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Mapping Biodiversity of the *Myristica* Swamps in Southern Kerala

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PREFACE

The *Myristica* swamps are swampy areas inside evergreen forests of low elevation. Earlier the tendency was to describe the entire area as *Myristica* swamp and Kulathupuzha and Anchal regions were described as two patches. On close examination we found that the swamps with stilt roots and knee roots could be clearly demarcated on either side of first order streams. We have mapped the swamps into more than 60 distinct entities. The edges of the swamps often rise abruptly and the plant composition changes drastically. We could not survey about half a dozen small swamps, the location of which we have described in the report. *Gymnacranthera canarica* cited in previous studies as the dominant tree in the *Myristica* swamps has recently been called *Gymnacranthera farquhariana* due to taxonomic precedence of usage of name. Since the publication of *The Flora of Presidency of Madras* (1915-1935), there has been nomenclatural changes for several species. The name changes of dominant plants in the study area are: *Entada rheedi* (*E. scandens), Actinodaphne malabarica (A. hookeri), Aporosa cardiosperma (A. lindleyana), Lagerstroemia speciosa (L. flosreginae), Terminalia elliptica (T. crenulata, T. tomentosa), Neolamarckia cadamba (Anthocephalus cadamba), Tabernaemontana alternifolia (T. heyneana), Mikania micrantha (M. scandens), Vanilla wightiana (V. aphylla), Gnetum edule (G. ula)*. In this regard, we followed Sasidharan (2007) for nomenclature.

Taxonomy of lower forms of animals is a challenging topic. We could identify odonates, butterflies and spiders to species level. Identification of other invertebrates had to be limited to higher taxonomic level. In the case of vertebrates we could identify almost all the known species, except a few; especially small frogs belonging to genus *Philautus* which does not fit into any of the species described so far. We were also constrained due to the current controversies surrounding amphibian taxonomy. We have followed Dutta's classification.

The soil of the swamps also shows many peculiarities. They are coarse structured and acidic with low base saturation and varying organic carbon contents.

As far as possible, place names used in Survey of India topo sheets are followed. Only exception is Sankli for Changili. Most of the names of swamps and locations are new and follow local names. These names are often derived from local colloquial use and have two parts; individual parts are capitalized to help pronunciation. Locally, *Mood* means base of tree, *Thadam* means small road, *Chal*, *Thodu* and Ar mean stream, rivulet and river respectively. *Para* is rock, *Theri* is slope and *Kunnu* is Hill. *Pacha* and *Karikkam* means evergreen patches. *Chathuppu* is swamp, *Padappu* is thicket. The accompanying CD contains details that could not be incorporated in this report because of space constraints. The whole report is included in the soft copy. Each and every swamp, animal and plant can be searched by name and information retrieved. GIS layers and boundary coordinates are also given.

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ABSTRACT

Myristica swamps were first described from Kulathupuzha in Kerala State in 1960. They have also been reported from Karnataka and Goa. Much of the *Myristica* swamps have been converted into paddy fields and the ecosystem has been highlighted as most critically needing conservation. *Myristica* swamps need special non-biotic conditions to develop, hence these ecosystems have become highly restricted and fragmented. In Kerala, these swamps are present in Anchal and Kulathupuzha Forest Ranges and Shendurney Wildlife Sanctuary (between 77. 27^{o} and 77. 58^{o} E and 8.74^{o}N and 9.03^{o}, below 200m MSL (so far wrongly reported as 300m). This study is the first of its kinds to map 60 individual swamp patches which constitute 1.5 km^{2} which hardly make up 0.004% of the total land area of Kerala and 0.014% of the total forest area of the state.

Mapping was done using a combination of GPS in relatively open areas and conventional survey under dense canopy. The swamps have been accurately plotted over 1:50,000 SOI toposheets enabling accurate relocation, spatial analysis and 3D visualization. Average annual rainfall of the area during the period of study was 1284.9 mm, and was distributed fairly well across the months. January and February were the driest months. Temperature varied between 29.5º C to 13º C. Winds of both South Western and North Eastern monsoons affect the area and the latter is characterized by thundershowers.

Each swamp has a central stream, which causes inundation of the swamps. Each swamp has different inundation characteristics such as time period of inundation, depth of inundation and area under inundation. Many of the swamps dry up during the months of December to March. Water table beneath the ground recedes below 50 cm during summer. The soils of these swamps vary in texture from sandy soils to sandy loams to silt loams and rarely clay loams depending on locational factors including geology and physiography of the land; gradational variations within the swamps being not uncommon. In general, most of the swamp soils are acidic (pH 4.5-6.0, exchange acidity < 2 cmol kg^{-1}, exchangeable bases < 5 cmol kg^{-1}) non-saline (electrical conductivity <70 µs cm^{-1}) and with low organic carbon content of 0.3 to 1.3%. But highly acidic peaty soil with pH values of 3 - 4 and organic carbon content of < 20% is also encountered. Gleying is common down the profile in most swamps except those that are very coarse textured.

The vegetation inside and outside the swamps have been analyzed using a total of 33 sample plots of 0.33 ha area each. Shrubs have been enumerated in subplots of 4x4m and herbs in subplots of 1x1m. All the species have been digitally photographed with close up views. Eighty two trees and ninety four species of herbs/shrubs constitute the vegetation. Forty nine lianas have also been recorded. Twelve of these plants species have been redlisted and about 28 species of them are endemic to Western Ghats. Out of the 19 sample plots, *Gymnacranthera farquhariana* was

dominant in 10 plots. *Myristica fatua var. magnifica* was the dominant tree in 6 swamps. In the remaining plots, *Vateria indica* was the dominant tree. *Holigarna arnottiana and Lophopetalum whightianum* dominated in another two plots.

The *Myristica* swamps are famed for its charismatic and archaic vegetation how ever studies documenting the animal wealth of these swamps are almost nonexistent. This study is the first effort to document and quantify animals of the *Myristica* swamps in Southern Kerala. Faunal biodiversity of the *Myristica* swamps consisted of Platyhelminthes- (Bipalium-2, tapeworm-1) 3 species, Nemathelminthes – 1 species, Annelida (Oligochaeta -2and Hirudinea-2) 4 species, Mollusca- 10 species, Unidentified Crustacean-1 species, Insecta- 281 species belonging to 83 identified families, Myriapoda- 6 species and Arachnidae 54 species, Pisces 14 species, Amphibia 56 species, Reptilia 55 species, Aves 129 species and Mammalia 27 species. Quantitative analysis of herpetofauna revealed that the differences in the environmental characteristics inside and outside the swamp play an important role in regulating the species diversity and abundance of both amphibians and reptiles. Amphibians were more susceptible to environmental changes. Patterns of diversity and abundance during day and night, across swamps and among months varied. There was no significant difference in patterns of diversity and abundance recorded during the two years. Many of the animals documented belong to redlist and endemic categories.

The present study highlights the enormous biodiversity of the *Myristica* swamp forests. The study also indicates that there are gaps in information which can be filled up only with further studies in this region. A challenge is how further studies can be carried out without disturbing the delicate ecosystem of these swamps. A pertinent question is whether all human entry should be banned into the best and least disturbed patches of swamps, leaving only the disturbed patches for human visits (tourism and academic study). Conservation of these small and scattered swamp patches must also address the contiguous areas. Strategies for management and conservation have been suggested in the above context.

LIST OF FIGURES

LIST OF TABLES

Chapter 1

INTRODUCTION

Myristica swamps were first reported by Krishnamoorthy (1960) from the Travancore region of South Western Ghats. These swamps were found in the valleys of Shendurney, Kulathupuzha and Anchal forest ranges in the southern Western Ghats. Champion and Seth (1968) classified the vegetation as Tropical fresh water swamp forests (4C/FS1). Pascal (1988) described the vegetation and Rodgers and Panwar (1992) highlighted the vegetation as most critically needing conservation. These swamps have also been reported from Uttara Kannada district of Karnataka Western Ghats (Chandran *et al*., 1999) and Satari region in Goa (Santhakumaran *et al*., 1995). Apart from the South Indian Western Ghats wooded fresh water swamps have been reported from Dehra Dun (Gupta *et al*., 2006) in India. Swamps with related vegetation have been reported from Venezuela and Amazon basin (Whitmore, 1993) and New Guinea (Corner, 1976). Varghese (1992) examined the floristics of a few patches in detail. In the Karnataka part of the Western Ghats, a critically endangered tree *Semecarpus kathalekanensis* has received much attention recently (Vasudeva *et al*., 2003). Studies documenting the animal wealth of these swamps are almost negligible hence there is no clear-cut idea about the faunal wealth.

The characteristic feature of the *Myristica* swamps is the abundance of trees belonging to the family Myristicaceae, particularly two species *viz*. *Myrisitica magnifica* and *Gymnacranthera farquhariana*. Other *Myristica* species found (although less frequently) are *Myristica malabarica* and *Knema attenuata*. A characteristic feature of these forests is the presence of pneumatophores or breathing roots, which are necessary for survival of trees in waterlogged conditions. The superficial lateral roots emerge into the air and loop back into the soil and form these breathing roots. Undergrowth is usually not dense and consists of spiny plants of genera *Pandanus* and *Calamus* and herbs of Zingiberaceae, Urticaceae, Aroideae and Acanthaceae.

It has been proposed in the earlier studies (Chandran *et al*., 1999, Varghese, 1992) that the *Myristica* swamps need special non-biotic conditions such as flat bottomed or gently sloping valleys in between heavily forested hills of evergreen forests, deep soil in the adjoining hills with rock below which will allow water to be stored above the rock layer, slow seepage of water from the side hills into the valley throughout the year, heavy annual

rainfall averaging 3000mm and temperature ranging from 20 to 30° C. Hence these swamps are highly restricted in distribution.

1.1 The study area – Location and physiography

The Western Ghats has unique assemblages of flora and fauna and is amongst the 34 biodiversity hot-spots identified in the world (Myers, 1998, 1999). The Southern part of the Western Ghats has precambrian archean crystalline hard rocks of about 2000 million years antiquity. The hills of the Western Ghats stretch 1600 km north-south between the river Tapti in Gujarat and Kanyakumari in Tamil Nadu. In the east, they merge gently with the Deccan Plateau. The hill chain is divided into two rather distinct bio-geographic units viz., the Nilgiris complex in the north and the Anaimalai-Palnis complex in the south by the Palghat Gap. Climatic conditions in the Western Ghats vary with the altitude and physical proximity to the Arabian Sea and the equator.

Previous studies (Rodgers and Panwar, 1988), (Ramesh *etal*., 1997) have identified the Kulathupuzha region as having high conservation value. The area has subsidiary hill ridges which are off-shoots of the Western Ghats forming valleys in different directions. The tops and higher slopes of the main ghats and the spurs are all steep and rocky while the lower slopes of the ghats are flats, hollows and depressions generally covered with dense forests. The streams that drain the area originate on the high slopes of the hills. Usually, these streams flow rapidly for the first few kilometers, tumbling over rocks and boulders forming small cascades. At the bottom of the valleys they begin flowing leisurely and emerge as gentle streams.

These low altitude valleys are habitat to one of the rarest ecosystems on planet earth- the *Myristica* swamp forests. The *Myristica* swamp forest patches of the Kulathupuzha region lie in the Southern Forest Circle of Kerala State, India (Fig. 1.1) located within the geo- coordinates 76º 55’ to77º10’E and 8º45’to 8º55’N (Kulathupuzha forest range in Trivandrum Division, Anchal forest range in Punalur Division and Shendurney Wildlife Sanctuary).

Generally the climate is hot and humid. The climate does not show marked variation in both seasonal and diurnal temperature. The hottest months of the year are March, April and May and the coldest months are December, January and February. The temperature ranges from 15° Celsius to 36° Celsius. The bulk of the rainfall is from the south-west monsoon between June and August. The North-East monsoon lasts for about three months from October to December. Few pre-monsoon showers are also

received during April-May. The annual rainfall recorded at KFDC Nursery, Kulathupuzha during 2005-2007 is about 1300mm. Humidity is highest in the months of June, July and August and the lowest during January, February and March ranging from 99% to 48%. The major river systems along which the *Myristica* swamps are located are the Kallada and Ithikkara rivers both of which are west flowing and originate in the forested hills of Kulathupuzha, Shendurney and Anchal regions. The whole area is ramified by a system of streams and rivulets. The Kallada River has two main tributaries, Kulathupuzha and Shendurney Rivers and is dammed (Kallada Irrigation Project) just below the confluence of the two tributaries. In River Kallada all the swamps except one are situated in Kulathupuzha branch. Only a small swamp, Onnam mile N flows to the Shendurney River. The area of swamps in the Shendurney catchment submerged by the Kallada Dam reservoir is not known.

Krisnamoorthy (1960) in his pioneering paper on *Myristica* swamps described the rocks underlying the swamps as gneisses. All the rock formations in the area have undergone varying degrees of weathering and lateritisation and lateritised gneisses are commonly observed along the lower contours adjoining the valleys. Fine gravel formed from the disintegration of rock is also present. The soil along the stream and river banks has been described as alluvial deposit and of sand brought down from the adjoining areas and is deep enough to support good tree growth. The different forest types which flank the swamp patches include Evergreen, Semi-evergreen and Moist deciduous forests. Grasslands, reed and bamboo patches and degraded forests are also present. Man-made sub-habitats associated with/derived from forests such as Forest Plantations of Teak, Eucalyptus, Acacia, etc, and Natural Forest Plantations of Social Forestry are also present. Other plantation projects in the vicinity of the swamps are those of Rehabilitation Plantation Ltd., State Farming Corporation, Oil Palm India, etc.

The hill tribe that inhabits the forests near the study area is the Kani tribe. Small and isolated populations of the Kurava tribe are also present. The Kanies are chiefly confined to Villumala, Peruvazhikala, 2nd mile, Pottamavu and Mylamoodu where they live in settlements. Non- tribal families are also present in these settlements but thy are more dominant in Dali, Mottal Moodu, Sastha Nada, Kanniyammar, Pillecode, Palli Thadam, Anakombu Rakiya Kala, Chudal, Katlapara and Aayiravalli, which are some other centers of human habitation in the vicinity of the swamps.

1.2 History

Myristicaceae, one of the largest families of Magnoliales, is pantropical and of uncertain geographic history. Phylogenetic analyses of Myristicaceae, using morphology and several plastid regions, confirm that the ancestral area was Africa-Madagascar and that Asian taxa are derived. However, Myristicaceae as a whole show strikingly lower molecular divergence than Annonaceae (which is believed to have begun its radiation in Africa and South America in the Late Cretaceous, with several lines dispersed from Africa-Madagascar into Laurasia as the Tethys closed in the Tertiary). Based on distribution of putatively primitive taxa in Madagascar and derived taxa in Asia, it has been suggested that Myristicaceae had a similar history indicating either a much younger age or a marked slowdown in molecular evolution. The oldest diagnostic fossils of Myristicaceae are Miocene seeds. Taxonomists consider Myristicaceae as an archaic one and group it along with the Magnolias, the most primitive of the flowering plants. Some consider this family as 'Living fossils', which due to some favourable circumstances escaped extinction. The present day geographic distribution of the nutmeg family members is considered enough evidence of the origin of the family before the breakup of the Gondwana land into present day landmasses. This can be proved striking similarity among transcontinental populations, such as tree habit, evergreen nature, reddish exudation, unisexual flowers, beetle pollination, and fleshy fruit with a single large seed enveloped in a brightly coloured aril despite their separation by thousands of kilometers of oceans. (Chandran *et al.*, 1999)

Peninsular India split from the Gondwana land about 150 million years ago and drifted northward over a 100 million years before colliding with the Asian mainland. During these 100 million years a series of volcanic eruptions gave rise to the extensive Deccan Traps. The hills were formed due domal uplift. The western faulting, led to a tilt which changed the pattern of drainage.

As the Western Ghats represent a tectonically active region with high rates of uplift, corresponding steep slopes and deep gorges with high potential for erosion and high sediment yields, very little fossil evidence exists to reliably reconstruct the prehistoric biodiversity of the Western Ghats. It has been observed by many workers that the flora of the Western Ghats share elements with Africa, Madagascar and South America as is also the case of many species of invertebrates. Though similarities are present in the lower vertebrates like freshwater fishes, amphibians and reptiles with

other eco-regions most of the land birds and mammals seem to be derived from the eastern Himalayan-Malayan complex after peninsular India became part of Asia.

Anthropogenic impacts and climatic changes have led to species extinctions in this region. Unique landscape elements such as the *Myristica* swamps were superseded by rice fields leading to local extinctions of trees such as *Myristica fatua* var *magnifica*, *Gymnacranthera farquhariana and Semecarpus auriculata.* The hills of the Western Ghats are now, mostly monoculture estates. *The* impact of invasions by aggressive alien plant species such as *Lantana camara, Chromolaena odorata and Mikania micrantha* is still being studied, but there is no doubt that the presence of these species will change the floral composition of an area either for the better or for the worse and will also lead to changes in the depending faunal communities.

Field observations by various workers, the ecological history of the Western Ghats and recent studies may cause the hypothesis that long back in time the *Myristica* swamps formed a network along the watercourses of the forests of the Western Ghats (Chandran *et al.*, 1999). A map released by French Institute of Pondicherry showed a large area of Punalur Forest Division and Shendurney wildlife division as *Myristica* swamps. But most swamps were converted into rice fields, or plantations of areca, coffee, rubber, etc. The possibility of submergence under hydel and irrigation projects like Thenmala cannot be ruled out. Destruction due to shifting agriculture or forestry operations that culled the soft-wooded evergreens in favour of economically preferred hardwoods, and plantation species is also a possibility.

Panwar has considered the *Myristica* swamps as unique areas at the ecosystem level than at species level as endemicity is high in these swamps though waterlogged conditions reduce species richness. Since *Myristica* swamps were not reported prior to the 1960's there is no record of the swamps that perished during the logging operations and The Grow More Food Scheme and due to the associated microclimatic changes.

1.3 Objectives of the study

This is the first attempt to map *Myristica* swamp forests in Southern Kerala. As many swamps have been destroyed in the past there is an urgent need to map and document the details of the remaining swamp forests. The extent and area of the swamps are not known. The relationships of the swamps to the streams and the catchment areas have not been worked out.

Actual mapping of biodiversity of flora and fauna, relation between climatic variables, topography, soil and hydrology is a pioneer effort. Paucity of scientifically collected data is a great barrier in formulating management and conservation strategies for these endangered and restricted swamp forests. In this context the objectives of the study are:

1. To survey and map the swamp forests in Southern Kerala and to organize the information into a dynamic GIS.
2. To document and compare the animal and plant wealth including the rare and threatened species across different *Myristica* swamps of Southern Kerala and to analyze the dependencies among them.
3. To characterize the soil, to understand the hydrological importance and their probable linkages in these forests and to associate the variables of climate, topography and biodiversity.
4. To use the Geographical Information System in registering and analyzing the data obtained and to develop conservation strategy for the swamp forests of the region.

1.4 Review of literature

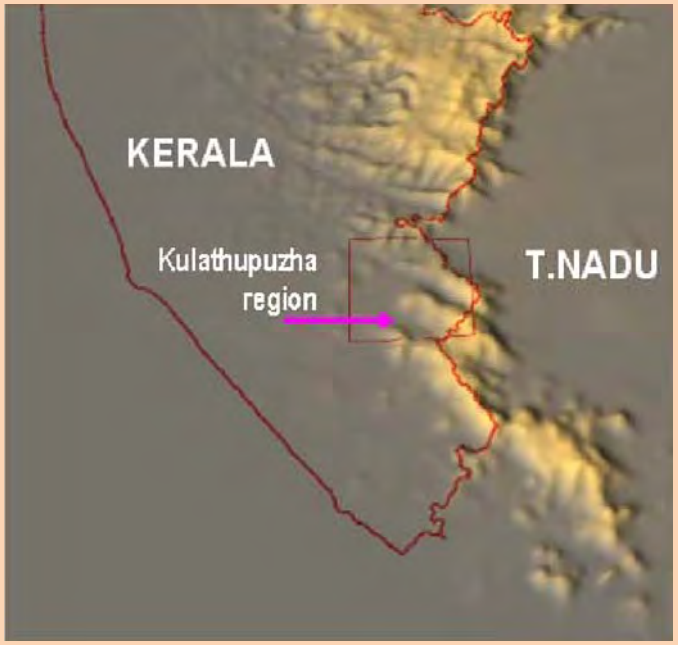
Swamp forests in India have been reported from the foothills of the Himalayas (Dakshini, 1960, Somadeva and Srivastava 1978, Ghildiyal and Srivastava 1989, Gupta *et al.,* 2006) and Kalakkad Mundanthurai (Ganesan, 2002). *Myristica* swamps from the Travancore region of South Western Ghats were first reported by Krishnamoorthy (1960) and were classified under a newly introduced category '*Myristica* Swamp Forests' under the Sub Group 4C by Champion and Seth (1968). In Uttara Kannada district of Karnataka studies (Chandran, 1993; Chandran *et al.,* 1999; Chandran and & Mesta, 2001) revealed 51 swamp patches and analysed the evolutionary and ecological characters of this unique ecosystem. Swamp forests associated with a sacred grove in the Satari taluk of Goa were reported by Santhakumaran *et al., (*1995). The floristic and edaphic attributes of fresh water swamp forests in Southern Kerala were studied by Varghese (1992). The Sacred Groves of North Malabar which had a small population of Myristicaceae was studied by M. Jayarajan (2004). Much of the *Myristica* swamps have been converted to paddy fields (Pascal, 1988). Rodgers and Panwar (1992) highlighted the vegetation as most critically needing conservation. Varghese and Menon (1999), Varghese and Kumar (1997) and Varghese and Krishna Moorthy (2006) have done vegetation oriented studies in swamp forests of the Western Ghats. French Institute, Pondicherry map published in 1997 included adjoining forests into *Myristica* swamps and

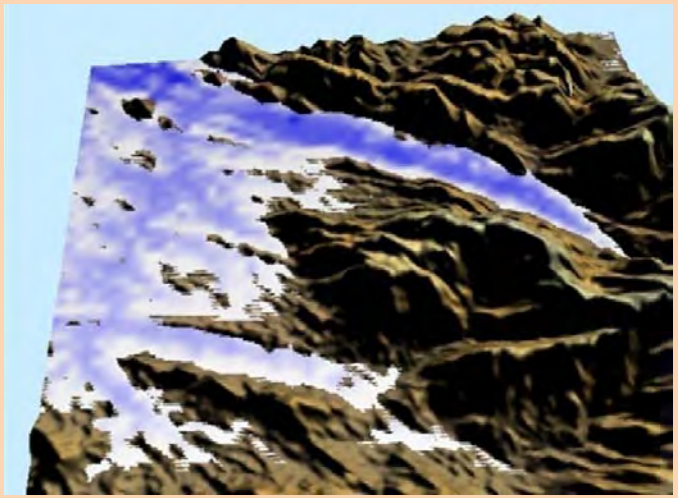
Ramesh *et al., (2003*) following this supposition has mentioned *Myristica* swamps as covering about 13 km^2. The present study is significant for its pioneering efforts. Exact boundary mapping had to wait for preset study. Present study is also first of its kind for animals of *Myristica* swamps. Publications as a result of the present study include (Roby and Nair 2006, 2007; Joyce *et al.,* 2005, 2007a, 2007b and 2007c and others under review and preparation).

Survey techniques include standard survey techniques and improvised methods. Manuals of surveying and GPS instruments provided necessary details. Manuals of remote sensing SW Erdas and GIS packages Mapinfo and Arc GIS provided the basic methods.

For vegetation sampling and surveys Muller and Dombois (1974) describe methods in detail. Sivaram (2005, 2006) critically examines biodiversity indices. Inter-active CDs for identification of trees and other plants provided species wise reference.

Sampling methods for amphibians and reptiles were available in Heyer, *et al.*, (1994). Krebs (1989) and Magurran (1998) provide methods for analyzing animal sampling data.





Region below 180m is shown filled.

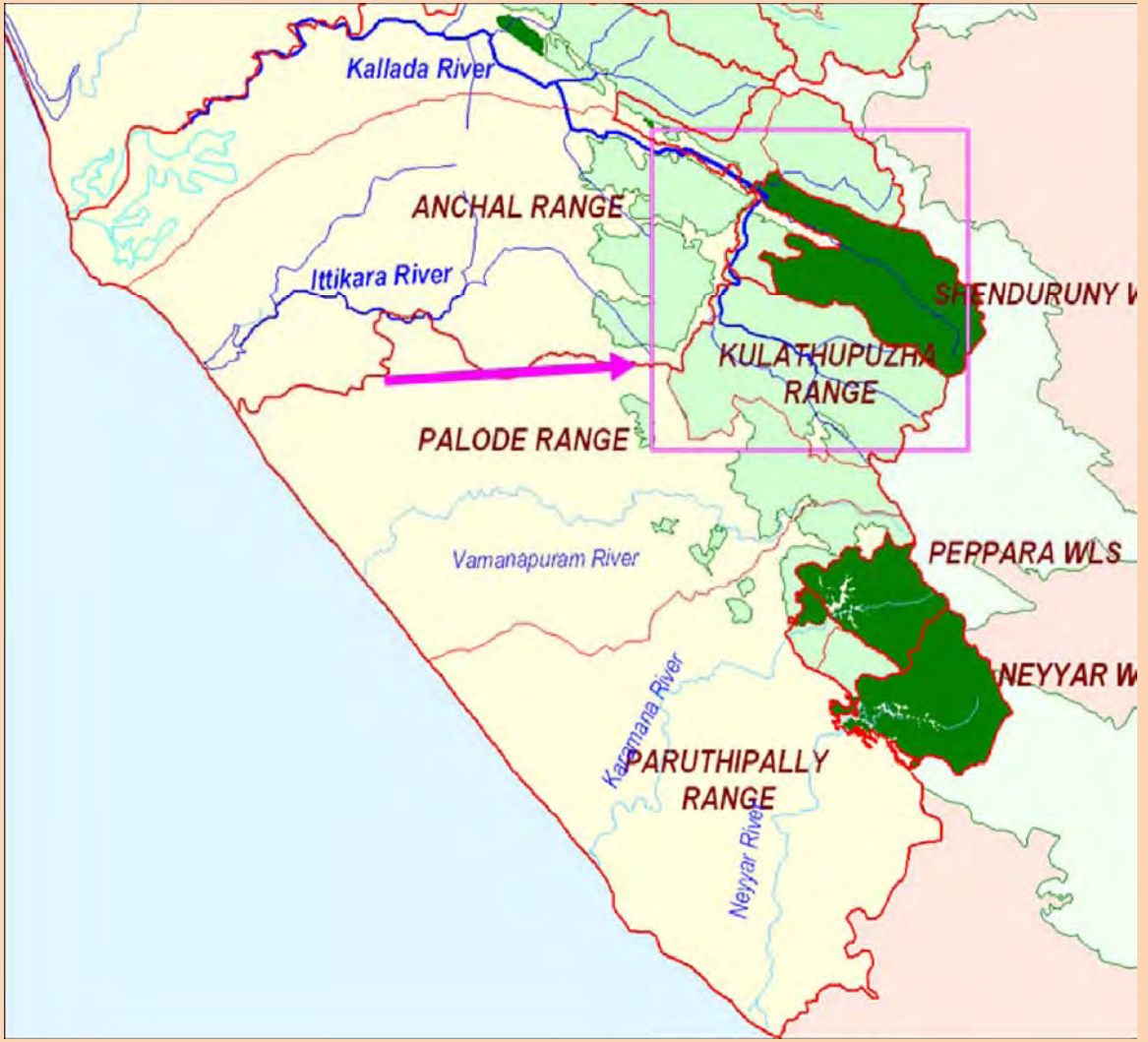


Fig 1 Location and topography of study area.

Chapter 2

MATERIALS AND METHODS

The hills in the Southern Western Ghats extend from Aryankavu pass to Cape Comerin. There is a distinct chain of hills south of Neyyar dam. North of this, in the Neyyar-Peppara-Kalakkad area, the ridge is quite steep on either side. The forest consisting of Kulathupuzha and Shendurney are situated north of this. The ghats in this area have three distinct chains of hills running in a south east direction. These hills create a series of unique valleys. The *Myristica* swamps are located at the foot hills of these valleys.

2.1 The study area

The *Myristica* swamp forests are one of the most endangered ecosystems in the Western Ghats of India (Forest Type 4C/FS1 of Champion and Seth, 1968). Even though the conservation values of these forests have been identified, hardly any detailed study, especially to spatially map the swamps, has been carried out. These swamps are seen at less than 300 m altitude in flat-bottomed valleys due to submergence during rainy season. They belong to a form of evergreen forest and due to the peculiar requirements, are seen only in few places. In the past, due to pressure on land, some of the valleys were converted to paddy fields. Only small remnants of this ecosystem remain in localities in Kulathupuzha, Anchal and Shendurney Wildlife Sanctuaries in southern Kerala (Fig 2.1).

Kulathupuzha Forest Range: Kulathupuzha forest range comes under Trivandrum forest division. Most of the area of this range comes under Kollam District. Remaining area is in Thiruvananthapuram District. Kulathupuzha forest range is one of the largest ranges in Kerala. About 40% of its area is under plantations of various types, the rest of the area is constituted by evergreen forests, grass lands, swamps, degraded forests and human habitations. Swamps are located on three main streams of Kulathupuzha forest range namely Pu Ar, Channa Mala and Dali Karikkam, they are all tributaries of Kulathupuzha River.

Anchal Forest Range: Anchal Forest Range comes under Punalur forest division, in Kollam District of Kerala. This forest range is remarkable in having human settlements all around. Forest area contains many plantations of *Elaeis guineensis* and *Acacia mangium*. Most of the area of the Anchal forest range is covered by hills, between which valleys are almost flat. The *Myristica* swamps are located on these hill valleys, in three main streams, Kochuchirakal Thodu, Kadavarath Thodu and Eravail Thodu. These later join Ithikkara River.

Shendurney Wild Life Sanctuary: The name of Shendurney is derived from the famed tree Chenkurinji (*Gluta travancorica*), which is frequent in this area. This wild life sanctuary comes under Thenmala Wildlife Division in Kollam district. Most of the areas of Shendurney are situated around the Thenmala reservoir is around the 200 m contour and have immense potential for *Myristica* swamps. The study areas of Shendurney are very near to Thenmala dam and reservoir. The *Myristica* swamps of Shendurney lie along the two streams - Kunjuman Thodu and Kattilappara, both of which are tributaries of Kulathupuzha River.

2.2 Survey and mapping

The swamps could be mapped using latitude-longitude data collected using Global Positioning System (GPS) receivers. But this had severe limitation as dense canopy was limiting GPS usage. To overcome these difficulties, a novel method using conventional survey and GPS readings was devised. To start mapping, a location such as road junction is identified in the map and on the ground. GPS readings are recorded from this point to the boundary of the swamp and mapping continued along the boundary. When the GPS is not able to provide values due to dense canopy overhead, distance and angle to the next point is measured using measuring tape and surveyor's compass. This is repeated till the GPS readings become available. Both these types of data are recorded in formats suitable for computer processing. In computer, a custom program converts angle – distance measurements to latitude-longitude values using the formula $x = d \cos \theta$ and $y = d \sin \theta$. *W*here **d** is the distance in meters and **θ** the angle (90- θ) from north (Fig. 2.2). The output, the lat long values of locations along boundary in Mapinfo Import Format (MIF) can be overlaid over existing layers and plotted using Mapinfo program. For each boundary, few reference points are also collected and checked to ensure accuracy. Nearly all the swamps were mapped in this way.

2.3 Vegetation studies

Vegetation in sample plots were enumerated to bring out the difference in vegetation inside and outside swamps. Both trees and undergrowth were considered, the former with girth more than 10cms. Undergrowth was grouped into herbs and shrubs based on height (below 1 meter and above 1 meter). These would include trees saplings and lianas as well. Each 100mx10m plot consisted of ten subplots of 10mx10m. The whole plot was enumerated for trees; shrubs were enumerated in 4mx4m area and herbs in 1mx1m area within each subplot (Fig. 2.3). Close-up photographs of specimens were taken using a digital Single Lens Reflex (SLR) camera for identification purposes. Collection of specimens was avoided as far as possible. Plants were identified by comparison with herbarium sheets at the Kerala Forest Research Institute, examination by botanists of the Institute

and by comparing pictures from published sources including the internet. The pictures are filed under taxonomic groups.

The data collected from the transects were summarized through database and spreadsheet programs. Summary table were further processed to get pictograms, IVI tables, biodiversity indices, density, frequency, abundance, IVI (Importance Value Index). Biodiversity indexes were calculated by using formula.

Density measures:

i) *Density (No. of individuals/ha)[D]*

$$= \frac{Number\ of\ individual\ s\ encountere\ d}{Total\ area\ sampled\ in\ m^2}\ 10{,}000$$

Ii) Relative Density (*RDi*)

= Number of individuals belonging to species *I* X 100
Total number of individuals

iii) Percentage Frequency (*Fi*)

= Number of quadrates in which Species *i* was present X100
Total number of quadrates sampled

iv) Relative Frequency (*RFi*) = $\frac{Fi}{\sum Fi}$

v) Relative Basal Area *(RBAi)* = $\frac{BAi}{BP}$

Where BAi = Sum of basal area of the trees belonging to species *i*

BP = Sum of basal areas of all the trees in a plot

Basal area of a tree = πr^2 ; r = $gbh/2\pi$

VI) Importance Value Index (IVI): It is used to express dominance and ecological success of any species. *IVI* = Relative Density *(RDi*) +Relative Frequency (*RFi*) +Relative Basal Area (*RBA*i)

Biodiversity indexes: Species richness indexes are follows

a) Simpson index

Diversity indices incorporate both species richness and evenness in to a single value. Simpson's index was the first diversity index used in ecology. It takes in to account the number of species present, as well as the relative abundance of each species. It represents the probability that two randomly selected individuals in the habitat belong to the same species. If the probability is high then the diversity of the community sampled is low.

$$\lambda = \sum_{i=1}^{s} Pi^2$$

Where *pi=ni/N, ni*= number of individuals of i th e species and *N* = total number of individuals for all S species in the population. The above equation applies only to finite communities where all of the members have been counted i.e. n=N where n is the total number of individuals in the sample and n is the total number of individuals in the population. In the case of infinite populations where it is impossible to count all the members, the unbiased estimator λ is given by

$$\lambda = \sum_{i=1}^{s} \frac{ni(ni-1)}{n(n-1)}$$

There is another version of the formula for calculating Simpson index. It is expressed as 1-λ. The value of this index also ranges between 0 and 1, but now, the greater the value sample diversity. This makes more sense. In this case, the index represents the probability that two individuals randomly selected from a sample will belong to different species. Yet another index is Simpson reciprocal index: 1/λ. The value of this index starts with 1 as the lowest possible figure. This figure would represent a community containing only one species. The higher the value, the greater the diversity. The minimum and maximum values for each of the three Simpson indices are:

1. Simpson index: $\lambda = \sum_{i=1}^{s} Pi^{2}$

   Minimum value: 1/(# of categories)

   Maximum value: 1

2. Simpson index of diversity: 1-λ

   Minimum value: 0

Maximum value: 1-1/(# of categories), approaches 1 as the number of categories increase.

3. Simpson reciprocal index: 1/λ

   Minimum value: 1

   Maximum value: # of categories

b) Shannon index

The Shannon index (also called the Shannon- weaver index or the Shannon - wiener index) H' is one of several diversity indices used to measure biodiversity. The advantage of this index is that it takes into account the number of species and the evenness of the species. The index is increased either by having more unique species or by having greater species evenness.

$$H' = -\sum_{i-1}^{s} Pi \ln Pi$$

Where *pi = ni/N* as in the case if Simpson index. by applying calculus, it can be shown that for any given number of species, there is a maximum possible *H', H' $_{max}$ =ln(S)* which occurs when all the species are present in equal

numbers. Since *pi* is the proportion of a given category, its maximum value is 1 and its minimum approaches 0 . For any base, the log of 1 is 0 and the log of any value between 0and 1 is a negative number. By reversing the sign, the index becomes positive and is easier to understand. The value of the H' is usually found to fall between 1.5 and 3.5 and only rarely surpasses 4.5. It has been shown that if the underlying distribution is log normal, 10^5 species will be needed to produce a value of *H'*>5.0(May, 1975)

Phenology of trees:

Phenological studies include observing various phenological stages of Rare, Endangered, and Threatened tree species (RET) found in *Myristica* swamps. Various reproductive phonological stages such as flowering fruiting, seed germination etc. of selected trees were recorded by continuous observation. The phenological observations were taken every month for two years using binoculars. The observations were made in two areas Kulathupuzha and Sastha Nada in Kulathupuzha Forest Range. Following species of trees were observed. *Myristica fatua var. magnifica, Gymnacranthera farquhariana, Syzygium travancoricum, Lophopetalum wightianum and Vateria indica.*

2.4 Faunistic studies

At the first level, the presence of species and anthropogenic disturbances were documented to produce an inventory of fauna of the *Myristica* swamps in Southern Kerala. At the second level abundances and distributions of individual herpetofaunal species in time and space were determined and quantification of disturbances was done. At the final level, general patterns of diversity were derived from the data, and it was tried to deduce the processes that account for those patterns.

Inventory: Visual Encounter Survey, Opportunistic sightings and Indirect Evidences.

Survey: The *Myristica* swamps forests of Kulathupuzha and Anchal Forest ranges and Shendurney wildlife ranges were searched for fauna. Opportunistic sightings were recorded. Indirect evidences like hoof/paw marks, dung/excreta, crab holes, earthworm casts, egg spawn were also recorded. Sightings obtained in transects while quantitative sampling were recorded.

Digital photos: Digital photos of animals were taken wherever possible. These photos were then sorted on the basis of date of photography and taxonomical position of the organism. The place, date and time of photography was noted.

Voucher specimens: Amphibians, reptiles and fishes were collected by hand. Each specimen was kept in a pearl pet jar along with pertinent data, which

was also recorded in the field notebook. Animals were killed by administering an overdose of chloroform. The dead specimen was arranged in the recommended standard posture fixed in 10% formalin solution and were preserved in 70% alcohol. Each specimen was given a Code and Location, time, place of collection, collector's name, and microhabitat occupied at the time of collection and activity was recorded. A catalogue of specimens collected was maintained (Both soft and hard copy).

Identification: Identification was done by referring to literature, comparing specimens and by seeking expert opinion. For the final inventory replicates and pseudo- replicates were avoided.

Selecting methodology: The *Myristica* swamp is a unique ecosystem. It is neither aquatic nor terrestrial. At the same time it is both. The degree and area of inundation keeps varying with the rainfall intensity so does the undergrowth, litter cover and water level above and below ground. The usual sampling methods such as transect, quadrate, cluster sampling, dredging, counting species or individuals/ catch etc followed for terrestrial, aquatic and usual wetlands are not effective. The sampling methods followed by workers in Mangroves and Non *Myristica* swamps are defeated due to the presence of Knee roots. Hence, it was difficult to arrive at a standard method fit for the field realities of *Myristica* swamps. Especially in the context that similar studies have not been conducted in India. To select a methodology, sampling was carried out from November 2004 till the next six months, with the following methods the most suitable method selected.

a) Visual Encounter Survey along stream (Heyer *et al*., 1994).
b) Visual Encounter Survey along transect (Heyer *et al*., 1994).
c) Adaptive cluster sampling (Thompson, 1991).
d) Time constrained searches (Campbell and Christman, 1982).
e) Quadrate method

Methodology for Herpetofauna: Visual Encounter Survey and medium intensity search along stream and terrestrial transects according to Heyer *et al*. was carried out in early mornings, late evenings and night. Transect size =100 x 4 x 2m (1 hour) and 6.25 x 4 x 2m (0.5 hour) following Bate *etal* 2004 which was inclusive of the different microhabitats of the swamp was taken. Transects were taken parallel to the swamp transects, in the forests adjoining the swamps for comparison. As the spatial areas of the swamps are less it was not possible to use standard quadrate size of 1000x1000 or 100x100m or to place them randomly. Quadrates of 8X8 m dimension were taken for sampling litter organisms. But these could not be repeated every month due to inundation, and soil surface churning by animals and washing away of litter by water after inundation.

Methodology for Microhabitat and environmental parameters: The following Environmental parameters and microhabitat features were measured. Canopy cover was estimated using Visual estimation and a densiometer, humidity and temperature using hygrometer and thermometer, water level using measuring rod and tape.

Data analysis: Data analysis for herpeto fauna was done using the statistical soft wares PAST and SPSS ver 10. Graphics were generated by PICTO, PAST and Excel. The Diversity {Shannon index $H=sum\ ((n_i\ /n)ln(n_i\ /n))$}, Dominance{ Dominance=1-Simpson index. $D= sum\ ((n_i\ /n)^2)$ where n_i is number of individuals of taxon *i*. }, Eveneness {Buzas and Gibson's evenness = e^H/S} and Richness {Margalef's richness index: $(S-1)\ /\ln(n)$, where *S* is the number of taxa, and *n* is the number of individuals} values were calculated using the Software Past. Paired t test was used to ascertain if there was any significant difference in the Diversity, Dominance, Evenness and Richness index values were calculated for

- The swamps and for the corresponding areas outside the swamps
- First and Second year of sampling

Similarity between the species composition for different months and swamps of transect sampling was determined by Hierarchical Cluster Analysis using paired linkage and Bray Curtis similarity index.

Percentage abundance of amphibians and reptiles for different months was calculated. Correlation between the total abundance of a species with its presence in number of plots was worked out using Spearman's Rank Correlation method. To study the differences in the day and night population patterns, semi intensive VES suggested by Heyer *et al*. (One man/ hour/quadrate) was conducted in two linear quadrates (of dimensions 100m x 4m x 2m) in *Myristica* swamps of southern Kerala. The observations were taken for both day and night for 13 months. The Wilcoxon Matched – Pairs Signed –Ranks test was chosen to determine significance. Significance level was taken as .05. N was taken as the number of pairs minus any pairs whose d is zero. Since the direction of the difference is not predicted, a two tailed region of rejection was considered appropriate.

2.5 Remote sensing, GIS and DEM

Base layers: The study area falls in two Survey of India (SOI) topo sheets of 1:50,000 scale, 58C/15 and 58H/01. These sheets were scanned at 200 Dots Per Inch (DPI), cropped, colour and tilt adjusted in Adobe Photoshop. The sheets were accurately registered using corner coordinates in raster GIS program Erdas and vector Geographic Information System (GIS) package Mapinfo. Boundaries, contour lines, rivers and streams and other features were digitized using Mapinfo. The contour lines were rasterised, and

interpolated to make Digital Elevation Model (DEM) data of 10m resolution (Fig 2.4).

In addition to the DEM data derived from topo sheets, DEM of 90 m resolution data from Shuttle Radar Topo Mission (SRTM) were downloaded from internet and used. Multispectral satellite images of 5.8m resolution were obtained from National Remote Sensing agency. These could be viewed as Red-Green-Blue (RGB) images after opening in Erdas using Generic Binary import option. The image was geo-corrected with respect to survey of India topo sheets. One of the main objectives of the project has been mapping of the *Myristica* swamps. *Myristica* swamps occur as patches on either side of small streams. Attempts would be made to identify the swamps in satellite images.

2.6 Soil and hydrology

The soil in these swamp forests were studied in detail by taking representative soil profiles and characterizing them with regard to physical, chemical and biological properties. Soil profiles and samples were made in plots used for vegetation studies. Hydrology of these swamps was studied by monitoring water table fluctuations and soil moisture dynamics (Fig. 2.5).

