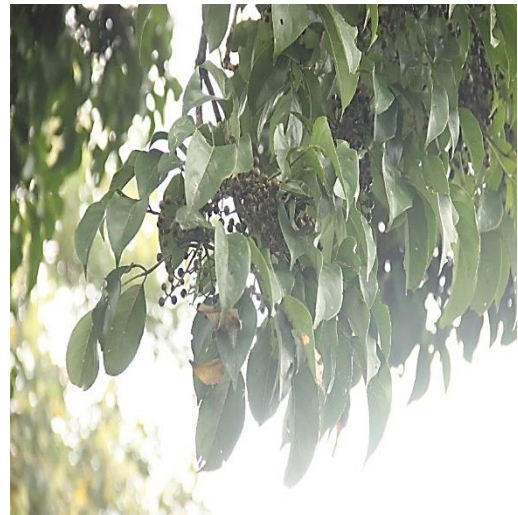
Turpinia malabarica



Glochidion ellipticum



Knema attenuata



Bischofia javanica



Sterculia guttata



Otonophelium stipulaceum

PLATE 2



Leea indica



Olea dioica



Litsea bourdillonii



Schefflera wallichiana



Drypetes venusta



Hopea parviflora

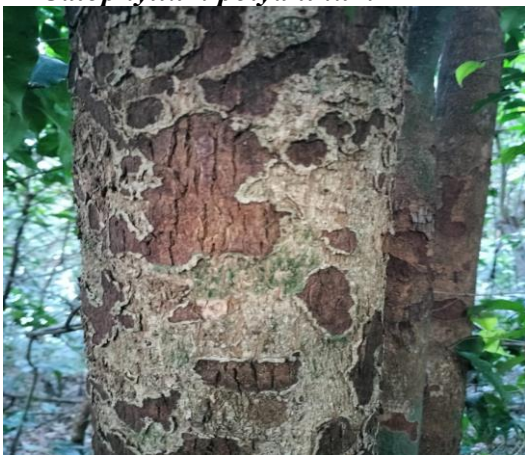
PLATE 3



Calophyllum polyanthum



Vepris bilocularis



Schleicheria oleosa



Artocarpus hirsutus



Terminalia bellirica



Vateria indica

PLATE 4



Xanthophyllum arnottianum



Hydnocarpus pentandra



Garcinia gummi-gutta



Lagerstroemia speciosa



Chionanthus mala-elengi



Aporosa lindleyana

PLATE 5



Chukrasia tabularis



Mesua ferrea



Ailanthus triphysa



Cullenia fruit



Cinnamomum malabattrum

PLATE 6



Aporosa cardiosperma



Agrostistachys borneensis



Elaeocarpus tuberculatus



Mimusops elengi

PLATE 7



Syzygium cumini



Grewia tiliifolia



Xylia xylocarpa



Terminalia elliptica

PLATE 8



Kingiodendron pinnatum



Elaeocarpus serratus



Tetrameles nudiflora



Terminalia paniculata

PLATE 9



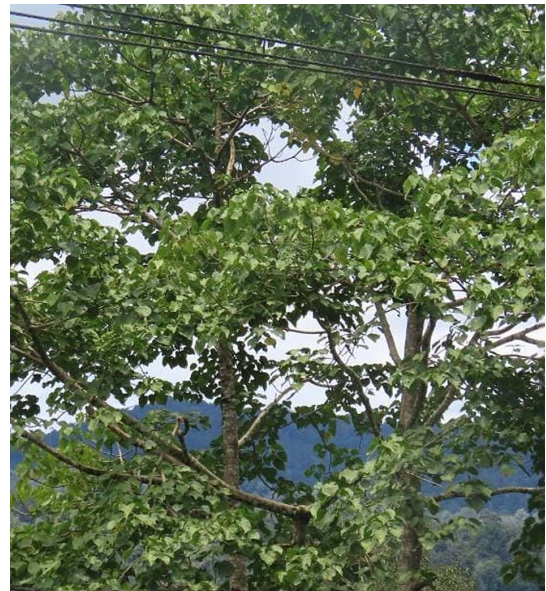
Gmelina arborea



Dysoxylum malabaricum



Lagerstroemia microcarpa



Macaranga peltata

PLATE 10



Ochlandra travancorica



Palaquium ellipticum



Caryota urens

PLATE 11



Dendrobium barbatulum



Hedychium venustum



Impatiens scapiflora



Globba sessiliflora

PLATE 12



Malabar Giant Squirrel



Loin-tailed Macaque

PLATE 13



Dense evergreen forest



Disturbed forest with canopy opening

PLATE 14



Riparian forest



Sholayar Reservoir view