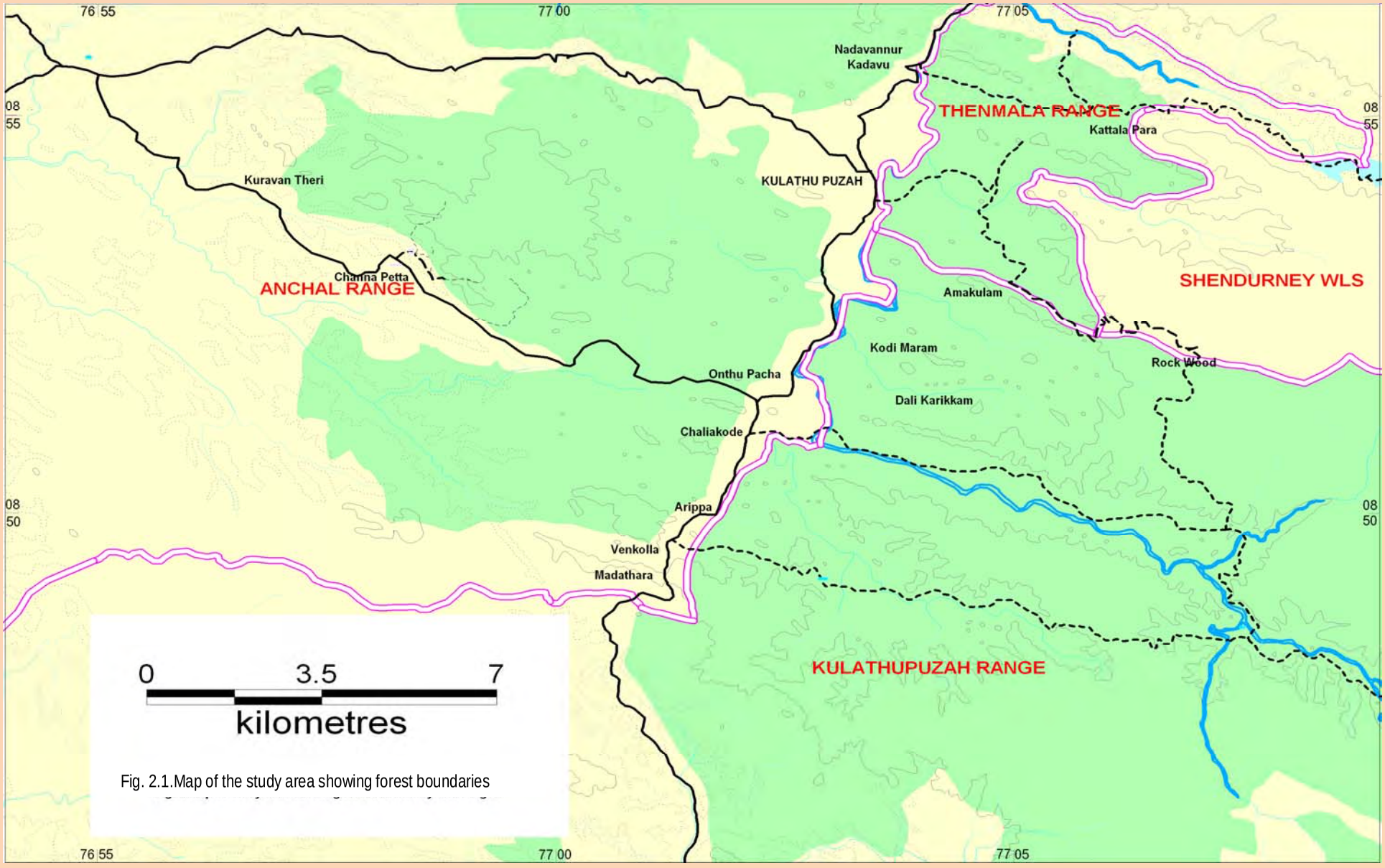


Fig. 2.1.Map of the study area showing forest boundaries

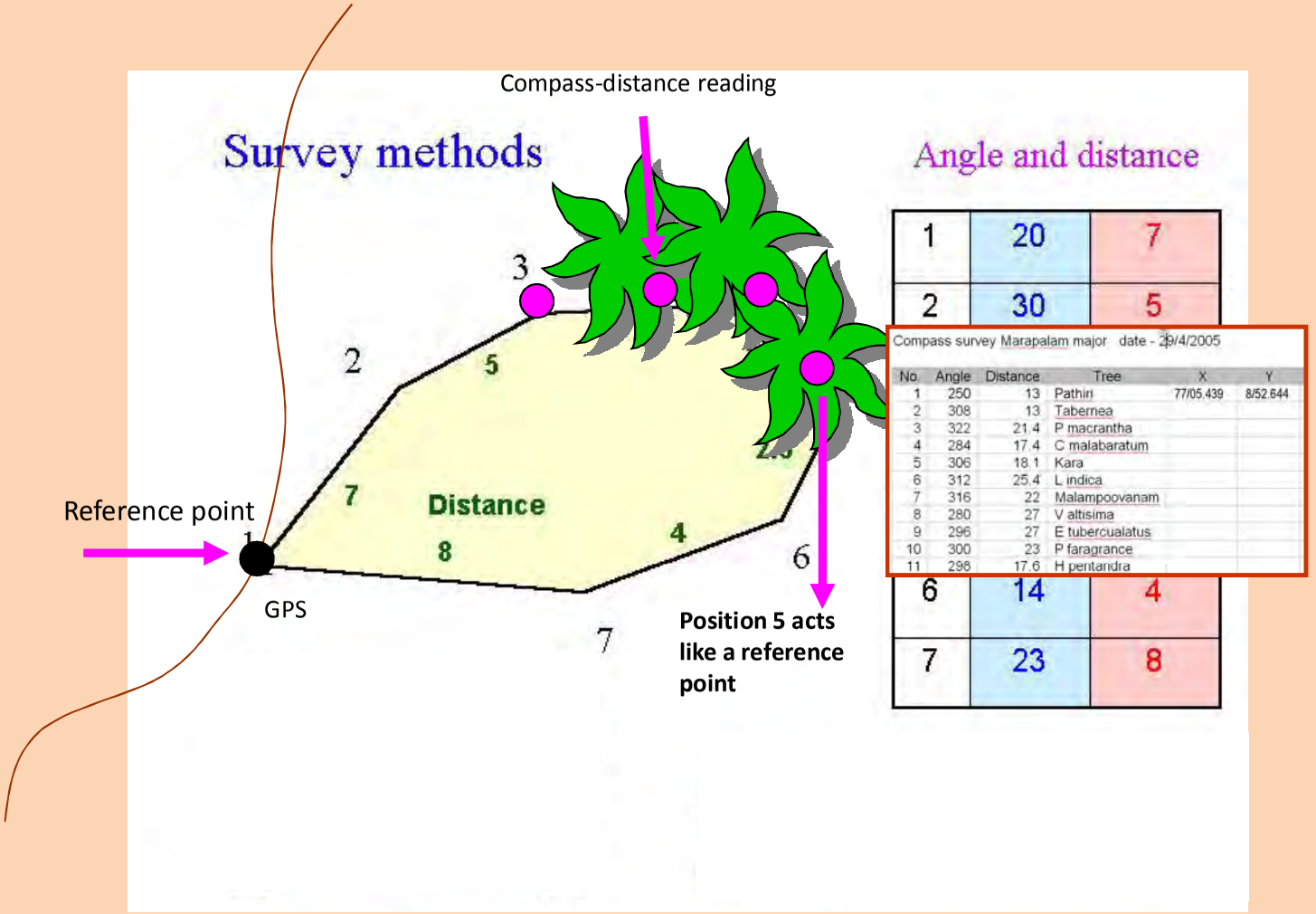


Fig. 2.2 Details of survey method employed.

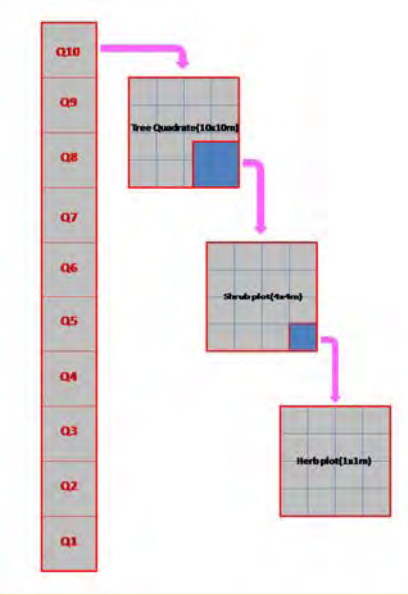


Fig 2.3 Vegetation sampling pattern

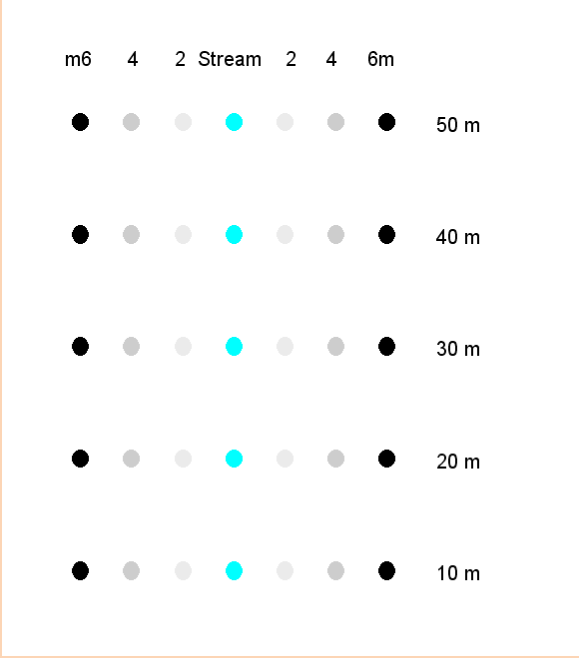


Fig 2.4 Design for water level measuring

Chapter 3

RESULTS

3.1 Mapping and grouping of *Myristica* swamps

Myristica swamps are located in Kulathu Puzha and Ithikkara Rivers. Down stream of Kulathu Puzha River is also known as Kallada River. Both the rivers are west flowing; these rivers originate from Kulathu Puzha, Anchal and Shendurney forest areas. In the forest region, Kallada River has two branches Kulathu Puzha and Shendurney Rivers. There is a dam in Kallada River just below the confluence of Kulathu Puzha River and Shendurney River. There are no other major dams in remaining part of Kallada River. In Kallada River almost all swamps are situated in Kulathu Puzha branch, only a small swamp Onnam Mile-N flows to Shendurney River. A total of 47 individual swamps drain to Kulathu Puzha River and 13 flows to Ithikkara River. The swamps of Ithikkara River come under Kollam District and those of Kulathu Puzha River come under Kollam and Thiruvananthapuram Districts.

The hills rise sharply at about 200m, the swamps are located at this point. In the case of Ithikkara River, the swamps are located around a group of hills. Since the swamps are located in only two rivers, it is interesting to examine the relation between the two. But for a sharp turn at Chozhiyakode, Kulathu Puzha River could join Itthikara River and flow west. *Myristica* swamps are described in four main groups. They are Pu Ar, Kulathu Puzha, Shendurney and Anchal (Fig. 3.1.1). Full list of swamps and their area is given in Appenidx I.

3.1.1 Group I – Pu Ar

There are a total of 10 swamps in Sastha Nada region draining to Pu Ar, a tributary of Kulathu Puzha River. Swamps coming under this group can be described under three sub groups. Pillekode, Muppathady and Kochamma come in the Pu Ar stream. Six swamps are situated in Sastha Nada stream which joins Pu Ar. The tenth swamp is situated on Venkolla stream which joins Pu Ar near its confluence with Kulathu Puzha River (Fig.3.1.2).

In subgroup one, Muppathady and Pillekode are two swamps which flow to Pu Ar. A very small swamp, Kochamma join Pu Ar down stream. There are six swamps in the second sub group. Chekidi Chal and Palli Thadam swamps are on two sides of a hillock and the streams from these swamps join immediately below the hill as Sastha Nada Stream. Uthiran Chira swamp is on another small stream which joins Sastha Nada stream slightly down stream. Three swamps Karinkurinji Up, Karinkurinji Down and Sastha Nada are situated further downstream of Sastha Nada Stream. These three swamps would have been a continuous patch if there was not a mud road passing through the middle of the patch. Sastha Nada Stream joins Pu Ar downstream. In the third group, a small stream from Ammayambalam swamp joins Pu Ar near Arippa (Table 3.1.1).

Table 3.1.1 Swamps in group I Pu Ar

Group	Name of swamp	Area in Ha
	Total	**22.29**
Ia. 1	Chekidi Chal	3.61
Ia. 2	Palli Thadam	3.24
Ia. 3	Uthiran Chira	1.45
Ia. 4	Karinkurinji Up	3.29
Ia. 5	Karinkurinji Down	3.95
Ia. 6	Sastha Nada	1.71
Ia. 7	Muppathadi	1.33
Ia. 8	Pillekode	0.98
Ia. 9	Kochamma	0.25
Ia. 10	Ammayambalam	2.48

3.1.2 Group II Kulathu Puzha

A total of 21 swamps (under five sub groups) draining to Kulathu Puzha River are described under this group. The sub groups are 1. Channa Mala, 2. Empong, 3. Dali 4. Kunju Man Thodu and 5. Sankli. The swamps are located in three main streams namely Channa Mala, Kunjuman Thodu and Dali Stream (Fig. 3.1.3).

IIa Sub group – Channa Mala

Table 3.1.2 Swamps in sub group IIa Channa Mala

Group	Name of swamp	Area in Ha
IIa. 1	Poovanathu Mood 0	3.24
IIa. 2	Poovanathu Mood 1	0.51
IIa. 3	Poovanathu Mood 2	0.29
IIa. 4	Poovanathu Mood 3	0.76
IIa. 5	Poovanathu Mood 4	1.22
IIa. 6	Chuvanna Karikkam	4.00
IIa. 7	Munnam Chal	10.00
IIa. 8	Plavu Chal	3.58
IIa. 9	Pullu Mala	1.50
IIa. 10	Perum Padappy	2.17
IIa. 11	Channa Mala - Up	0.31
IIa. 12	Channa Mala - Down	2.19
	Total	29.77

IIb Sub group-Emponge

This is the only one swamp which directly flows to Kulathu Puzha River through a small stream.

IIc Sub group-Dali

This includes two swamps flowing directly to Kulathu Puzha River. The swamps are situated almost at the beginning of Dali stream. These swamps have many peculiarites including large trees, woody lianas and thick undergrowth of *Pandanus thwaitesii*.

IId Sub group- Kunju Man Thodu

This includes three swamps in Kunju Man Thodu. This stream joins with another stream in Shendurney Sanctuary and flows to Kulathu Puzha River. Swamps Marappalam Major, Marappalam Minor and Mottal Mood, all of them are at the starting point of first order streams.

IIe Sub group - Sankli

This includes three swamps in Sankli area. The 200 m countour extent all the way up to Sankli area. Inspite of this, only few *Myristica* swamps could be located from the region. Of these, Choondi Para is the farthest, it is on a small stream joining Pongu Malai River, there are rocks on the stream with trees of *Myrsitica fatua var. magnifica* and *Gymnacranthera farquharana*. One peculiarity of the swamp is presence of large number *Humboltia decurrens* trees. Swamp, Valavu Para Pacha is also beside the same river. This is a fairly good swamp with large trees and climbers. Manjalu Para swamp, though located very near Thekkumala River, there was some obstruction, possibly after a massive mud flow, and the whole swamp was in a permanently inundated condition. One could see a large number of saplings (Table 3.1.3).

Table 3.1.3 Swamps in sub groups IIb,c,d,e Kulathu Puzha

Group	Name of swamp	Area in Ha
IIb.1	Empong	3.32
IIc.1	Dali Karikkam	6.00
IIc.2	Chithirakkala Pacha	4.00
IId.1	Marappalam Minor	0.26
IId.2	Mottal Mood	2.28
IId.3	Marappalam Major	1.31
IIe.1	Choondi Para	1.50
IIe.2	Valavu Para Pacha	5.00
IIe.3	Manjalu Para	3.00
	Total	26.67

This includes 12 swamps in Channa Mala Stream and Poovanathu Mood streams. Poovanathu Mood stream joins Channa Mala stream. Five swamps Povanathu Mood 0, 1, 2, 3 and 4 are located near the origin of Povanathu Mood stream. Munnam Chal is an extensive swamp located on a stream that joins Poovanathu Mood stream. Chuvanna Karikkam is another swamp that joins below

Poovanathu Mood stream. Plavu Chal and Pullu Mala swamps drain to Darpappana stream (originates from Rock Wood area) and joins Channa Mala stream. Perum Padappy and Channa Mala Up and Down are swamps that drain directly to Channa Mala stream. Two more small swamps draining to Channa Mala by name Kinattin Kara Pacha and Pandari Kunnu are reported near Amakulam but we have not surveyed them or included in the present list (Table 3.1.2).

3.1.3 III Shendurney group

Shendurney could be further divided in to three sub groups (Fig.3.1.4).

Sub group-IIIa

The first group consists of eight swamps that drain to Neduvannur Thodu (Table 3.1.4). They are

Table 3.1.4 Swamps in sub group IIIa Shendurney

Group	Name of swamp	Area in Ha
IIIa.1	Irrikappara	1.04
IIIa.2	Kurunthotti Valavu	0.79
IIIa.3	Kambaka Thottam	1.55
IIIa.3	Choodal SE	1.77
IIIa.4	Onnam Junda	1.39
IIIa.5	Vilakku Maraum N	1.67
IIIa.6	Vilakku Maraum S	0.71
IIIa.7	Choodal S	0.53
	Total	**9.45**

Sub group IIIb

There are seven swamps in this group that drain to Kunjuman Thodu (Table 3.1.1). They are tabulated below.

Table 3.1.5 Swamps in sub group IIIb and c Shendurney

Group	Name of swamp	Area in Ha
IIIb.1	Onnam Mile S	7.82
IIIb.2	Munnkuthu	12.50
IIIb.3	Manchal	1.26
IIIb.3	Kattila Para	0.40
IIIb.4	Kattila Para SE	0.22
IIIb.5	Kattila Para S	2.32
IIIb.6	Choodal E	2.90
IIIc.1	Onnam Mile N	0.48
	Total	27.9

Sub group IIIc

This group is made up of a small swamp, Onnam Mile N which drains directly into the Shendurney reservoir

3.1.4 IV Anchal group

The 19 swamps in Anchal Range could be classified into three sub groups. The swamps are in tributaries of Ithikkara River; they originate from different sides of a group of four hills. The rivulets from the swamp group 3 take a circuitous route and join Ithikkara River (Fig.3.1.5).

Sub group -IVa

The six swamps in this group are located on Kochu Chirakkal Thodu, which takes a circuitous turn and joins Ithikara River. Ampalathu Pacha 1 and 2 are small swamps on a small stream. Chettadi 1 and 2 are two swamps on another small stream; the upstream one is about 5 ha in area. Compared to other swamps it is less moist and this reflects in its tree composition. Mottillam Pacha and Anavettam Chal are two swamps on another stream. At Mottilam Pacha *Myristica* trees are located along rocky steep stream. The stream becomes fairly large at Anavettan Chal and extends into valleys on either side. The stream containing first two swamps join with the stream harboring remaining four swamps of the group (Table 3.1.6).

Table 3.1.6 Swamps in subgroup IVa Anchal

Group	Name of swamp	Area in Ha
IVa.1	Ammbalathu Pacha (1&2)	1.75
IVa.2	Chettadi (1&2)	5.00
IVa.3	Anavettan Chal	2.00
IVa.4	Mottilam Pacha	1.00
	Total	**9.75**

Sub group -IVb

There are a total of 7 small swamps located on the stream Eravail Thodu. Kodikuthy Pacha and Eravail Pacha form a subgroup and are situated near the point of origin of the stream. Kalyani-1 and Kalyani-2 are at the tip of another sister stream. There are six more swamps enroute this stream, Konju Kuzhy, Pandari Karikkam, Kuruvan Thery, Kayyalappara, Mukkode and Podiyan Pacha. Cultivation extends upto Kodikuthi pacha. Kuruvan Thery swamp is about 500m from habitation.

Kodikuthi pacha has mostly small trees of *Myristica fatua var. magnifica*. Kalayani upstream is remarkable in that it has very steep edges and major tree is *Gymnacranthera farquhariana*. The other small swamps Podiyan Pacha Kayyalappara and Pandarikarikam are also in this group. Kuravan Thery is remarkable in that it is beside a large stream and consists of scattered

Myristica trees along the stream. Other swamp, Mukkode is further down stream. There are reports of a three smaller swamps namely Pandarikarikkam, Kayyalappara and Podiyan pacha, they are not included in the present list (Table 3.1.7).

Table 3.1.7 Swamps in sub group IVb Anchal

Group	Name of swamp	Area in Ha
IVb.1	Kodukuthi Pacha	1.16
IVb.2	Eravail Pacha	0.23
IVb.3	Kalyani Up	0.66
IVb.4	Kalyani Down	0.25
IVb.5	Konju Kuzhi	1.12
IVb.6	Kuravan Thery	2.00
IVb.7	Mukkode	1.50
	Total	**6.92**

Sub group IVc

There are two swamps in this group, they are situated in two perineal streams at one kilometer distance. Of these Neerattu Thdam on the northern side of the hill is large and more than 10 hectare in area. The second one is Valiya Pacha, just a stretch of few *Myristica* trees. Neerattu Thadam is remarkable in another way, the swamps start at 100 meter elevation onwards. This brings about changes in its structure and composition. A small patch, called Pangalam Patcha containing *Myristica* trees is reported upstream of Valiyapacha, this is no included in the present list (Table 3.1.8).

Table 3.1.8 Swamps in sub group IVc Anchal

Group	Name of swamp	Area in Ha
IVc.1	Valiya Pacha	1.00
IVc.2	Neerattu Thadam	15.84
	Total	16.84

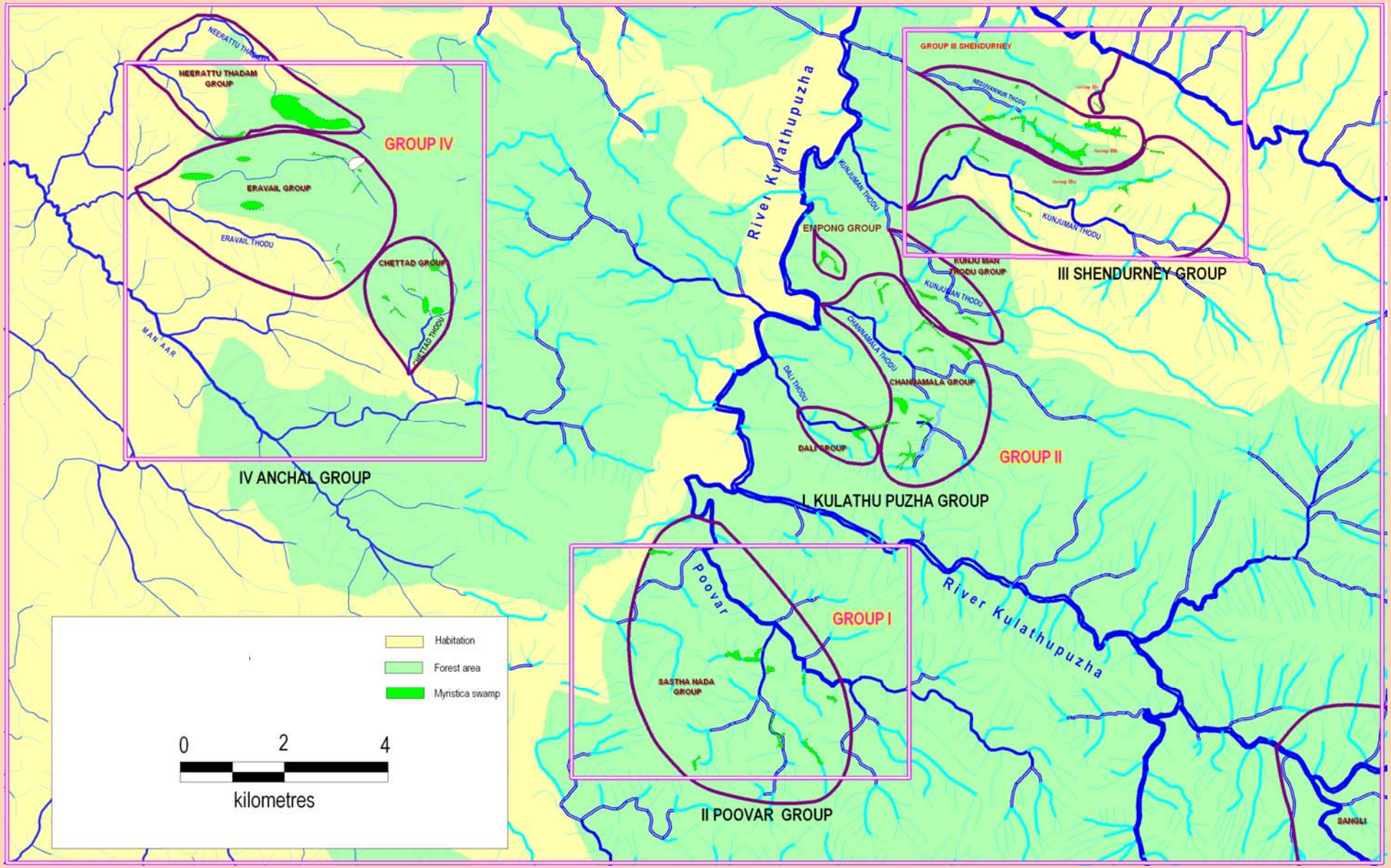


Fig. 3.1.1 Map of Swamp groups

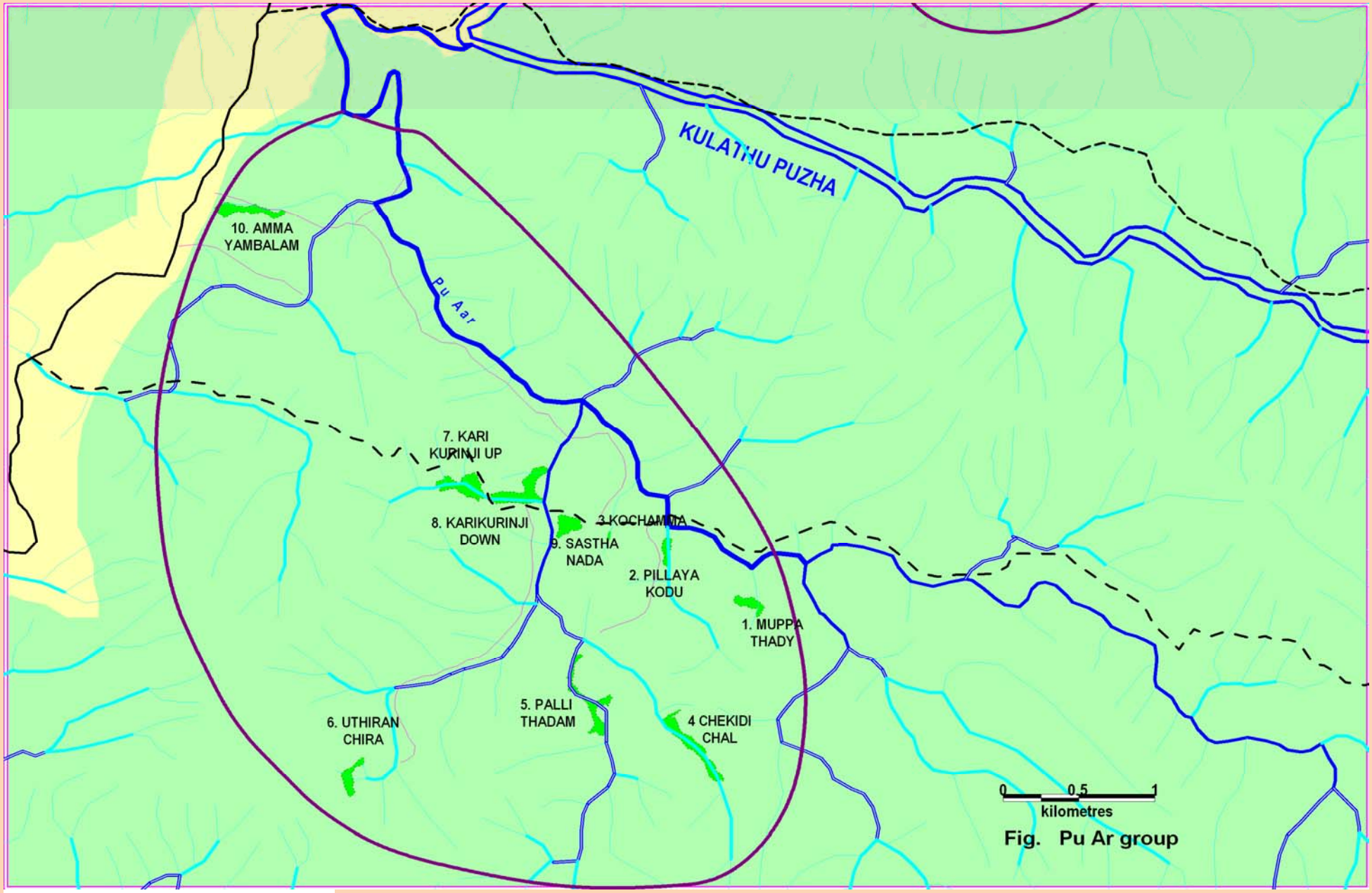


Fig. 3.1.2 Map of Swamp group- Pu Ar

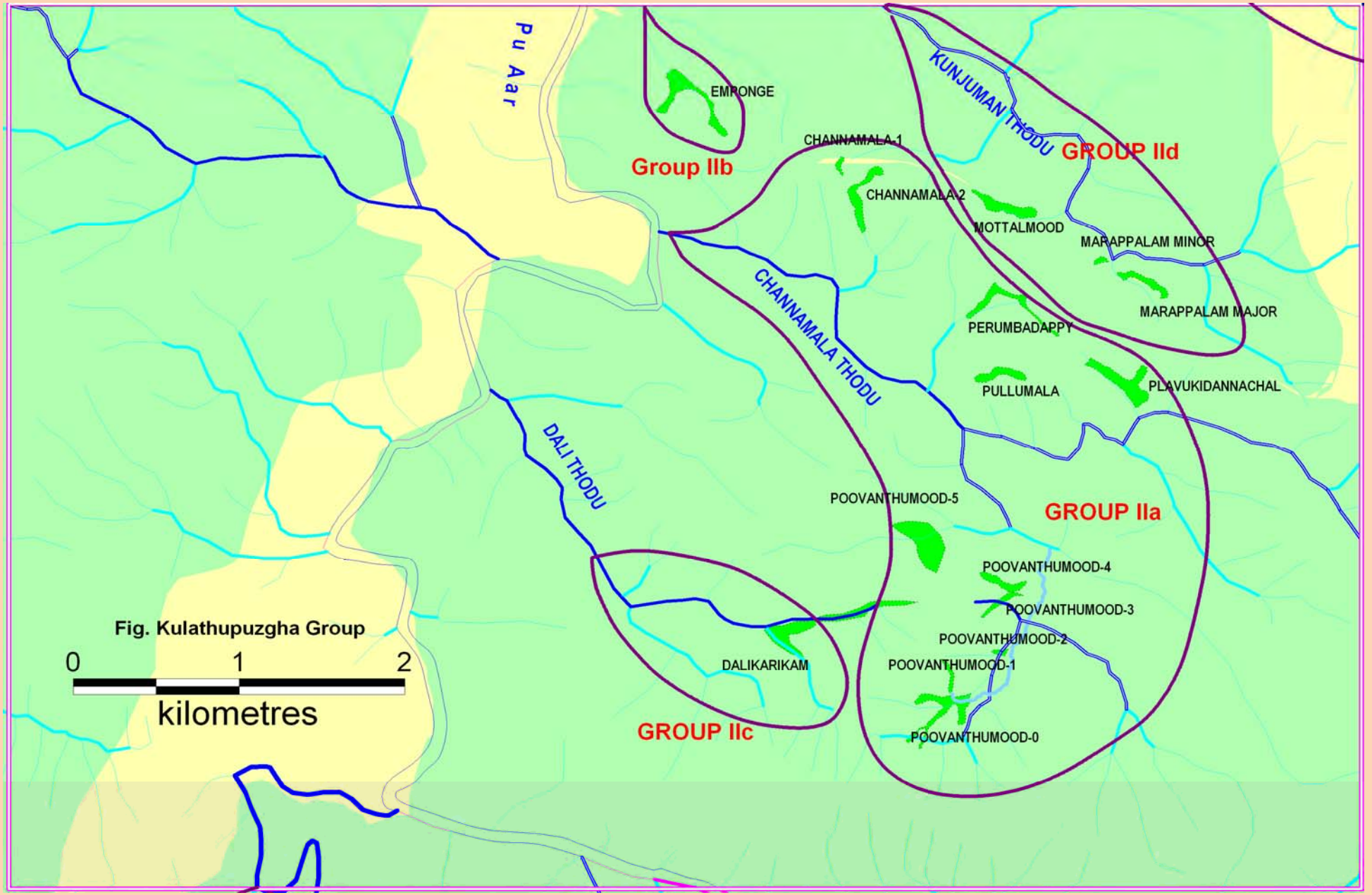


Fig. 3.1.3 Map of Swamp group Kulathupuzha

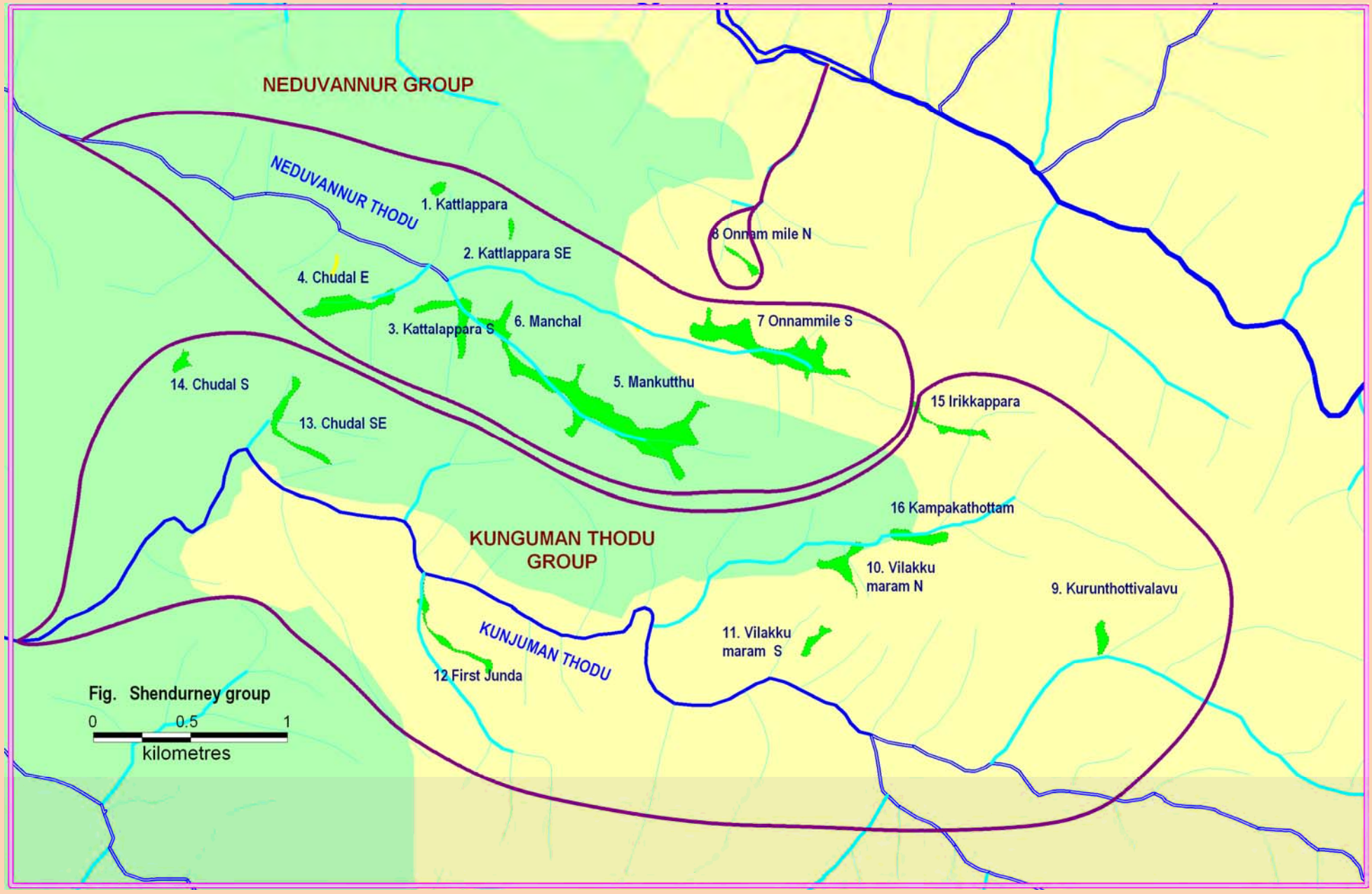


Fig. 3.1.4 Map of Swamp group Shendurney

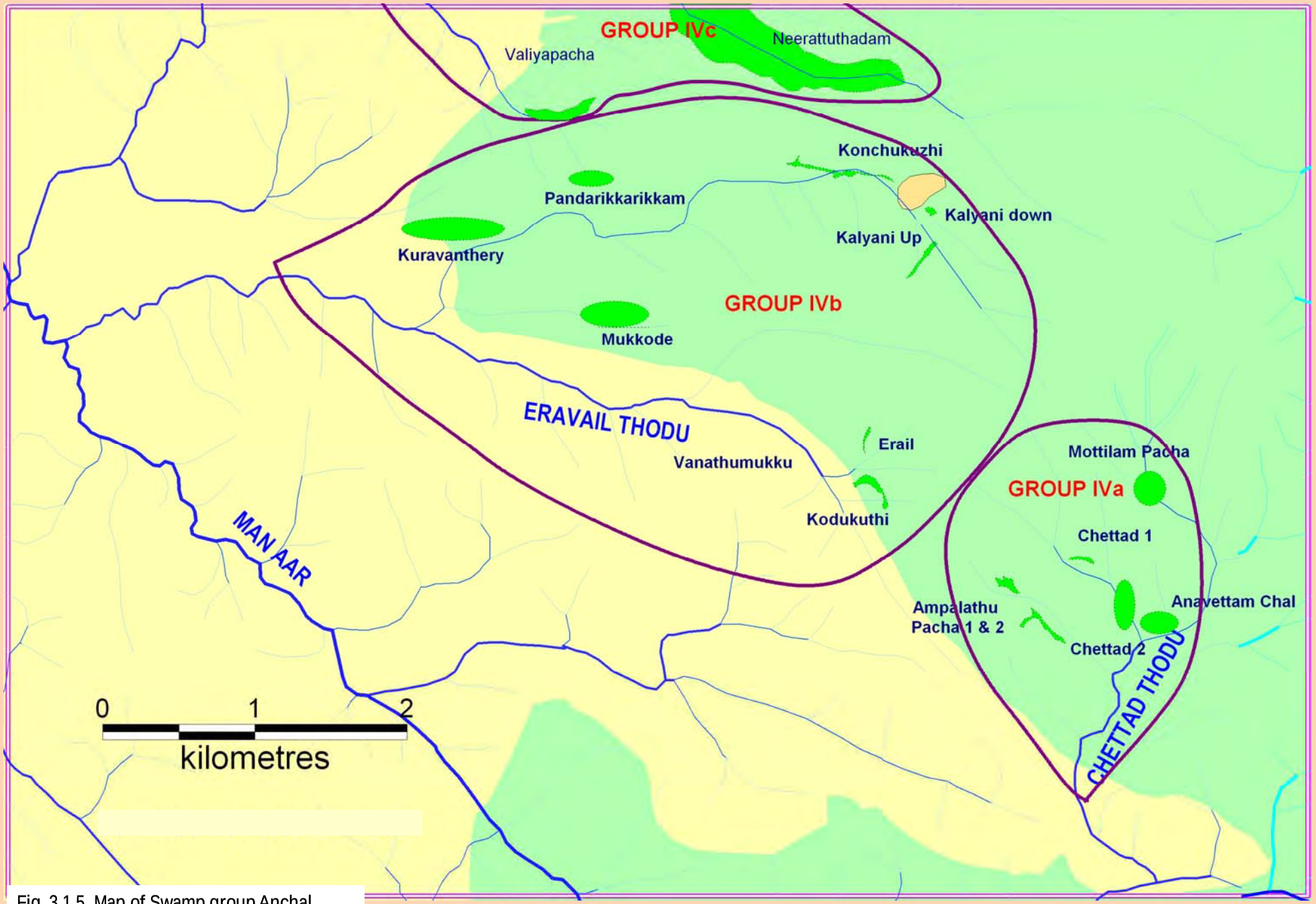


Fig. 3.1.5 Map of Swamp group Anchal

3. 2 DESCRIPTION OF SWAMPS

Myristica swamps are described in four main groups. They are Pu Ar, Kulathu Puzha, Shendurney and Anchal. Full list of the swamps is given in Appendix I.

3.2.1 GROUP I - PU AR

There are a total of 10 swamps in Sastha Nada region draining to Pu Ar, a tributary of Kulathu Puzha River (Fig. 3.2.1).

1) Chekidi Chal

The swamp is situated near Sastha Nada. Chekidi Chal swamp is situated along a right branch of the Venkolla - Sankli road. This is one of the longest swamps in this group. The swamp is situated in a deep valley. The swamp contains a number of *Myristica* trees of large size but is scattered in distribution. Large number of other trees is present in the swamp, namely *Lophopetalum wightianum*, *Holigarna arnottiana*, *Hopea parviflora,* etc. Ground is covered by *Ochlandra travancorica, Lagenandra ovata, Phrynium pubinerve, etc. Ochlandra travancorica* covers about 50 percent of the ground cover. Upstream end of the swamp is covered by evergreen forests. The swamp has a main stream coming from the surrounding forest and entering the swamp as a small water fall. The stream flows to Pu Ar *via* Sastha Nada stream. Animals consist of several species of fishes, amphibians and reptiles, details of which given in the report. Anthropogenic disturbance found in the swamp is mainly illegal brewing of alcohol and fishing.

2) Palli Thadam

This swamp is also situated in Sastha Nada area. The swamp is located on the other side of Chekidi Chal hill. The swamp has a number of *Myristica* trees which are scattered here and there. Ground vegetation consists of *Lagenandra ovata, Phrynium pubinerve*, *Pandanus*, *Calamus*, Grasses and Cyperaceae members. Woody climbers are present in the swamp. A big stream flows through the swamp and joins the stream from the Chekidi Chal in Sastha Nada. This stream joins Pu Ar, a tributary of Kulathu Puzha River. The swamp is surrounded by evergreen forests except at the downstream end, where there are paddy fields. Animals consist of several species of fishes, amphibians and reptiles, details are given in the report. Anthropogenic disturbance from the swamp are dependence of locals on the swamps for fire wood, non wood forest products and fishing by alteration of stream flow.

3 Uthiran Chira

This is a typical *Myristica* swamp in Kulathu Puzha Forest Range, located near the Sastha Nada bus terminus. The swamp is fully inundated and

has luxurious growth of *Myristica* trees. The geomorphology of the swamp is peculiar as the upstream end of the swamp is broader and downstream end has slight elevated narrow constriction, which may be the reason for permanent inundation in the swamp. There is only one stream entering the swamp from surrounding evergreen forests. The stream from the swamp flows to Kulathu Puzha River via Pu Ar. *Myristica* trees constitute the vegetation, they are densely packed. Ground cover consists of *Lagenandra ovata, Phrynium pubinerve, Schumannianthus virgatus*, etc. Climbers are mainly of *Chilocarpus denudatus and Kunstleria keralensis*. Regeneration of *Myristica* trees can be seen inside the swamp. Animals consist of several species of amphibians and reptiles, details of which are described in the report. Anthropogenic disturbances are relatively less.

4 Karinkurinji up

This is the most accessible swamp in the Sastha Nada area as it lies beside the Venkolla- Sankli road. A magnificent view of stilt roots and knee roots of *Myristica* trees can be obtained from the road itself. The swamp is quite flat and large parts are inundated. Most of the surrounding area of the swamp is covered by plantations, though a small patch of evergreen forest is present. There is only one stream in the swamp which flows to Kulathu Puzha River via Pu Ar. A concrete wall constructed by the forest department for increasing water storage had to be broken up following drying up of swamp trees due to water logging. *Myristica* trees, mainly *Gymnacranthera farquhariana* and *Myristica fatua var. magnifica* dominate in the swamp. The undergrowth consists of *Lagenandra ovata*, Zingiberaceae and Araceae members. There are woody lianas present in the swamp. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Anthropogenic disturbances are mainly in the form of local people's dependence on the swamps for non wood forest products and fire wood.

5 Karinkurinji down

This is actually continuation of swamp Karinkurinji Up, on the other side of the road. The swamp is one to three meter below the level of the road and is clearly visible from the road. The stream in the swamp joins with Sastha Nada stream inside the swamp and flows into Kulathu Puzha River via Pu Ar. The swamp is dominated by *Myristica* trees; undergrowth consists of the herb *Lagenandra ovata* belonging to the family Araceae. Members of Zingiberaceae and Cyperaceae are also present in the swamp. Climbers are present in the swamp. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Anthropogenic disturbances reported from the swamp are similar to those reported from the upstream patch.

6 Sastha Nada

Sastha Nada swamp is situated on the right bank of the Sastha Nada stream near the Sastha Nada temple. Geographically it is the extension of Karinkurinji swamp but is separated by the Venkolla-Sankli road. The swamp is almost flat. Water logging occurs only during the peak rainy season. There is no well marked stream inside the swamp though during the rainy season many streamlets flow inside the swamp which join to flow into Sastha Nada stream and finally to Kulathu Puzha River via Pu Ar. There are no steep edges surrounding the swamp. One side of the swamp is flanked by Sankli road beyond which are evergreen forests. Sastha Nada stream flows along another side of the swamp and the remaining two sides are covered by degraded forests. This is the driest swamp in Kulathu Puzha region which is reflected in its tree composition, *Gymnacranthera farquhariana* being the most frequent tree*. Myristica fatua var. magnifica* trees are very few in number. Non - *Myristica* trees are well represented. Undergrowth consists of canes, *Pandanus, and Lagenandra ovata*. Animals consist of several species of amphibians and reptiles, details of which are given in the report. Anthropogenic disturbance is high especially in pilgrim season due to the vicinity of Sastha temple.

7 Muppathadi

The swamp is situated very near to Pu Ar and is located in a deep valley surrounded by evergreen forest except on one side where grassy areas are present. The swamp has one stream originating from surrounding evergreen forest, which flows to Pu Ar. *Myristica* trees dominate; non-*Myristica* trees like *Lophopetalum wightianum, Holigarna arnottiana,* etc. are also present. The ground vegetation consists of *Lagenandra ovata*, ferns, *Calamus*, *Pandanus*, reeds, etc. Woody climbers are present in the swamp. A large woody *Entada rheedi* climber that grows from one edge of the swamp spreads over a large portion of swamp canopy. Animals consist of several species of amphibians and reptiles, details of which are given in the report. Anthropogenic disturbances found in the swamp are local dependence upon the swamp for non wood forest products.

8 Pillekode

The swamp is located along a deep valley very near to Pillekode settlement. Inspite of a perennial stream, the swamp is relatively dry due to which only one or two *Myristica fatua var. magnifica* trees are found in the swamp. The swamp is surrounded by plantations except in the upstream end, where paddy fields are continuous with the swamp. There is only one stream in the swamp coming from the cultivated land continuous with the swamp. *Gymnacranthera farquhariana* trees dominate the swamp followed by *Vateria indica, Lophopetalum wightianum*, etc. Ground vegetation is mainly of *Barleria*

courtallica, *Pandanus, Calamus*, etc. Woody climbers are present in the swamp. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Anthropogenic disturbance is frequent in the swamp and is usually in the form of local dependence for poles, fire wood, non wood forest products and fishing.

9 Kochamma

The swamp is situated on a small stream, near to Sastha Nada. This stream crosses the Sankli road and flows to Pu Ar. The swamp contains few trees of *Gymnacranthera farquhariana*. The edges of the swamp are covered by trees of *Humboldtia decurrens*. Ground vegetation is very thin, consisting of a few *Lagenandra ovata* and *Phrynium pubinerve*. Plenty of seedlings of *Humboldtia decurrens* are found in the swamp. The woody climber *Chilocarpus denudatus* is found in the swamp. There are five gully plugs found in the swamp made by the forest department for checking soil erosion. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report.

10 Ammayambalam

This is one of the easily accessible swamps in Kulathu Puzha as it is situated very near to the Thenmala - Trivandrum road, near to Ammayambalam Siva temple and Arippa Forest School. Part of the swamp remains inundated condition even in the month of February. Surrounding slopes are high and steep in some regions. There is a stream in the centre of the swamp, which originates from one end of the swamp. This stream joins Venkolla stream and finally Kulathu Puzha River via Pu Ar. The swamp is completely covered with *Pandanus* which reaches up to 3m height. Dominant trees are *Vateria indica*, *Gymnacranthera farquhariana* and *Myristica fatua var. magnifica and Syzygium trvancoricum. Myristica* trees are scattered in distribution but a group of *Myristica* trees in dense growth is found in the centre of the swamp. Ground is covered mostly with *Pandanus* followed by *Ochlandra travancorica*, *Calamus hookerianus*, *Carex sp*, grasses, etc. Climbers are mainly of Climbing fern, *Chilocarpus denudatus*, *Kunstleria keralensis*, etc. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Anthropogenic disturbance is high in the swamp, due to the vicinity of road, habitation nearby and temple.

3.2.2 GROUP II KULATHU PUZHA

A total of 21 swamps (under five sub groups) draining to Kulathu Puzha River are described under this group. The sub groups are 1. Channa Mala, 2. Emponge 3. Dali 4. Kunju Man Thodu and 5. Sankli. The swamps are

located in three main streams namely Channa Mala, Kunjuman Thodu and Dali Stream (Fig. 3.2.2 and 3.2.3).

II a Sub group – Channa Mala

This includes 12 swamps in Channa Mala Stream and Poovanathu Mood streams. Poovanathu Mood stream joins Channa Mala stream. Five swamps Poovanathu Mood 0, 1, 2, 3 and 4 are located near the origin of Poovanathu Mood stream. Munnam Chal is an extensive swamp located on a stream that joins Poovanathu Mood stream. Chuvanna Karikkam is another swamp that joins below Poovanathu Mood stream. Plavu Chal and Pullu Mala swamps drain to Darpappana stream (originates from Rock Wood area) and joins Channa Mala stream. Perum Padappy and Channa Mala Up and Down are swamps that drain directly to Channa Mala stream. Two more small swamps draining to Channa Mala by name Kinattin Kara Pacha and Pandari Kunnu are reported near Amakulam but we have not surveyed them or included in the present list.

1 Poovanathu Mood 0

The swamp is situated very near to Kodimaram about 6 kilometers from Randam mile (means 2nd mile) and can be reached by travelling along a road branching left from Amakulam – Rock wood road at Randam mile. Another approach road is from Nalam mile (means 4th mile) via Munnam Chal; this road branches left from Amakulam- Rock wood road at Nalam mile. The swamp is a large one and is ramified into many branches. The swamp is inundated throughout the year. Small streamlets join to form a big central stream which flows to Poovanathu Mood stream which joins Kulathu Puzha River via Channa Mala Thodu. The dominant trees are of Myristicaceae family. The swamp also contains large sized non - *Myristica* trees such as *Lophopetalum wightianum, Hopea parviflora, Persia macrantha, Syzygium travancoricum and Holigarna arnottiana*. Ground vegetation consists of ferns, reeds, canes, *Pandanus* and members of Cyperaceae, Zingiberaceae and Poaceae. There are woody climbers in the swamp. The swamp is surrounded by low elevation evergreen forests. Animals consist of several species of fishes, amphibians and reptiles. Anthropogenic disturbance is very less in this swamp due to its distance from human settlements.

2 Poovanathu Mood 1

This is a small swamp situated opposite Poovanathu Mood-0 described above, across the road. The swamp is very narrow, about 10-20m wide and placed along a small valley. The swamp is inundated and the feeder stream is located centrally. The stream from the swamp flows to Poovanathu Mood-0 swamp. The ephemeral stream originates from a hillock, and at places flows rapidly through boulders. The swamp consists of *Myristica* trees mainly.

Other trees are also present in the swamp. Ground vegetation consists of ferns, *Pandanus*, *Calamus* and Cyperaceae, Araceae and Poaceae members. Woody climbers are also present in the swamp. The swamp is surrounded by evergreen forests. The sides of the swamp are slightly steep, especially the upstream end of the swamp. Anthropogenic disturbance is relatively less in this swamp.

3 Poovanathu Mood 2

The swamp is situated perpendicular to the Randam Mile – Kodimaram road, near Poovanathu Mood-3 swamp. The swamp is a small patch, roughly triangular in shape, the downstream end being slightly wider. The swamp has a main stream flowing through the centre of the swamp. This stream comes from the surrounding evergreen forest and flows to Kulathu Puzha River via Poovanathu Mood and Channa Mala stream. The swamp is inundated and has thick undergrowth of *Pandanus*, *Calamus* and Cyperaceae members. Herbs and climbers are present in the swamp. There was not much anthropogenic disturbance in this swamp.

4 Poovanathu Mood 3

The swamp is situated along Randam Mile – Kodimaram road before Poovanathu Mood-2 swamp. The swamp is narrow, the trees being distributed on both sides of the stream. The swamp contains one stream that originates from one end of the swamp. The stream from the swamp flows to Kulathu Puzha River, via Poovanathu Mood stream and Channa Mala Thodu. *Myristica* trees dominate in the swamp. The ground vegetation is mainly *Pandanus*, *Calamus*, ferns and *Lagenandra ovata*. Clumps of *Pinanga dicksonii* are also found in some parts of the swamp. Woody climbers such as *Entada rheedi, Chilocarpus denudatus*, etc. are present in the swamp. The swamp is surrounded by low elevation evergreen forests with potential areas of *Myristica* swamps. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Anthropogenic disturbance is very less compared to other swamps in the forest range.

5 Poovanathu Mood 4

The swamp is situated adjacent to the Poovanathu Mood-3 swamp. This swamp is almost similar to that of Poovanathu Mood-3 swamp in appearance. *Myristica* trees are dominant. Large sized non-*Myristica* trees are found in the swamp. Ground vegetation consists of ferns, *Pandanus*, *Calamus*, and members of Araceae, Cyperaceae, and Poaceae families. Both woody and non woody climbers are present in the swamp. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the

report. Anthropogenic disturbance in the form of pole cutting was found in the swamp.

6 Chuvanna Karikkam

The swamp is situated very near to Kodimaram. A road deviating right from the Randam Mile - Kodimaram road after the Poovanathu Mood swamps, leads to Chuvanna Karikkam swamp. The swamp is a typical *Myristica* swamp with high level of inundation, surrounded by low elevation evergreen forests. Main trees are *Myristica fatua var. magnifica and Gymnacranthera farquhariana*. There is a stream in the centre of the swamp which flows to Kulathu Puzha River via Channa Mala Thodu. Almost all the non - *Myristica* trees reported from the *Myristica* swamps are present here. Ground vegetation consists of ferns, reeds, canes, *Pandanus* and members of Araceae, Zingiberaceae, and Poaceae families. Climbers, both woody and non woody are found in the swamp. Clumps of *Pinanga dicksonii* stand out. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Anthropogenic disturbances are very less.

7 Munnam Chal

There are two roads which lead to the Munnam Chal swamp - one is from Randam Mile and the other is from Nalam mile; both are right deviations from Amakulam – Rock wood road. The swamp is very near to the Poovanathu Mood area. Most of the areas of Munnam Chal are flat and have high potential for *Myristica* swamp forests. There are many patches of *Myristica* swamps in the valleys of this forest area. The swamp patches are inundated, have plenty of *Myristica* trees such as *Myristica fatua var.magnifica, Gymnacranthera farquhariana, Myristica malabarica and Knema attenuata*. Non-*Myristica* trees found in the swamp are *Lophopetalum wightianum, Holigarna arnottiana, Hydnocarpus pentandra, Semecarpus auriculata, Baccaurea courtallensis*, etc. Ground vegetation consists mainly of *Pandanus*, *Calamus*, *Ochalandra, Pinanga dicksonii*, and members of Poaceae, Araceae, Cyperaceae, Zingiberaceae families. Most of the streams in this area flow to Poovanathu Mood stream, and then it joins with Channa Mala Thodu, a tributary of Kulathu Puzha River. At the extreme south end of Munnam Chal area, a *Myristica* swamp with a south flowing stream is present. This stream joins the Kulathu Puzha River at Nangachi, which in contrast to other streams of the area flows directly into Kulathu Puzha River. Animals consist of several species of fishes, amphibians and reptiles which need to be further investigated. Anthropogenic disturbances are very less.

8 Plavu Chal

The swamp is situated 200 m left of the Poovanathu Mood - Kodimaram road and can be reached through a forest foot path. The swamp has two branches with streams flowing through the centre of both these branches. The stream coming out from the swamp flows to Channa Mala Thodu. The swamp is generally marshy in appearance, with seasonal inundation. Trees of *Myristica fatua var.magnifica* and *Gymnacranthera farquhariana* are dominant. Few big trees of *Syzygium travancoricum* are present inside the swamp. One edge of the swamp has a grassy patch with non-*Myristica* trees of *Hopea parviflora, Lagerstroemia speciosa, etc.* Ground vegetation consists of members of Cyperaceous, Poaceae and Araceae. Climbers found inside the swamp are *Chilocarpus denudatus, Myxospyrum smilacifolium, etc.* The upstream end of the swamp has a rocky region. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Anthropogenic disturbance is basically due to dependency for NWFP.

9 Pullu Mala

The swamp is situated near Poovanathu Mood area on the right side of the road. The swamp is about 500 m from Poovanathu Mood - Kodimaram road. There is no proper road to the swamp and one must depend on animal tracks for reaching the swamp. The swamp is quite inundated and has trees of *Myristica fatua var. magnifica* and *Vateria indica*. Trees of *Gymnacranthera farquhariana* are few inside the swamp. Adjacent side is covered by grassy areas after a small strip of evergreen forest. Ground vegetation is mainly *Carex* sp., grasses, etc. Climbers are found inside the swamp, mainly *Chilocarpus denudatus and Myxospyrum smilacifolium.* The swamp has only one stream that flows directly into Channa Mala Thodu near the swamp. This is the only swamp in Kulathu Puzha, whose side is flanked by grass land; there is no buffer of non swamp wooded forest. Anthropogenic disturbance is not serious in the swamp, but collection of aril of *Myristica* fruit and honey is common. Nearest settlement is Randam Mile at about 4 km from the swamp.

10 Perum Padappy

The swamp is situated about 2 km from Randam Mile; it is about 6 km from Kulathu Puzha. To reach the swamp, one must take right deviation from Poovanathu Mood- Kodimaram road; the swamp is very near the road. The swamp has trees of *Myristica fatua var. magnifica* and *Gymnacranthera farquhariana.* Tree density is very low. The *Myristica* trees are distributed mainly in the central portion of the swamp. The swamp has open areas. The swamp has only one stream which originates from one end of the swamp. The inundated condition is seen only in some areas of the swamp. An extension of

the swamp without *Myristica* trees reach till Channa Mala stream. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in swamp sheets in the report. The swamp is highly disturbed due to near by human settlements especially pole cutting, collection of fire wood, honey, aril of fruit of M*yristica* trees, etc.

11, 12 Channa Mala Up and Down

The swamp is near Amakulam junction, about 5 km from Kulathu Puzha town. A right deviation road from Amakulam junction leading to Channa Mala settlement leads to the swamp. The jeepable road to the settlement cuts the swamp into two segments. The swamp is 1 km long and 30-60 m wide. The swamp has a main stream which flows to Channa Mala Thodu. Though the stream is flowing even in the dry months, the amount of water in the stream is very less. Slushy condition prevails in the central portion of the swamp. The swamp contains many big trees of *Myristica fatua var. magnifica and Gymnacranthera farquhariana*. The narrow extension to the swamp across the road is sparsely distributed with *Myristica* trees. The ground vegetation consists mainly of *Lagenandra ovata*, *Phrynium pubinerve*, *Calamus hookerianus*, etc. The surrounding slopes are very steep. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. The swamp is highly disturbed due to nearby settlements situated in the 2 km circle.

Sub group-Emponge

1 Empong

Emponge swamp is situated about one km from the Kulathu Puzha River. A right deviation from Amakulam – Rockwood road near Chambinium leads to the swamp. The swamp is adjacent to the Areca and Rubber plantation of the local people. All sides of the swamp are quite steep. The surrounding vegetation is evergreen forest. The swamp is crescent shaped with two branches. Trees in the swamp are fairly large. Seventy percent of the ground vegetation is covered by *Pandanus*. *Calamus* and other herbs like *Lagenandra ovata* are also found inside the swamp. Inundation is seen in some parts of the swamp and soil is wet in most parts of the swamp. Large trees of *Myristica fatua var. magnifica* and *Gymnacranthera farquhariana* are found inside the swamp. The water from the swamp flows through a rubber plantation and paddy field, before joining the Kulathu Puzha River. In the peak rainy months of June and July the swamp is flooded with water and large number of fishes especially Puntius and Garra enter the swamp from Kulathu Puzha River through the connecting stream. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Anthropogenic disturbance is high and is in the form of local dependence upon the swamp for fire wood, non wood forest products etc.

Sub group-Dali Karikkam

1 Dali Karikkam

This swamp is situated about 200m to the right of Kodimaram. The swamp has thick undergrowth of *Pandanus thwaitesii*. Some parts of the swamp are permanently inundated. The stream from the swamp flows to Dali stream, which discharges into the Kulathu Puzha River. The downstream end of the swamp is adjacent to rubber plantations of local people. The swamp is surrounded by evergreen forests on all other sides. The swamp has both *Myristica* trees and non *Myristica* trees. The swamp has two branches with prominent streams. Woody climbers are found in the swamp. Ground vegetation consists of ferns, *Lagenandra ovata*, *Schumannianthus virgatus* and members of Araceae, Zingiberaceae, Cyperaceae, Poaceae families. Animals consist of fishes, amphibians and reptiles. Serious anthropogenic disturbance was not recorded from the swamp.

2 Chithirakkala Pacha

The swamp is actually an extension of the Dali Karikkam swamp and can be reached by turning right from Kodimaram. The swamp is surrounded by steep sloping terrain. There is one stream in the swamp, which flows into Dali Karikkam. Upstream end of the swamp is very narrow while the downstream end of the swamp is slightly wider. Trees of *Myristica* are dominant. The ground vegetation in the swamp is very thin and consists of *Lagenandra ovata* and other Zingiberaceae, Poaceae members. Trees are densely packed in the swamp. Animals consist of fishes, amphibians and reptiles. Anthropogenic disturbance was not recorded from the swamp.

IId Sub group- Kunju Man Thodu

Kunju Man Thodu stream joins another stream from Shendurney Sanctuary and flows to Kulathu Puzha River. There are three Swamps namely Marappalam Major, Marappalam Minor and Mottal Mood in this group; all of them are at the starting point of first order streams.

1 Marappalam Minor

The swamp is situated almost perpendicular to the Amakulam – Rockwood road near Marappalam. The swamp is small but with plenty of *Myristica* trees. The downstream end of the swamp is inundated and the soil here is slushy. The upstream end of swamp is steep and rocky, stream originates from here. There are two stone hedges above this region constructed by forest department for checking soil erosion. The swamp is surrounded by evergreen forest. There is only one stream which flows through the centre of the swamp and joins with Kunjuman Thodu, a tributary of Kulathu Puzha River.

Ground vegetation is thin, and consists mainly of *Pellionia heyneana,* especially at the rocky edges of the swamp. Saplings of *Vateria indica* are plenty in the swamp. *Vateria indica* and *Gymnacranthera farquhariana* constitute the dominant trees. Few small trees of *Myristica fatua var. magnifica* and a few big trees of *Lophopetalum wightianum* and *Holigarna arnottiana* are also found in the swamp. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Being situated beside the road and near habitation, there are disturbances of pole cutting and collection of minor forest product.

2 Mottal Mood

This is one of the easily approachable swamps in Kulathu Puzha and is situated along the Amakulam –Rockwood road near Randam Mile. Parts of the swamp are inundated year round. Swamp consists of plenty of *Myristica* trees with prominent knee roots and stilt roots. There is a stream flowing through the centre of the swamp, which originates from the upstream edges of the swamp. The stream from the swamp flows to Kunjuman Thodu. The trees inside the swamp are densely packed. *Myristica fatua var.magnifica and* Gymnacranthera *farquhariana* are the dominant trees inside the swamp. The swamp contains large trees of *Lophopetalum wightianum and Vateria indica*. Climbers are mainly of *Chilocarpus denudatus* and *Entada rheedi*. Ground vegetation is not thick and consists mainly of *Calamus*, *Ochlandra travancorica*, *Pandanus, Lagenandra ovata, etc*. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Human intervention is high inside the swamp when compared to other swamps. Locals sometimes collect poles and non wood forest products. Sand mining is also found in the stream of the swamp.

3 Marappalam Major

This swamp is situated very near Marappalam Minor swamp and flanks the right side of the Amakulam – Rockwood road. Parts of the swamp are inundated perennially. Edges of the swamp are very steep. The swamp is surrounded by evergreen forests and degraded forests developed after plantation logging. There are two streams inside the swamp which unite in the middle part of the swamp and flows to Kulathu Puzha River via Kunjuman Thodu. Generally trees are not dense, but *Myristica* trees are frequent in the inundated regions of the swamp. Large *Syzygium trvancoricum* trees are present. The ground vegetation is mainly of *Lagenandra ovata*. Climbers are mainly of *Chilocarpus denudatus*, *Kunstleria keralensis, Combretum sp, Tetracera acara, etc*. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Anthropogenic disturbance is high.

Sub group - Sankli

This includes three swamps in Sankli area. The 200 m contour extend all the way up to Sankli area. Inspite of this, only few *Myristica* swamps could be located from the region. Of these, Choondi Para is the farthest; it is on a small stream joining Pongu Malai River, there are rocks on the stream with trees of *Myrsitica fatua var. magnifica* and *Gymnacranthera farquhariana*. One peculiarity of the swamp is the presence of large numbero of *Humboltia decurrens* trees. Swamp, Valavu Para Pacha is also beside the same river. This is a fairly good swamp with large trees and climbers. Manjalu Para swamp, though located very near Thekkumala River, there was some obstruction probably due to mud flow and whole swamp is in a permanently inundated condition. One could see a large number of saplings.

1 Choondi Para

The swamp is about six km from Sankili junction. Sankili is situated 18 km from Venkolla junction; and can be reached by a mud road which is motorable in dry season. To reach the swamp one must travel along the road from Sankli towards Pandi Mottai, cross the Choondipara stream and walk through the evergreen forests. The swamp is very narrow and long and trees are scattered on both sides of a swiftly flowing stream. The stream is a tributary of Choondipara. The swamp is flanked by steep slopes covered with reeds. Soil is thin and more of rocky nature. Trees of *Humboltia decurrens* are common. Medium sized trees of Myristicaceae are also present. Animals consist of fishes, amphibians and reptiles.

2 Valavupara Pacha

Valavupara Pacha swamp is located in Sankli area. The swamp is situated 2 km from Sinikala Ar Chappthu, about 500m from Pongumala Ar, to the right side of the Tekkumala Ar, a major tributary of the Kulathu Puzha River. This swamp can be reached by turning left at Appuppankutty from Choondippara road, walking 200m to the Pongumala Ar, crossing the Pongumala Ar and walking for about 500m distance through evergreen forests. Valavupara Pacha swamp is a typical *Myristica* swamp with *Myristica fatua var. magnifica* trees; marshy in appearance and with one big stream inside the swamp. The vegetation composition is same as that of *Myristica* swamps in Kulathu Puzha region. The stream from the swamp flows directly to the Pongumala Ar. Pongumala Ar then joins with Sinikala Ar and flows as Tekkumala Ar and finally joins with Sankli Ar and flows as Kulathu Puzha River. This patch of *Myristica* swamp is surrounded by evergreen forests. Animals consist of fishes, amphibians and reptiles. Anthropogenic disturbance is almost nil due to the distance from human settlements.

3 Manjalu Para

Manjalu Para swamp is located in Sankli area on the right side of the Tekkumala Ar about 1km north of the stream and can be reached by crossing the stream and walking about half km through the evergreen forest. The swamp is flooded and has a peculiar appearance due to clumps of *Myristica fatua* trees of pole size. Ground vegetation is mainly of Cyperaceae. The swamp has a lot of open space which is covered by grasses. At one edge a small pond is present. A distinct stream is absent, instead complete inundation is present. The stream from this swamp directly enters into the Tekkamala Ar which joins with Sankli Ar. Animals consist of fishes, amphibians and reptiles.

3.2.3 GROUP III SHENDURNEY

The swamps in Shendurney can be further divided in to three subgroups as shown earlier (Fig. 3.2.4).

Sub group-1

The first group consists of eight swamps. These drain to Neduvannur Thodu. They are

1 Irrikappara

The swamp is situated on the right side of the road near Irikka Para along the Kattila para – Kallar road. Irrikka Para is about 2 km from Kattila Para forest station and can be reached by a forest foot path, about 100 m through the forest. The swamp is very narrow and is situated along a small streamlet flowing into the Kunjuman Thodu. The swamp has slushy soil, thin under growth and scattered trees, few of which are *Myristica* trees. The upstream end of the swamp is rocky. Anthropogenic disturbance is significant in the swamp.

2 Kurunthotti Valavu

Kurunthotti Valvu is small swamp located to the left side of Onnam mile – Vilakku Maram road which deviates from Kattila Para – Kallar road beyond Irikka Para. The swamp is inundated and has two water holes made by the forest department for animals. There is a single stream in the middle of the swamp which flows to Kunjuman Thodu. One side of the swamp is quite steep. The swamp contains many large trees of *Gymnacranthera farquhariana, Myristica fatua var. magnifica, Hopea parviflora, Lophopetalum wightianum, Vateria indica, and Artocarpus hirsutus,* with GBH in the range of 100-200cm. Small trees include *Baccaurea courtallensis*, *Actinodaphne malabarica*, *Macaranga peltata*, *Xanthophyllum arnottianum*, *Hydnocarpus pentandra, etc*. The under growth consists mainly of tree saplings. *Though* saplings of *Syzygium trvancoricum* were seen inside the swamp, mature trees were not present. Few canes and *Pandanus* are also present. Climbers are few in this swamp. Animals

consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Anthropogenic disturbances were less.

3 Kambaka Thottam

The swamp is situated on a small branch road of Onnam mile – Vilakku Maram road, which deviates right from just beyond Kurunthotti Valavu junction. The swamp is situated on the right side of this road. *Myristica* trees are dominant, areas of the swamp are inundated and the swamp is surrounded by evergreen forests. The stream from the swamp flows to Kunjuman Thodu. One side of the swamp is covered by dense clumps of *Vateria indica* trees. Large areas of the swamp are open and are covered by grasses and cyperaceous members. Woody climbers are *Myxospyrum smilacifolium*, *Pothos scandens, Piper* sp, etc. Anthropogenic disturbances have been recorded from the swamp.

4 Choodal SE

The swamp is located very near to the Choodal – Vilakku Maram road, on right side near Choodal and about two kilometers from Kattila Para forest station. The easiest approach road is from Kattila Para. The swamp is very narrow and situated on the small streamlets of Kunjuman Thodu. The swamp has open areas. The surroundings of the swamp are very steep with evergreen forests. The swamp has two branches. The soil is slushy. Ground vegetation is thin and is dominated by *Lagenandra ovata*, *Phrynium pubinerve* and members of Araceae and Zingiberaceae families. *Calamus*, *Pandanus* and Ferns are also found in the swamp. Trees are scattered and few are of *Myristica* trees present in the swamp. Human intervention is low compared to the swamps in Kulathu Puzha.

5 Onnam Junda

The swamp is situated on a streamlet of Kunjumon Thodu. It can be reached by foot path deviating right, near the Onnam Junda on the Choodal-Vilakku Maram road. Enormous *Vateria indica* trees along the streamlets at the beginning of the swamp catch one's eye. The swamp proper starts only after a 200m stretch of *Vateria indica*. This swamp has large trees of *Vateria indica* followed by *Gymnacranthera farquhariana*, *Myristica fatua magnifica*, *and Lophopetalum wightianum.* Undergrowth is of mainly *Lagenandra ovata, Calamus,* Common fern and *Baccaurea courtallensis* tree saplings and seedlings of *Syzygium trvancoricum*. A few large lianas of *Chilocarpus denudatus*, *Kunstleria keralensis* and some small climbers are also found in the swamp. The sides are steep and have profuse growth of canes. Anthropogenic disturbance is basically due to collection of NWFP and firewood.

6 Vilakku Maram N

This swamp is situated near Vilakku Maram and can be reached by a foot path turning right from Choodal- Vilakku Maram road. Swamp is inundated and has large *Myristica* trees. There are large rocks at the down stream end. Forest department has made three water holes inside the swamp for animals. This is one of the largest swamps in this area. The stream in the swamp flows to Kunjuman Thodu. The swamp is surrounded by evergreen and semi evergreen forests. Most frequent trees are *Myristica fatua var. magnifica*, *Gymnacranthera farquhariana* and *Vateria indica*. Ground vegetation consists of tree saplings, Ferns, *Phrynium pubinerve, Calamus hookerianus* and a few *Lagenandra ovata* plants. Large climbers *Chilocarpus denudatus Bauhinia phoenicea and Kunstleria keralensis* are present but liana density was low. Anthropogenic disturbance is nil.

7 Vilakku Maram S

The swamp is situated along the road to Vilakku Maram N swamp. The swamp is enclosed by evergreen forests and is small with few scattered trees of *Gymnacranthera farquhariana, Vateria indica and Myristica fatua var. magnifica.* The stream flows to Kunjuman thodu. Some parts of the swamp are inundated. Upstream end of the swamp is very narrow with rocks. Ground vegetation is less and mainly of *Pandanus*, *Calamus*, *Phrynium pubinerve, Lagenandra ovat*a, etc. Climbers are few in the swamp. Anthropogenic disturbance is negligible.

8 Choodal S

The swamp is very near Choodal and can be reached by travelling along the Choodal – Ampathacre road for 500m and climbing down a steep slope on the left side of the swamp. The swamp is small and located on a streamlet of Kunjuman Thodu. There is a pond made by forest department on the left side. The swamp is encircled by evergreen forests. Trees are scattered in distribution and are mainly of *Gymnacranthera farquhariana* and *Myristica fatua var. magnifica*. Ground vegetation consists of *Ochalandra travancorica, Calamus hookerianus, Lagenandra ovata*, etc. Climbers like *Chilocarpus denudatus*, *Combretum* sp, and *Piper* sp are present in the swamp. Anthropogenic disturbance is quite high.

Sub group-2 Kunjuman Thodu

There are seven swamps in this. They drain to Kunjuman thodu, they are tabulated below.

1 Onnam Mile S

The swamp is situated very near to Onnam mile along a mud road deviating right from Onnam mile. The swamp is big, almost flat, and with branches. A big stream flows through the centre of the swamp and flows to the Kattila Para stream which joins Kulathu Puzha River at Neduvannur kadavu. The swamp has many *Myristica* trees and *Syzygium trvancoricum* trees. The swamp is surrounded by evergreen forests. Forest Department has constructed 3 water holes. Three large rocks inside the swamps are notable. The under growth is relatively less in spite of open canopy and consists of *Phrynium pubinerve, Carex spp.*, small clumps of *Pandanus* and some canes. Lianas consist of *Chilocarpus* denudatus, *Combretum sp.*, *Kunstleria keralensis*, *Ventilago bombaiensis*, *Myxospyrum smilacifolium*, etc. *Gymnacranthera farquhariana, Myristica fatua var. magnifica, Syzygium trvancoricum, Vateria indica*, *Hopea parviflora and Lophopetalum wightianum* constitute the dominant tree species. Anthropogenic disturbance is less.

2 Munkuthu

The swamp is situated about 2 km from Kattila Para along a road forking right, from Kattila Para – Kallar road near Kattila Para forest station. This road leads to Choodal via Kattila Para S swamp. This is the largest swamp in Shendurney WLS. The swamp is almost flat and is separated from its downstream end extension called Manchal by the road. The swamp has many branches drained by small streamlets. Most parts of the swamp are inundated. The upstream end of the swamp is flanked by forest plantations; the remaining adjoining areas are covered by evergreen forests. There are 10 watering holes dug by the Forest department. Under growth consists of *Pandanus thwaitesii, Phrynium pubinerve, Schumannianthus virgatus, Carex* sp*., etc.* Canes and reeds are less. Lianas include *Kunstleria keralensis*, *Chilocarpus denudatus Gnetum edule, c*limbing ferns, etc. Large number of *Hopea* trees was extracted from the swamp, to be used as railway track sleepers, in the past. *Myristica fatua var. magnifica* and *Gymnacranthera farquhariana* are the dominant trees followed by *Syzygium trvancoricum*, *Vateria* indica and *Hopea parviflora.* Anthropogenic disturbance is not significant.

3 Man Chal

This swamp is the downstream end of the MunKuthu swamp, and is separated by the road. It is small but has many *Myristica* trees. The stream from the Mun Kuthu swamp flows to Man Chal swamp and discharges to Kulathu Puzha River via Kattila Para stream. Swamp is inundated and has a luxurious under growth of *Pandanus*. There is a water hole made at the drier end. The entrance to the swamp is notable due to the presence of a huge *Tetrameles nudiflora* tree standing right on the rock and sending out its huge roots all across the swamp.

One has to skirt a large patch of *Pandanus* growth to enter the main body of the swamp. The *Pandanus thwaitesii* is very thick, more than 2m in height. Lianas are profuse and include *Entada rheedi*. *Gymnacranthera farquhariana* and *Myristica fatua var. magnifica* were equally dominant followed by *Lophopetalum wightianum*. Undergrowth consists of *Pandanus sp*, *Lagenandra ovata* and *Phrynium pubinerve.* Anthropogenic disturbance is not significant.

4 Kattila Para p

This is a very small swamp and is situated very near to Kattila Para forest station. Inundation and profuse Pandanus growth are its salient characters. The swamp is surrounded by plantations. The stream from the swamp flows to Kattila Para stream. There are four *Myristica fatua var. magnifica* trees of medium size and low canopy height; two *Ficus* trees and two *Holigarna arnottiana* trees. Almost all the trees in the swamp have profuse growth of the climbing fern and *Pothos scandens* on the trunks. Under growth consisted of thick *Pandanus,* 2m high and a few clumps of *Phrynium pubinerve*. Pepper vines are present on a few trees. Two cane saplings and few plants of *Eupatorium odoratum* and *Osbeckia malabathricum*. Animals consist of several species of fishes, amphibians and reptiles, details of which are given in the report. Serious anthropogenic disturbance was not observed from in swamp.

5 Kattilappara SE

This is a small swamp located near Kattila Para settlement. Approach road is from Kattila Para – Kallar road along a mud road deviating right. The swamp is situated left of Kattila Para settlement and shares a side with cultivated land. Swamp is moist and has a trees distributed densely. The swamp has been separated into different levels by gully plugging. The lower level is narrow, rocky and has *Pandanus* and *Ochlandra* seedlings. The upper reach is level and a pond has been dug in the middle. It is said that the pond is perennial. Dominant trees are *Vateria indica, Gymnacranthera farquhariana and Myristica fatua var. magnifica. Vateria indica* has high regeneration. Under growth includes ferns*, Lagenandra ovata* and climbers include *Myxospyrum smilacifolium*, *Chilocarpus denudatus*, etc. Anthropogenic disturbance is present in the swamp; locals divert water flow of swamp for agriculture.

6 Kattila Para S

The swamp is situated beside the Kattila Para - Choodal road via MunKuthu, just after MunKuthu swamp. The road cuts the swamp into 2 segments and each segment has separate streams. The road along the swamp is water logged till January and jeepable there after. The streams from the swamp flow to Kattila Para stream. The downstream areas are continuous with area under cultivation; the crops being pepper, rubber, coconut and areca nut. Two water

holes made by forest department are present, one in each segment. Upper reaches of this swamp has tall *Pandanus thwaitesii about* 3 m in height. Swamp contains big trees of *Gymnacranthera farquhariana, Myristica fatua var. magnifica, Holigarna arnottiana, Lophopetalum wightianum* and *Syzygium travancoricum, etc.* which are densely packed. Undergrowth consists of *Pandanus thwaitesii, Kunstleria keralensis, Phrynium pubinerve, Lagenandra ovata, Selaginella, Schumannianthus virgaus, Calamus,* Cyperaceae *and* Poaceae *members.* Climbers *Chilocarpus denudatus*, *Combretum* sp. were present. Serious anthropogenic disturbance is not present in the swamp.

7 Choodal E

The swamp is situated near Kattila Para – Choodal road on left side of Choodal junction. A steep climb down of about 200m, via teak plantation leads to the swamp. Forest Department has constructed a water hole at the entry of the swamp. The swamp is very wet. In the upper areas swamp slopes down fast and has rocks leading to more or less level ground. On one side of the swamp is a foot path beyond which are plantations. *Gymnacranthera farquhariana and Myristica fatua var. magnifica* dominates. Other trees are *Vateria indica*, *Myristica malabarica* and *Knema attenuate*. In the upper region undergrowth is sparse. Few cane saplings are there. Some *Pandanus* is present. *Ochlandra* is present on edges. *Selaginella sp* and *Lagenandra ovata* are also present. Tree saplings are few. Animals consist of several species of fishes, amphibians and reptiles, details are described in the report. Anthropogenic disturbance is negligible.

Sub group-III

The first group consists of eight swamps these drain to Neduvannur Thodu. They are

1 Onammile N

This is the only one swamp in Shendurney WLS which directly flows to the reservoir. The swamp is located near the Onnam mile junction in Kattila Para – Kallar road, on left side. The swamp is small, with slushy soil and open areas. The forest department had made two ponds for animals. Large trees of more than one meter GBH and scattered sparsely are present. *Syzygium travancoricum* is the dominant tree. Other trees are *Myristica fatua var. magnifica*, *Gymnacranthera farquhariana*, *Vateria indica*, *Hopea parviflora*, *Hydnocarpus pentandra*, *Leea indica*, etc. Undergrowth consists of reeds, *Carex* spp., etc. Thick patches of *Ochlandra are found* downstream end of the swamp. Large climbers are absent but Piper vines are present. The swamp is surrounded by evergreen forest. Anthropogenic disturbance is nil in the swamp.

3.2.4 GROUP IV ANCHAL

The 19 swamps in Anchal Range can be classified into three sub groups. The swamps are in tributaries of Ithikkara River, they originate from different sides of a group of four hills. The rivulets from the swamps take a circuitous route and join Ithikkara River (Fig. 3.2.5).

Sub group -1

The six swamps in this group are located on Kochu Chirakkal Thodu, which takes a circuitous turn and join Ithikara River. Ampalathu Pacha 1 and 2 are small swamps on a small stream. Chettadi 1 and 2 are two swamps on another small stream; the upstream one is about 5 ha. Compared to other swamps, it is less moist and this reflects in its tree composition. Mottillam Pacha and Anavettamchal are two swamps on another stream. At Mottilam Pacha *Myristica* are trees located along rocky steep stream. The stream becomes fairly large at Anavetttanchal and extends into valleys on either side. The stream containing first two swamps join with the stream harboring remaining four swamps of the group.

1 Ammbalathu Pacha (1&2)

These two swamps are situated on the Kudukan Para hill valleys in Anchal forest range. Approach road turns left from Anakulam. These swamps are small separate patches located on the same stream. The streams originate from Kudukan Para and flows to Kochu Chirakal thodu which joins with Kal Ar a tributary of Man Ar which is a tributary of Ithikkara River. Though the soil is slushy, small rocks are found inside the swamp. The swamp contains many big shrubs of *Barleria courtallica* which is the dominant ground vegetation. Herbs are few and consist of *Lagenandra ovata, Phrynium pubinerve*, etc. Surrounding forest is semievergreen. Trees consist of *Vateria indica, Gymnacranthera farquhariana, Myristica fatua var. magnifica*, etc. Climbers consist of *Chilocarpus denudatus* and *Entada rheedi*. The nearby settlement, with a population about 3000 individuals, is about 3km from the swamp. The locals enter the swamp for fire wood collection and honey.

2 Chettadi (1&2)

These swamps are situated along the streams from Kudukan Para and Ambala Kunnu. The route to the swamp is a left forking road from Anakulam which leads to 500m near the swamp. A foot path leads to Chettadi swamp. Chettadi -2 swamp is big. The dominant vegetation is the *Myristica* trees; *Myritica fatua var. magnifica* and *Gymnacranthera farquhariana*. Non-*Myristica* trees like *Vateria indica* are also present. The ground in this swamp is almost level and has very thin undergrowth. Actually this swamp is the downstream end of the Chettad -1 swamp, which is small and has few *Myristica* trees

distributed on both sides of the stream. The swamp is surrounded by semi-evergreen forest and is highly disturbed.

3 Anavettam Chal

Annavettan Chal lies downstream of streamlets originating from Kallyani Kunnu. It is a narrow swamp of about 2 m with several extensions to either side. Some of the extensions are considered as individual swamp patches by the locals. The main stream is fed by small streamlets flowing into the main swamp from the branches. *Myristica* trees of medium size are scattered along the sides of the stream. Non *Myristica* trees are also present. Undergrowth is sparse in the centre of the swamp but quite dense along the periphery.

4 Mottilam Pacha

Mottilam pacha lies along one of the streamlets feeding Anavettam Chal. To reach the swamp one must walk upstream along the stream in Annavettam Chal and climb up a steep rock and cascade. The swamp is situated just above the cascade. The swamp can also be reached from Kalyani swamps via a footpath. The stream is very swift and shallow and a few meter wide. *Myristica fatua var. magnifica* trees are present along the stream along with a few small non *Myristica* trees. The ground slopes steeply and is rocky leading to the formation of many small waterfalls. Undergrowth is sparse. The surroundings of the swamp are step and rocky covered with ferns and herbs and leads to tracts of semi- evergreen forests. Evidences of large scale arrack distillation carried out in the past are present.

Sub group-2

There are a total of 10 small swamps located on the stream Eravail Thodu. Kodikuthy Pacha and Eravail Pacha form a subgroup and are situated near the point of origin of the stream. Kalyani-1 and Kalyny-2 are at the tip of another sister stream. There are six more swamps enroute of this stream, Konju Kuzhy, Pandari Karikkam, Kuravan Thery, Kayyala Para, Mukkode and Podiyan Pacha. Cultivation extends upto Kodi Kuthi pacha. Kuruvan Thery swamp is about 500m from habitation.

1 Kodukuthi Pacha

The swamp is situated about 1 km from Vanathu Mukku junction. Vanathu Mukku can be reached either by the road from Onthu Pacha (on Kulathu Puzha Trivandrum road) to Anchal or from Anchal via Channa Petta. About half kilometer from Vanathu Muku is a human settlement which can be reached by a jeepable mud road. From here a half kilometer walk through paddy fields and degraded forests adjoining the fields leads to Kodu Kuthy pacha. The swamp is very narrow and long and is in a highly disturbed condition. Pole cut trees with

the GBH range in between 10 -25 cover the swamp. Big trees are very few and of these only a few trees are of *Myristica.* The single stream which flows through the middle of the swamp which originates from Ambala Kunnu flows into Eravail thodu before joining Ithikkara Ar via Man Ar. Surrounding forest is degraded semi-evergreen.

2 Eravail Pacha

Eravail Pacha is a stream adjacent to Kodu Kuthy Pacha. The stream from this swamp joins with the stream from Kodu Kuthi Pacha. The disturbance levels and vegetation composition are similar to that at Kodu Kuthi Pacha. *Myristica fatua var. magnifica* tree is the dominant tree inside the swamp. The swamp is very narrow and is contiguous with private property along one side and forest plantations on the other side.

3 and 4 Kalyani Up and Kalyani Down

Kalyani-1&2 are about 3 km from Vanathu Mukkku. Kalayani-1 is situated upstream and is a larger of the two. The swamp is located near the Vannathu Mukku- Kalyani road. The swamp is rocky and there are several cascades. Canopy cover is not complete. The stream is relatively large and of about 2m width but dries up completely in February. *Myristica* trees of various sizes are present scattered throughout the swamp. Kalyani upstream is remarkable in that it has very steep valleys and major tree *Gymnacranthera farquhariana*. *Myristica fatua var.magnifica* is very few in number. One side of Kalyani upstream is a cultivated field. A concrete and wire fence has been made to restrict the encroachment. The streams originate from Ponnman Kunnu, Ambala Kunnu and Kallyani Kunnu. Disturbance is high due to human intervention, nearby settlement and cultivation field. Further downstream lies Konju Kuzhi. Pandari Karikam is the next swamp on the stream. The stream drains into Kuravan Thery swamp before joining the main river.

5 Konju Kuzhi

The swamp can be reached by following a road deviating left, about one kilometer before Kalyani swamp, for about 500m through the forest. The swamp is branched; the main body is narrow and long. Three streamlets flow into one major stream which is a bout 2m wide at places. The water flows to Pandari Karrikam, Kuruvan Thery and finally flows into and out of Mukkode swamp and joins Man Ar which is a tributary of Itthikara River. The swamp is flooded in some areas; big rocks and laterite soil is found in the non- inundated parts. As the swamp slopes considerably, water flows turbulent in rainy season. A small water fall is present at the upstream end. *Myristica* trees are *Myristica fatua var.magnifica, Gymnacranthera farquhariana, Knema attenuata.* The main

Non-*Myristica* trees are *Hopea parviflora, Xanthophyllum arnottianum, Aporosa cardiosperma, Leea indica, Vitex altissima, Mangifera indica, Tetrameles nudiflora, Calophyllum polyanthum, Grewia tiliifolia, Kingiodendron pinnatum, Artocarpus hirsutus, Baccaurea courtallensis, Lophopetalum wightianum, Holigarna arnottiana, Strombosia zeylanica, Persia macrantha, Bombax ceiba, Scolopia crenata,* etc. Ground vegetation is less and mainly consists of *Ochalandra travancorica, Calamus hookerianus, Pinanga dicksonii Anaphyllum wightii*, *Schumannianthus virgatus*, etc. *Kunstleria keralensis, Chilocarpus denudatus, Butea sp, Calycopteris floribunda, Zizyphus rugosa, Piper sp.,* is the main climbers.

6 Kuravan Thery

Kuruvan Thery is the second last major swamp along the streams originating from Kalyani Kunnu region. This swamp can be reached by following the road from Kuruvanthery junction to the Kuruvan Thery checkpost. From here a jeepable road leading to forest plantations have to be followed. After about 1 km, a steep climb down towards the right leads us to the stream. This place is a minor pilgrimage for the local Muslims. The stream is quite wide and swift here still *Myristica* trees are present. *Gymnacranthera farquhariana, Myristica fatua var. magnifica, Holigarna arnottiana, Semecarpus auriculata, Vateria indica, Hydnocarpus pentantra, Aporosa cardiosperma, Neolamarckia cadamba*, *Strombosia ceylanica* are the main trees in this swamp.

7 Mukkode

This swamp is very near Mukkode junction lying on the Kulathu Puzha Anchal road. It is the last major swamp lying along the streams originating at Kalyani Kunnu area before the stream joins a major tributary of Ithikkara, the Man Ar. The swamp is very narrow and long. It is drained by a single stream which enters the swamp from the surrounding forest. Most of the swamp is surrounded by private land cultivated with arecanut and rubber plantations. The remaining area belongs to forest department and is covered by semi evergreen and degraded forests. The swamp has medium sized trees of *Myristica* and non-*Myristica* species. Lianas and undergrowth are sparse.

Sub group – 3

There are two swamps in this group, they are situated in two perennial streams at 1 kilometer distance. Of these Neerattu Thdam on the northern side of the hill is large and more than 10 hectare in area. The second one is Valiya Pacha, just astretch of few *Myristica* trees. Neerattu Thadam is remarkable in another way; the swamps start at 100 metre elevation onwards. This brings about changes in its

structure and composition. A small patch, called Pangalam Pacha containing *Myristica* trees is reported upstream of Valiya Pacha.

1 Valiya Pacha

Approach to Valiya Pacha is from Channa Petta. From Channa Petta, Kuravan Thery junction must be reached. Turn right to a steeply climbing road which leads to Kuravan Thery guard station. There is a jeep road from here. Valiya Pacha is on a small stream about one meter wide. Valiya Pacha meaning big green is actually a misnomer as it contains only few patches of *Myristica* trees along the stream. A smaller patch called Pangalam Pacha lies in the vicinity of this swamp. The swamp is surrounded by semi evergreen forests. The dominant trees are *Gymnacranthera farquhariana, Myristica fatua var. magnifica, Persia macrantha, Holigarna arnottiana, Alstonia scholaris, Xanthophyllum arnottianum, Lophopetalum wightianum, Vateria indica, Semecarpus auriculata, Sterculia gluta, Mangifera indica, Glochidion ellipticum*, *Neolamarckia cadamba, Baccaurea courtallensis, Ficus hispida, Cinnamomum malabatrum, Macaranga peltata, etc.* Branching fern, *Thottea siliquosa*, *Pandanus thwaitesii, Calamus hookerianus, Melastoma malabathricum, Lagenandra* ovate, *Schumannianthus virgatus*, *Zingiber zerumbet*, Cyperaceae and Poaceae members form bulk of the undergrowth. Climber like *Entada scandens, Gnetum edule, Zizyphus rugosa, Myxospyrum smilacifolium, etc.* is also present.

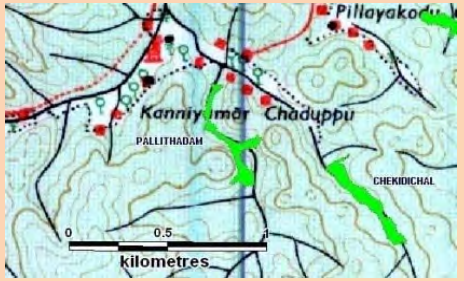
2 Neerattu Thadam

The approach to this swamp is from Channa Petta through Vanathu Mukku via Ayiravally Kavu. This road leads past Kalyani-1 and Kayani-2 and ends at Neerattu Thadam. The stream is almost one meter wide when it enters the swamp. A small settlement with a few houses is present here. There is a large oil palm plantation on the right side of the stream and is a large settlement up stream. Neerattu Thadam is one of the largest swamps in Southern Kerala. The stream is about three meter wide and half meter deep at places. There are large water logged patches along the stream. Trees of oil palm and arecanut are also seen inside the swamp. In spite of the large stream, the area is a typical *Myristica* swamp with *Myristica fatua var.magnifica* is the dominant tree. These trees show excessive stilt root formation along the streams. Other dominant trees are *Holigarna arnottiana, Vateria indica*, etc. Undergrowth is sparse. Tree saplings are dense in some areas. The soil is sandy in most areas but has alluvial sediments in other parts. The swamp is surrounded by plantations of Acacia and Oil palm and paddy fields. Anthropogenic disturbances are high. There is a high tension electric line which passes through the centre of the swamp; this area has been cleared and thus breaks the continuity of the

swamp. Illegal alcohol brewing, charcoal making, collection of NWFP and firewood are the main anthropogenic threats.

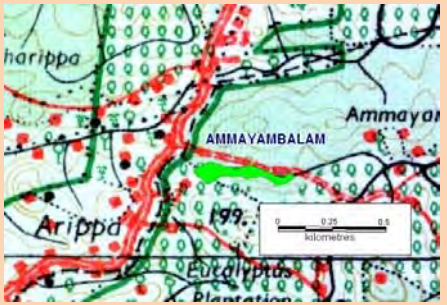
- Group I – Pu Ar
  - Ia.1. Mupathadi
  - Ia.2. Pillekode
  - Ia.3. Kochamma
  - Ia.4. Chekidi Chal
  - Ia.5. Palli Thadam
  - Ia.6. Uthiran Chira
  - Ia.7. Karinkurinji Up
  - Ia.8. Karinkurinji Down
  - Ia.9. Sastha Nada
  - Ia.10 Ammayambalam

Chekidi Chal

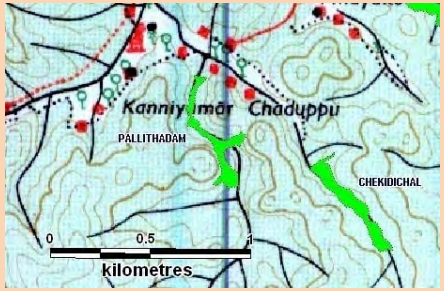


Karinkurinji Up

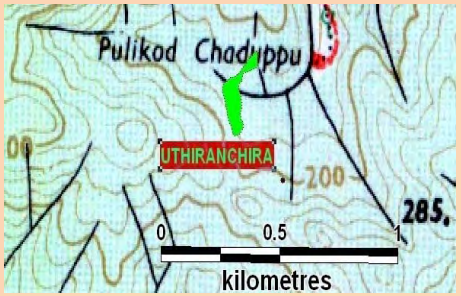
Ammayambalam



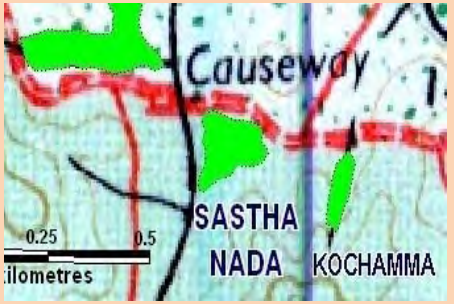
Palli Thadam



Uthiran Chira



Kochamma



Sastha Nada

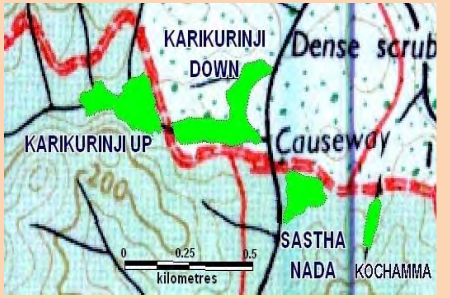
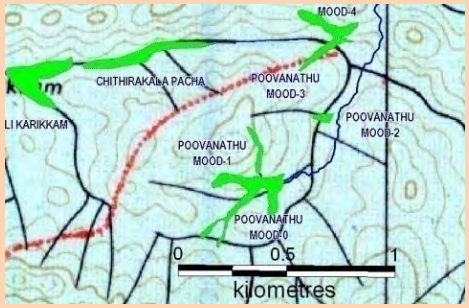


Fig. 3.2.1 Swamps of Group I – Pu Ar

- Group II-Kulathupuzha
- Sub Group IIa-Channa Mala

  - IIa.1 Poovanathu Mood -0
  - IIa.2 Poovanathu Mood-1
  - IIa.3 Poovanathu Mood-2
  - IIa.4 Poovanathu Mood-3
  - IIa.5 Poovanathu Mood-4
  - IIa.6 Chuvana Karikkam
  - IIa.7 Munnam Chal
  - IIa.8 Plavu Chal
  - IIa.9 Pullu Mala
  - IIa.10 Perum Padappy
  - IIa.11 Channa Mala Up
  - IIa.12 Channa Mala Down

Poovanathu Mood-0



Poovanathu Mood-4

Plavu Chal

Poovanatu Mood-1

Poovanathu Mood-3

Munnam Chal

Chuvanna Karikkam

Pullu Mala

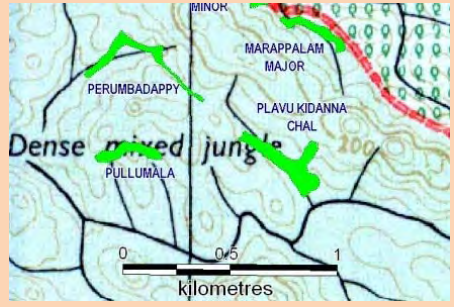
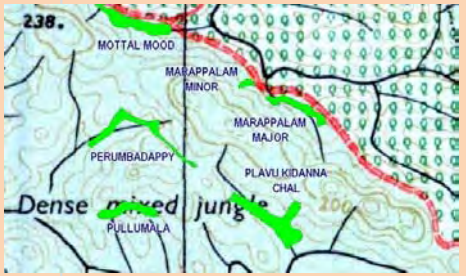


Fig. 3.2.2 Swamps of Group II –Kulathupuzha

- Group II - Kulathupuzha
  - Sub Group IIb - Empong
    - IIb.1 Empong
  - Sub Group IIc - Dali
    - IIc.1 Dali Karikkam
    - IIc.2 Chithirakala Pacha
  - Sub Group IId - Kunjuman Thodu
    - IIc.1 Mottal Mood
    - IIc.2 Marappalam Major
    - IIc.3.Marappalam Minor
  - Sub Group IIe - Sankili
    - IId.1 Choondi Para
    - IId.2 Valavu Para Pacha
    - IId.3 Manjalu Para

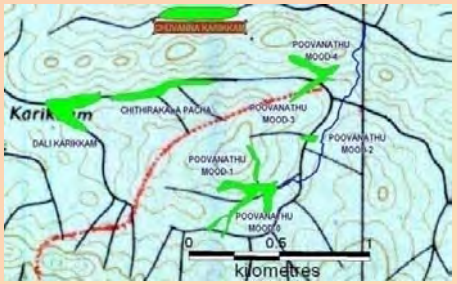
Empong

Marappalam Minor



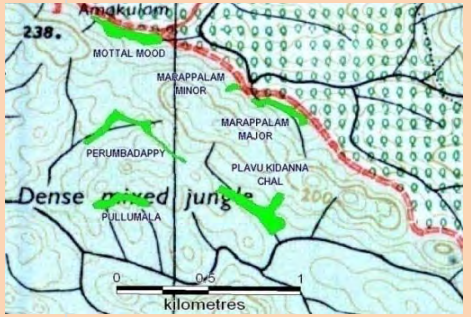
Marappalam Major

Dali Karikkam



Chithirakkala Pacha

Mottal Mood



Valavupara Pacha

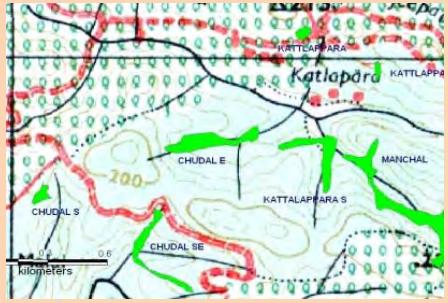
Manjalu Para

Fig. 3.2.3 Swamps of Group II –Kulathupuzha

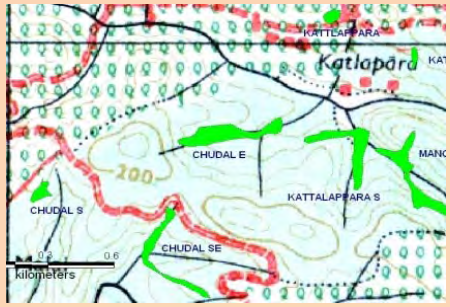
- Group III - Shendurney
  - Sub Group IIIb
    - IIIb.1 Onnam Mile S
    - IIIb.2 Mun Kuthu
    - IIIb.3 Man Chal
    - IIIb.4 Kattila Para
    - IIIb.5 Kattila Para SE
    - IIIb.6 Kattila Para S
    - IIIb.7 Chudal E
  - Sub Group IIIc
    - IIIc.1 Onnam Mile N

Onnam Mile S

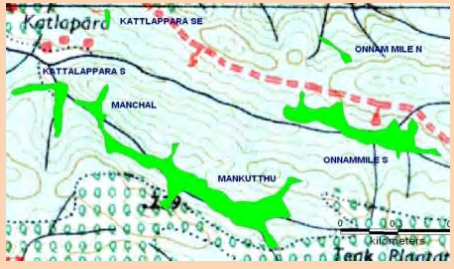
Kattila ppara



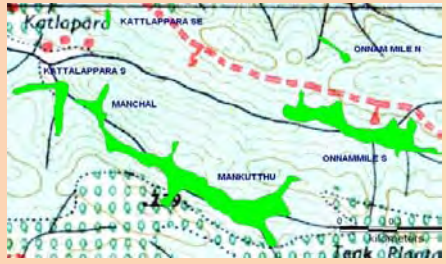
Chudal E



Mun Kuthu



Man Chal



Kattilappara SE

Onnam Mile N

Fig. 3.2.4 Swamps of Group III **Shendurney**

- Group- III Shendurney
  - Sub Group IIIa
    - IIIa.1 Irikka Para
    - IIIa.2 Kurunthotti Valavu
    - IIIa.3 Kambaka Thottam
    - IIIa.4 Chudal SE
    - IIIa.5 Onnam Junda
    - IIIa.6 Vilakkumaram N
    - IIIa.7 Vilakkumaram S
    - IIIa.8 Chudal S

Kurunthotti Valavu

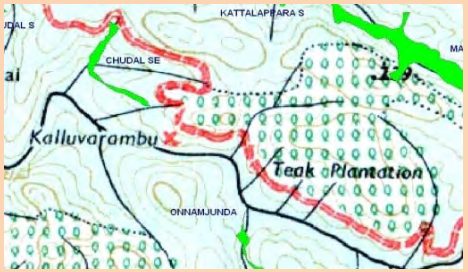
Onnam Junda

Kambaka Thottam

Irikkappara

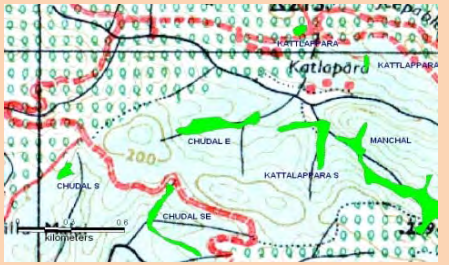
Vilakkumaram S

Choodal SE



Vilakku Maram N

Choodal S



Kattilappara S

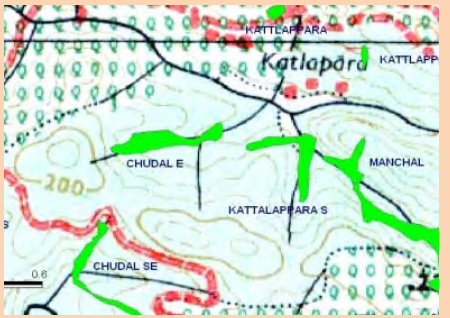


Fig. 3.2.5 Swamps of Group III **Shendurney**

- Group IV - Anchal
  - Sub Group IVa
    - IVa.1 Ambalathu Pacha
    - IVa.2 Chettadi
    - IVa.3 Anavettam Chal
    - IVa.4 Mottilam Pacha
  - Sub group IVb
    - IVb.1 Kodukuthy
    - IVb.2 Eravail Pacha
    - IVb.3 Kalyani Up
    - IVb.4 Kalyani Down
    - IVb.5 Konju Kuzhy
    - IVb.6 Kuruvan Thery
    - IVb.7 Mukkode
  - Sub Group IVc
    - IVc.1 Valiya Pacha
    - IVc.2 Neerattu Thadam

Mottilam Pacha

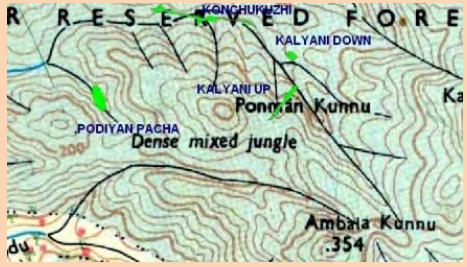
Valiiya Pacha

Neerattu Thadam

Chettadi

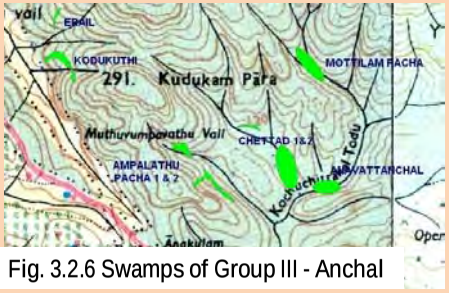
Ana Vettam Chal

Kalyani Up



Kuravan Theri

Ambalathu Pacha



Kodi Kuthy Pacha

Eravail Pacha

Kalyani Down

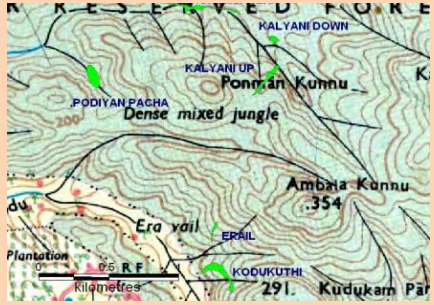


Fig. 3.2.6 Swamps of Group III - Anchal

3.3 VEGETATION: RESULTS AND DISCUSSION

A total of 19 plots of 10x100m were laid out inside the swamps for enumeration of trees, shrubs, herbs and regeneration. A total of 14 plots were enumerated outside the swamp. Subplots of 4x4m and 1x1m were used for enumeration of herbs and shrubs. The plots are listed in Table 3.3.1. Under each category plot wise summary and abundance details are given. Close up photographs of most of the plants are included in the report. Full list of plants is given in Appendix II. Transect data is summarised in Appendix IV.

Table 3.3.1 List of plots laid out for enumeration of vegetation

Sl. No	Inside swamp	Outside swamp
1)	Chakidi Chal	Chakidi Chal
2)	Channa Mala	Channa Mala
3)	Emponge	Emponge
4)	Karinkurinji	Karinkurinji
5)	Marappalam Major	Marappalam Major
6)	Marappalam Minor	Marappalam Minor
7)	Mottal Mood	Mottal Mood
8)	Muppathadi	Muppathadi
9)	Neerattu Thadam1	
10)	Neerattu Thadam2	
11)	Perum Padappy	Perum Padappy
12)	Pillekode	
13)	Plavu Chal	Plavu Chal
14)	Poovanathu Mood-0	
15)	Poovanathu Mood-3	Poovanathu Mood-3
16)	Poovanathu Mood-4	
17)	Pullu Mala	Pullu Mala
18)	Sastha Nada	Sastha Nada
19)	Uthiran Chira	Uthiran Chira

Myristica swamps contain a rich variety of plants. Mushrooms, mosses, pteridophytes, and gymnosperm (*Gnetum*) are the lower groups of plants. Angiosperms could be classified into herbs, shrubs, climbers and trees. Moist climate is conducive to fungus growth. A total of about 60 different mushrooms could be recorded from the swamp. Altogether of 90 species of herbs/shrubs were recorded from inside the swamp and 53 from out side. They are distributed in 39 families. Maximum number of herbs was in family Rubiaceae, followed by Zingiberaceae, Melostomataceae, Commelinaceae and Cyperacae. A total of 50 species of climbers were recorded from inside the swamp and 34 from out side. They are distributed in 25 families. Maximum number of climbers was in family Verbanaceae, followed by Araceae, Asclepedaceae and Combretaceae. A total of 80 species of trees were recorded from inside the swamp and 88 from out side. They are distributed in 40 families. The maximum trees are in family Euphorbiaceae, followed by Lauraceae, Myristicaceae, Clusiacea and Dipterocarpaceae. Two typical swamp profiles are shown in Fig. 3.3.0

3.3.1 HERBS

HERBS INSIDE

There were a total of 1148 individual herbs in 19 plots. Chakidi Chal had the maximum number of herbs (14%). This was followed by Poovanathu Mood-0 (11%), PilleKode (9%), Poovanathu Mood-3 (7%), etc. Photos of the most frequent herbs are shown in Fig. 3.3.1; Plot summary is shown in Appendix IV. Herbs inside and outside are examined separately and then compared.

Density and abundance

Chakidi Chal had the maximum density of herbs followed by Poovanthu Mood 0 and Pillekode. Several plots had only about one fourth of this density. When all the individuals in plots are considered together, *Lagenandra ovata* was the common herb (35%) followed by *Ophiorrhiza eriantha* (12%), Grass (10%), *Cyanotis* sp. (10%), *Selaginella brachystachya* (7%), Carex sp. (5%), etc. How ever the dominance in different plots changes. There was a total of 41 species of herbs for all plots together (Table 3.3.2 and Fig. 3.3.2)

Table 3.3.2 Total number of individual herbs and number of species in sample plots

Sl. No	Species	Total	%	No of Species	Dominant species
1.	Chakidi Chal	160	13.94	5	*Psychotria flavida*, *Lagenandra ovata*
2.	Poovanathu Mood-0	127	11.06	8	*Cyanotis sp*, *Psychotria flavida*, *Lagenandra ovata*, *Selaginella brachystachya*
3.	Pillekode	102	8.89	10	*Lagenandra ovata*, *Cyanotis sp*, *Pothose scandens*
4.	Poovanathu Mood-3	82	7.14	10	*Selaginella brachystachya*, *Carex sp*
5.	Emponge	71	6.18	8	Grass,*Phrynium pubinerve*
6.	Perum Padappy	71	6.18	7	*Lagenandra ovata*, Grass, *Cyanotis* sp.
7.	Pullu Mala	63	5.49	5	*Carex sp*, *Psychotria flavida*, *Grass*
8.	Marappalam Minor	53	4.62	7	*Pellionia heyneana*, *Lagenandra ovata*, *Barleria courtallica*
9.	Karinkurinji	50	4.36	5	*Lagenandra ovata*
10.	Uthiran Chira	50	4.36	1	*Lagenandra ovata* was the only species
11.	Poovanathu Mood-4	45	3.92	3	*Selaginella brachystachya, Carex sp*
12.	Neerattu Thadam1	41	3.57	2	Very few herbs and grass
13.	Muppathadi	40	3.48	6	*Lagenandra ovata*, *Cyanotis* sp.
14.	Marappalam Major	39	3.40	3	*Lagenandra ovata*
15.	Channa Mala	38	3.31	6	*Lagenandra ovata*
16.	Mottal Mood	38	3.31	4	*Lagenandra ovata*
17.	Plavu Chal	37	3.22	8	*Lagenandra ovata*, *Cyanotis sp*
18.	Sastha Nada	35	3.05	8	*Barleria courtallica*, *Lagenandra ovata*, *Phrynium pubinerve*
19.	Neerattu Thadam 2	6	0.52	3	Very few herbs
	Total	1148	100.00		

Total composition, species wise

When the number of herb species in each plot is considered, Pillekode and Poovanathu Mood- 0 had the highest number (10 species each). This was followed by four plots with 8 species of herbs, and so on.

Species occurrence in plots

No species was found occurring in all 19 plots. *Lagenandra ovata* was found in 13 plots, *Carex* sp. in 8 plots, *Cyanotis sp.* in 7 plots, *Psychotria flavida* in 6 plots, *Christella parasitica* in 6 plots and Grass in 5 plots.

Plot wise species dominance

As many as 9 plots had *Lagenandra ovata* as the most common herb. In Marappalam Minor, *Pellionia heyneana* was more than *Lagenandra ovata*. Other plots had Grass, *Carex* sp. or *Cyanotis sp.* as the most common species.

HERBS OUTSIDE

Density and abundance

A total of 723 individual herbs were recorded from 14 plots, out of this *grass* comes maximum (28%), this is followed by *Zingiber zerumbet* (15%) and *Dracaena terniflora* (12%). This is followed by plants such as *Ventilago bombaiensis*, *Pandanus furcatus, Carex* sp*., Schumannianthus virgatus* and *Selaginella brachystachya*. There were 42 species of herbs in all plots together. Details are shown in Table 3.3.3.

Table 3.3.3 Total number of individual herbs and number of species in sample plots

	Species	Total	%	No of Species	Dominant species
1.	Uthiran Chira	200	27.66	12	Grass, *Zingiber zerumbet*, *Christella prasitica, Schumannianthus virgatus*
2.	Karinkurinji	93	12.86	10	Grass and *Zingiber zerumbet*.
3.	Poovanathu Mood-3	84	11.62	7	*Carex sp*, *Selaginella brachystachya*, *Draceana terniflora*,
4.	Emponge	64	8.85	9	*Pandnus furcatus*, *Draceana terniflora* and *Calamus hookerianus.*
5.	Marappalam Minor	48	6.64	5	*Pellionia hyneana*, *Draceana terniflora* and *Selaginella brachystachya*
6.	Sastha Nada	46	6.36	4	*Zingiber zerumbet*, grass
7.	Chakidi Chal	39	5.39	4	*Zingiber zerumbet*, grass
8.	Plavu Chal	35	4.84	7	*Ventilago bombaiensis*
9.	Mottal Mood	31	4.29	8	*Draceana terniflora* and *Barleria courtallica*
10.	Marappalam Major	22	3.04	8	*Draceana terniflora*
11.	Channa Mala	19	2.63	6	*Draceana terniflora*
12.	Perum Padappy	15	2.07	4	*Ventilago bombaiensis* and *Psychotria flavida*
13.	Pullu Mala	14	1.94	3	Grass, *Zingiber zerumbet*
14.	Muppathadi	13	1.80	1	*Draceana terniflora*
	Total	723	100.00		

Total composition species wise

Uthiran Chira had maximum (12 species), followed by Karinkurinji (10), and Mottal Mood (8), Marappalam Major (8), etc.

Common species in plots

No species was found occurring in all the plots; *Dracaena terniflora* were recorded in 10 plots. *Zingiber zerumbet* in 6 plots and *Carex* sp., grass, and *Piper nigrum was* in 5 plots each. The remaining 37 species were occurring in 4 or fewer plots.

Plot wise species dominance

Dracaena terniflora was the most common herb in five plots. Grass was dominant in three plots. *Ventilago bombaiensis* was dominant in two plots. On others *Carex sp*, *Pandanus furcatus* and *Pellionia heyneana* were common (Fig. 3.3.3).

COMPARISON - HERBS INSIDE AND OUTSIDE

Total number of species was more or less similar inside the swamp (41) and out side (42). But the total number of individuals in plots out side (723 in 14 plots) was slightly less, compared to 1148 individuals in 19 inside plots. Maximum number of species was slightly higher out side the swamp (12); inside had 10 species. Inside the swamp, as many as 9 plots had *Lagenandra ovata* as the most common herb. In Marappalam Minor, *Pellionia heyneana* was more than *Lagenandra ovata*. Other plots had grass, *Carex* sp. or *Cyanotis* sp. as the most common. Outside the swamp, *Dracena terniflora* was the most common herb in 9 plots. *Zingiber zerumbet* was found in 6 plots. *Carex* sp, grass, *Lagenandra ovata* was the common herb (35%) followed *Ophiorrhiza eriantha* (12%), grass (10%), *Cyanotis* sp. (10%), *Selaginella brachystachya* (7%), *Carex* sp. (5%), etc (Fig. 3.3.4 and 3.3.5). However the dominance in different plots changes (Appendix V). In the plots outside the swamps, *grass* comes maximum in number (28%), this is followed by *Zingiber zerumbet* (15%) and *Dracaena terniflora* (12%) and plants such as *Ventilago bombaiensis*, *Pandanus thwaitesii, Carex* sp*., schumannianthus virgatus and Selaginella brachystachya.*

The plots with more herb individuals had more number of species also. In general, dominant species of herbs are found in more number of plots. When individual plots are examined, some plots have fair amount of *Selaginella brachystachya* or grass. Some of the plots with less number of herb individuals had high number of species. The composition inside and outside was entirely different; while the swamps had hydrophilic herbs, out side plots had grass, *Zingiber zerumbent, Dracaena terniflora*, etc.

3.3.2 SHRUBS

SHRUBS INSIDE

Density and abundance

Shrubs inside and outside are examined separately and then compared. There were 5,282 individual shrubs in 19 plots. Chakidi Chal had maximum number of shrubs (23%) followed by Karinkurinji (11%), Channa Mala (7%), Plavu Chal (6%), Perum Padappy (5%), least was in Neerattu Thadam I and II (Table 3.3.4 and Fig 3.3.7). There were a total of 65 species of shrubs. Photographs of most common shrus and climbers are shown in Fig. 3.3.6 and plot wise summary of data is given in Appendix IV.

Table 3.3.4 Total number of individual shurbs and number of species of shrubs in each sample plot

No	Species	Tot ind	%	Occurrence in plots	Common species
1.	Chakidi Chal	1220	23.10	16	*Lagenandra ovata*, *Ochlandra travancorica*, *Christella parasitica*, *Schumanniathus virgatus*
2.	Karinkurinji	552	10.45	11	*Lagenandra ovata*, *Phrynium pubinerve*
3.	Channa Mala	352	6.66	17	*Lagenandra ovata*, *Christella parasitica*, *Cyanotis* sp, *Piper nigrum*, *Ochlandra travancorica*
4.	Plavu Chal	342	6.47	21	*Lagenandra ovata*, *Cyanotis sp.*
5.	Perum Padappy	328	6.21	17	*Lagenandra ovata*, *Pandanus thwaitesii*, *Calamus hookerianus*
6.	Mottal Mood	308	5.83	14	*Lagenandra ovata*,
7.	Pillekode	299	5.66	19	*Lagenandra ovata*, *Barleria courtallica*, *Piper nigrum*, *Carex sp*
8.	Marappalam Major	278	5.26	11	*Lagenandra ovata*
9.	Sastha Nada	258	4.88	22	*Barleria courtallica*, *Lagenandra ovata*, *Piper nigrum*, *Phrynium pubinerve*
10.	Muppathadi	234	4.43	15	*Lagenandra ovata*
11.	Poovanathu Mood-0	234	4.43	21	*Lagenandra ovata*, *Ochlandra travancorica*, *Piper nigrum*, *Christella parasitica*,
12.	Empong	189	3.58	18	*Phrynium pubinerve*, *Christella parasitica*, *Piper nigrum*, *Gomphandra tetrandra*, *Pandanus thwaitesii*
13.	Pullu Mala	153	2.90	10	*Carex sp*, *Ochlandra travancorica*, *christella parasitica*,
14.	Marappalam Minor	146	2.76	15	*Lagenandra ovata*, *Calamus hookerianus*, *Barleria courtallica*, *Pandanus thwaitesii*
15.	Poovanathu Mood-3	113	2.14	17	*Pandanus thwaitesii*, *Carex sp*, *Christella parasitica*
16.	Uthiran Chira	103	1.95	11	*Lagenandra ovata*, *Pothos scandens*, *Kunstleria keralensis*
17.	Poovanathu Mood-4	100	1.89	13	*Carex sp*, *Pandanus thwaitesii*, *Calamus hookerianus*
18.	Neerattu Thadam1	38	0.72	14	*Pothos scandens*, *Combretum latifolium*, *Calamus hookerianus*
19.	Neerattu Thadam2	35	0.66	10	*Carex sp*, *Pandanus thwaitesii*
	Total	5282	100.00		

Total composition, species wise

Surprisingly, there were large numbers of species in each plot. The maximum was in Sastha Nada (22 species), followed by Plavu Chal (21 species), Poovanathu Mood-0 (21 species), etc.

Species occurrence in plots

No shrub was common to all the 19 plots. Climber *Piper nigrum* was recorded from 17 plots, another two climbers *Pothos scandens* and *Chilocarpus denudatus* recorded from 16 and 15 plots. *Carex* sp. was present in 15 plots. *Calamus hookerianus*, *Kunstleria keralensis* and *Lagenandra ovata* was present in 14 plots each. *Myxospyrum smilacifolium* was recorded from 13 plots, *Combretum latifolium* in 12 plots and *Phrynium pubinerve* from 12 plots.

Plot wise species dominance

Lagenandra ovata was the most frequent herb in as many as 12 plots. Three plots had *Carex* sp. and one plot each had *Phrynium pubinerve* and *Barleria courtallica as dominant species.*

SHRUBS OUTSIDE

Desnity and abundance

A total of 4,453 individuals were recorded from 14 plots outside the swamp. There were a total of 92 species of shrubs. Chakidi Chal and Plavu Chal had maximum number of shrubs (14 % and 11%) which was followed by Muppathadi (10%) Karinkurinji (9%) Poovanathu Mood-3 (8%) and Uthiran Chira(8%). Marappalam Minor had least shrubs (0.5%) (Fig. 3.3.8 and Table 3.3.5).

Total composition species wise

The most dominant species was *Zingiber zerumbet* (14%) and *Psychotria flavida* (14%) followed by *Ochlandra travancorica* (8*%), Ventilago bombaiensis* (7%), *Pandanus thwaitesii (7*%) and *Dracaena terniflora* (6%).

Species occurrence in plots

No species of shrub was present in all the outside plots; *Psychotria flavida* was recorded in 11 *plots, Christella parasitica, Calamus hookerianus* and *Piper* sp. were present in 10 plots each and *Calamus thwaitesii, Carex sp*, *Smilax zeylanica*, *Strychnose cloubrina* and *Zingiber zerumbet* were found in 8 plots each.

Table 3.3.5 Total number of individual shrubs and number of species in sample plots

Sl. No.	Species	Total	%	No of Species	*Dominant species*
1.	Chakidi Chal	605	13.59	21	*Ochlandra travancorica and Zingiber zerumbet*
2.	Plavu Chal	489	10.98	23	*Ventilago bombaiensis, Connaurus sp.*
3.	Muppathadi	439	9.86	24	*Psychotria flavida*

Sl. No.	Species	Total	%	No of Species	*Dominant species*
4.	Karinkurinji	395	8.87	22	*Zingiber zerumbet, Helicteres isora, Alpinia malaccensis*
5.	Poovanathu Mood-3	375	8.42	12	*Pandanus thwaitesii, Carex sp, Psychotria flavida, Alpinia malaccensis*
6.	Uthiran Chira	361	8.11	27	*Zingiber zerumbet, Helicteres isora, Schumannianthus virgatus*
7.	Emponge	312	7.01	25	*Pandanus thwaitesii and Ventilago bombaiensis, Dracaena terniflora*
8.	Pullu Mala	291	6.53	30	*Psychotria flavida and Smilax zeylanica*
9.	Channa Mala	256	5.75	26	*Dracaena terniflora, Phaeanthus malabaricus, and Psychotria flavida*
10.	Mottal Mood	233	5.23	28	*Combretum latifolium, Barleria courtallica*
11.	Perum Padappy	206	4.63	27	*Ventilago bombaiensis and Psychotria flavida*
12.	Sastha Nada	192	4.31	25	*Zingiber zerumbet, Helicteres isora, Schumannianthus virgatus*
13.	Marappalam Major	188	4.22	25	*Dracaena terniflora, Pandanus thwaitesii*
14.	Marappalam Minor	111	2.49	20	*Dracaena terniflora, Calamus hookerianus*
	Total	4453	100.00		

Plot wise species dominance

Three plots had *Zingiber zerumbet*, *Helicteres isora* and *Schumannianthus virgatus* as the dominant species. Three plots had *Dracaena terniflora* as the main species and others had species such as *Ventilago bombaiensis*, *Pandanus thwaitesii* and *Psychotria flavida* as leading species.

COMPARISON: SHRUBS INSIDE AND OUTSIDE

Total number of species of shrubs out side was higher (91 versus 65). Density of shrubs was more or less similar inside and outside. Inside the swamp, Chakidi Chal had the maximum number of individuals. But number of shrub species was less. Inside the swamp, total number of species in plots ranged from 10 to 22. Out side the swamp, total number of shrub species in plots ranged from 12 to 30. Considering commonness of speices, no shrub was common to all plots inside the swamps. *Lagenandra ovata* was the most frequent shrub in as many as 12 plots. Three plots had *Carex* sp. and one plot each *Phrynium pubinerve* and *Barleria courtallica*. Out side the swamps, three transets had *Zingiber zerumbet*, *Helicteres isora and*, *Schumannianthus virgatus* as the dominant species. Three plots had *Dracaena terniflora* as the main species and others had species such as *Ventilago bombaiensis*, *Pandanus thwaitesii* and *Psychotria flavida* as leading species. Overall *Psychotia flavida* had a prominent position (Fig. 3.3.9 and 3.3.10).

3.3.3 REGENERATION

Density and abundance

Saplings in plots inside the swamp were enumerated. Myristica fatua var.magnifica saplings accounted for 25%, *Vateria indica* 18%, *Gymnacranthera farquhariana* 15%, *Holigarna arnottiana* 9%, *Xanthophyllum arnottianum* 7% and *Lophopetalum wightianum* 7 percent. Other trees had very little regeneration. Marappalam Minor had 12% of the total, followed by Mottal Mood (9%), Plavu Chal (8%) and Channa Mala (8%), Emponge (7%). Least number of saplings was found in Sastha Nada (Table 3.3.6 and Fig. 3.3.11).

Table 3.3.6 Density and abundance of saplings in sample plots inside the swamp

	Plot	Total	%	Species	*Dominnat species*
1.	Marappalam Minor	834	11.81	28	*Vateria indica, Holigarna arnottiana, Xanthophyllum arnottianum*
2.	Mottal Mood	604	8.55	21	*Myristica fatua var.magnifica, Gymnacranthera farquhariana, Vateria indica, Holigarna arnottiana*
3.	Plavukidanna chal	558	7.90	25	*Vateria indica, Myristica fatua var.magnifica, Lophopetalum wightianum, Gymnacranthera farquhariana*
4.	Channa Mala	544	7.70	31	*Myristica fatua var.magnifica, Gymnacranthera farquhariana, Semecarpus auriculata, Xanthophyllum arnottianum*
5.	Emponge	514	7.28	25	*Myristica fatua var.magnifica,Lophopetalum wightianum, Gymnacranthera farquhariana*
6.	Poovanathu Mood-3	487	6.89	23	*Myristica fatua var.magnifica, Lophopetalum wightianum, Gymnacranthera farquhariana, Pinanga dicksonii*
7.	Uthiran Chira	451	6.38	21	*Myristica fatua var.magnifica, Gymnacranthera farquhariana, Holigarna arnottiana, Xanthophyllum arnottianum*
8.	Perum Padappy	387	5.48	33	*Gymnacranthera farquhariana, Holigarna arnottiana, Mastixia arborea*
9.	Pillekode	377	5.34	23	*Holigarna arnottiana, Lophopetalum wightianum, Xanthophyllum arnottianum,Vateria idica*
10	Marappalam Major	354	5.01	15	*Myristica fatua var.magnifica, Holigarna arnottiana, Gymnacranthera farquhariana, Xanthophyllum arnottianum*
11	Pullu Mala	346	4.90	19	*Vateria indica, Holigarna arnottiana, Myristica fatua var.magnifica, Xanthophyllum arnottianum*
12	Neerattu Thadam2	345	4.88	9	*Hoilgarna arnottiana, Xanthophyllum arnottianum Vateria indica, Gymnacranthera farquhariana, Myristica fatua var.magnifica*
13	Muppathadi	333	4.71	15	*Myristica fatua var.magnifica, Gymnacranthera farquhariana,, Xanthophyllum arnottianum*
14	Neerattu thadam1	317	4.49	16	*Vateria indica, Gymnacranthera farquhariana, Myristica fatua var.magnifica, Xanthophyllum arnottianum*
15	Poovanthu Mood-4	315	4.46	30	*Gymnacranthera farquhariana, Holigarna arnottiana, Myristica fatua var.magnifica*
16	Chakidi Chal	238	3.37	16	*Myristica fatua var.magnifica, Holigarna arnottiana, Xanthophyllum arnottianum*
17	Sastha Nada	60	0.85	7	*Symplocose cochinchinensis, Lophopetalum wightianum, Gymnacranthera farquhariana,*
	Total	7064	100.00		

Commonness of saplings of trees

No species were found commonly in all the plots, *Gymnacranthera farquhariana* were present in 17% of the plots, *Lophopetalum wightianum* (16%), *Xanthophyllum arnottianum* 16%, *Holigarna arnottiana*, *Hydnocarpus pentandra*, *Myristica fatua var.magnifica* 15% were recorded in each plot.

3.3.4 TREES

TREES INSIDE

Periphery of the *Myristica* swamps were demarcated through compass and GPS surveys. Plots of 100x10m (0.1ha) were laid out inside the swamps for enumerating trees. A total of 19 plots were enumerated. To contrast this, 14 plots were enumerated outside the swamps. The combined tree composition inside the swamps was as follows. When indidually analyzed there would be more specific patterns. Photos of the most frequent herbs are shwn in Fig. 3.3.6, Table 3.3.7, Plot summary is shown in Appebdix 5).

Table 3.3.7 Density and abundance of trees in sample plots in side the swamp

	Plot	Total	%	Occurrence	*Dominance*
1.	Neerattu Thadam1	389	12.54	20	*Myristica fatua var.magnifica,Vateria indica,Lophopetalum wightianum,Semecarpus auriculata, Gymnacranthera farquhariana*
2.	Neerattu Thadam2	364	11.73	16	*Holigarna arnottiana,Vateria indica,Myristica fatua var.magnifica,Xanthophyllum arnottianum,Lophopetalum wightianum*
3.	Sastha Nada	241	7.77	35	*Gymnacranthera farquhariana, Lophopetalum wightianum, Macaranga peltata, Xanthophyllum arnottianum, Hydnocarpus pentandra.*
4.	Uthiran Chira	201	6.48	6	*Myristica fatua var.magnifica, Gymnacranthera farquhariana,Xanthophyllum arnottianum,Semecarpus auriculata, Mastixia arborea*
5.	Karinkurinji	179	5.77	13	*Gymnacranthera farquhariana,Myristica fatua var.magnifica, Lophopetalum wightianum,Knema attenuata, Hydnocarpus pentandra*
6.	Muppathadi	149	4.80	12	*Gymnacranthera farquhariana,Myristica fatua var.magnifica,lophopetalum wightianum,Baccaurea courtallensis, Elaeocarpus tuberculatus*
7.	Perum Padappy	149	4.80	20	*Lophopetalum wightianum, Gymnacranthera farquhariana,Myristica fatua var.magnifica, Xanthophyllum arnottianum,Mastixia arborea*
8.	Plavu Chal	149	4.80	19	*Gymnacranthera farquhariana,Myristica fatua var.magnifica,Vateria indica,Hydnocarpus pentandra,Baccaurea courtallensis*
9.	Marappalam Major	134	4.32	12	*Gymnacranthera farquhariana,Myristica fatua var.magnifica,Holigarna arnottiana,Syzygium travancoricum,Lophopetalum wightianum*
10.	Mottal Mood	131	4.22	12	*Myristica fatua var.magnifica, Gymnacranthera farquhariana,Vateria indica,Lophopetalum wightianum,Knema attenuata*
11.	Poovanathu Mood-0	131	4.22	9	*Gymnacranthera farquhariana,Myristica fatua var.magnifica,Lophopetalum wightianum,Holigarna arnottiana*
12.	Poovanathu Mood-3	129	4.16	8	*Myristica fatua var.magnifica, Gymnacranthera farquhariana,Lophopetalum wightianum,Holigarna arnottiana,Mastixia arborea*
13.	Channa Mala	128	4.13	13	*Gymnacranthera farquhariana, Myristica fatua var.magnifica,Xanthophyllum arnottianum,Lophopetalum wightianum*
14.	Poovanathu Mood-4	119	3.83	16	*Gymnacranthera farquhariana,Myristica fatua var.magnifica,Lophopetalum wightianum,Holigarna arnottiana,Xanthophyllum arnottianum*
15.	Marappalam Minor	110	3.54	23	*Vateria indica, Gymnacranthera farquhariana, Lophopetalum wightianum, Xanthophyllum arnottianum, Myristica fatua var.magnifica.*
16.	Pillekode	110	3.54	19	*Gymnacranthera farquhariana,Vateria indica,Lophopetalum wightianum,Holigarna arnottiana, Baccaurea courtallensis*
17.	Empong	109	3.51	18	*Myristica fatua var.magnifica,Lophopetalum wightianum, Gymnacranthera farquhariana,Holigarna arnottiana*
18.	Pullu Mala	92	2.96	15	*Vateria indica,Myristica fatua var.magnifica,Holigarna arnottiana, Gymnacranthera farquhariana,Lophopetalum wightianum*
19.	Chakidi Chal	89	2.87	16	*Myristica fatua var.magnifica, Gymnacranthera farquhariana, Holigarna arnottiana, Hydnocarpus pentandra,*
	Total	3103	100.00		

Density and abundance

There were 3103 trees in the plots. There were a total of 75 species of trees. Among the plots, total number of trees ranged from 89 to 389. The maximum was in Neerattu Thadam and minimum in Chakidi Chal. A total of 75 tree species were recorded from the plots.

Total composition, species wise

Myristica fatua var. *magnifica* and *Gymnacranthera farquhariana* constituted about 25.5% and 21.5% of trees respectively. Both these species belong to Myristicacea family. The former was found in inundated areas and the latter in less water logged areas. This was followed by *Vateria indica*, *Holigarna arnottiana* and *Lophopetalum wightianum* (6-10%). These were followed by *Helicteres isora* (3.72%), *Xanthophyllum arnottianum* (2.41%), *Aporosa cardiosperma* (2.13%) and *Hydnocarpus pentandra* (1.99%). There were about 85 other species of trees, of which three species belonged to Myristicaceae family. They were *Myristica malabarica*, *Knema attenuate* and *Myristica beddomei*.

Species occurrence in plots

The number of tree species in plots ranged from 6 to 35. Maximum was in Sastha Nada and minimum in Uthiran Chira.

Plot wise species dominance

Out of the 19 sample plots, *Gymnacranthera farquhariana* was dominant in 9 plots*. Myristica fatua var. magnifica* was second place in six of these swamps. Out of the 19 swamps, *Myristica fatua var. magnifica* was the dominant tree in 6 swamps. In four plots *Gymnacranthera farquhariana* occupied the top position. In the remaining plots, *Vateria indica* was the dominant tree in one plot, *Holigarna arnottiana in* one plot and *Lophopetalum whightianum* in another plot. Details are shown in Fig 3.3.13. Presence of tree species across the 19 plots inside show that *Gymnacranthera farquhariana* were present in all the plots, *Myristica fatua var.magnifica* in 18 plots, *Holigarna arnottiana* in 18 plots, *Lophopetalum wightianum* in 17 plots and *Vateria indica* was found in 11 plots.

TREES OUT SIDE

A total of 14 plots were laid out side the swamps. Total of 1229 individual trees were recorded from these plots. A total of 90 tree species were recorded from the plots. Details are given in Tabel 3.3.8 and Fig. 3.3. 14. (suggestion: rewrite)

Density and abundance

The number of trees in the plots ranged from 35 to 154. The maximum was in Karinkurinji and minimum in Uthiran chira.

Table 3.3.8 Density and abundance of trees in sample plots outside the swamp

	Plot	Total	%	No Species	Dominence
1.	Karinkurinji	154	12.53	15	Helecteres isora,Cinnamomum malabatrum, Leea indica, Tabernaemontana alternifolia, Macaranga peltata
2.	Chakidi Chal	140	11.39	25	Aporosa cardiosperma, Terminalia elliptica, Olea dioica, Macaranga peltata, Actinodaphne malabarica
3.	Poovanathu Mood 3	113	9.19	27	Xanthophyllum arnottianum, Baccaurea courtallensis,Erythroxylon lanceolata,Syzygium mundagam, Strombosia ceylanica
4.	Channa Mala	95	7.73	34	Tabernaemontana heyneana, Aporosa cardiosperma, Actinodaphne malabarica, Xanthophyllum arnottainum
5.	Sastha Nada	93	7.57	21	Macaranga peltata, Tabernaemontana alternifolia,, Helecteres isora, Aporosa cardiosperma, Actinodaphne malabarica
6.	Emponge	88	7.16	34	Xanthophyllum arnottinaum, Knema attenuata, Diospyros paniculata
7.	Perum Padappy	87	7.08	38	Cinnamomum malabatrum, Xanthophyllum arnottinaum, Baccaurea courtallensis, Ixora brachiata, Aporosa cardiosperma
8.	Marappalam Major	86	7.00	34	Strombosia ceylanica, Diospyros paniculata, Baccaurea courtallensis, Xanthophyllum arnottinaum, Knema attenuata
9.	Marappalam Minor	80	6.51	34	Xanthophyllum arnottinaum, Baccaurea courtallensis,Vateria indica, Strombosia ceylanica, Knema attenuata
10.	Plavu Chal	72	5.86	21	Ixora brachiata., Xanthophyllum arnottinaum, Aporosa cardiosperma, Strombosia ceylanica
11.	Mottal Mood	70	5.70	26	Xanthophyllum arnottinum,Macaranga peltata, Baccaurea courtallensis, Strombosia ceylanica, Aporosa cardiosperma
12.	Muppathadi	62	5.04	18	Strombosia ceylanica, Ixora brachiata , Xanthophyllum arnottinaum
13.	Pullu Mala	54	4.39	18	Ixora brachiata, Aporosa cardiosperma, Cinnamomum malabatrum
14.	Uthiran Chira	35	2.85	18	Helecteres isora, Olea dioica, Leea indica, Lagerstroemia spieciosa, Baccaurea courtallensis
	Total	1229	100.00		

Species occurrence in plots

The number of tree species in the plots ranged from 15 to 38. The maximum was in Perum Padappy and minimum was in Karinkurinji.

Plot wise species dominance

Four plots had *Xanthophyllum arnottianum* as the dominant species. Two plots each had dominance of *Strombosia ceylan*ica, *Helecteres isora*, and *Ixora brachiata*. Three plots had other dominant trees.

COMPARISON OF TREES INSIDE AND OUTSIDE

There were a total of 75 species of trees inside the swamps. Out side, this number was 90. Inside the swamps, there were a total 3103 individual trees in 19 plots. Maximum in one plot was 389 individuals. Out side the swamps, the number of trees were only about half of this. Maximum in one plot was 154 individauls. Maximum number of species in one plot was 35 species inside, out side it was 38 species. Inside the swamps, *Gymnacranthera farquhariana* was common to all the plots. *Myristica fatua var. magnifica* and *Holigarna arnottiana* was present in 18 plots. *Lophopetalum wightianum* was present in 17 plots. Out side the swamps, no tree was present commonly in all plots. *Ixora brachiata* and *Xanthophyllum arnottianum* were found in 9 plots. Presence of *Knema attenuata*, *Myristica malabarica*, *Baccaurea courtallensis*, *Leea indica* are remarkable as they are found in the periphery of swamps. With regard to dominant trees inside the swamps, *Gymnacranthera farquhariana* was dominant in 9 plots. *Myristica*

fatua var. magnifica was second place in six of these swamps. *Myristica fatua var. magnifica* was the dominant tree in 6 swamps. In four plots *Gymnacranthera farquhariana* occupied the top position. In the remaining plots, *Vateria indica* was the dominant tree in two plots, *Holigarna arnottiana* in one plot and *Lophopetalum wightianum* in one plot. Out side the swamps; four plots had *Xanthophyllum arnottianum* as the dominant species. Two plots each had dominance of *Strombosia ceylanica*, *Helecteres isora***,** and *Ixora brachiata.* Three plots had other dominant trees.

Table 3.3.9 Comparison of Shanon index for trees, herbs, shrubs and saplings inside swamp.

No.	Plot	Trees	Herbs	Shrubs	Sapling
1)	Chakidi Chal	1.8201	0.9073	1.3713	1.9693
2)	Channa Mala	1.3953	1.0149	1.0653	1.7925
3)	Emponge	2.0221	1.1611	2.2864	2.2064
4)	Karinkurinji	1.7293	0.3501	0.5050	
5)	Marappalam Major	1.1970	0.3957	0.8010	1.3594
6)	Marappalam Minor	2.5299	1.5400	1.8442	1.7644
7)	Mottal Mood	1.5943	0.6072	1.1562	1.8746
8)	Muppathadi	1.1496	1.2606	1.6609	1.6231
9)	Neerattu Thadam	1.3732	0.1169	2.3054	1.8284
10)	Neerattu Thadam	1.2659	0.0000	1.8525	1.4786
11)	Perum Padappy	2.1677	1.1934	1.1062	2.6598
12)	Pillekode	1.9606	1.6900	2.2024	2.5059
13)	Plavu Chal	1.9093	1.2602	1.6531	1.9529
14)	Poovanathu Mood-0	1.1667	1.7448	2.1340	
15)	Poovanathu Mood-3	1.1125	1.4153	2.0230	1.8805
16)	Poovanathu Mood-4	1.6169	0.5780	1.6628	2.2827
17)	Pullu Mala	1.8487	1.3123	1.4333	1.8457
18)	Sastha Nada	2.6616	1.5678	2.2982	1.0360
19)	Uthiran Chira	0.8283	0.0000	2.0932	1.7176

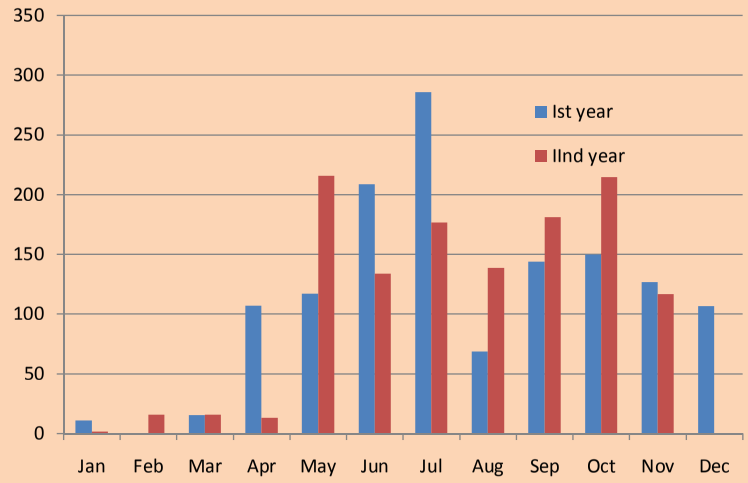


Fig. 33.0 Rain fall in Kulathu Puzha

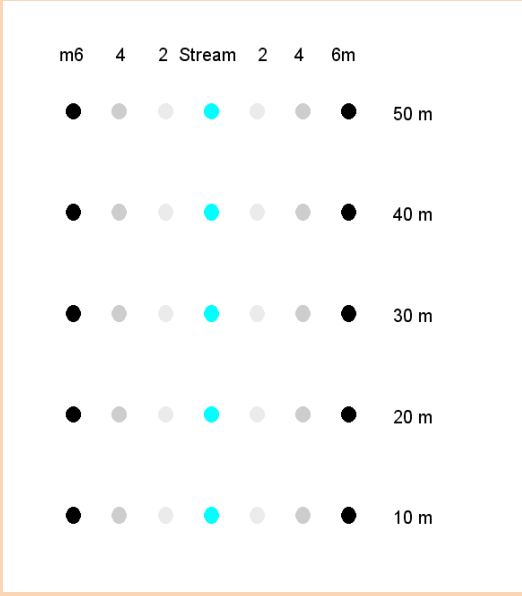


Fig. 33.0 Design for water level data recording

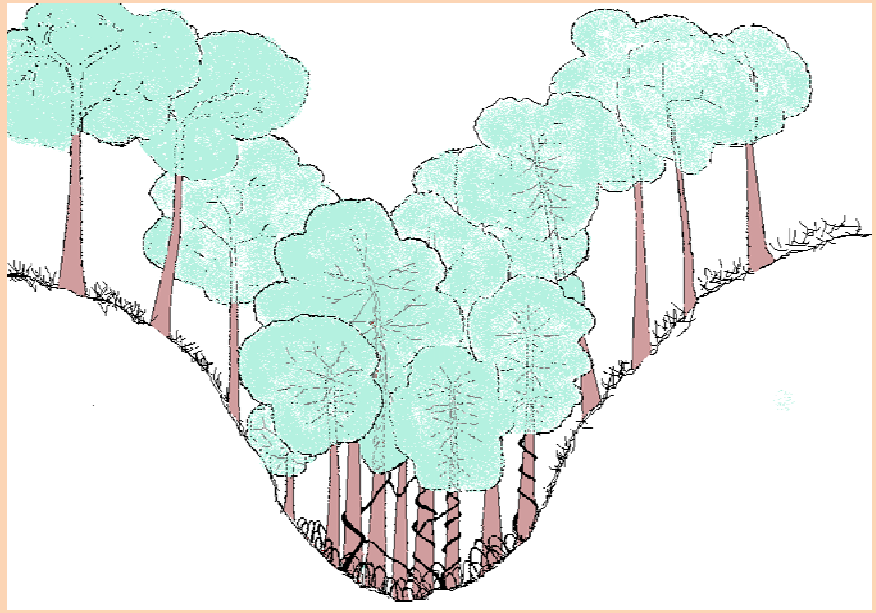


Fig. 33.0 Swamp profile in narrow valley

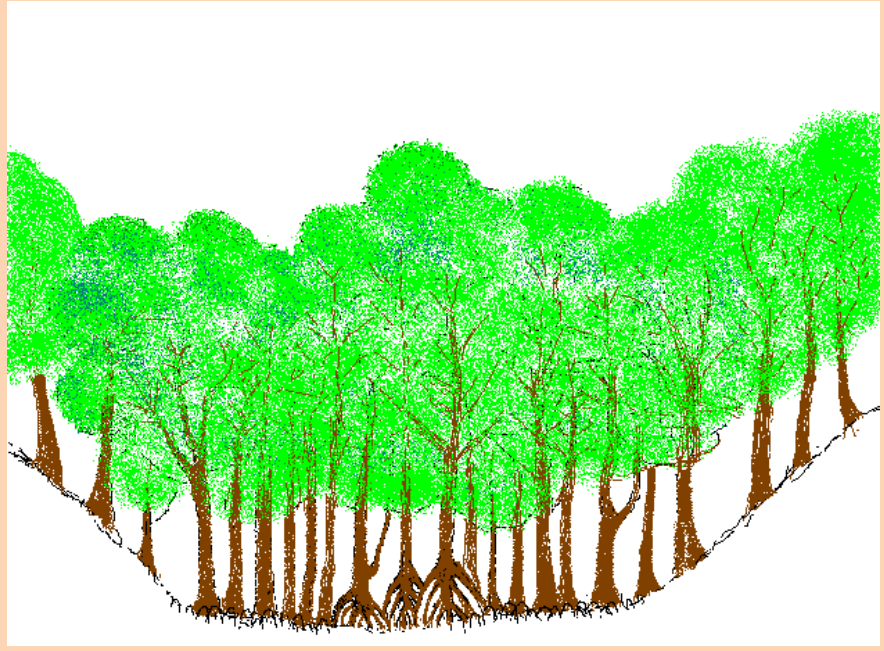
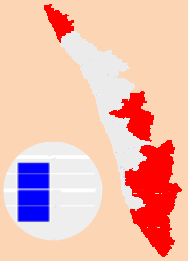
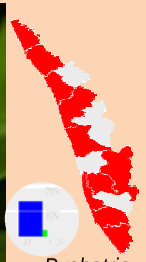


Fig. 33.0 Swamp profile in flat valley



Legenandra ovata

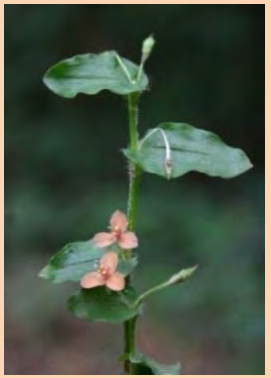


Pychotria flavida

Cyanotis sp.

Pollia secundiflora

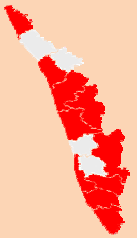
Dictiospermum montanum

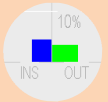


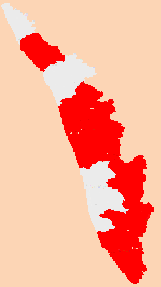
Murdannia pauciflora

Carex sp.

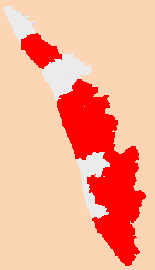
Zingiber zerumbent





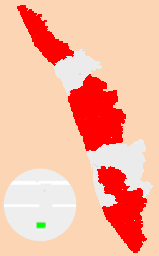


Barleria courtallica



Anaphyllum wightii

Globba ophiogloba

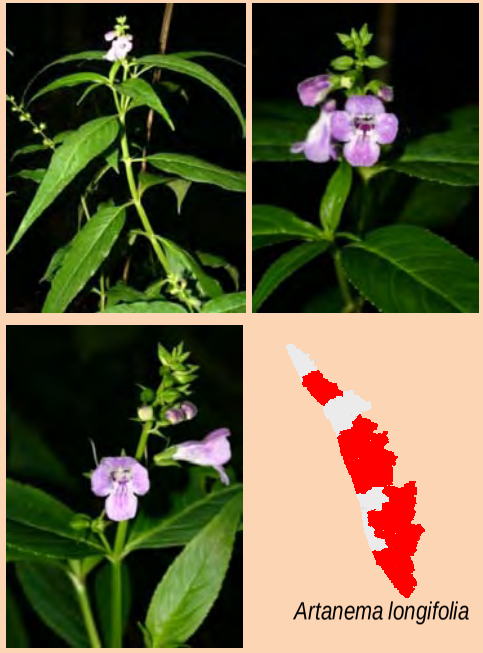


Alpinia malaccensis

Fig. 3.3.1a Major herbs

Curculigo trichocarpa

Costus speciosus



Artanema longifolia

Schumannianthus virgatus

Neurocalyx calycinus

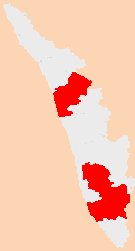
Sonerila rheedi

Thottia silicosa

Osbekia muralis

Fig. 3.3.1b Major herbs



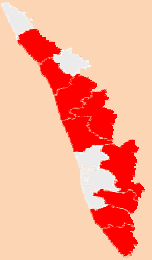



Phrynium pubinerve

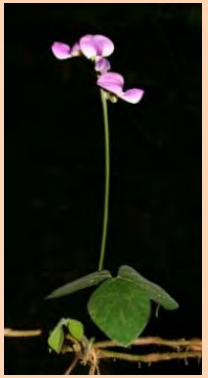
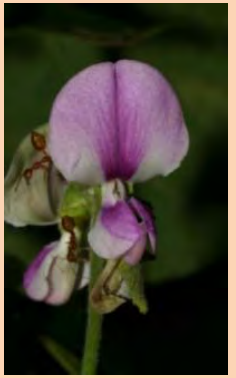
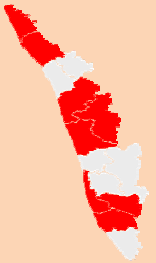



Pellionia heyneana





Desmodium motorium

Calopogonium mucunoides



Grass




Weeds: Mimosa diplotricha, Lantana camara, Mikania micrantha, Chromolena odoratum

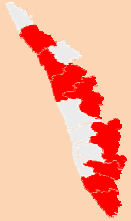


Trichopus zeylanicus

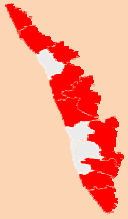


Leptaspis urceolata

Fig. 3.3.1c Major herbs



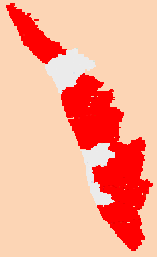
Flemingia macrophylla



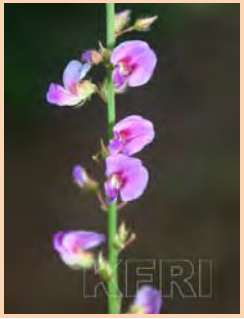
Desmodium triangulare

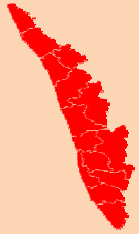
Stenochlaena palustris

Christella parasitica

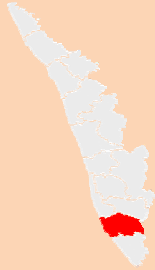


Draceana terniflora





Desmodium triquetrum



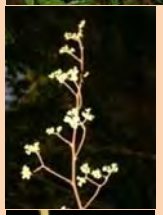
Desmodium heterocarpon

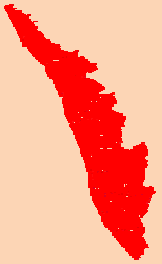
Aphyllorchis montana

Selaginella brachystachya

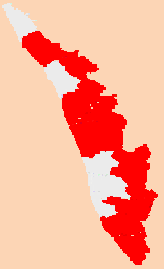
Selaginella vaginalis

Fig. 3.3.1d Major herbs

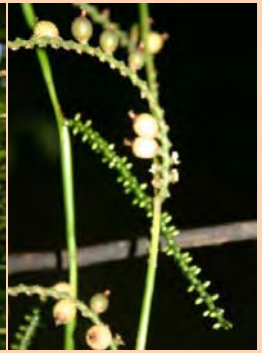


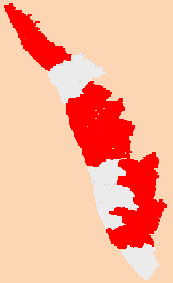


Zyzyphus rugosa

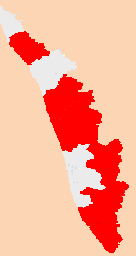


Calamus thwaitesii





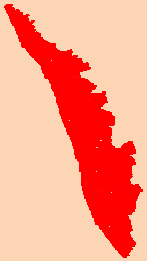
Calamus hookerianus

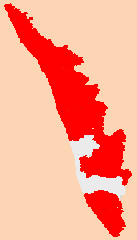


Clausena austroindica

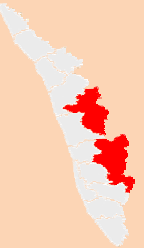
Ochlandra travancorica

Melastoma malabathricum



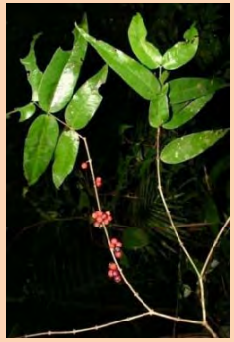


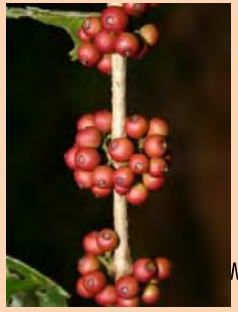
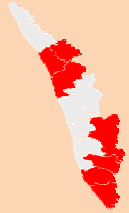
Gomphandra tetrandra



Cayratia pedata

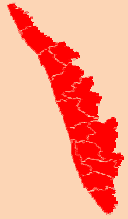
Fig. 33.6a Major shrubs and climbers



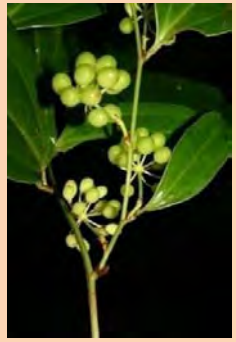
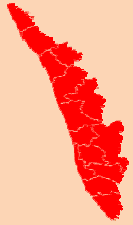



Memecylon randerianum

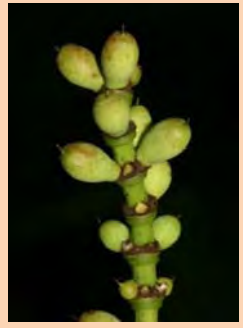


Helicteres isora

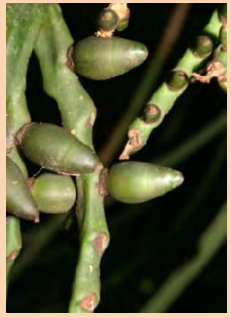
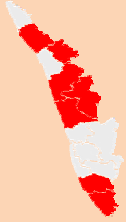




Smilax zeylanica

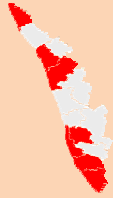



Gnetum edule

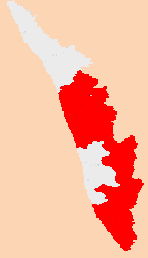


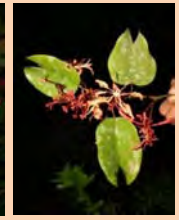
Pinanga dicksonii

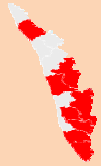



Pandanus furcatus

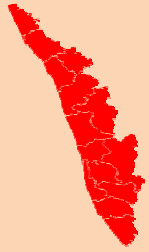
Pandanus thwaitesii



Bauhinia phoenicea

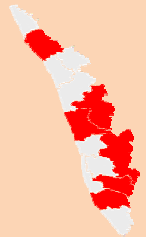




Myxopyrum smilacifolium

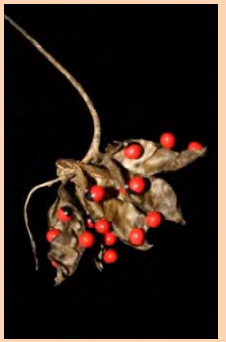
Fig. 33.6b Major shrubs and climbers

Acacia torta

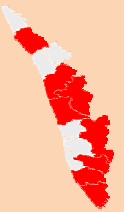


Ventilago bombaiensis

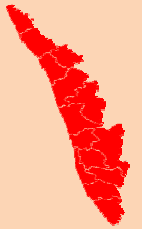
Abrus pulchellus



Chilocarpus denudatus



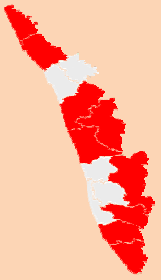
Piper nigrum



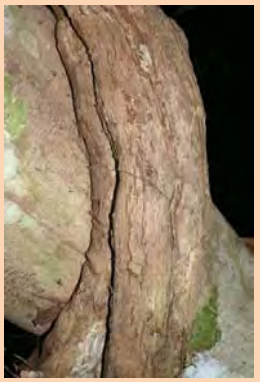
Piper mullesua

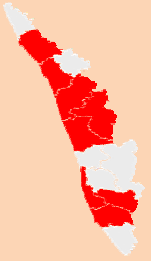
Connarus sp

Kunstelaria keralensis

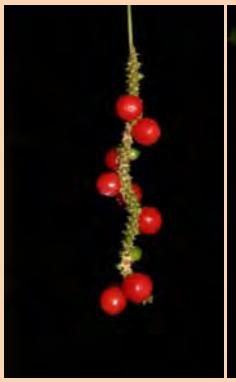


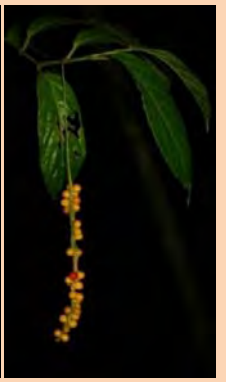
Entada rheedei

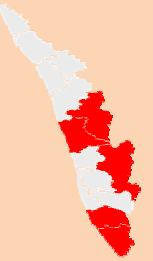




Combretum latifolium

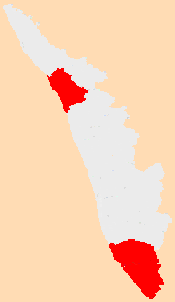






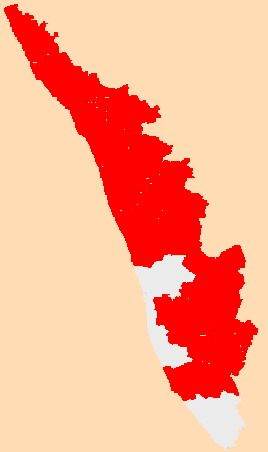
Piper barberi

Fig. 33.6c Major shrubs and climbers

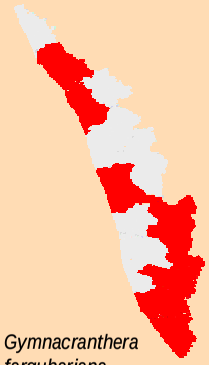


Myristica fatua var. magnifica

Fig. 3.3.13a Major trees

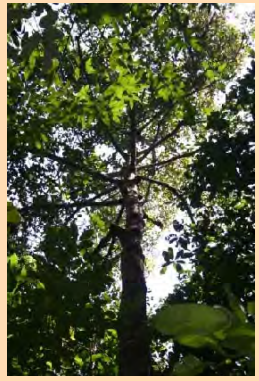


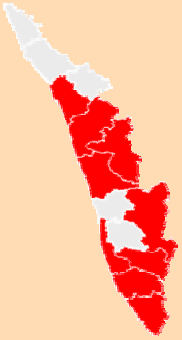
Knema attenuata



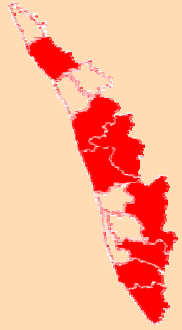
Gymnacranthera farquhariana

Gymnacranthera farquhariana





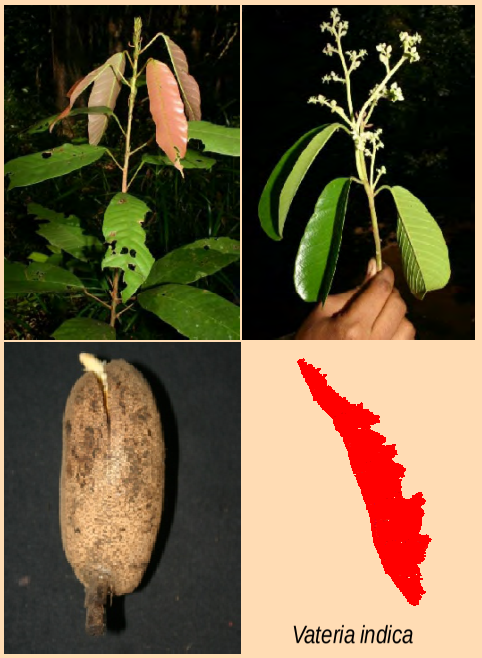
Myristica malabarica



Myristica beddomei

Fig. 3.3.13b Major trees

Vitex altisima



Vateria indica

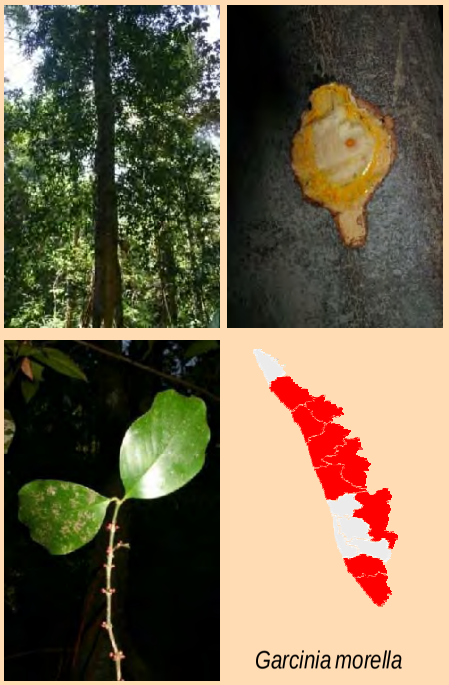
Xanthophyllum arnotianum

Ixora brachiata

Artocarpus hisutus

Neolamarckia cadamba

Cinnamomum malabatrum



Garcinia morella

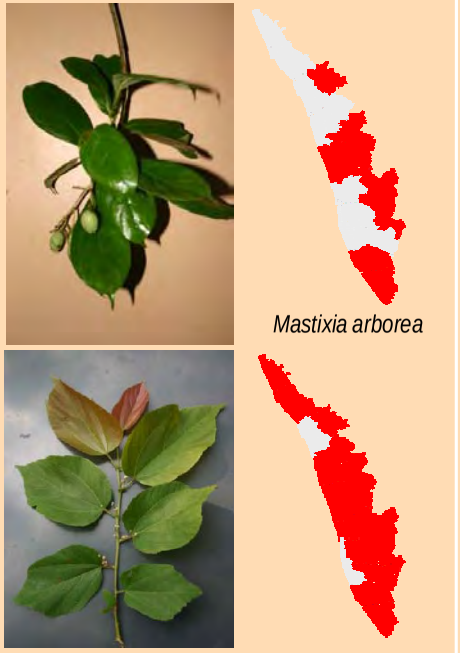
Fig. 3.3.13c Major trees

Beccaurea courtallensis

Elaeocarpus tuberculatus

Elaeocarpus glandulosus

Dipterocarpus indicus



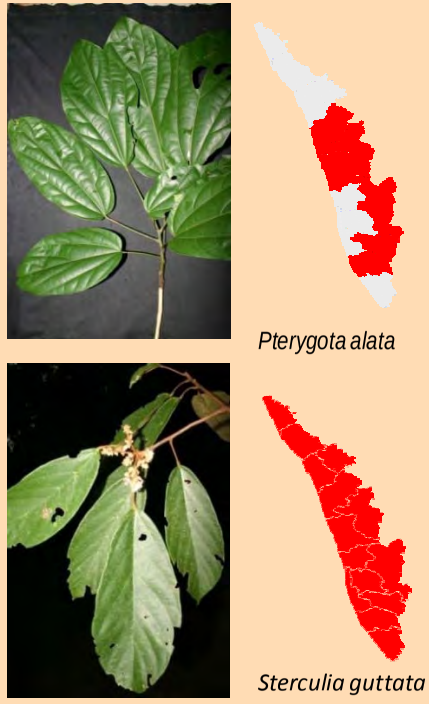
Mastixia arborea

Grewia tiliifolia

Fig. 3.3.13d Major trees

Syzygium mundagam

Mesua ferrea



Pterygota alata

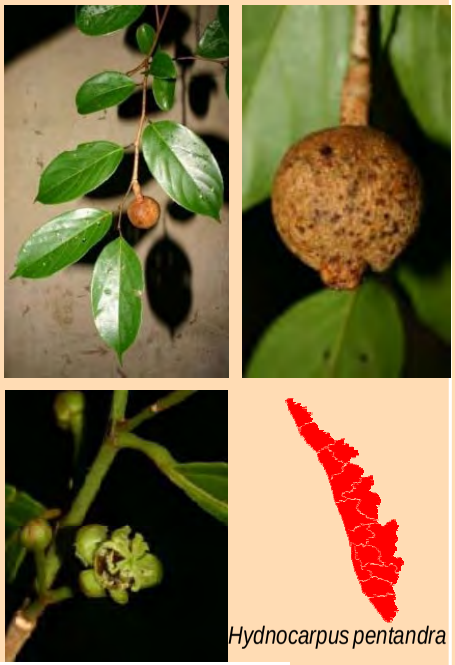
Sterculia guttata

Hopea parviflora

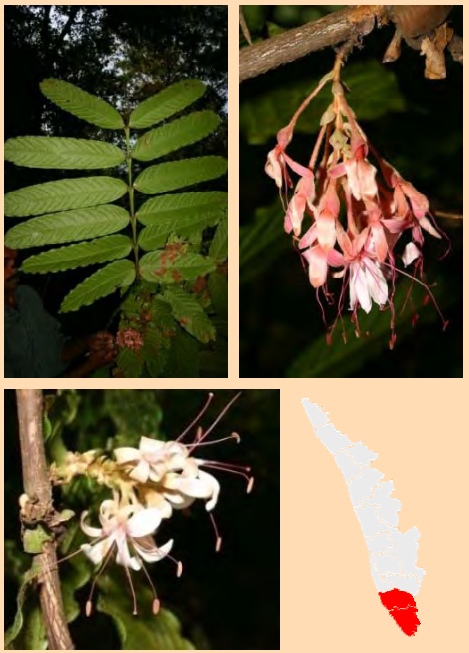
Holigarna arnottiana

Aporosa cardopsperma

Flacourtia montana



Hydnocarpus pentandra

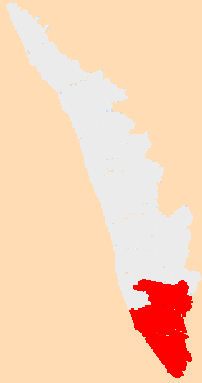


Humboldtia decurrens

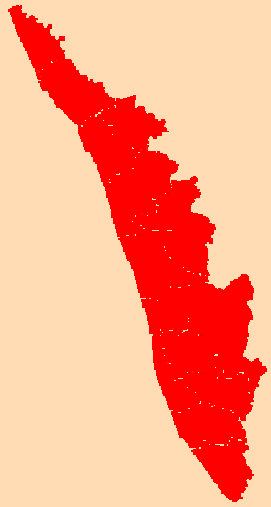
Leea indica

Semecarpus auriculata

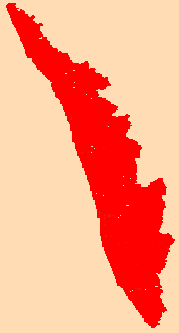
Fig. 3.3.13e Major trees



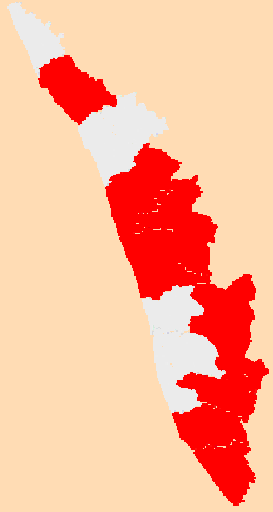
Litsea travancorica



Fagraea ceilanica

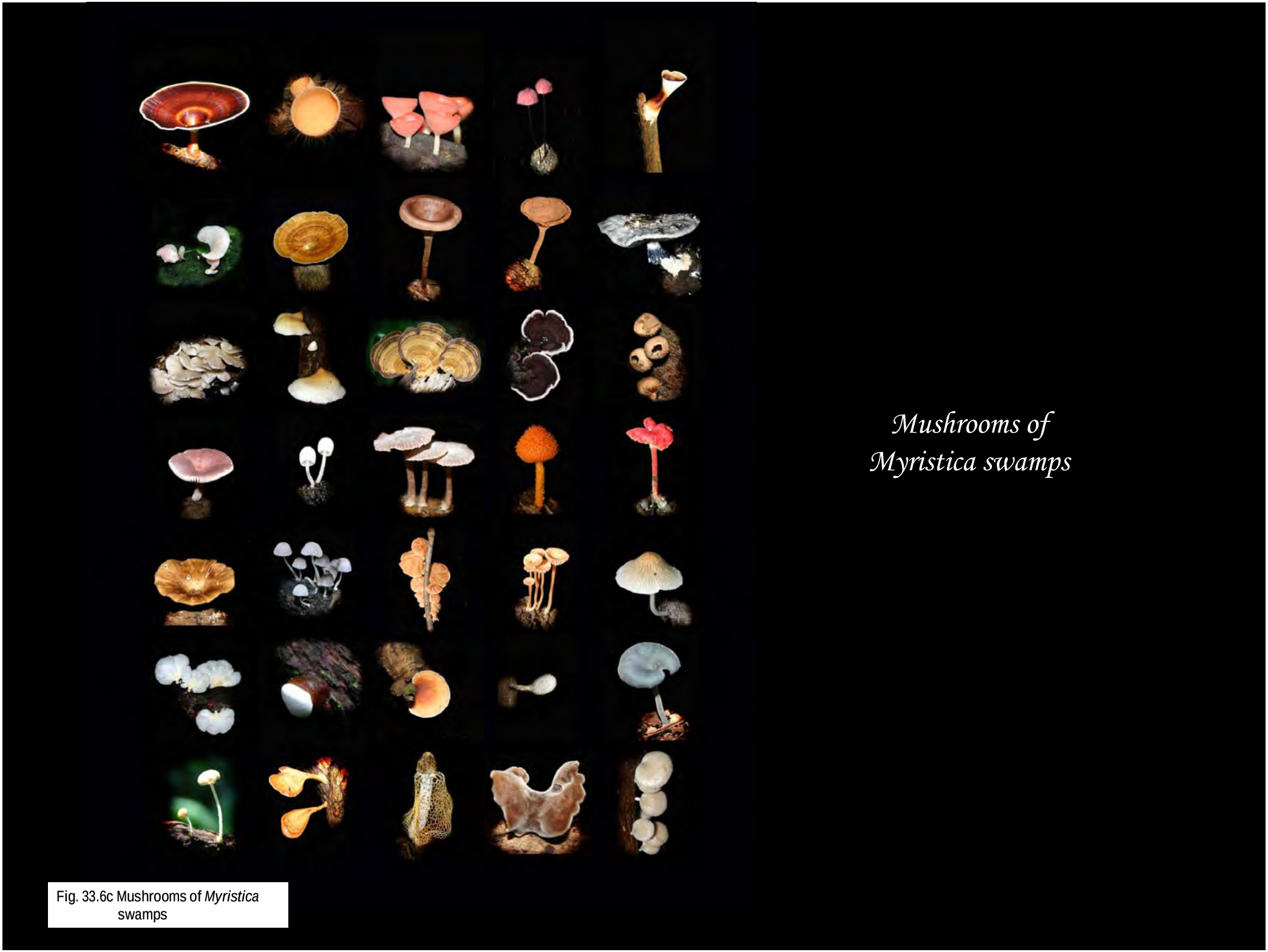


Lagerstroemia speciosa



Scolopia crenata

Fig. 3.3.13f Major trees



Mushrooms of Myristica swamps

Fig. 33.6c Mushrooms of *Myristica* swamps

3.4 ANIMALS

The *Myristica* swamps are famed for its charismatic and archaic vegetation but studies documenting the animal wealth of these swamps are almost nonexistent. The present study highlights the enormous animal diversity housed in these swamps, much of which is yet to be inventoried completely. The swamps and its immediate surrounding forests have a number of wild fruit bearing trees such as *Garcinia, Myristica, Syzygium, Holigarna*, members of Lauraceae, Meliaceae, Myrtaceae, etc., which provide food for many wild mammals and birds. High humidity, moderate temperature, stable micro climatic conditions and a variety of microhabitats supports diversity and abundance of fauna. The swamps have 23 % butterflies, 11% spiders, 8.4 % fishes, more than 50 % amphibians, more than 20 % reptiles, 26.6% birds, 6.6 % mammal species of Kerala. (Table 3.4.1).This data is significant because the *Myristica* swamps in Kerala hardly make up 0.004% of the total land area of Kerala (38,864 km^2) and 0.014% of the total forest area of Kerala (11,126.46km^2). The presence of diverse carnivores, reptiles, amphibians, odonates and spiders, indicates the complexity of the food webs supported by the area.

The main animal groups covered in detail during the study were butterflies, odonates, arachnids, fishes, amphibians, reptiles, birds and mammals. In addition to this, other vertebrate groups such as annelids, crabs, insects, mollusks were also looked into but due to lack of time and expertise these were not studied in detail. The large number and diversity of predators like crabs, odonates, arachnids, frogs, reptiles, some birds and mammals indicate the richness and complexity of the food webs in the swamps.

For each major group of animal, species accumulation curve for two years, species diversity over months and composition over taxonomic groups are provided. In case of large groups, summary tables are given, species level list is provided in the appendix.

3.4.1 Animal Diversity

Invertebrate diversity in *Myristica* swamps can be summarized as Platyhelminthes - (Bipalium, tapeworm) 3 species, Nemathelminthes – 1 species, Annelida - (2 Oligochaeta and Hirudinea) 4 species, Mollusca- 10 species, Crustacea-1 species, Insecta- 281 documented species, Myriapoda- 6 species and Arachnidae 54 species.

Table 3.4.1: Summary of vertebrate diversity in *Myristica* swamps

Class	Order	Family	Genus	Species	% of Kerala
Picses	5	7	11	14	8.4
Amphibia	2	5	15	56	>50
Reptilia	2	13	38	55	>20
Aves	14	37	94	129	26.6
Mammalia	6	16	24	27	6.6

Annelids

Phylum Annelida comprised of two groups Leeches (Hirudinea) and earthworms (Oligochaeta) with two species each. Though diversity was less in this phylum, abundance was high. All the swamps had earthworm castings though relatively less in Anchal. Leeches were all together absent from Anchal range which may be an indication of the desiccation in that area. Leeches were absent in the drier swamps of Kulathupuzha and Shendurney during the dry months but reappeared during the wet months. The presence/ absence of leeches in swamps were positively correlated with the increase in humidity, increase in litter and canopy cover and increase in inundation period. The larger earthworm was prey to boar and uropeltids.

Arthropods

The phylum Arthropoda was dominant in the invertebrates of the swamps. Four classes Crustacea, Insecta, Myriapoda and Arachnida were documented. In class Crustacea, the order Decapoda consisted of three crab species. One of the species could be identified as *Travancoriana schirgere* (Kara njand). The other crabs are locally known as Kuva njand and Para njand. Though the crabs are quite small in size, all the three crabs are used as food by the Kani tribals of the area. A pair of Para njand, the largest of the three, was also observed tearing up and feeding on a live *Rana temporalis* (Fig. 3.4.0). It has been believed that crabs are 'carrion eaters' and detrivores. But there have been reports of land crabs eating an omnivore's diet and even hunting for small fish. Either way it can be assumed that the large number of crabs in *Myristica* swamps plays diverse roles in energy and

nutrient recycling processes. The large number of crab holes may also alter the soil properties and micro - hydrology of the swamps.

Insects

In the class Insecta, 14 orders namely Odonata, Dermaptera, Dictyoptera, Hemiptera, Isoptera, Orthoptera, Phasmida, Coleoptera, Diptera, Hymenoptera, Neuroptera, Ephemeroptera, Embioptera and Lepidoptera were identified. A total of 433 species were sighted out of which 281 could be photographed. Of these two orders, Odonata and butterflies from order Lepidoptera were identified till species level, the details of which are given in Table 3.4.2, 3.4.3 and Appendix III. Three species of honey bees *Apis dorsata*, *Apis indica* and *Trigona* sps. have been identified from the swamps. Honey is a major MFP for both tribal and non tribal inhabitants near the forest.

Odonates

There are about 6,000 species of Odonates (Dragonflies (Anisoptera) and damselflies (Zygoptera)) all over the world and about 500 known species of odonates in India. This group of insects is of evolutionary significance as it was amongst the first insects to develop wings and the first of these appeared about 250 million years ago. Odonates are also ecologically significant as the adult and larvae dragonflies are predators and feed on mosquitoes, midges, butterflies, moths, bees and other Odonates. Odonates are in turn eaten by birds and mammals. Other than their role in the food web, odonates are being recognized as indicators of quality of the biotope. The hill streams species are usually habitat specialists in relation to pool breeders. Also odonates found in undisturbed forest wet lands tend to be specialists when compared to their counter parts in industrial or urban lands. Studies have also shown that odonates are sensitive not only to the quality of the wetland but also to the major landscape changes, especially changes in the riparian zone. Long term conservation of odonates can only be addressed through freshwater biodiversity conservation programmes.

About 67 species of odonates are endemic to peninsular India, most of which prefer the riparian ecosystem. During this study, data for Odonates was not collected quantitatively. Eighteen species from 16 genera belonging to 7 Families were recorded. The *Myristica* Bambootail, a damselfly of the Western Ghats believed to be restricted to *Myristica* swamps, was also recorded during the study. Figure 3.4.1 gives the Species accumulation curve, Species diversity of odonates in *Myristica* swamps over Months and Diversity within odonate groups in *Myristica* swamp forests, respectively. The list of odonates from the *Myristica* Swamps is given in Table 3.4.2. The species accumulation curve plotted for number of species / time unit indicates that there are more species to be recorded from the swamps. The

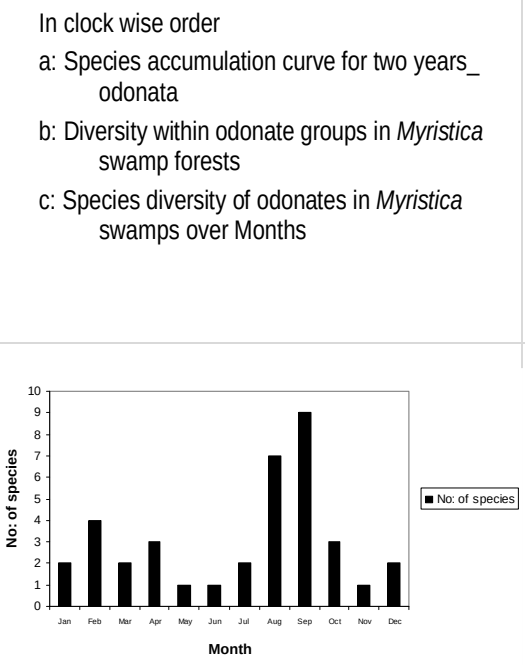
months of August and September recorded the highest species diversity. Damselflies showed higher diversity than dragonflies with 10 species in 6 families compared to 10 species of dragon flies in one family.

In clock wise order

a: Species accumulation curve for two years_ odonata

b: Diversity within odonate groups in *Myristica* swamp forests

c: Species diversity of odonates in *Myristica* swamps over Months



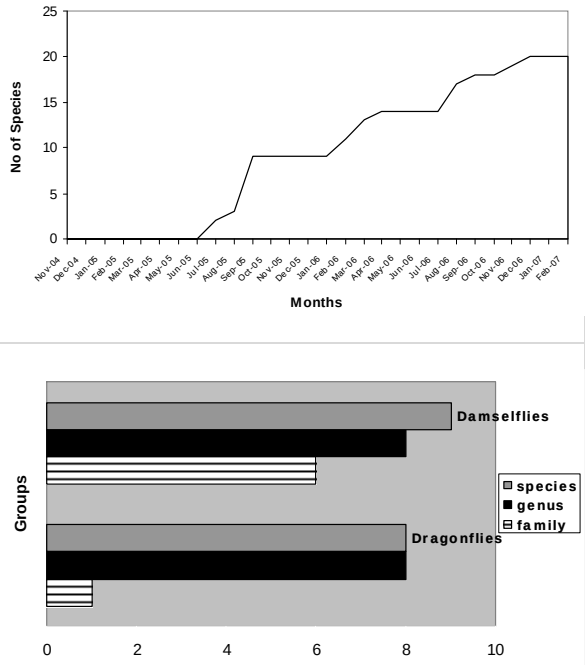


Figure 3.4.1 Odonates of *Myristica* swamps-species accumulation curve, diversity across months and groups.

Table 3.4.2. List of Odonates in *Myristica* swamps of Southern Kerala

Sub Order Dragonflies Anisoptera Family Libellulidae

Family	Common Name	Binomial
Libellulidae	Ditch Jewel	*Brachythemis contaminata* (Fabr.,1793)
Libellulidae	Emerald-banded Skimmer	*Cratilla lineata* Foerster,1903
Libellulidae	Ground Skimmer	*Diplacodes trivialis* (Rambur,1842)
Libellulidae	Fulvous Forest Skimmer	*Neurothemis fulvia* (Drury,1773)
Libellulidae	Pied Paddy Skimmer	*Neurothemis tullia* (Drury,1773)
Libellulidae	Crimson-tailed Marsh Hawk	*Orthetrum pruinosum* (Rambur,1842)
Libellulidae	Coral-tailed Cloud Wing	*Tholymis tillarga* (Fabr.,1798)
Libellulidae	Crimson Marsh Glider	*Trithemis aurora* (Burmeister,1839)

Sub Order Damselflies Zygoptera

Family	Common Name	Binomial
Chlorocyphidae	Stream Ruby	*Rhinocypha bisignata* (Selys,1853)
	River Heliodor	*Libellago lineata* (Fraser,1928)
Protoneuridae	*Myristica* Bambootail	*Phylloneura westermanni* Selys,1860
	Nilgiri Bambootail	*Esme longistyla* Fraser,1931
Lestidae	Emerald Spreadwing	*Lestes elatus* Hagen in Selys,1862
Euphaeidae	Malabar Torrent Dart	*Euphaea fraseri* (Laidlaw,1920)
Caloptergidae	Clear-winged Forest Glory	*Vestalis gracilis* (Rambur,1842)
	Black-tipped Forest Glory	*Vestalis apicalis* Selys,1873
Platystictidae	Pied Reedtail	*Protosticta gravelyi* Laidlaw,1915
		unidentified

Butterflies

Butterflies in the Western Ghats belong to five families, 166 genera and 330 species. Of these, 37 species are endemic. These 330 species of butterflies depend on over 1000 of species of plants for feeding and breeding. Diversity of butterflies in the Western Ghats is thus related not only to adult feeding habitats, but also to larval food plants. Comparative studies on butterflies using selectively logged and unlogged forests in Kalakkad-Mundanthurai Tiger Reserve has suggested that butterfly diversity tends to increase in selectively logged habitats. However, it has been pointed out that this increase is due to the invasion by ubiquitous species at the expense of habitat specialists such as *Idea malabarica*.

The butterflies recorded during the study were found to visit both swamp and non-swamp areas, that is no species was found to be specific to the swamp. But some indicators of healthy evergreen forest such as *Idea malabarica* was recorded from the swamp. Butterflies are important as pollinators; this becomes especially important as many species of trees in the swamps depend on insect pollination. Some butterflies were specific to the canopy while others preferred the shrubs and herbs in the swamp periphery. They are an important part of food web as they are prey to some insects, spiders, birds and mammals. The butterflies were not quantitatively recorded during this study. We recorded 81 species of butterflies from the swamps. This comes to 25% of butterflies found in Kerala state. The species accumulation curve has almost flattened indicating that almost all the species have been recorded. All the five butterfly families of the Western Ghats have been represented.

Figure 3.4.3 gives the species accumulation curve, species diversity of butterflies in *Myristica* swamps over months and diversity within butterfly families in *Myristica* swamp forests, respectively. The summarised list of butterflies from the *Myristica* swamps is given in table 3.4.3 and detailed list in Appendix III. Among the butterflies, species such as *Idea malabarica* (Malabar tree nymph, found only in evergreen forest), *Triodes minos* (Southern Bird Wing, largest wing span in India) and *Papilio polymnestor* (Blue Mormon, second largest wing span in India) are of interest. The species richness showed variation over the months with the least numbers being observed during the wet months of June, July and August.

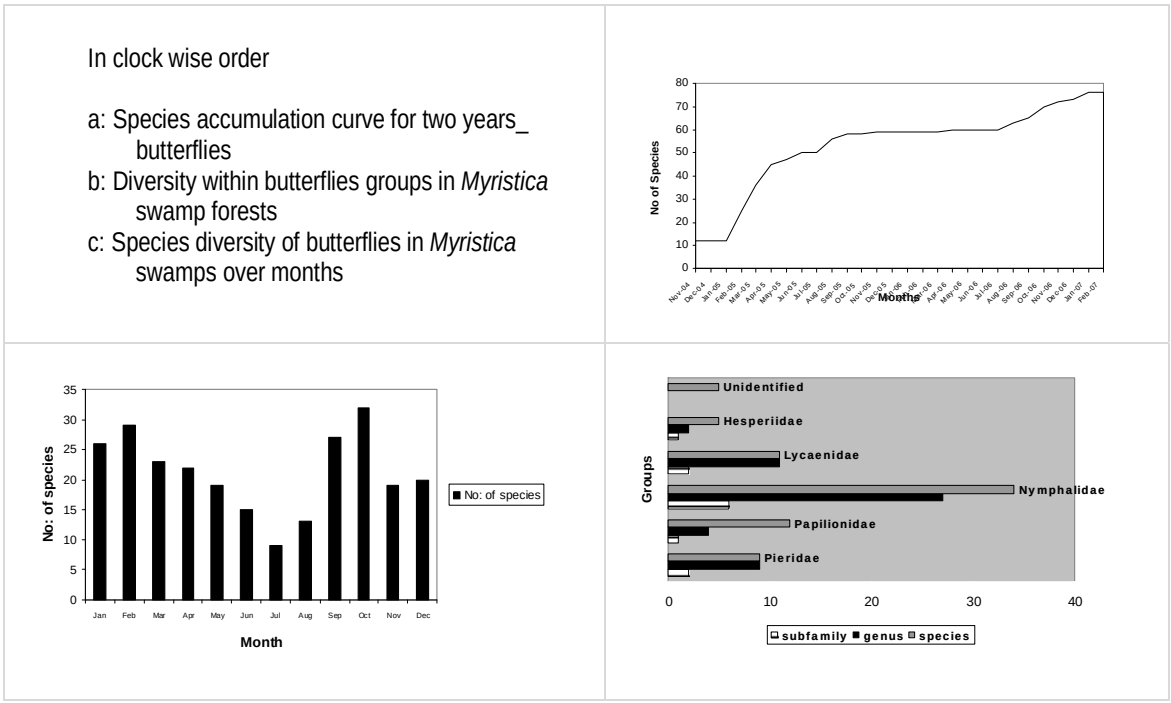


Fig. 3.4.3 Butterflies of *Myristica* swamps-species accumulation curve, diversity across months and groups.

Table 3.4.3. List of Butterflies in *Myristica* swamps of Southern Kerala

No	Family	Species
1.	Pieridae	10
2.	Papilionidae	12
3.	Nymphalidae	35
4.	Lycaenidae	11
5.	Hesperiidae	6
6.	Unidentified	7
Total	5	81

Other insects

As all the insect groups could not be identified upto species level due to expertise and time constraints present, the photographed insects were classified as follows.

Table 3.4.4. List of Insects in *Myristica* swamps of Southern Kerala

No	Order	Species
1.	Coleoptera	11
2.	Embioptera	2
3.	Dermaptera	1
4.	Dictyoptera	9
5.	Diptera	25
6.	Ephemeroptera	1
7.	Hemiptera	25

No	Order	Species
8.	Hymenoptera	28
9.	Isoptera	12
10.	Neuroptera	1
11.	Orthoptera	25
12.	Phasmida	1
13.	Lepidoptera (Rhopalocera)	81
14.	Lepidoptera (Heterocera)	41
15.	Odonata (Zygoptera)	10
16.	Odonata (Anisoptera)	8
Total		281

Myriapods

In the class Myriapoda two orders Chilopoda (centipedes) and Diplopoda (millipedes) with two and four species each respectively were observed. Centipedes (Class Chilopoda) are swift venomous predators though not fatally injurious to humans. Diplopods are detritivores and feed on decaying plant matter.

Arachnids

The *Myristica* swamps of southern Kerala have 5 groups of arachnids- namely spiders, harvestmen, scorpions, whip scorpions and ticks. Arachnids comprise more than 65,000 to 73,000 described species of which about 40,000 described are spiders (order Araneae). The order Araneae has about 38 super families and 111 families. Of the 111 families seven are *incertae sedis*. Spiders also play a significant ecological role as exclusive predators. All spiders are venomous but only a few species are venomous enough to harm humans. The venom of some spiders is useful in study of neuromuscular and cardiac pharmacology. Rajasekhar *et al.* (2003) had suggested that spiders may also serve as bio-control agents.

In India the best account so far (Tikader, 1987) lists 1066 spider species. A paucity of information does exist on Indian arachnids. During this study, forty seven different types of spiders belonging to 15 families and 34 genera have been recorded from these swamp forests. Of the total spider species in Kerala, 11% have been recorded from the *Myristica* swamp forests. Of these one could be identified upto family level (could be new genus) and 27 up to genus level. Nineteen spiders were identified up to species level. The dominant families were Salticidae with eight species, Araenidae with seven species, Oxyopidae with five and Lycosidae were represented by four species.

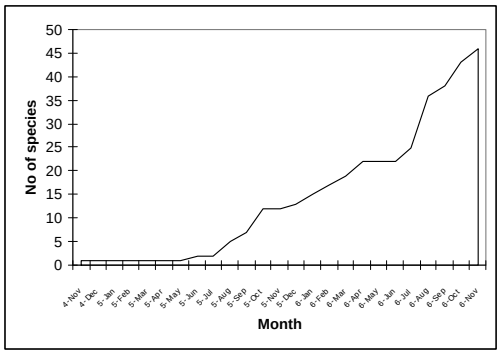
Diversity within the spider families varied (Fig 3.4.6). Of the more than 400 spider species in Kerala, 47 have been recorded from these swamp forests during our non-intensive study. The species accumulation curve (Fig 3.4.6) indicates that there are more spiders out there to be discovered. The species diversity of spiders showed monthly variation (Fig 3.4.6) with the month of August having the highest species diversity with 17 species and the months of May and June with not even one species. During the post monsoon and pre monsoon months spider diversity varied between the upper limit of eight and lower limit of five. This follows the observations of Rajashekar and Raghavendra (2003) that the density and diversity of spiders corresponded to the occurrence of prey and that spiders are observed less during monsoons. How the destruction of these swamps has been detrimental to the arachnid population of the region and its supporting invertebrate food web is yet to be studied. The families Salticidae, Araneidae and Oxyopidae were most dominant.

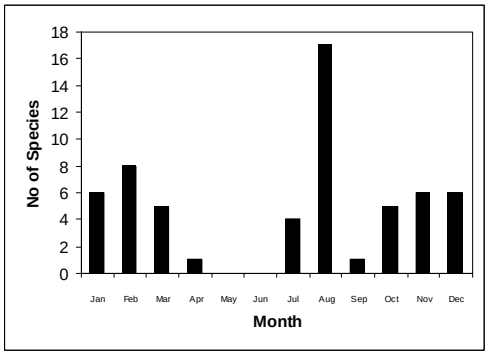
In clock wise order

a: Species accumulation curve of spiders for two years

b: Diversity within spider families in *Myristica* swamp forests

c: No of spider species found in each month





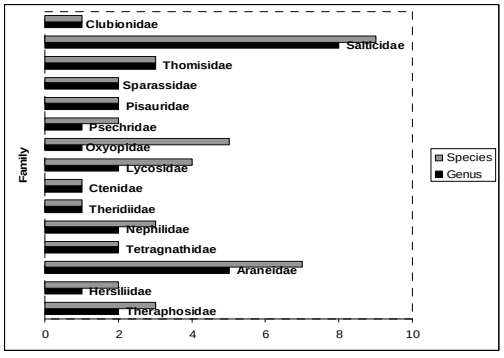


Fig 3.4.6 Arachnids of *Myristica* swamps-species accumulation curve, diversity across months and groups.

The other orders of Arachnida were not subjected to detailed study. Amblypygids or tailless whip scorpions belong to the order Amblypygi in the class as of 2002, approximately 5 families, 17 genera and 136 species have been described. They are found in tropical and subtropical regions and are usually subterranean or nocturnal. They may hide under logs, bark, stones, or leaves; they prefer a humid environment.

Scorpions belong to the order Scorpiones. Over 2000 species of scorpions have been reported. Though all scorpions are toxic (generally neurotoxic) scorpion venom are optimized for action upon other arthropods and thus relatively harmless to humans. Harvestmen are Arachnids of order Opiliones. This group constitutes more than 6300 described species. They are widely distributed and found on all continents except Antarctica.

Ticks along with mites, constitute the order Acarina. Ticks are ecto-parasites. Ixodidae or hard ticks is a major family of Acarina and is capable of transmitting many human, livestock and animal diseases. Hard ticks may remain attached to the skin of a host for long periods of time. All the above orders were represented in the *Myristica* swamps and the list of the same is provided in table 3.4.5. Full list is given in Appendix III.

Table 3.4.5: List of Arachnids in *Myristica* swamps of Southern Kerala

No	Order	Super families	Family	Species
1.	Acari		1	3
2.	Amblypygi		1	1
3.	Scorpiones		1	1
4.	Opiliones		1	2
5.	Araneae	Theraphosoidea	1	3
6.	Araneae	Eresoidea	1	2
7.	Araneae	Araneoidea	3	13
8.	Araneae	Lycosoidea	5	14
9.	Araneae	Sparassoidea	1	2
10.	Araneae	Thomisoidea	1	3
11.	Araneae	Salticoidea	1	9
12.	Araneae	*Incertae sedis*	1	1

Vertebrates

All the five major classes of the Phylum Chordata, Sub Phylum Vertebrata namely fishes, amphibians, reptiles, birds and mammals are represented in the *Myristica* Swamps the details of which are as follows.

Fishes

There are around 218 species of primary and secondary freshwater fishes in the Western Ghats. Fifty three (53)% of all fish species (116 species in 51 genera) in the Western Ghats are endemic of which 14 were reported from *Myristica* swamps. In general, the small and rapidly flowing hill streams support only a few species of specialized fish. Species poor fish communities are also seen in the higher elevation streams of the Western Ghats. Smaller species inhabit shallow, clear and rocky pools and streams.

The list of fishes from the *Myristica* Swamps is given in the Table 3.4.6. Even though the *Myristica* swamp forests are a wetland, it does not support many fish species. This may be due to the following reasons:

- Acidic soil
- Water with low dissolved oxygen
- Substantial presence of litter with slow decay rate in the water
- Lack of perennial water/ inundation
- Habitat constantly disturbed by the presence and activities of wild pig and elephant.
- Very shallow and stagnant water
- Lesser diversity and abundance of water insects in many swamps
- Profusion of knee roots and stilt roots which may prevent habitation by large fishes.
- Presence of more favourable habitats such as clear streams with year round water and profusion of water insects, in the vicinity of the swamps.
- Burrowing and secretive fish species may have escaped detection as sampling procedures such as dredging and dragging were avoided in interests of preserving the ecosystem.

Fishes of interest are

- *Barilius bakeri* (Malabar Baril) which is `endemic to Ker and TN and *Puntius denisonni* (Denison's Barb) which is also endemic. Both these fishes are very beautiful in appearance and the latter is prized as an ornamental fish.

- *Garra mullya* has been recorded only from the swamp Emponge, the feeder stream of which flows directly into Kulathupuzha river. During the months of July and August, the swamp is highly inundated and the streams overflow due to excess of water. The content and velocity of the river water is also increased. During this time this fish moves from the river through the stream and reaches the swamp. This phenomenon last only during the days of inundation. The local inhabitants near the swamp utilize this opportunity to capture many fish.

- The fish *Anguila bengalensis bengalensis* has been sighted only once from inside a swamp in Anchal. This was during the dry month of February. While digging the bed of a dried stream in the swamp, a soil cyst containing the fish was disturbed.

- *Wallago attu* and *Clarius dussumieri dussumieri* were observed from the swamp Marappalm Major, Minor and Mottal Mood only during the night of the wet months June, July and August. The streams from these swamps join Kunjuman Thodu at hardly a distance of 200 m from the swamp's mouth.

The streams and rivulets in the study area, but outside the swamps harboured about three times the species richness in fishes when compared to the species richness of fish inside the swamps. The species accumulation curve (Fig3.4.8) indicates that almost all the fishes present in the swamps have been recorded. The species richness of fishes was lowest during the dry months of March, April, January, February and May in that order. It was highest during the months of June, July and August after which it gradually

decreased towards December (Fig: 3.4.8). Cypriniformes was the most diverse fish order (Fig 3.4.8).

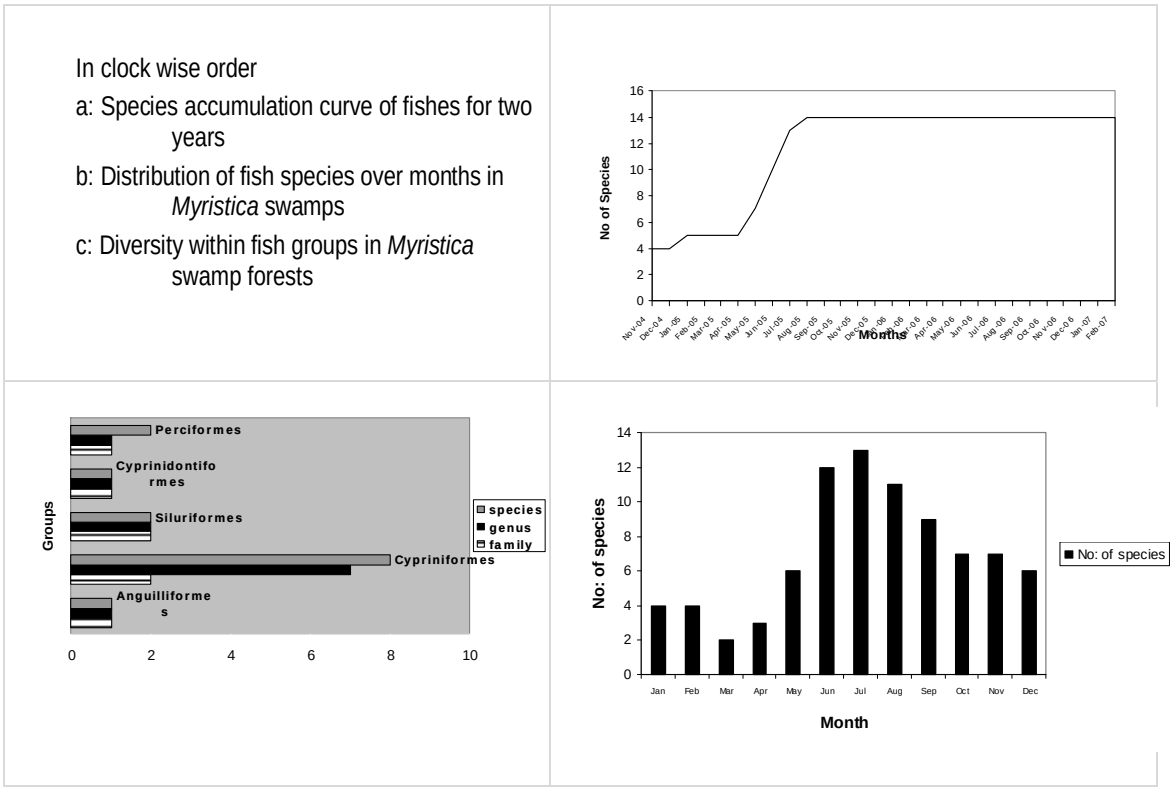


Fig. 3.4.8 Fishes of *Myristica* swamps-species accumulation curve, diversity across months and groups.

Table 3.4.6: List of Fishes of *Myristica* Swamps in Southern Kerala

Order	Family	Genus	Name of fish	Common Name	Endemicity
Cyprinidontiformes	*Aplocheilidae*	Aplocheilus Mc Clelland	*Aplocheilus lineatus* (*Valenciennes*)	Malabar Killie	
Perciformes	*Channidae*	Channa Scopoli	*Channa orientalis* (Bloch)	*Snakehead*	
			Channa striata (Bloch)	*Striped snakehead*	
Cypriniformes	Cyprinidae	*Barilius* Hamilton-Buchanan	*Barilius bakeri* Day	*Malabar Baril*	*Endemic to Ker and TN*
			Barilius gatensis (*Valenciennes)*	*River carp Baril*	
		Danio Hamilton-Buchanan	*Danio aequipinnatus* (Mc Clelland)	*Giant Danio*	
		Puntius Hamilton-Buchanan	*Puntius denisonni (Day)*	*Denison's Barb*	*Endemic*
			Puntius fascicatus (Jerdon)	*Melon Barb*	
		Parlusciosoma	*Parlusciosoma daniconicus* (Hamilton)-Buchnan)		
		Garra Hamilton-Buchanan	*Garra mullya* (Sykes)	*Mullya Garra*	
	Cobitidae	Lepidocephalus Bleeker	*Lepidocephalus thermalis (Valenciennes) Loach?*	*Malabar loach*	
Anguilliformes	Anguillidae	Anguilla	*Anguila bengalensis bengalensis(*Gray and Hardwicke*)*	*Eel*	
Siluriformes	*Siluridae*	Wallago Bleeker	*Wallago attu (Bloch and Schneider)*	*Boal*	
	Clariidae	Clarius Scopoli	*Clarius dussumieri dussumieri Valenciennes*	*Valenciennes clarid*	
5	*7*	*11*	*14*		

Amphibians

There are one hundred and twenty one species of amphibians known from the Western Ghats. These 121 species fall under 24 genera, six families and two orders.

Diversity within families

We documented the presence of 56 species of amphibians belonging to 15 genera and five families from the swamps. As in the Western Ghats where the family Ranidae (true frogs) has the largest number of species (49) amounting to 42% of the amphibian fauna of the Western Ghats, Ranidae (20 species) was the most dominant and constituted 92.52 % of the total population in *Myristica* swamp transects. The second most abundant family was Rhacophoridae (> 22 species) 6.24 %. In the Western Ghats too Rhacophoridae with 30 species (25% of the amphibian fauna is the second largest family. Bufonidae (3 species) constituted 0.87% of the population while Icthyophidae (2 species) and Microhylidae(2 sps) constituted 0.085% and 0.064% respectively. Four species, *Limnonectes keralensis* (29.27%), *Rana temporalis* (28.65%), *Nyctibatrachus major* (15.07%) and *Euphlyctis cyanophlyctis* (7.25%) contributed to 80.24 % of the total amphibian population in transects. These species belong to the family Ranidae. Only *Polypedates psuedocruciger*, *Bufo melanostictus* and *Rhacophorus malabaricus* were the non–ranids which showed comparatively high abundance. Of the 56 species encountered in random searches 14 species were never found in the transects. As in the Western Ghats, there are more species of terrestrial and arboreal amphibians than aquatic ones Species accumulation curve (Fig 3.4.10) has stabilized which indicates that almost all the species in the area have been sighted as almost recorded. Variations in diversity of amphibian populations of *Myristica* Swamps over different months are shown in Fig. 3.4.10.

The wet months of July, August and June showed the highest abundances in that order which is expected due to the brisk reproductive activity after the first consistent rains at the end of May. The driest months of February, March and April had percent abundance ranging between eight and seven. These values are higher for the comparatively less dry months. During the driest months only semi adult and adult frogs were seen. The abundance of the amphibian population outside the swamps suffered evident decline during the driest months. The abundances showed an upward trend both inside and outside the swamps during the wet seasons but during the very dry months showed a reciprocal trend (Fig. 3.4.23a). This may be an indication that amphibians move into the swamps to avoid the harshness of dry season. The same pattern was followed for species richness too. In fact,

the species richness inside the swamps, of the drier months was higher than those of the wetter months (Fig. 3.4.23b). This was in sharp contrast to the areas outside the swamps wherein the species richness was very low during the dry months of January, February and March. This phenomenon can have two possible explanations, which may also be overlapping in effect. Firstly, the swamps may be preferred over the adjoining areas as a habitat during the dry months. Secondly, the genus *Philautus* was very rare in the swamps during the wet season when compared to the months of January and February. As this genus was not common in the swamp transects during wet season but were sighted from the periphery of the swamp and the adjacent forests it may also be concluded that this group of frogs may not need the highly inundated and humid atmosphere of the swamps during rainy season but may treat it as a refuge during the low humidity dry seasons. Lack of litter, which is the main habitat of the genus *Philautus*, due to inundation and flooding associated with rainy season may also be the reason for members of the genus avoiding the swamps during wet season. This would not have a drastic effect on the abundance trends because *Philautus* constitutes only about 6% of the total abundance in the swamps.

Though there is a remarkable diversity of caecilians in the Western Ghats (16 out of 20 species known in India occur in the Western Ghats; all 16 being endemic) and the highest diversity of species in any given landscape is noticed in the southern half of the Western Ghats, we were able to record only two species. This may be due to the following reasons:

- Acidic soil
- Soil with low dissolved oxygen
- Very shallow and stagnant water present year round in most parts of the swamps.
- As these are burrowing and secretive some species may have escaped detection as sampling procedures involving any irreversible changes in the micro and macro ecosystem such as digging and altering litter cover were avoided in the interests of preserving the ecosystem.

The summarized list of amphibians from the *Myristica* swamps is given in table 3.4.7 and detailed list in Appendix III. High species richness in these swamps confirm to the results of analysis of the patterns of amphibian distribution by previous workers in the Western Ghats has suggested that widespread rainfall, shorter dry season and a more uniform local climate have contributed to the high levels of diversity and endemism than elevation per se.

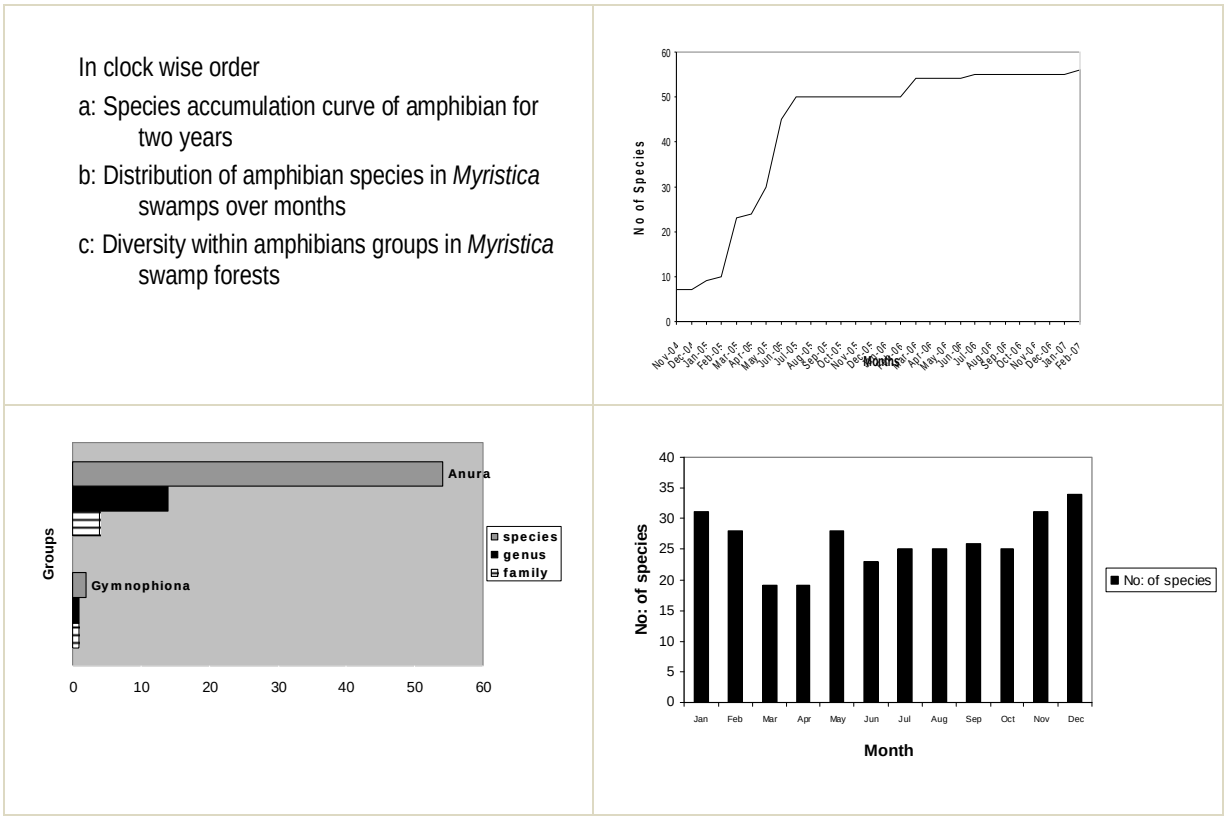


Fig: 3.4.10 Amphibians of *Myristica* swamps-species accumulation curve, diversity across months and groups.

Table 3.4.7 List of Amphibians of *Myristica* Swamps in Southern Kerala

No	Order	Family	Genus	#Species
1.	Gymnophiona	Icthyophiidae	Icthyophis	2
2.	Anura	Bufonidae	Bufo	3
3.		Microhylidae	Kaloula	1
4.			Ramanella	1
5.		Rhacophoridae	Philautus	18
6.			Polypedates	3
7.			Rhacophorus	4
8.		Ranidae	Euphlyctis	2
9.			Hoplobatrachus	1
10.			Indirana	5
11.			Limnonectes	3
12.			Micrixalus	1
13.			Nyctibatrachus	4
14.			Rana	3
15.			Sphaerotheca	1
16.			Doubts	4
Total	2	5	15	56

Reptiles

About 157 species of reptiles are known from the Western Ghats majority of which are snakes. In all, 97 species, representing 36 genera (2 genera of turtles/tortoises, 20 snakes, 14 lizards) are endemic. Endemism is highest amongst snakes, especially with the family Uropeltidae alone contributing 33 species. Amongst lizards, dwarf geckoes (*Cnemaspis* spp) and

skinks (*Ristella, Lygosoma, Mabuya* and *Scincella*) have the maximum number of endemic species.

Diversity within families

We documented the presence of 55 species of reptiles belonging to 37 genera and 13 families from the swamps. Snakes consisted of 5 families, 21 genera and 29 species. Lizards were of 5 families, 12 genera and 22 species and testudines constituted 3 families, 4 genera and 4 species.

Snakes: The Family Colubridae had 18 species and constituted 20.40 % of the total reptilian population in transects. Family Viperidae had only four species but made up 25.63%, elapidae with 4 species had 0.84% of the population while Uropeltidae having 2 species made up 1.05 % of the reptilian population. The family Typhlopidae was not sighted inside the transect even once. Two species, *Trimeruserus malabaricus* (22.80 %) and *Xenochrophis piscator* (8.902 %), contistuted to 31.7 % of the total reptile population in transects. The snakes Python and King Cobra were also reported from the swamps by local inhabitants but we were not able to validate those claims.

Lizards: The Family Scincidae had 6 species and constituted 32.43% of the total reptilian population in transects. Family Agamidae had only seven species and made up 12.66 percent. Geckkonidae with 6 species had 6.70 % of the population while Varanidae and Chaemleonidae with one species each had 0.21% and 0.10 % of the population. Three species, *Trimeruserus malabaricus* (22.8%), *Mabuya macularia* (14.64%), *Sphenomorphus dussumeri* (12.66%) and *Calotes ellioti* (6.70%), contributed 33.99 % of the total reptile population in transects. Tortoises: Though four species of testudines have been recorded from the *Myristica* swamps, not even one could be sighted from the transects. Summary list of reptiles is given in Table 3.4.8 and complete list in Appendix III.

Species accumulation curve (Fig. 3.4.12) has stabilized which indicates that almost all the species in the area have been recorded. Variations in diversity of reptilian populations of *Myristica* swamps over different months is also given in the figure. Of the 55 species encountered in random searches 16 species were never found in the transects. The increase in abundance started with wet months of June, July and August in increasing order, then decreasing in September. The next upward curve began with the dry months of January and February, February showing the highest abundances. These values are higher for the comparatively less dry months. The abundance of the reptilian population was lowest in the transects outside the swamps during the driest months but the upward trend was present for

both inside and outside the swamps during the wet seasons (Fig. 3. 4. 26 a & b). This may be an indication that like amphibians, reptiles too move into the swamps, either to avoid the harshness of dry season or to utilize the high numbers of prey in the swamps. The species richness did not follow any set pattern. This may be attributed to the increased mobility of reptiles which may reduce their chances of being sighted inside the transects. Also reptiles are less affected by micro changes in the environment when compared to amphibians, especially with respect to temperature and humidity.

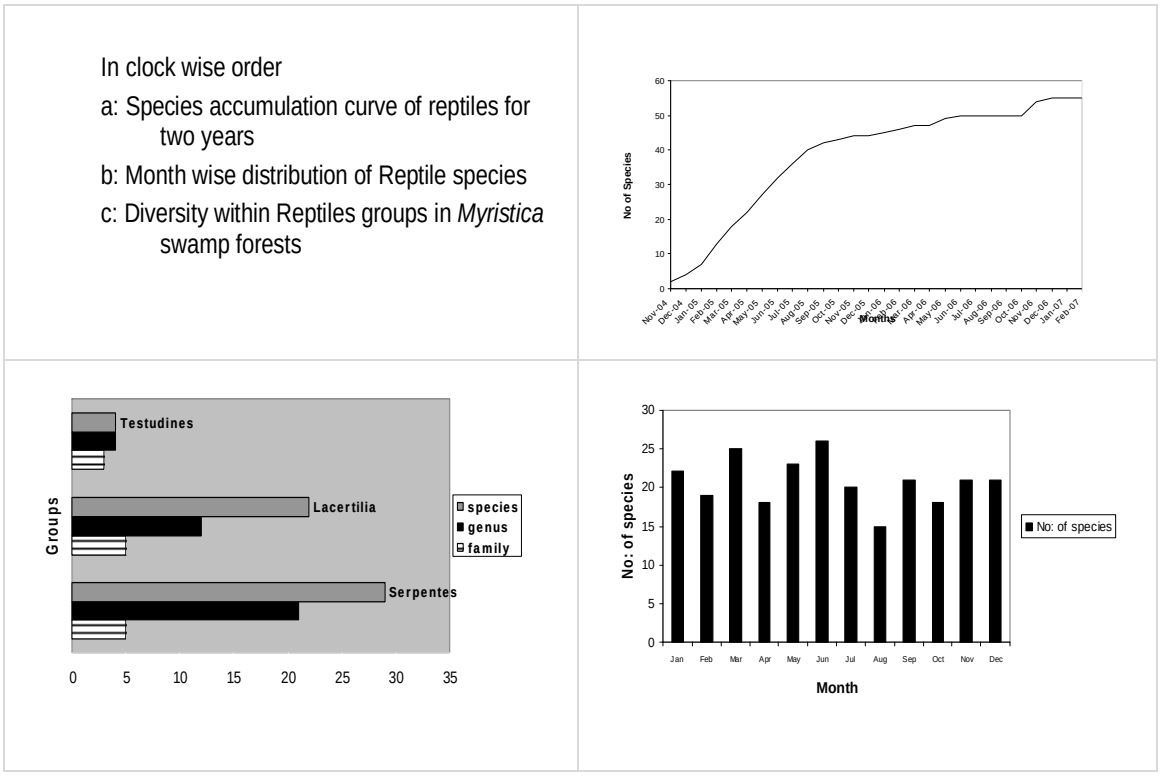


Fig 3.4.12: Reptiles of *Myristica* swamps-species accumulation curve, diversity across months and groups.

The reptilian population differs from the amphibian population by reduced dominance shown by any particular species, genera or family. Though *Trimeruserus malabaricus, Mabuya macularia, Sphenomorphus dussumeri,* are relatively more abundant than the other species, and the family Scincidae and Viperidae shows dominance the relative dominance is not as high as shown by the family Ranidae in amphibians.

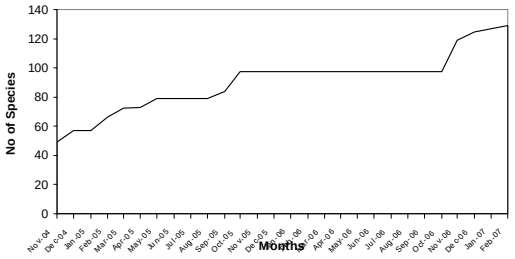
Table 3.4.8 List of Reptiles of *Myristica* Swamps in Southern Kerala. Complete list is given in Appendix 20

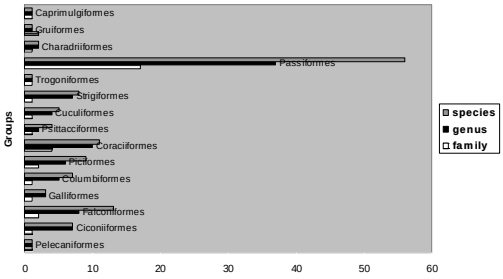
No	Order	Family	No of Species
1.	Squamata *(Serpentes)*	Colubridae	*18*
2.		Elapidae	*4*
3.		Viperidae	*4*
4.		Uropeltidae	*2*
5.		Typhlopidae	*1*
6.	(Lacertilia)	Agamidae	*7*
7.		Geckkonidae	6
8.		Varanidae	1
9.		Chaemleonidae	*1*
10.		Scincidae	*7*
11.	Testudines	Bataguridae	*2*
12.		Trionychidae	*1*
13.		Testudinidae	*1*
Total	2	13	*55*

Birds

The total number of birds all over the world has been estimated as about 8600. If sub species and races are taken into account the figure would rise to nearly 30,000. About 1200 species of birds have been recorded from India of which around 600 forms of resident and migratory birds have been reported from the Western Ghats. Nineteen species may be considered endemic to the Western Ghats. Wet evergreen forests and montane sholas, despite providing habitat to a number of specialists and endemic birds with greater conservation value, are comparatively less diverse in bird species than secondary/disturbed evergreen and moist deciduous forests. In the present study 129 bird species were recorded from the *Myristica* Swamps. Only birds sighted from inside the swamps were taken into account. This forms about half of the bird species recorded from Trivandrum Forest Division by a BNHS study. The summarized list of birds recorded from the *Myristica* Swamps is given in table 3.4.9 and detailed list Appendix III. The species accumulation curve (Fig. 3.4.14) shows that after long plateau fresh species were recorded. This may be due to the following seasons:

- Inexperience of the field worker in identification of birds during the first year
- Thick canopy and low light entry into the swamp impedes vision





Species accumulation curve of Birds for two years

Diversity within Bird groups in *Myristica* swamp forests

Fig 3.4.14: Birds of *Myristica* swamps-species accumulation curve and diversity across groups.

The month wise distribution of bird species did not follow a specific pattern. Sightings of birds during rains were less when compared to the other times. Diurnal birds were more in number than nocturnal birds. Though some interesting migrants were seen in the Kulathupuzha area which are less wooded, and also in the forests outside the swamp patches, none were sighted in the swamp except common birds like wagtail. The orders Passeriformes, Coraciiformes and Falconiformes were the most diverse in that order (Fig 3.4.14).

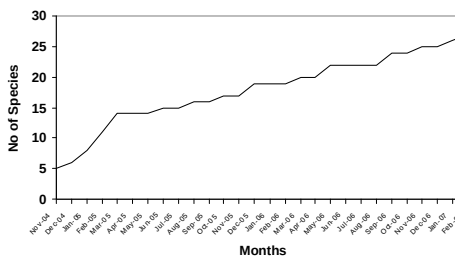
Table 3.4.9: List of Birds of *Myristica* Swamps of Southern Kerala. Complete list is given in Appendix 21

	Order	No of species
1.	Pelecaniformes	1
2.	Ciconiiformes	7
3.	Falconiformes	13
4.	Galliformes	3
5.	Columbiformes	7
6.	Piciformes	9
7.	Coraciiformes	11
8.	Psittacciformes	4
9.	Cuculiformes	5
10	Strigiformes	8
11	Trogoniformes	1
12	Passiformes	56
13	Gruiformes	1
14	Charadriiformes	2
15	Caprimulgiformes	1
	Total	129

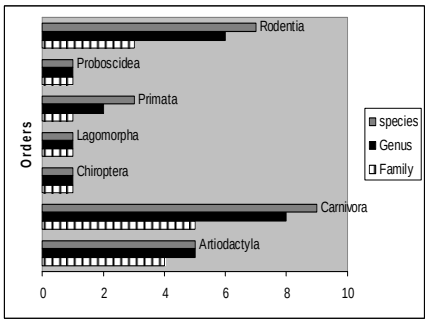
Mammals

Mammals are characterized by their ability in females to produce milk for their young and constitute about 5,800 species distributed in about 1,200 genera, 152 families and up to forty-six orders though this varies with the classification scheme followed. Four hundred and eight (408) species are

recorded from India, with 44 of them being endemic to the country. One hundred and twenty species of mammals are known from the Western Ghats of which fourteen species are endemic. Around 120 species of mammals have been reported so far from Kerala. Evergreen forests are particularly suited to frugivorous arboreal mammals. Destruction of evergreen forests adversely affects the civets, and endemic species of arboreal mammals like the spiny dormouse, the Nilgiri langur, Lion-tailed macaque (which may be affected by an opening of 0.5 sq km of canopy). The Asian elephant though more of a habitat generalist is also under threat directly from man and also from habitat loss. These animals have been reported from the swamps also, the summarized list of which is in table 3.4.10 and detailed list in Appendix III. Other than the list there have been sightings of bats, rodents like shrews and rats but their identity could not be validated. Pug marks of tiger was seen in a swamp in the Shendurney Wildlife Sanctuary but it was not recorded in the list as further validation of the same was not possible.



Species accumulation curve of mammals for two years



Diversity within mammal groups in *Myristica* swamp forests

Fig 3.4.15 Mammals of *Myristica* swamps-species accumulation curve, diversity across months and groups.

The presence of Loris in the swamps was reported by the local inhabitants but since direct or indirect evidence was lacking it was not included in the list. The species accumulation curve (Fig.3.4.15) indicates that there are more animals to be recorded in the swamps. This may be attributed to the high mobility and lower distribution density of mammals which reduces the chance of sightings. The month wise distribution of mammal species over months did not follow a specific pattern. Sightings of these animals were less during rainy season. Sightings were more during the day than during the night. The order Rodentia was most diverse followed by Carnivora and Artiodactyla (Fig. 3.4.15). But the number of sightings for the order Carnivora was the least. Only animals sighted from inside the swamp were recorded. Animals/ indirect evidences sighted from near the swamps were not used for compiling the list mammals in the list.

Table 3.4.10: List of Mammals in *Myristica* swamps of southern Kerala (See also Appendix 22)

No	Order	Family	No of species
1.	Artiodactyla	*Bovidae*	1
2.		*Cervidae*	2
3.		Tragulidae	1
4.		Suidae	1
5.	Carnivora	*Canidae*	1
6.		Felidae	3
7.		Herpestidae	2
8.		Ursidae	1
9.		Viverridae	2
10.	Chiroptera	*****	1
11.	Lagomorpha	Leporidae	1
12.	Primata	Cercopithecidae	3
13.	*Proboscidea*	*Elephantidae*	1
14.	Rodentia	Hystricidae	1
15.		Muridae	2
16.		Sciuridae	4
Total	7	16	27

Platyhelminthes

Bipalium sp

Nemathelminthes

Annelida

Oligochaeta

Species 1

Species 2

Hirudinea

Crustacea

Myriapoda-Diplopoda

Hexapoda

Travancoriana schirgere

Species 2

Species 3

Two Crabs of sps 2 feeding on a live Rana temporalis frog

Fig. 3.4.0.a: Other invertebrates of *Myristica* swamps

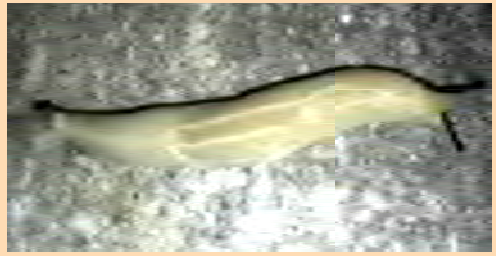
Mollusca - gastropoda

Slug 1

Snail 2

Indrella sp 1

Snail 3



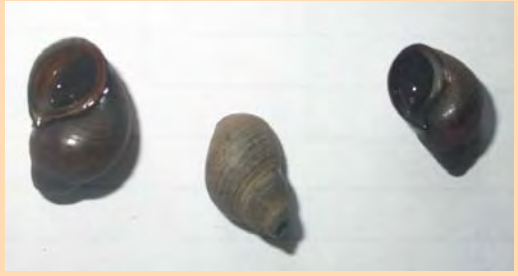
Slug 2

Indrella sp 2

Snail 4

Snail 5

Snail 1



Snail 6

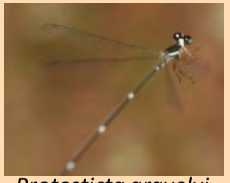
Fig. 3.4.0b Other invertebrates of *Myristica* swamps

Diplacodes trivialis

Cratilla lineata

Lestes elatus

B.Damsel flies



Protosticta gravelyi

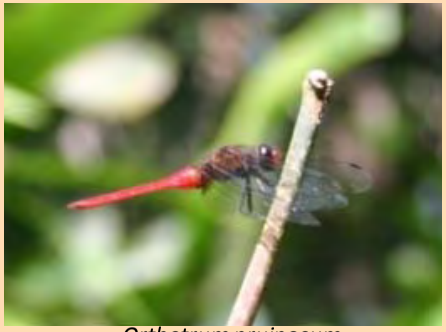
Vestalis gracilis

Brachythemis contaminata

Neurothemis fulvia

Vestalis apicalis

Rhinocypha bisignata



Orthetrum pruinosum

Trithemis aurora

Libellago lineata

Euphaea fraseri

A.Dragon flies

Tholymis tillarga

Phylloneura westermanni

Esme longistyla

Fig. 3.4.2 Odonates of *Myristica* swamps

Butterflies

- Family Pieridae ✔
  - Sub family – Colanidae
  - Sub family - Pierinae
- Family Papilionidae ✔
  - Sub family – Papilioninae
- Family Nymphalidae
  - Sub family - Charaxinae
  - Sub family - Danainae
  - Sub family – Limenitinae
  - Sub family - Morphinae
  - Sub family - Satyrinae
  - Sub family – Nymphalinae
- Family Lycaenidae
  - Sub family - Polyommatinae
  - Sub family – Theclinae
- Family Hesperiidae
  - Sub family – Hesperiinae
- Unidentified

Sub family -Colanidae

Euremia hecabe

Fig. 3.4.4 a Butterflies of *Myristica* swamps

Family Pieridae

Sub family-Pierinae

Delias eucharis

Leptosia nina

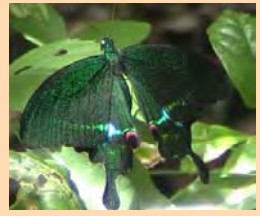
Appias albina

Hebomoia glaucippe

Family Papilionidae, Sub family - Papilioninae

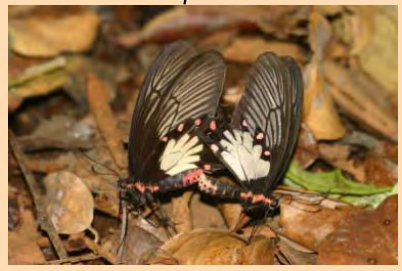
Papilio helenus

Papilio polymnestor



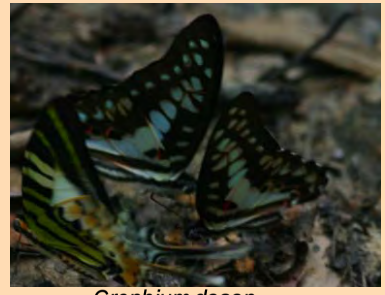
Papilio paris

Pachliopta hector



Pachliopta aristolochiae

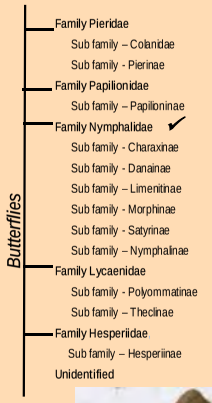
Graphium sarpedon



Graphium doson

Graphium agamemnon

Graphium antiphates



Sub family - Charaxinae

Polyura athamus

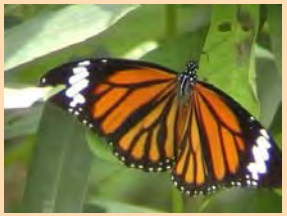
Cupha erymanthis

Sub family - Morphinae

Unidentified

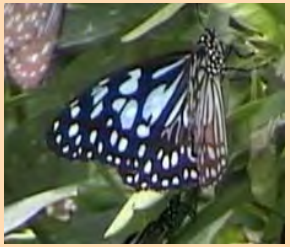
Sub family - Danainae

Euploea core



Danaus genutia

Tirumala septentrionis



Tirumula limniace

Parantica aglea

Family Nymphalidae

Sub family – Limenitinae

Neptis jumbah

Ariadne merione

Parthenos sylvia

Tanaecia lepidea

Athyma ranga

Sub family - Satyrinae

Melanitis leda

Elyminas hypermnestra

Ypthima baldus

Ypthima huebneri

Sub family - Nymphalinae

Junonia iphita

Cyrestis thyodamas

Junonia atlitess

Hypolimnas bolina

Fig. 3.4.4 b Butterflies of *Myristica* swamps

Butterflies

- Family Pieridae
  - Sub family – Colanidae
  - Sub family - Pierinae
- Family Papilionidae
  - Sub family – Papilioninae
- Family Nymphalidae
  - Sub family - Charaxinae
  - Sub family - Danainae
  - Sub family – Limenitinae
  - Sub family - Morphinae
  - Sub family - Satyrinae
  - Sub family – Nymphalinae
- Family Lycaenidae ✔
  - Sub family - Polyommatinae
  - Sub family – Theclinae
- Family Hesperiidae ✔
  - Sub family – Hesperiinae
- Unidentified

Unidentified

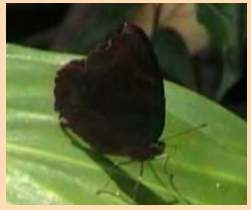


Fig. 3.4.4 Butterflies of *Myristica* swamps

Family Hesperiidae
Sub family - Hesperiinae

Ampitta discorides

Psolos fuligo

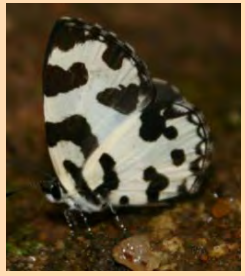
sp1

sp2

sp3

Family Lycaenidae

Sub family - Polyommatinae

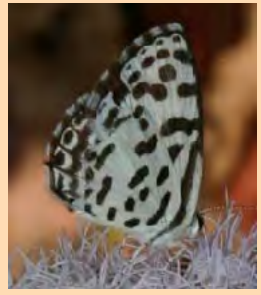


Caleta caleta

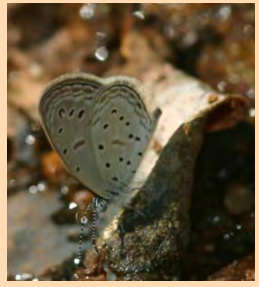
Jamides celeno

Discolampa ethion

Actolepis puspa



Castalius rosimon



Zizula hylax

Sub family - Theclinae

Zeltus amasa

Curetis thetis

Thaduka multicaudata

unidentified

Arachnids of Myristica swamps

Scorpiones (Buthidae)

Neoscona 2

Nephilidae *Nephila kuhlii*

Opiliones

Araneae-

Super Family Araneoidea

Araneidae

Neoscona 3

Nephila pilipes

Tick 1

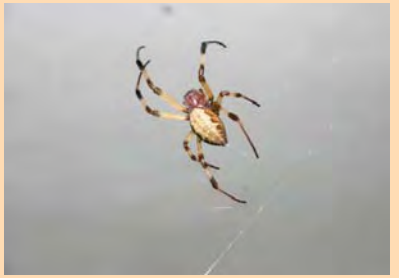
Acari
(Ixodidae)

Tick 2

Tick 3

Argiope anasuja

Gasteracantha dalyi



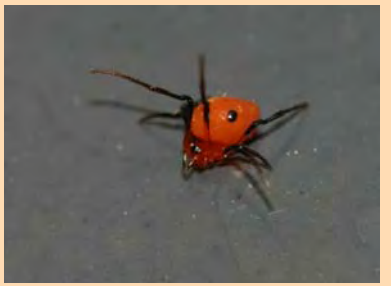
Nephylengis malabarensis

Amblypygi (Phrynichidae)

Phrynichus phipsoni,

Neoscona 1

Heurodes



Theridiidae *Theridula angula*

Fig 3.4.7a Arachnids of *Myristica* Swamps

Super Family Araneoidea
Tetragnathidae

Leucauge sp.1

Opadometa fastigata

Super Family Eresoidea
Hersiliidae

Hersilia savignyi

Hersilia sp.1

Fig 3.4.7b Arachnids of *Myristica* Swamps

Super Family Lycosoidea, Pisauridae

Perenethis venusta

Thalassius albocinctus

Ctenidae , *Ctenus sp.1*

Super Family *incertae sedis*
Clubionidae

Clubiona sp.1

Super Family Lycosoidea
Oxyopidae, *Oxyopes* sp.3

Oxyopes sp.2

Oxyopes hindostanicus

Psechridae, *Psechrus torus*

Thomisidae

Thomisus andamanensis

Thomisidae (undescribed genus

Lycosoidae

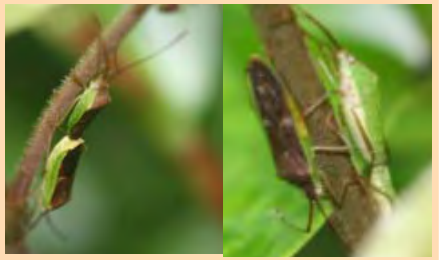
Pardosa sp.2

Lycosa sp.1

Hemiptera

Heteroptera

Coreidae



Lygaeidae

Fig. 3.4.5a: Other insects of *Myristica* swamps

Pentatomidae

Catacanthus incarnatus

Pyrrhocoridae

Iphitia sp

Hemiptera

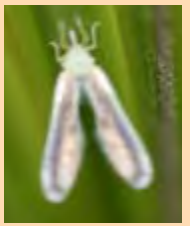
Homoptera

Reduviidae

Scutelleridae

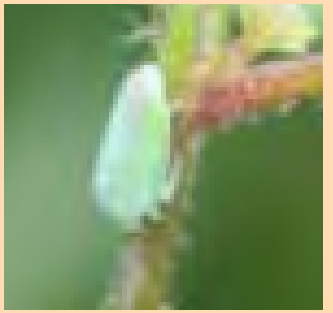
Derbidae

Cicadidae



Fulgoridae

Cicadellidae



Hymenoptera

Formicidae

Unidentified families

Fig. 3.4.5b:Other insects of *Myristica* swamps

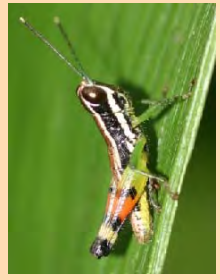
Orthoptera

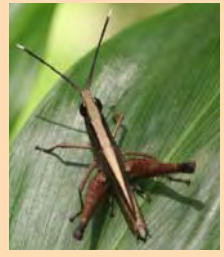
Grillidae

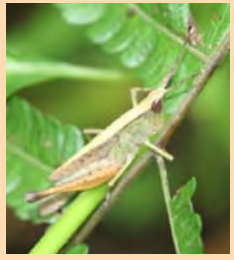
Tridactylidae

Acriididae

Orthoptera



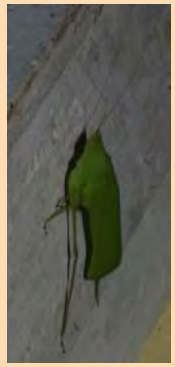


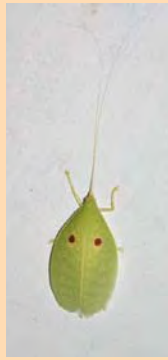


Acriididae

Aularcus milliaris

Tettigonidae





Spathosternum sp

Diptera

Asilidae

Empididae

Colobata sp

Calliphoridae

Muscidae

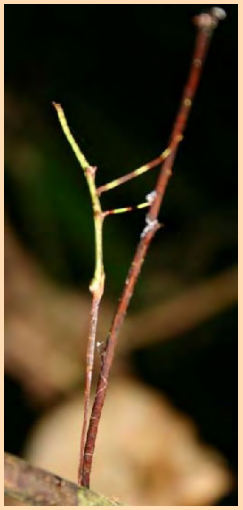
Diopsidae

Tipulidae

Tanyderidae

Fig. 3.4.5c:Other insects of *Myristica* swamps

Phasmida

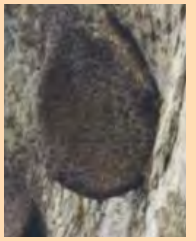


Diptera

Unidentified sp

Hymenoptera

Apidae



Mutilidae

Sphecoidae

Vespidae

Dermaptera

Labiduridae

Neuroptera

Unidentified

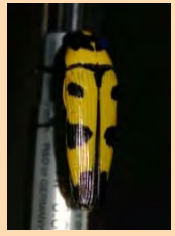
Coleoptera

Brenthidae

Chrysomelidae

Cicindelidae

Scarabaeidae



Buprestidae

Curculionidae

Unidentified

Dictyoptera

Blattoria

Mantodea

Ephemeroptera

Asilidae feeding on Ephemeroptera

Isoptera

Embioptera

Fig. 3.4.5d:Other insects of *Myristica* swamps

Lepidoptera – Heterocera

Agaristidae

Nyctemera coleta

Arctiidae

Chionaema peregrina

Gelechidae

Timira

Geometridae

Dysphania percota

Pyraustidae

Saturnidae

Ourapteryx marginata

Arctiidae

Asura sp

Utethisa pulchella

Lasiocamph-idae

Lymantriidae

Lymantria ampla

Euproctis

Oecophoridae

Semiothesia sps

Unknown

Flattidae

Unknown

Noctuidae

Nyctipao macrops

Fig. 3.4.5e:Other insects of *Myristica* swamps

Puntius fasciatus

Barilius gatensis

Barilius bakeri

Garra mullya

Aplochilus lineatus

Puntius denisonni

Lepidocephalus thermalis

Danio aquipinnatus

Fig. 3.4.9 Fishes of *Myristica* swamps

Amphibians of Myristica swamps

Family : Icthyophidae

Genus Icthyophis

Icthyophis tricolor

Family:Microhylidae

Genus Ramanella

Ramanella triangularis

Genus Kaloula

Kaloula taprobanica

Fig: 3.4.11a. Amphibians of *Myristica* swamps

Limbless - 1sp.
Toads - 3sp.

Microhylids - 1sp

Ranids - 8 genera
- *Euphlyctis -2/2*
- *Hoplobatrachus- 1/ 2*
- *Indirana- 5/ 7*
- *Limnonectes- 2/ 5*
- *Micrixalus- 1/ 7*
- *Nyctibatrachus- 3/ 5*
- *Rana- 3/ 5)*
- *Tomopterna- 1/ 4*

Rhacophorids - 3 genera

Family : Bufonidae.

Bufo melanostictus

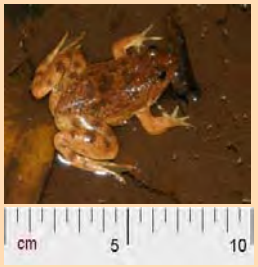
Breeding male

Family : Ranidae

Genus Micrixalus

Micrixalus fuscus

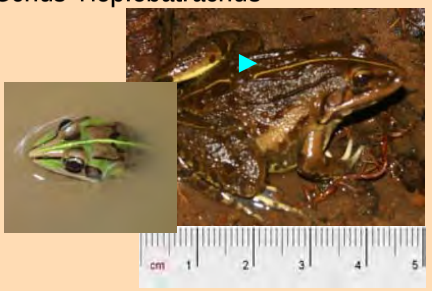
Genus Euphlyctis



Euphlyctis cyanophlyctus

Euphlyctis hexadactyus

Genus Hoplobatrachus



Hoplobatrachus tigerinus

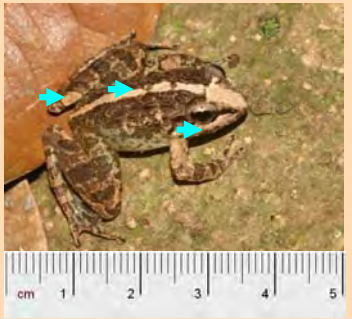
Genus Indirana

Indirana brachytarsus

Genus Indirana

Indirana semipalmatus

Indirana beddomii



Indirana leptodactylus

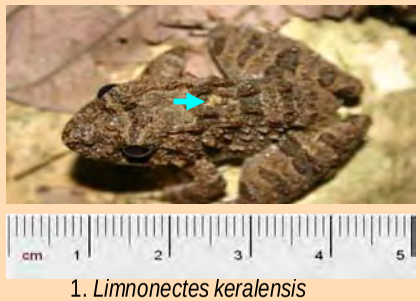
Indirana leithi

Ranids cont'd

- *Limbless - 1sp.*
- *Toads - 3sp.*
- *Microhylids - 1sp*
- *Ranids - 8 genera*
  - *Euphlyctis -2/2*
  - *Hoplobatrachus- 1/ 2*
  - *Indirana- 5/ 7*
  - *Limnonectes- 2/ 5*
  - *Micrixalus- 1/ 7*
  - *Nyctibatrachus- 3/ 5*
  - *Rana- 3/ 5)*
  - *Tomopterna- 1/ 4*
- *Rhacophorids - 3 genera*

Genus: Nyctibatrachus

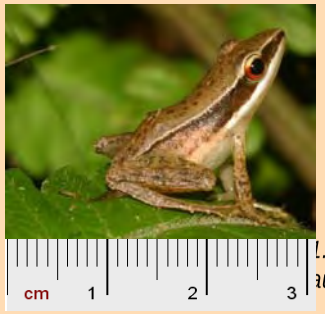
Nyctibatrachus aliciae



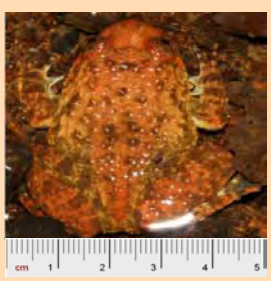
Genus: Limnonectes

1. *Limnonectes keralensis*

Genus: Rana



l. Rana aurantiaca



3. *Nyctibatrachus major*

2. *Limnonectes limnocharis*

2. *Rana malabarica*

2. *Nyctibatrachus minor*

Family : Rhacophoridae

- *Limbless - 1sp.*
- *Toads - 3sp.*
- *Microhylids - 1sp*
- *Ranids - 8 genera*
- *Rhacophorids - 3 genera*
  - *Polypedates – 2/2*
  - *Rhacophorus-2/5*
  - *Philautus-8/14*

Polypedatus maculatus

3. *Rana temporaliis*

Genus: Tomopterna

1. *Tomopterna rufescens*

Rhacophorus cf lateralis

Rhacophorus malabaricus

Polypedatus maculatus

Genus: Rhacophorus

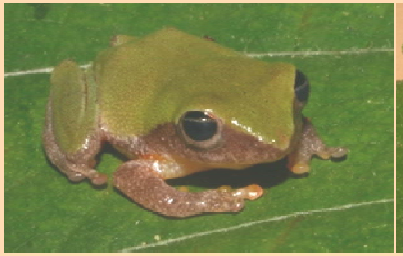
Genus: Polypedates

Fig: 3.4.11b. Amphibians of *Myristica* swamps

Limbless - 1sp.
Toads - 3sp.
Microhylids - 1sp
Ranids - 8 genera
Rhacophorids - 3 genera
Polypedates – 2/2
Rhacophorus-2/5
Philautus-8/14 ✔

Size of Philautus vary from 1.5 to 3 cm in length

Rhacophorids Genus: **Philautus**


P. flaviventris


Philautus charius


P. leucorhinus


P. tinniens


P. pulcherrimus


P. temporalis


P. variabilis

Some Unidentified Amphibians of *Myristica* swamps


Philautus sp1


Philautus sp 5


Philautus sp 3


Philautus sp 4


Philautus sp 6

452B36


Philautus sp11

Philautus sp 7


Philautus sp13


Philautus sp 8


452A1


Philautus sp 9

Philautus sp 12


452A3

452 A2

Fig: 3.4.11c. Amphibians of *Myristica* swamps

Family Testudines

Geoemyda silvatica

Family Bataguridae

Melanochelys trijuga

Family Testudinidae

Indotestudo travancorica

Lacertilia -Agamidae

Psamophillus sps

Draco dussumeiri

Calotes calotes

Calotes versicolor

Calotes ellioti

Agamidae

Otocryptis beddomii

Geckkonidae

Cnemaspis cf *wyanadensis*

Cnemaspis

Fig 3.4.13a Reptiles of *Myristica* Swamps

Lacertilia - Geckkonidae

Hemidactylus 1

Hemidactylus cf *frenatus*

Hemidactylus 2

Scincidae

Mabuya macularia

Mabuya carinata

Ristella beddommi

Sphenomorphus dussumeri

Skink 3

Fig 3.4.13 b Reptiles of *Myristica* Swamps

Serpentes- Viperidae

Trimeruserus malabaricus

Hypnale hypnale

Serpentes

Typhlopidae

Ramotyphlops braminus

Uropeltidae

Melanophidium cf *punctatum*

Uropeltis macrolepis

Colubridae

Ptyas mucosa

Xenochrophis piscator

Ahateulla nasuta

Oligodon cf *affinis*

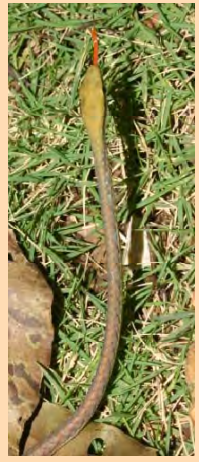
Fig 3.4.13 c Reptiles of *Myristica* Swamps

Amphsiema beddomi

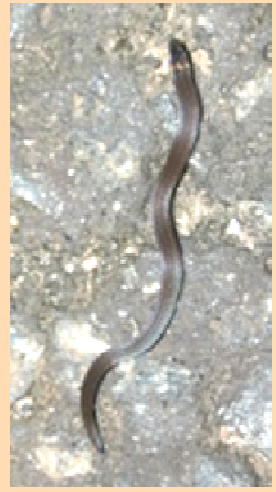
Amphsiema stolatum

Colubridae

Dendrelaphis tristis



Dendrelaphis pictus



Xylophis sternorhynchus

Chrysopelea ornata

3.4.2 Animals Transects

Transects of 100m x 4m were laid out for sampling animals. The transect data was collected for two successive years (2004 -2006). Total area falling inside the transect was examined. Transects inside the swamps and outside the swamps were grouped separately. During the first year, 15 transects were laid out inside the swamps and 15 outside. During the second year 9 transects were laid out inside the swamps and 9 outside. The transects in the second year was meant for checking the trend in animal numbers and therefore a reduction in the number of transects. Night sampling was carried out inside two swamps to compare animal numbers during day time and night time. Night observations were taken for 13 months. The transects were visited every month and quantitative data on amphibians and reptiles collected. Enumeration results from the transects inside and outside swamps are discussed separately, both for first and second year.

Amphibians inside swamps: First year

As mentioned above, during the first year, 15 transects were laid out inside the swamps and 15 outside. Transects were visited every month and quantitative data collected.

Density and abundance

A total of 10,421 individual amphibians were recorded from 15 transects inside the swamps during the first year. A total of 8327 individuals were recorded from 9 transects in the second year.

Table 3.4.11. Abundance and number of species (N and S) of amphibians inside the swamps during first year (across the swamps).

Sl. No	Transect	Total	No of Species
1.	Uthiran Chira	2210	25
2.	Empong	1305	23
3.	Chakidi Chal	799	21
4.	Karinkurinji	742	15
5.	Mottal Mood	646	21
6.	PilleKode	643	28
7.	Pillekode	608	17
8.	Marappalam Major	533	21
9.	Muppathadi	515	30
10.	Ammayambalam	506	22
11.	Poovanathu Mood-3	443	24
12.	Poovanathu Mood-4	417	23
13.	Poovanathu Mood-1	404	22
14.	Poovanathu Mood-0	392	23
15.	Sastha Nada	258	15
	!Total	10421	

During first and second years Uthiran Chira had the maximum number of individuals, 2210 and 2250 individuals respectively. Both these years, the animals were in the order *Rana temporalis, Limnonectes keralensis* and *Euphlictis cyanophlictis*. During the first year Uthiran Chira was followed by Empong (1305 individuals) and Chakidi Chal (799). During the first year, the least was from Poovanthu Mood 0 and Sastha Nada. During the second year Ammayambalam had the least number of individuals.

Total number of species in transect

During the first year**,** a total of 46 species of amphibians were recorded. Muppathadi had 30 species, Marappalam 28 speies and other transects showed gradual decrease with Sastha Nada and Karinkurinji showing the least (15 species). During the second year, Marappalam Major had the maximum number of species (24) followed by Marappalam Minor(23) and Mottal Mood (22). The least was in Ammayambalam, 14 species.

Commonality of species

During the first year**,** as many as 8 species were present in all the 15 transects, another eight species were present in 10 or more transects. On the lower side, 4 species were recorded from one transect only. During the second year, as many as 9 species were present in all transects. The next 9 species were also well distributed (Appedix IV and VI).

Transect wise species dominance

During the first year**,** *Limnonectes keralensis* was the most common species in 7 transects. *Nyctibatrachus major* was the most common species in 5 transects. *Rana temporalis* was the most common species in 3 *transects*. During the second year, Limnonectes *keralensis* was the most common, present in 5 transects. *Nyctibatrachus major* was the most common species in 3 transects. *Rana temporalis* was the most common species in one transect.

Amphibians inside swamps: Second year

Density and abundance

A total of 8327 individuals were recorded from 9 transects. The total for 15 transects in first year was 10,421 individuals. To compare with this, the number in 9 transects in second year has to be suitably adjusted to 8327/9*15= 13,878,). Uthiran Chira had the mximum number of individuals (31%) followed by Pillekode (12%) and Marappalam Minor(12%). The least was in Ammayambalam.

Total composition species wise

Of the total, *Rana temporalis* constituted 28%, *Limnonectes keralensis* 26%, *Nyctibatrachus major* 16% and *Euphlictis cyanophlictis* 11%. Species wise, all the transects had good number with Marappalam Major recording the maximum (24 species) and Ammayambalam (14 species) recording the least.

Species occurrence in transects.

As many as 9 species were present in all the plots. The next 9 species were also well represented (Appendix IV and VI).

Table 3.4.12. Abundance and number of species (N and S) of amphibians inside the swamps during II year across the swamps

	Species	Total	%	No of Species
1.	Uthiran Chira	2550	30.62	20
2.	Pillekode	1021	12.26	19
3.	Marappalam Minor	975	11.71	23
4.	Marappalam Major	883	10.60	24
5.	Mottal Mood	864	10.38	22
6.	Empong	818	9.82	19
7.	Karinkurinji	460	5.52	18
8.	Sastha Nada	458	5.50	17
9.	Ammayambalam	298	3.58	14
	Total	8327	100.00	

Transect wise species dominance

Limnonectes keralensis was the most common, present in 5 transects. *Nyctibatrachus major* was the most common species in 3 transects. *Rana temporalis* was the most common species in 1 transect.

Amphibians outside swamps: First year

Total composition of individuals: There were a total of 564 individuals from 15 transects. Uthiran Chira had the maximum (24%) followed by Ammayambalam, which had (17%), followed by Marappalam Major (10) and Poovanathu Mood-1 (10%). The least was in Sasthanada (1%).

Table 3.4.13 Abundance and number of species (N and S) of amphibians outside the swamps during first year across the swamps.

	Name of organism	Total	%	No of species
1.	Uthiran Chira	133	23.58	9
2.	Ammayambalam	97	17.20	10
3.	Marappalam Major	54	9.57	10
4.	Poovanathu Mood-1	54	9.57	5
5.	Poovanathu Mood-3	45	7.98	9
6.	Poovanathu Mood-0	28	4.96	8
7.	Karikurinji	27	4.79	9
8.	Empong	26	4.61	5
9.	Muppathadi	22	3.90	6
10.	Pillekode	17	3.01	3
11.	Chakidi Chal	16	2.84	4
12.	Marappalam Minor	15	2.66	5
13.	Poovanathu Mood 4	13	2.30	6
14.	Mottal Mood	11	1.95	4
15.	Sastha Nada	6	1.06	3
	Total	564	100.00	

Total composition species wise

Ammayambalam and Marappalam Major had 10 speceis each, three other transects had 9 species each. The least number of 3 species was from Sasthanada transect.

Species occurrence in transects

Limnonectes keralensis was present in 14 transects, *Rhacophorus malabaricus* in 13 tranasects. Other species were present in 7 or less transects. Nine species were present in 1 transect each.

Transect wise species dominance

Limnonectes keralensis was the most frequent species in 12 transects. In two transects *Rana temporalis* was the common species. Details are shown in Appendix IV and VI.

Amphibians outside swamps: Second year

Total Composition individuals

There were a total of 654 individuals in 7 transects. Ammayambalam had the maximum number of individuals (47%), followed by Karinkurinji (25%). Marappalam Minor had the least number of individuals (1.5%).

Total composition species wise

Number of species was in same order as number of individuals. Ammayambalam had the maximum number of species (12) followed by Karinkurinji (10 speceis). Marappalam Minor had the least (2 speceis).

Table 3.4.14 Abundance and number of species (N and S) of amphibians outside the swamps during second year (across the swamps).

	Transect	Total	%	No of Species
1.	Ammayambalam	306	46.79	12
2.	Karikurinji	166	25.38	10
3.	Marappalam Major	73	11.16	8
4.	Mottal Mood	50	7.65	6
5.	Empong	26	3.98	6
6.	Uthiran Chira	23	3.52	3
7.	Marappalam Minor	10	1.53	2
	Total	654	100.00	

Species occurrence in transects

No species was present in all the transects plots. *Limnonectes keralensis* and *Indirana beddomei* were present in 6 transects each.

Transect wise species dominance

In five transects, *Limnonectes keralensis* was the most common species. Ten species were present in one transect each only. Details are shown in Appendix IV and VI.

Reptilesinside swamps: First year

Total Composition individuals

A total of 574 individuals were recorded from 15 transects, 9 transects had value in the range of 7-9%. The least was from Pillekode which had about 2%.

Total composition species wise

Good number of species were present in the transects, the maximum was in Marappalam Major (27 species), followed by Poovanathu Mood-0 (19). The least was in Chakidi Chal.

Table 3.4.15 Abundance and number of species (N and S) of reptiles inside the swamps during I year across the swamps

	Name of swamp	Total		No of Species
1.	Marappalam Minor	*50*	8.71	16
2.	Ammayambalam	49	8.54	16
3.	Marappalam Major	48	8.36	27
4.	Empong	47	8.19	13
5.	Poovanathu Mood-1	45	7.84	15
6.	Karinkurinji	45	7.84	17
7.	Poovanathu Mood-0	44	7.67	19
8.	Poovanathu Mood-4	44	7.67	14
9.	Muppathadi	41	7.14	16
10.	Poovanathu Mood-3	40	6.97	14
11.	Uthiran Chira	32	5.57	11
12.	Mottal Mood	28	4.88	14
13.	Chakidi Chal	27	4.70	9
14.	Sastha Nada	20	3.48	13
15.	Pillekode	14	2.44	10
	Total	574	100.00	

Species occurrence in transects

Mabuya macularia was present in all the transects, *Trimeruserus malabaricus* was present in 14 plots. As many as 9 species were present in only one transect.

Transect wise species dominance

In 10 transects, *Trimeruserus malabaricus* was the most common species. *Mabuya macularia* and *Sphenomorphus dussumeri* were common in two transects each. Details are shown in Appendix IV and VI.

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Reptiles inside swamps: Second year

Total Composition individuals

There were total of 382 individuals in 9 transects. Mottal mood had the maximum number of individuals (17%), followed by Sastha Nada, Marappalam Minor and Karikurinji. Marapplam major had the least (7%).

Table 3.4.16. Abundance and number of species (N and S) of reptiles inside the swamps during II year across the swamps

	Name of Reptile	Total	%	No of speceis
1.	Mottal Mood	66	17.28	14
2.	Sastha Nada	63	16.49	11
3.	Marappalam Minor	57	14.92	6
4.	Karinkurinji	54	14.14	12
5.	Pillekode	32	8.38	12
6.	Uthiran Chira	31	8.12	9
7.	Ammayambalam	27	7.07	9
8.	Marappalam Major	26	6.81	31
9.	Empong	26	6.81	11
	Total	382	100.00	

Total composition species wise

Surprisingly, Marapplam major which had the least number of individuals had the maximum number of species (31). This was followed by Mottal Mood, Karinkurinji, Pillekode, Sastha Nada and Empong which had species in the range of 14 to 11. Marappalam Minor had the least number of species (6).

Species occurrence in transects

Trimeruserus malabaricus was present in all 9 transects, *Xenochrophis piscator* in 8 Calotes *ellioti* in 7 transects and *Mabuya macularia* in 7 transects. There were 7 species recorded from one transect each only.

Transect wise species dominance

Mabuya macularia was most common in 3 transects. *Sphenomorphus dussumeri* and *Trimeruserus malabaricus* were common in two transects each.

Reptiles out side swamps: First year

Total Composition individuals

There were a total of 85 individuals from 15 transects. The maximum was in Karinkurinji (13%) followed by Marapplam Minor (11%) and Mottal Mood (11%). The least was inSastha Nada which had only about 1% of the individuals.

Total composition species wise

Karikurinji had 6 speceis, while Muppathadi and Marappalam had 5 speceis each. The least was in Sastha Nada which had only one species.

Species occurrence in transects

No species was present in all the transects. *Uropeltid macrolepis* was present in 11 transects. *Hypnale hypnale* and *Mabuya macularia* were present in 5 transects each. *Trimeruserus malabaricus* was the most common species in 8 transects. *Mabuya macularia* was dominant in three swamps.

Table 3.4.17 Abundance and number of species (N and S) of reptiles outside the swamps during I year across the swamps

No.	Transect	Total	%	No of Species
1.	Karinkurinji	11	12.94	6
2.	Mottal Mood	9	10.59	4
3.	Marappalam Minor	9	10.59	4
4.	Muppathadi	8	9.41	5
5.	Marappalam Major	7	8.24	5
6.	Poovanthu Mood-1	7	8.24	2
7.	Ammayambalam	6	7.06	4
8.	Poovanthu Mood-3	6	7.06	4
9.	Poovanthu Mood-0	5	5.88	2
10.	Poovanthu Mood-4	5	5.88	4
11.	Emponge	4	4.71	3
12.	Uthiran Chira	4	4.71	4
13.	Chakidi Chal	3	3.53	2
14.	Sastha Nada	1	1.18	1
	Total	85	100.00	

Reptiles outside swamps: Second year

Total Composition individuals

A total of 63 individuals were recorded from 7 transects. Mottal mood contained the maximum number of individuals (63%). This was followed by Uthiran Chira and Karinkurinji. The least was in Ammayambalam (6%). No animals were recorded from two transects.

Total composition species wise:

Number of species was in the same order as number of individuals with Mottal Mood recording 8 species and Ammayambalam recording 3 species.

Species occurrence in transects:

Three species *Hypnale hypnale*, *Otocryptis beddomii* and *Riopa punctata* were present in three transects each. Six species were present in one transect each only.

Transect wise species dominance.

Only one species was found to be common to two transects.

Table 3.4.18 Abundance and number of species (N and S) of reptiles outside the swamps during II year across the swamps

No	Plot	*Total*	%	No of species
1.	Mottal Mood	40	63.49	8
2.	Marappalam Major	8	12.70	4
3.	Uthiran Chira	6	9.52	3
4.	Karikurinji	5	7.94	3
5.	Ammayambalam	*4*	6.35	3
	Total	63	100.00	

3.4.3 Ecological perspective

Swamp wise

Amphibians

The wet swamps of Uthiran Chira, Emponge and PilleKode showed the highest abundance of 30.17%, 13.46% & 10.32% in that order which is expected as these swamps remain moist even during the driest seasons. The driest swamp Sastha Nada had the lowest percent abundance of 4.54%. It is surprising that the swamp Ammayambalam which is quite moist in comparison with other swamps had only 5.09% of the total abundance while the drier swamp Marappalam Minor had 10.25%. This may be attributed to other factors such as litter and canopy cover and variety of microhabitats all of which are higher in Marappalam Minor. (Table 3.4.19 and Fig 3.4.18a). The trends were very different in the transects outside the swamps with Ammayambalam, Karinkurinji and Uthiran Chira having the highest abundance in that order. Species richness was the highest in Uthiran Chira, Marappalam Minor and Major with 31, 29 and 28 species respectively inside the swamps while on the outside of the swamps Ammayambalam and Marappalam Major had the maximum number of 13 species followed by Karinkurinji with 11 and Uthiran Chira with 10 (Fig 3.4.18b.). Though the trends obtained from the transects outside the swamps are not exactly reciprocal, they seem to indicate that where abundances are very high inside the swamp the corresponding transect has a relatively low abundance and vice versa. Hypothesizing from the above observations it may be suggested that amphibians move into the swamps not only to avoid the harshness of dry season (inundation is not the only factor) but also for other habitat parameters such as high litter cover and depth, high canopy cover, etc.

Table 3.4.19 Abundance, Percentage abundance, and number of species of amphibians recorded during transect sampling for different swamps from inside and outside the *Myristica* swamps for two years.

	INSIDE			OUTSIDE		
Swamps	No.of individuals sighted	%	No of species sighted	No of individuals sighted	%	No of species sighted
Uthiran Chira	4760	30.17	31	156	14.84	10
Emponge	2123	13.46	25	52	4.95	7
Pillekode	1629	10.32	22	17	1.62	3
Marappalam Minor	1618	10.25	29	25	2.38	6
Mottal Mood	1510	9.57	26	72	6.85	8
Marappalam Major	1416	8.97	28	127	12.08	13
Karinkurinji	1202	7.62	21	193	18.36	11
Ammayambalam	804	5.10	22	403	38.34	13
Sastha Nada	716	4.54	20	6	0.57	3
Total	15778	100		1051	100	

The swamp-wise change in the richness, dominance, diversity, and evenness for the amphibians recorded from inside the swamps are given in Fig 3.4.16. These

values showed a significant difference at the 0.01 level for (2-tailed) with the values obtained for outside the swamps (Table 3.4.20). The dendrogram for month wise similarity for species distribution is given in Fig 3.4.17 highlights the clusters formed by the wet swamps (Emponge and PilleKode) which is linked to Uthiran Chira the wettest swamp of the lot. These three swamps lie far apart from each other and the feeder streams drain into different tributaries of the Kulathupuzha.

Table 3.4.20 Differences between the diversity indices of transects inside and outside the *Myristica* swamps calculated using Paired Samples Test

Variables	Mean	Std. Error Mean	t
Margalef	1.62	0.15	10.971**
Evenness	-0.31	6.19E-02	-5.038**
Shanon	0.45	8.05 E-02	5.572**
Dominance	-8.03E-02	2.21E-02	-3.633**

** Significant at P= 0.01 * Significant at P= 0.05

The similarity in this case may be explained by the similarity in inundation patterns and other microhabitat conditions. This group stands apart from the other swamps with the wettest swamp Uthiran Chira being the most different. Marappalam Minor and Mottal Mood show the highest similarity and are linked to Marappalam Major. These three swamps lie close to each other and the feeder streams of all the three drain directly into a tributary of the Kulathupuzha River, Kunjuman Thodu. Ammayambalam and Sastha Nada are not at all similar in terms of location, feeder streams or microhabitat parameters. But they show similar species composition and distribution, probably because both the swamps have conditions less preferred by the amphibians. Karinkurinji has been linked to this group. Karinkurinji lies close to Sastha Nada and flow into the same stream. In fact it is suspected that initially Sastha Nada, Karinkurinji and another swamp patch may have formed a single large swamp patch before being fragmented into three by the Sankli road and plantation work.

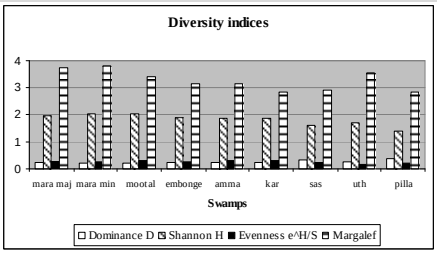


Fig 3.4.16: Variations in the Dominance, Diversity, Evenness and Richness indices across the swamps for two years from March 2005 to February 2007in the *Myristica* swamp forests of Southern Kerala.

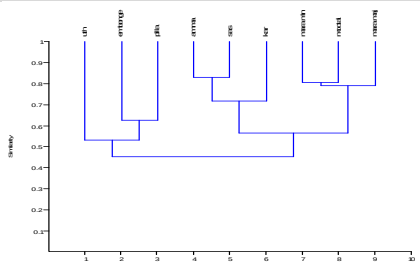


Fig 3.4.17: Dendrogram of swamp wise similarity shown by amphibian species composition of *Myristica* swamps using Bray Curtis Similarity index.

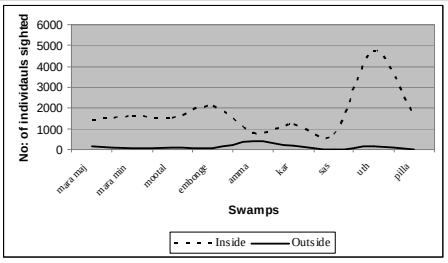


Fig 3.4.18 a. Differences in the abundance trends of amphibians over the swamps inside and outside the swamps

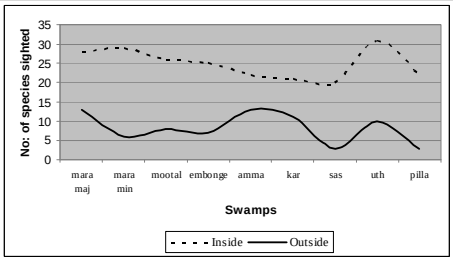


Fig 3.4.18b . Differences in the species richness trends of amphibians over the swamps inside and outside the swamps

Reptiles

The swamps Marapalam Minor, Mottal Mood and Karinkurinji showed the highest abundances of 14.70%, 14.70% and13.60%. The driest swamp Sastha Nada followed with 11.40%. Ammayambalam, Marappalam Major and Emponge came next with 10.44%, 10.16% and 10.03% respectively. The lowest percent abundance of 6.32% was at PilleKode. (Table 3.4.21 and Fig 3.4.21a&b). The trends in the transects outside the swamps are quite interesting with Mottal Mood and Karinkurinji having 42.48% and 14.16% respectively. But Marappalam Minor which had the highest percent abundance with Mottal Mood in the transects inside the swamps has only 7.96 %. Marappalam Major had 13.27%. PilleKode had the lowest percentage abundance, no animals (Fig 3.4.21b).

Table 3.4.21 Abundance, Percentage abundance, and number of species of reptiles recorded during transect sampling for different swamps from inside and outside the *Myristica* swamps for two years.

	INSIDE			OUTSIDE		
Swamps	No individuals sighted	%	No species sighted	No individuals sighted	%	No species sighted
Marappalam Minor	107	14.70	15	9	7.96	4
Mottal Mood	107	14.70	19	48	42.48	11
Karinkurinji	99	13.60	19	16	14.16	9
Sastha Nada	83	11.40	17	1	0.88	1
Ammayambalam	76	10.44	21	10	8.85	5
Marappalam Major	74	10.16	21	15	13.27	8
Emponge	73	10.03	16	4	3.54	3
Uthiran Chira	63	8.65	16	10	8.85	6
Pillekode	46	6.32	15	0	0.00	0
Total	728	100		113	100	

The trends obtained from the transects outside the swamps are similar to those from inside the swamps though the swamp-wise change in the diversity indices (given in Fig 3.4.19) showed significant differences with the values obtained for outside the swamps (Table 3.4.22). Drawing inference from the above, it may be suggested that though there is a wide gap between the number of individuals and species sighted from the transects inside the swamps and the

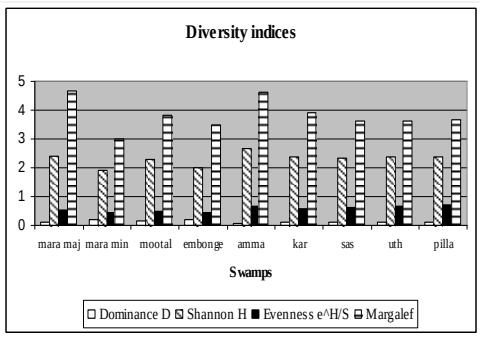
transects outside the swamps, the general trend of diversity and abundance across the swamps are similar for the outside and inside figures. This is quite in contrast to that of amphibians. The dendrogram for month wise similarity for species distribution is given in Fig 3.4.20

Table 3.4.22 Differences between the diversity indices of transects inside and outside the *Myristica* swamps calculated using Paired Samples Test

Variables	Mean	Std. Error Mean	t
Margalef	2.1800	0.33	6.651**
Evenness	-0.2887	3.71E-02	-7.777**
Shanon	1.0604	0.2665	3.979**
Dominance	0-.2673	0.1169	-2.287*

**Significant at P= 0.01, * Significant at P= 0.05

Significant clusters are Karinkurinji and Mottal Mood and Ammayambalam and Marappalam Major. Emponge shows similarity to Ammayambalam and Marappalam Major. All the other swamps stand apart as single entities with Sastha Nada as most different. As expected this grouping is much different from that obtained for amphibians. The environmental parameters most affecting this distribution seems to be the presence of knee roots and stilt roots, undergrowth especially *Legenandra ovata* and *Phrynium*. Though Uthiran Chira is literally blanketed with Arial roots, year around inundation and highly acidic water and soil, lack of litter except in the periphery, etc may serve as a deterrent to dense reptile population.



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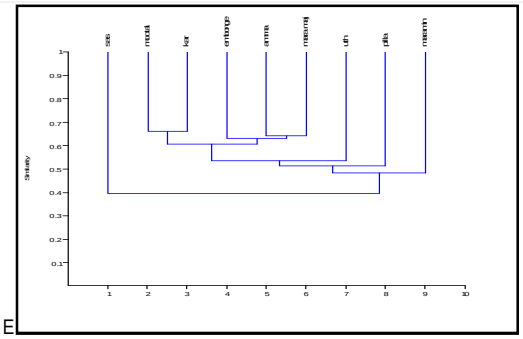
3.4.19: Variations in the Dominance, Diversity, Evenness and Richness indices across the swamps for two years from March 2005 to February 2007in the *Myristica* swamp forests of Southern Kerala



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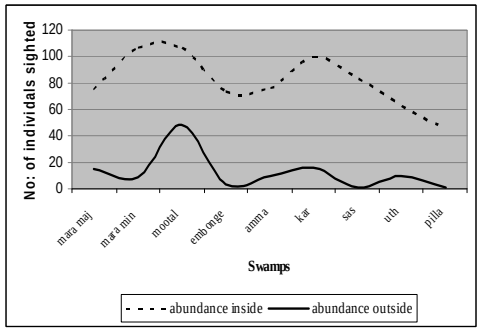
3.4.20: Dendrogram of swamp wise similarity shown by reptile species composition of *Myristica* swamps using Bray Curtis Similarity index.



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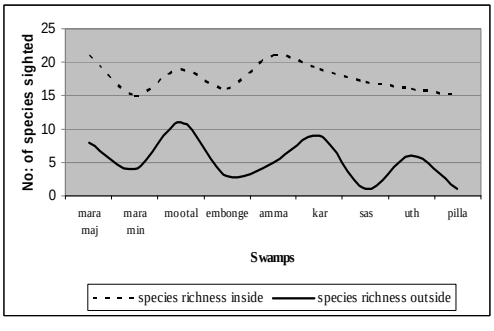
3.4.21a. Differences in the abundance trends of reptiles over the swamps inside and outside the swamps



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3.4.21b. Differences in the species richness trends of reptiles over the swamps inside and outside the swamps

Month wise

Amphibians

The month-wise change in the richness, dominance, diversity, and evenness for the amphibians recorded from inside the swamps are given in Fig 3.4.22a and 3.4.22b. These values showed a significant difference at the 0.01 level for (2-tailed) with the values obtained for outside the swamps. There was no significant difference in the dominance values (Table 3.4.24). This could be because the species *Limnonectes keralensis* and *Rana temporalis* made up bulk of the population, both inside and outside the swamps. Another interesting pattern is the positive correlation, significant at the .01 level (2-tailed), between the abundance of a particular species and the total number of swamps it was found in. This follows the view that high cumulative relative abundance of a species is also correlated to high niche breadth. Dendrogram of month wise similarity shown by amphibian species composition of *Myristica* swamps using Bray Curtis Similarity index (paired linkage).

The dendrogram for month wise similarity for species distribution is given in Fig 3.4.24 and it highlights the clusters formed by the wet months (June, July, August), the dry months (January , February, March, April) and the moderate wet months (September, October, November, December). The Kulathupuzha region gets rains all around the year. The first rains usually fall by the end of March and by the beginning of May the rains can be attributed to the South west monsoons. There is a slight lull in the rains during the months of September and October. The precipitation during the Northeast and retreating South west monsoons get overlapped and these are heavy deluges though for a shorter duration when compared to the evenly distributed rainfall of the South west monsoons. The months of November and December may get a few rains. The clumping of the months indicates that the amphibian population may vary according to the variations in precipitation and associated changes in temperature and humidity.

Table 3.4.23 Abundance, Percentage abundance, and number of species of amphibians recorded during transect sampling for different months from inside and outside the *Myristica* swamps.

	INSIDE			OUTSIDE		
Months	No of individuals sighted	%	No of species sighted	No of individuals sighted	%	No of species sighted
March	1348	7.19	31	0	0	0
April	1326	7.07	28	3	0.25	3
May	1529	8.16	19	113	9.28	10
June	2262	12.07	19	225	18.47	9
July	3010	16.06	28	228	18.72	16
August	2560	13.65	23	166	13.68	17
September	1037	5.53	25	60	4.93	7
October	717	3.82	25	90	7.39	9

	INSIDE			OUTSIDE		
Months	No of individuals sighted	%	No of species sighted	No of individuals sighted	%	No of species sighted
November	1196	6.38	26	71	5.83	12
December	963	5.14	25	144	11.82	9
January	1257	6.70	31	83	6.81	13
February	1543	8.23	34	35	2.87	8
Total	18748	100		1218	100	

Table 3.4.24: Differences between the diversity indices of transects inside and outside the *Myristica* swamps calculated using Paired Samples Test

Variables	Mean	Std. Error Mean	t
Margalef	1.54	0.33	4.633**
Evenness	-0.21	7.13	-2.968**
Shanon	0.54	0.16	3.462**
Dominance	-5.26	2.75	-1.915^{ns}

**Significant at P= 0.01, ns= non significant

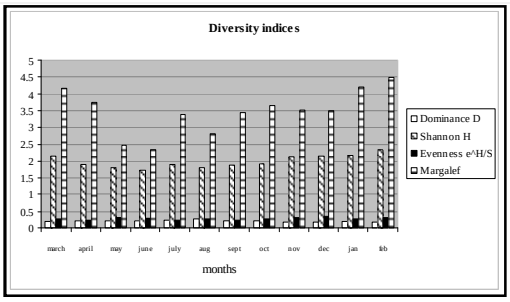

Fig 3.4.22a: Variations in the Dominance, Diversity, Evenness and Richness indices across the months for two years from March 2005 to February 2007in transects inside the *Myristica* swamp forests of Southern Kerala

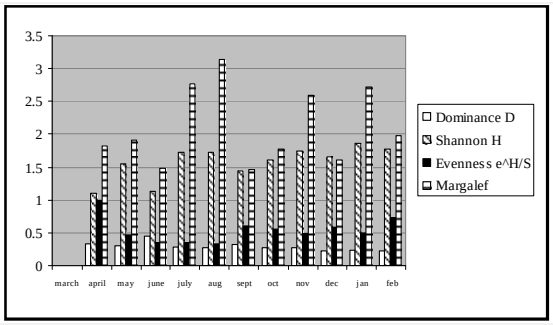

Fig 3.4.22b: Variations in the Dominance, Diversity, Evenness and Richness indices across the months for two years from March 2005 to February 2007in transects outside the *Myristica* swamp forests of Southern Kerala

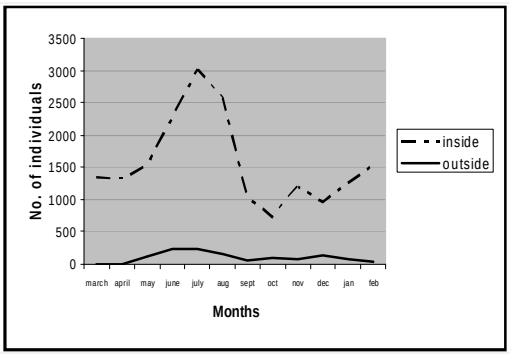

Fig 3.4.23a. Differences in the abundance trends of amphibians over the months inside and outside the swamps

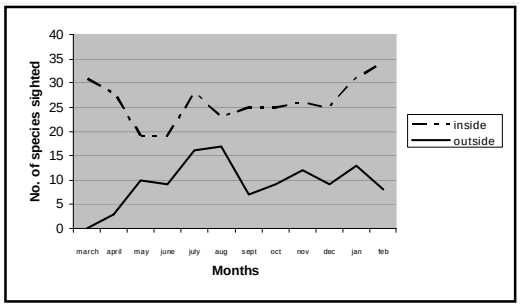

Fig 3.4.23b. Differences in the species richness trends of amphibians over the months inside and outside the swamps

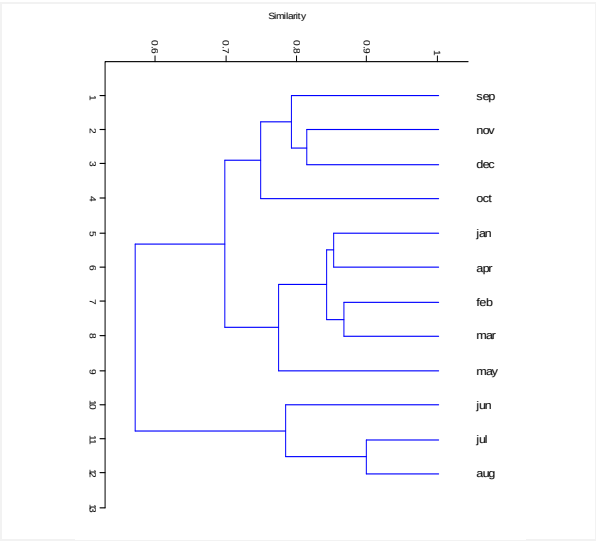

Fig 3.4.24: Dendrogram of month wise similarity shown by amphibian species composition of Myristica swamps using Bray Curtis Similarity index.

Reptiles

The month-wise change in the richness, dominance, diversity, and evenness for the amphibians recorded from inside the swamps are given in Fig 3.4.25a and 3.4.25b. These values showed a significant difference at the 0.01 level for (2-tailed) with the values obtained for outside the swamps (Table. 3.4.26). Another interesting pattern is the positive correlation, significant at the 0.01 level (2-tailed), between the abundance of a particular species and the total number of swamps they inhabit. The amphibian population also followed this trend. The reptilian population differs from the amphibian population by reduced dominance shown by any particular species, genera or family. Though *Trimeruserus malabaricus*, *Mabuya macularia* and *Sphenomorphus dussumeri*, are relatively more abundant than the other species, and the family Scincidae and Viperidae shows dominance it is not as high as that shown by the family Ranidae in amphibians. Dendrogram of month wise similarity shown by reptilian species composition of *Myristica* swamps using Bray Curtis Similarity index (paired linkage).

The dendrogram for month wise similarity for species distribution is given in Fig 3.4.27 The wet months (June, July, August) cluster together. January and April, October and December and May and March form natural clusters.

Table 3.4.25 Abundance, Percentage abundance, and number of species of reptiles recorded during transect sampling for different months from inside and outside the *Myristica* swamps.

	Inside			Outside		
Month	Abundance	%	Species	Abundance	%	Species
February	146	15.27	21	6	4.05	5
August	98	10.25	26	10	6.76	5
January	96	10.04	21	11	7.43	7
July	92	9.62	23	18	12.16	8
June	80	8.37	18	22	14.86	9

	Inside			Outside		
Month	Abundance	%	Species	Abundance	%	Species
March	79	8.26	22	7	4.73	4
September	73	7.64	20	6	4.05	4
November	67	7.01	21	5	3.38	3
May	66	6.90	25	15	10.14	6
April	60	6.28	19	12	8.11	5
December	56	5.86	18	28	18.92	7
October	43	4.50	15	8	5.41	5
	956	100		148	100	

Table 3.4.26 Differences between the diversity indices of transects inside and outside the *Myristica* swamps calculated using Paired Samples Test.

Variables	Mean	Std. Error Mean	t
Margalef	-0.16	2.76	-5.823**
Eveness	-0.51	3.56	-14.423**
Shanon	-0.51	3.56	-14.423**
Dominance	2.63	0.24	10.798**

**Significant at at P= 0.01

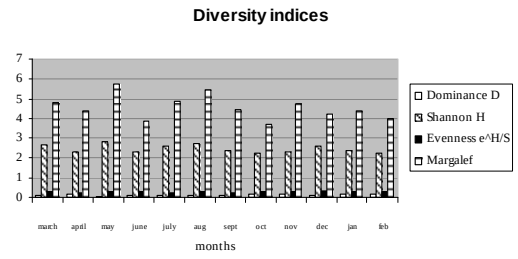

Fig 3.4.25 a: Variations in the Dominance, Diversity, Evenness and Richness indices across the months for two years from March 2005 to February 2007in transects inside the *Myristica* swamp forests of Southern Kerala

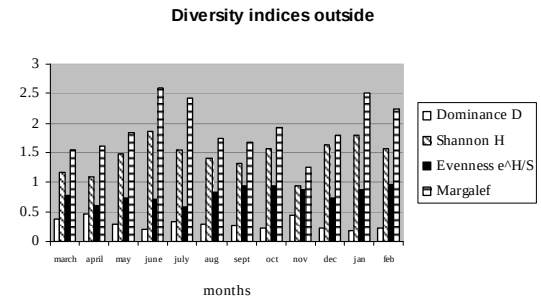

Fig 3.4.25 b: Variations in the Dominance, Diversity, Evenness and Richness indices across the months for two years from March 2005 to February 2007in transects outside the *Myristica* swamp forests of Southern Kerala

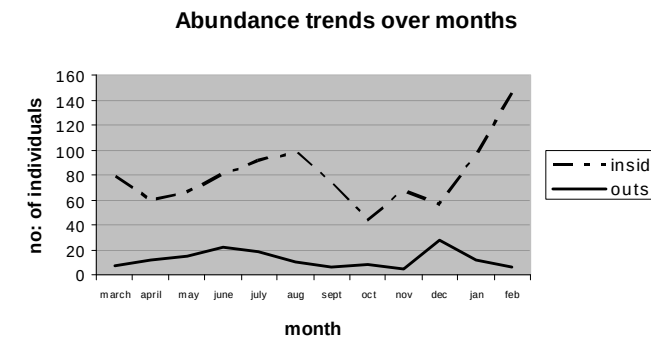

Fig 3.4.26 a Differences in the abundance trends of reptiles over the months inside and outside the swamps

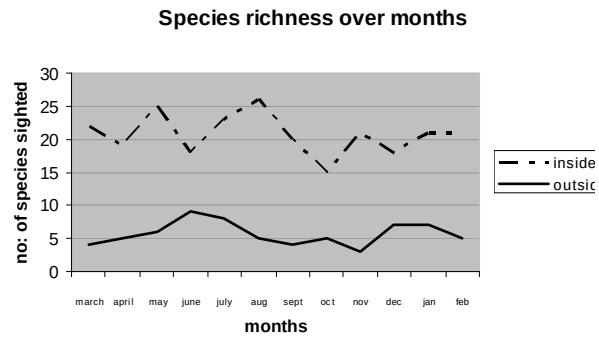

Fig 3.4.26 b Differences in the species richness trends of reptiles over the months inside and outside the swamps

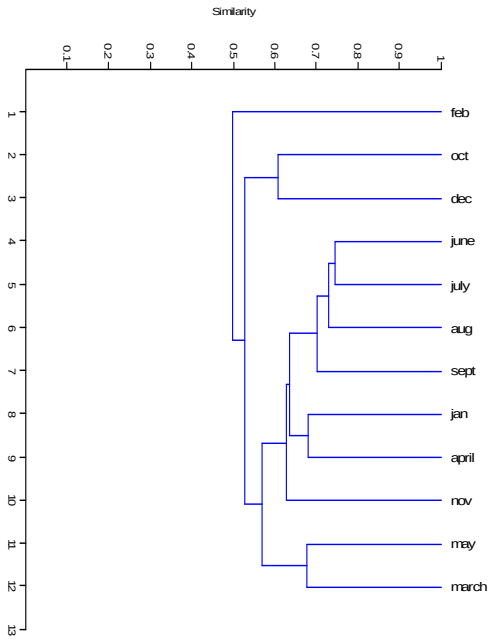

Fig 3.4.27: Dendrogram of month wise similarity shown by reptilian species composition of *Myristica* swamps using Bray Curtis Similarity index.

Diurnal and Nocturnal patterns

A total of 3062 amphibians and reptiles were sighted during the 13 months from October 2005 to October 2006. Of these, 1278 were seen during day and 1784 during night which was 41.737% and 58.262% of the total respectively. Of these 2844 were amphibians and 218 were reptiles. Amphibians constituted 92.88047 % and reptiles 7.11953% of the total. Marappalam Minor with 1694 individuals made up 55.32332% of the total sightings while Mottal Mood made up 44.67668% with 1368 sightings. Taking each of the groups as individual entities the following distribution could be observed.

Table 3.4.27 Summary of herpeto-faunal population encountered in day and night study

	Numbers	Percentages
Total	3062	
Day	1278	41.737
Night	1784	58.262
Reptiles	208	
Day	126	57.79
Night	92	42.201
Amphibians	2844	
Day	1152	40.576
Night	1692	59.493

It is basically the amphibians which sway the total percentages because of their higher number. Reptiles and amphibians have widely differing ecological needs which is reflected in the day- night distribution of both groups. The day night distribution in amphibians and reptiles are almost reversed.

Amphibians:

Case A- The data pertain to number of amphibians sighted during night and day for 13 months. The observations are paired by months.

Table 3.4.28 No. of amphibians sighted during night and day for 13 months with non-parametric calculations

Month	Night	Day	Difference d	Rank of d	Rank with less frequent sign
October	107	27	80	7	
November	118	43	75	6	
December	126	35	91	10	
January	160	32	128	12	
February	249	114	135	13	
March	194	111	83	8	
April	149	63	86	9	
May	51	82	-31	-5	5
June	201	323	-122	-11	11
July	141	153	-12	-3	3
August	93	72	21	4	
September	54	47	7	2	
October	48	50	-2	-1	1

Here, N = 13 ,T =20 (5+11+3+1). The calculated T value (20) is more than the tabular t value, 17, for N= 13 at 5% significance. It may therefore be concluded that there is a significant difference between the amphibian abundances during night and day.

Case B- The data pertain to number of amphibian species sighted during night and day for 13 months.

Table 3.4.29 No. of amphibian species sighted during night and day for 13 months with non-parametric calculations

Month	Night	Day	Difference d	Rank of d	Rank with less frequent sign
October	12	5	7	10	
November	11	10	1	2.5	
December	12	8	4	8.5	
January	16	8	8	11	
February	20	18	2	5	
March	16	16	0		
April	11	7	4	8.5	
May	9	8	1	2.5	
June	13	10	3	6.5	
July	10	11	-1	-2.5	2.5
August	9	9	0		
September	6	9	-3	-6.5	6.5
October	9	8	1	2.5	

Here, N = 11, T = 9 (6.5+2.5). The calculated T value (9) is less than the tabular t value, 11, for N = 11 at 5% significance. It may therefore be concluded

that there is no significant difference between the amphibian species richness during night and day.

Reptiles: Observations and Results:

Case A- The data pertain to number of reptiles sighted during night and day for 13 months. The observations are paired by months.

Table 3.4.30 No. of reptiles sighted during night and day for 13 months with non-parametric calculations

Month	Night	Day	Difference d	Rank of d	Rank with less frequent sign
October	3	2	1	2	2
November	51	7	44	13	13
December	15	6	9	8	8
January	2	13	-11	-9	
February	6	19	-13	-10	
March	3	11	-8	-6.5	
April	2	20	-18	-12	
May	3	11	-8	-6.5	
June	5	20	-15	-11	
July	0	7	-7	-5	
August	0	6	-6	-4	
September	1	2	-1	-2	
October	1	2	-1	-2	

Here, N = 13, T = 23 (2+13+8). The calculated T value (23) is more than the tabular t value, 17, for N= 13 at 5% significance. It may therefore be concluded that there is a significant difference between the reptile abundances during night and day.

Case B- The data pertain to number of reptiles species sighted during night and day for 13 months.

Table 3.4.31 No. of reptilian species sighted during night and day for 13 months with non-parametric calculations

Month	Night	Day	Difference d	Rank of d	Rank with less frequent sign
October	1	2	-1	-2.5	
November	2	5	-3	-7	
December	4	5	-1	-2.5	
January	1	4	-3	-7	
February	4	7	-3	-7	
March	2	4	-2	-5	
April	2	7	-5	-11.5	
May	2	7	-5	-11.5	
June	4	11	-7	-13	
July	0	4	-4	-9.5	
August	0	4	-4	-9.5	
September	1	2	-1	-2.5	
October	1	2	-1	-2.5	

Here, N = 13, T could not be calculated. As T value could not be calculated as all ranks have similar signs, the test could not be proceeded with. Since every month higher number of species was observed during day, it may be concluded that there is a significant difference between the reptiles species richness during night and day. Both the swamps followed the same pattern, though the number of reptiles was very less in Mottal Mood when compared to Marapalam Minor.

This could be due to:

high inundation both in terms of depth and area coverage

lower temperature

lesser basking spaces

Comparison over the two years

In this section a comparison has been done for the diversity and abundance patterns shown by amphibians and reptiles inside and outside the nine *Myristica* swamps where sampling was carried out for both years. Reptiles and Amphibians have been treated as separate groups. Comparison has been done only for the patterns shown for the two years and not for inside and outside the swamps to avoid repetition.

Amphibians

A total of 46 species of amphibians were recorded from the transects. Muppathadi had 30 species; Marappalam Minor had 28 species while Uthiran Chira had 25. The transects in Sastha Nada and Karinkurinji showed the least (15) number of species. As many as 8 species were present in all the 15 transects. Another nine species were present in 10 or more transects. On the lower side, 5 species were recorded from one transect only. (Table 3.4.32 and Appendix IV & VI). Tadpoles of the three dominant species namely - *Nyctibatrachus major*, *Limnonectes keralensis*, and *Rana temporalis* were found in 8, 2 and 3 swamps respectively. *Limnonectes keralensis* was the most common species in 7 transects. *Nyctibatrachus major* was the most common species in 5 transects. *Rana temporalis* was the most common species in 3 transects.

In the second year: A total of 8327 individuals were recorded from 9 transects (Table 3.3.2). (If the number of amphibians in all swamps were considered to be uniform over space and time then there would have been 13,878 individuals (8327/9*15= 13,878) as the total for 15 transects in the second year. This would be an increase over the first year total of 10,421. But this comparison can be misleading. If location being considered the constant the total number of 8327 individuals from 9 swamps be compared with the total number of 7451 individuals counted from only these swamps during the first year then it contradicts the earlier statement of an increase in population on the second year. It can only be concluded that more data over a larger time span is needed to

predict the trends in amphibian populations. Uthiran Chira had the maximum number of individuals (31%) followed by PilleKode (12%) and Marappalam Minor (12%). The least was in Ammayambalam (5.50%).Of the total, *Rana temporalis* constituted 28%, *Limnonectes keralensis* 26%, *Nyctibatrachus major* 16% and *Euphlictis cyanophlictis* 11%. Species wise, Marappalam Major recorded the maximum (24 species). Marappalam Minor had 23 species and Sastha Nada (17 species) and Ammayambalam (14 species) recorded the least.

As many as 9 species were present in all the plots. Three species each were present in 8 and 7 plots. Four species were seen from only one plot. Tadpoles of *Nyctibatrachus major* were found in two swamps. The total number of species sighted from the transects decreased from 46 species in the first year to 35 in the second year. The decrease in tadpoles and species diversity may be attributed to various reasons – The Poovanathu Mood series swamps along with Muppathadi may be more conducible for species diversity. *Limnonectes keralensis* was the most common species in 5 transects. *Nyctibatrachus major* was the most common species in 3 transects. *Rana temporalis* was the most common species in 1 transect.

Diversity indices

The swamp wise change in the richness, dominance, diversity, and evenness for the amphibians recorded from inside the swamps for the first and second years are given in Fig 3.4.28a and 3.4.28b. The values obtained for the first year did not show any significant difference at the 0.05 level for (2-tailed) with the values obtained for the second year in the swamps (Table 3.4.33). The Shanon(5%), evenness(5%) and dominance (1%) indices values for the first and second years showed significant correlation with each other. The dendrogram for swamp wise similarity for species distribution for first year and second year is given in Fig 3.4.30a and 3.4.30b and it highlights the clusters formed by the swamps; Marappalam Major , Marappalam Minor and Mottal Mood, and to a lesser extent Ammayambalam and Karinkurinji. The similarity between Emponge and Uthiran Chira in the first year is being not repeated during the second year is probably due to the desiccation of Emponge due to less inundation caused by temporary stream blocks built for fishing and water diversion purposes by the local inhabitants. The similarity between PilleKode and Sastha Nada has also not been repeated and this too may be attributed to the habitat alteration made by anthropogenic disturbances. As the dendrogram is also affected by the presence and absence of even one particular species whereas the diversity indices deal more with the numbers, it may be concluded that though the overall species abundance and diversity patterns remain the same over the two years there is change in species richness and distribution (Fig 3.4.29a and 3.4.29b) of the non-dominant species.

Outside

Table 3.4.32 Abundance, Percentage abundance, and number of species of amphibians recorded during transect sampling for different swamps from inside and outside the *Myristica* swamps for first year and second year.

First Year

	INSIDE			OUTSIDE		
Months	No. of individuals sighted	%	No. of species sighted	No. of individuals sighted	%	No. of species sighted
Marappalam Major	*533*	*7.15*	*21*	*54*	*13.60*	*10*
Marappalam Minor	643	8.63	28	15	3.78	5
Mottal Mood	646	8.67	20	22	5.54	4
Emponge	1305	17.51	20	26	6.55	5
Ammayambalam	506	6.79	20	97	24.43	10
Karinkurini	742	9.96	16	27	6.80	9
Sastha Nada	258	3.46	15	6	1.51	3
Uthiran Chira	2210	29.66	29	133	33.50	9
Pillekode	608	8.16	17	17	4.28	3
Total	7451	100		397	100	

Second Year

MONTHS	INSIDE			OUTSIDE		
	No. of individuals sighted	%	No of species sighted	No of individuals sighted	%	No of species sighted
Uthiran Chira	2550	30.62	21	23	3.52	3
Pillekode	1021	12.26	21	0	0.00	0
Marappalam Minor	975	11.71	22	10	1.53	2
Marappalam Major	883	10.60	24	73	11.16	8
Mottal Mood	864	10.38	22	50	7.65	6
Emponge	818	9.82	19	26	3.98	6
Karinkurini	460	5.52	18	166	25.38	10
Sastha Nada	458	5.50	17	0	0.00	0
Ammayambalam	298	3.58	14	306	46.79	12
Total	8327	100		654	100	

able 3.4.33 Differences between the diversity indices of amphibians sighted in the transects inside the *Myristica* swamps for the first and second years, calculated using Paired Samples Test

	Paired Differences Mean	Paired Differences Std. Error Mean	t	df
Shanon	4.94E-02	5.89E-02	0.840 ns	8
Eveness	1.83E-02	1.24E-02	-1.473 ns	8
Margalef	-0.21	0.20	-1.021 ns	8

Dominance	1.83E-02	1.24E-02	-1.473 ns	8

ns= non significant

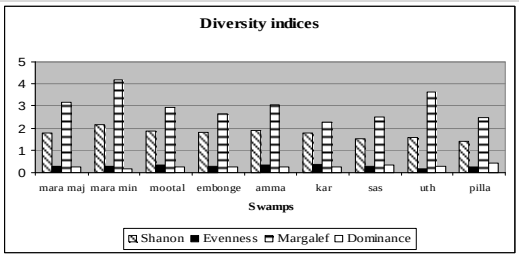

Fig 3.4.28 a : Variations in the Dominance, Diversity, Evenness and Richness indices across the nine swamps for the year from March 2005 to February 2006 in the *Myristica* swamp forests of Southern Kerala

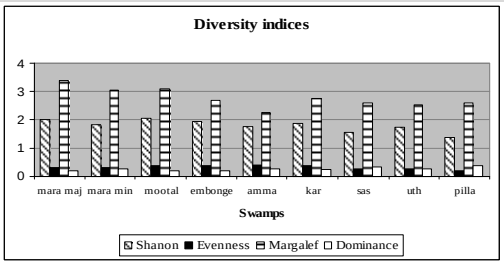

Fig3.4.28 b : Variations in the Dominance, Diversity, Evenness and Richness indices across the nine swamps for the year from March 2006 to February 2007 in the *Myristica* swamp forests of Southern Kerala

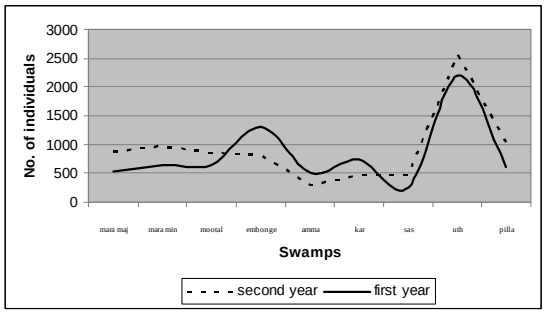

Fig 3.4.29 a. Differences in the abundance trends of amphibians over the swamps for two years

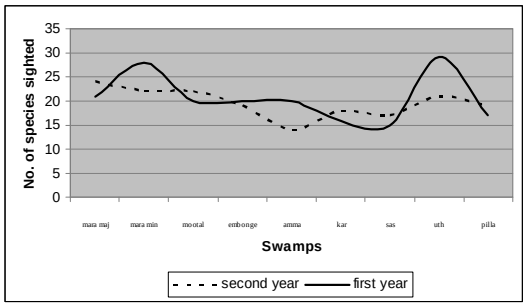

Fig 3.4.29 b. Differences in the species richness trends of amphibians over the swamps for two years

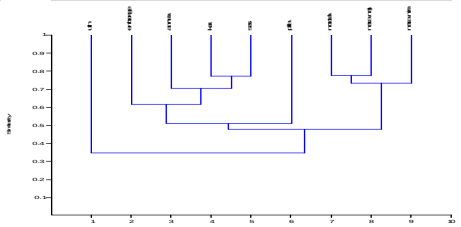

Fig 3.4.30 a: Dendrogram of swamp wise similarity shown by amphibian species composition of *Myristica* swamps using Bray Curtis Similarity index for first year

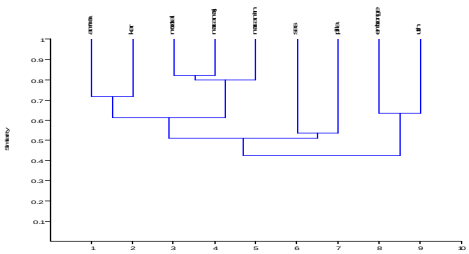

Fig 3.4.30 b: Dendrogram of swamp wise similarity shown by amphibian species composition of *Myristica* swamps using Bray Curtis Similarity index for second year

Reptiles

In the first year a total of 576 individuals were recorded from 15 transects. The relative abundance was in the range of 7-9%. The least was from PilleKode which had 2.44%. Forty one species were present in the transects. Marappalam Major (27 species) had the maximum number of species followed by Poovanathu Mood-0 (19) (Table 3.4.34 and Appendix IV & VI). The least was in Chakidi Chal (9) and PilleKode (10). *Mabuya macularia* was present in all the transects. *Trimeruserus malab*aricus was present in 14 plots. As many as 9 species were present in only one transect. In 10 transects, *Trimeruserus malabaricus* was the most common species. *Mabuya macularia* and *Sphenomorphus dussumeri* were the most common in two transects each. In the second year, there were total of 382

individuals in 9 transects. Mottal mood had the maximum number of individuals (17%), followed by Sastha Nada , Marappalam Minor and Karinkurinji. Marappalam Major had the least (7%).

Surprisingly, Marappalam Major which had the least number of individuals had the maximum number of species (31). This was followed by Mottal mood, Karinkurinji, PilleKode , Sastha Nada and Empong which had species in the range of 14 to 11. Marappalam Minor had the least number of species (6) (Table 3.4.34). *Trimeruserus malabaricus* was present in all 9 transects*, Xenochrophis piscator* in 8 and *Calotes ellioti* in 7 and *Mabuya macularia* in 7 transects*.* There were 7 species recorded from one transect each only*. Mabuya macularia* was most common in 3 transects*. Sphenomorphus dussumeri* and *Trimeruserus malabaricus* were common in two transect each*.*

Diversity indices

The swamp wise change in the richness, dominance, diversity, and evenness for the amphibians recorded from inside the swamps for the first and second years are given in Fig 3.4.31a and 3.4.31b. The values obtained for the first year did not show any significant difference at the 0.05 level for (2-tailed) with the values obtained for the second year in the swamps (Table 3.4.35). The diversity indices were not co-related either. The dendrogram for swamp wise similarity for species distribution for first year and second year is given in Fig 3.4.33a and 3.4.33 b and the abundance and diversity patterns in Fig 3.4.32a and 3.4.32b indicate that unlike amphibians the reptiles show different patterns across the swamps in the first and second year. As reptiles are highly mobile and they are less densely and widely distributed, it may be unable to deduce patterns of distribution and abundance from two years data. Again unlike amphibians the reptiles are less dependent on the swamps for their existence and may have a much more extended home range. The presence or absence of these animals may also depend on the level and extent of inundation which is highly varying.

Outside

Table 3.4.34 Abundance, Percentage abundance, and number of species of reptiles recorded during transect sampling for different swamps from inside and outside the *Myristica* swamps for first year and second year.

First Year

	INSIDE			OUTSIDE		
Months	No of individuals sighted	%	No of species sighted	No of individuals sighted	%	No of species sighted
Marappalam Major	48	13.83	17	7	14	5
Marappalam Minor	50	14.41	13	9	18	4
Mottal Mood	41	11.82	11	8	16	4
Emponge	48	13.83	13	4	8	3
Ammayambalam	49	14.12	17	6	12	4
Karinkurini	45	12.97	14	11	22	6
Sastha Nada	20	5.76	11	1	2	1
Uthiran Chira	32	9.22	13	4	8	4
Pillekode	14	4.03	7	0	0	0
Total	347	100		50	100	

Second year

	INSIDE			OUTSIDE		
Months	No of individuals sighted	%	No of species sighted	No of individuals sighted	%	No of species sighted
Marappalam Major	26	6.81	11	8	12.70	4
Marappalam Minor	57	14.92	10	0	0.00	0
Mottal Mood	66	17.28	14	40	63.49	8
Emponge	26	6.81	7	0	0.00	0
Ammayambalam	27	7.07	11	4	6.35	3
Karinkurini	54	14.14	12	5	7.94	3
Sastha Nada	63	16.49	10	0	0.00	0
Uthiran Chira	31	8.12	9	6	9.52	3
Pillekode	32	8.38	14	0	0.00	0
Total	382	100		63	100	

Table 3.4.35 Differences between the diversity indices of reptiles sighted in the transects inside the *Myristica* swamps for the first and second years, calculated using Paired Samples Test.

	Paired Differences Mean	Paired Differences Std. Error Mean	t	df
Shanon	-8.00E-02	.14572739	-0.549 ns	8
Eveness	5.95E-02	3.46E-02	1.719 ns	8
Margalef	-0.58977778	0.31	-1.909 ns	8
Dominance	8.69E-03	3.42E-02	0.254 ns	8

ns= non significant

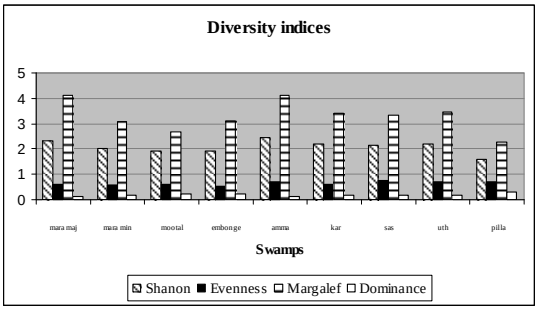

Fig 3.4.31 a : Variations in the Dominance, Diversity, Evenness and Richness indices across the nine swamps for the year from March 2005 to February 2006 in the *Myristica* swamp forests of Southern Kerala

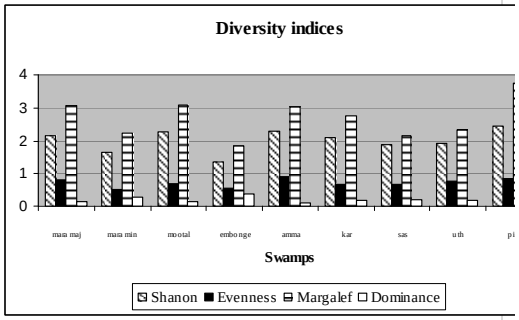

Fig3.4.31 b: Variations in the Dominance, Diversity, Evenness and Richness indices across the nine swamps for the year from March 2006 to February 2007 in the *Myristica* swamp forests of Southern Kerala

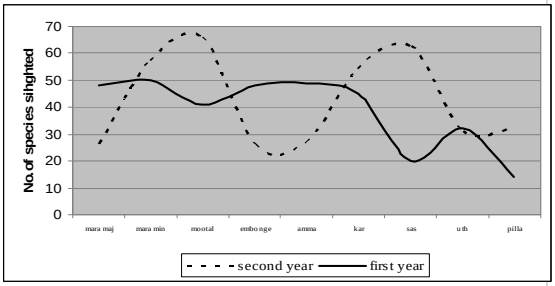

Fig 3.4.32 a. Differences in the abundance trends of reptiles over the swamps for two years

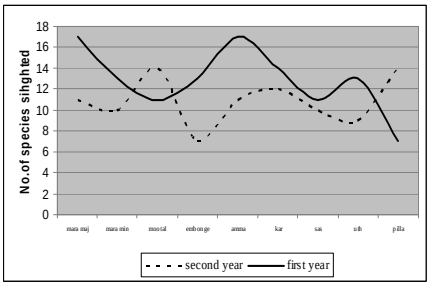

Fig 3.4.32 b. Differences in the species richness trends of reptiles over the swamps for two years

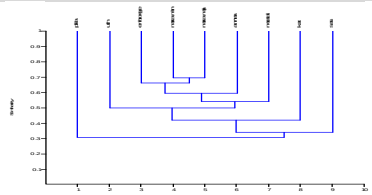

Fig 3.4.33 a: Dendrogram of swamp wise similarity shown by reptile species composition of *Myristica* swamps using Bray Curtis Similarity index for first year

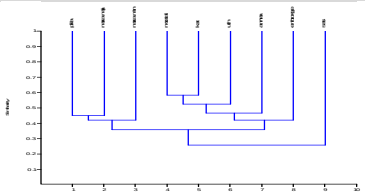

Fig 3.4.33 b: Dendrogram of swamp wise similarity shown by reptile species composition of *Myristica* swamps using Bray Curtis Similarity index for second year

As the microhabitat requirements and niche position of reptile and amphibians are highly different, their population patterns have not been compared as such an exercise would be futile and misleading in the absence of the context of factors which affect the populations of these groups.

3.4.4 Interactions between biotic and abiotic factors

Subtle changes in an ecosystem may not be directly observable or measurable but these can been understood by studying the diversity and abundance patterns of the flora and fauna of the ecosystem and the results of biodiversity quantification can be applied as an aid for management and conservation strategies.

The trees present in the *Myristica* swamps were divided into five categories; namely red, orange, yellow, green and blue, along an increasing gradient of tolerance to inundation starting with red at the lowest tolerance level. The number of trees in each category was correlated with the average area under inundation. The abundance of trees in the blue category showed positive correlation at 5% significance to the average area under inundation while those in other categories except orange showed negative correlation at 5%. The abundance of trees in orange category showed no correlation with the inundated area of the swamp. The two dominant trees in the swamp *Myristica fatua var. magnifica* and *Gymnacranthera farquharina* belonged to the blue category. The correlation between abundance of *Myristica fatua var. magnifica* and inundated area was highly significant at 1% but there was no significant correlation between *Gymnacranthera farquhariana* and inundated area.

The total abundance of frogs in various swamps was positively correlated to the area under inundation ($t = 2.65$, $p < 5\%$). The two dominant families Ranidae and Rhacophoridae followed the same trend ($t = 2.60$ and 2.43% respectively, $p < 5\%$). Of the ten most dominant frogs the abundance of four showed positive correlation to the area under inundation and the presence of *Myristica fatua var. magnifica* while the other six did not exhibit such result. The abundance of ten frog species showed no significant correlation to that of *Gymnacranthera farquharina.*

In a typical *Myristica* swamp average area under inundation should be 90-100% and depth of inundation should be at least 30cm. Dominant vegetation should be *Myristicaceae*, especially the highly inundation tolerant *Myristica fatua var. magnifica.* Other inundation tolerant trees with wider distribution range such as *Gymnacranthera farquhariana, Syzygium travancoricum, Lophopetalum wightianum*, *Vateria indica*, etc, should form the allied species while the trees of the red, orange and yellow categories would form edge species indicating nearness of swamps. In such a scenario, the dominant amphibians would be semi arboreal (*Rana temporalis*, *Rana aurantica* and *Polypedates psuedocruciger*) and purely aquatic (*Hoplobatrachus tigerinus)*.

But the ground truth is that *Myristica fatua var. magnifica* dominates in only three of the eight swamps. The other swamps are dominated by trees of

wider tolerance i.e. *Gymnacranthera farquhariana*, *Lophopetalum wightianum*, *Vateria indica* and *Syzygium travancoricum. These are* more inundation tolerant than the green category trees shows relatively low abundance in the swamps as only a few of the thousands of germinated seedlings survive. The presence and abundance of trees in the yellow, orange and red categories change with species overlapping into different levels of inundation.

In amphibians *Limnonectes keralensis* the second most abundant frog (N= 4638) dominates in four swamp while the most abundant *Rana temporalis* (N= 4665) dominates in the other four. Frogs of the *Indirana*, *Micrixalus*, *Nyctibatrachus* and *Philautus* genera etc. which have microhabitat requirements other than what should be available in a classical *Myristica* swamp, are also fairly abundant. Heterogeneity in microhabitat have led to increased diversity as amphibians and trees which are not tolerant to usual *Myristica* swamp conditions can also proliferate. These trees and amphibians are also found in evergreen forests and their presence indicates that many swamps do not have the required level of moisture to support a classical *Myristica* swamp.

Table 3.4.36 Correlation between abundance of various tree categories and average area under inundation for eight different *Myristica* swamps

Tree category	Tree species	*T value*
Red	*Dimocarpus longan, Dispyros buxifolia, Pinanga dicksonii, Strombosia ceylanica,, Tabernaemontana heyneana, Xylopia parvifolia*	-2.16*
Orange	*Hopea parviflora, Semecarpus auriculata, Syzygium travancoricum, Aporosa lindiliyana, Mastixia arborea, Elaeocarpus tuberculatus, Baccaurea courtallensis, Knema attenuata*	-1.14 ^{ns}
Yellow	*Hydnocarpus pentandra, Xanthophyllum arnottianum, Holigarna arnottiana*	-2.32*
Green	*Vateria indica, Lophopetalum wightianum*	-2.39*
Blue	*Myristica fatua var. magnifica*	7.18**
	Gymnacranthera farquhariana	0.429 ^{ns}
	Total for blue category	2.74*

^{ns} Non significant, * Significant at 5%, **Significant at 1%

Table 3.4.37 Correlation between abundance of selected amphibian species from eight *Myristica* swamps, average Inundated area (%) and abundance of *Myristica magnifica* trees from each of the swamps.

Amphibian species	Average area inundated	No. of *Myristica magnifica*
Rana temporalis	2.847297*	3.892959**
Limnonectes keralensis	0.793074 ^{ns}	1.251855 ^{ns}
Nyctibatrachus major	0.724695 ^{ns}	0.10812 ^{ns}
Euphlyctis cyanophlyctis	1.058651 ^{ns}	1.532676 ^{ns}
Polypedates psuedocruciger	2.453256*	2.979697*
Limnonectes limnocharis	0.986382 ^{ns}	0.942102 ^{ns}
Hoplobatrachus tigerinus	2.698415*	3.662463**
Nyctibatrachus minor	0.491449 ^{ns}	-0.1092 ^{ns}
Rana aurantiaca	3.233729**	4.729402**
Indirana beddomii	0.854307 ^{ns}	0.442423 ^{ns}

^{ns} Non significant, * Significant at 5%, **Significant at 1%

We also tried to predict the areas in Kerala which had the potential to support a *Myristica* swamp ecosystem. The parameters used for prediction were, area under 200m altitude, forest type (evergreen or semi-evergreen) and proximity within two kilometer to a stream. Data on the above parameters were analyzed using GIS software Arc GIS.9. Adding other parameters like soil type, annual rainfall and average temperature will further lessen this area. Ground checking of present land-use patterns will lead to further reduction of the areas having potential for *Myristica* swamps.

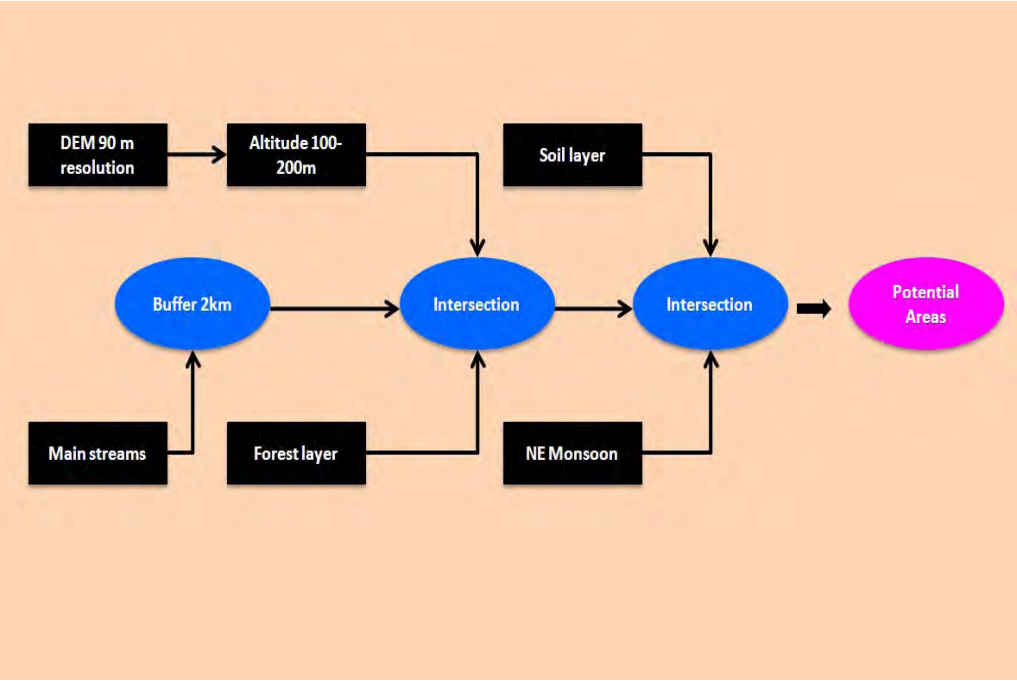

Fig 3.4.34 Chart showing steps used for predicting potential *Myristica* swamps

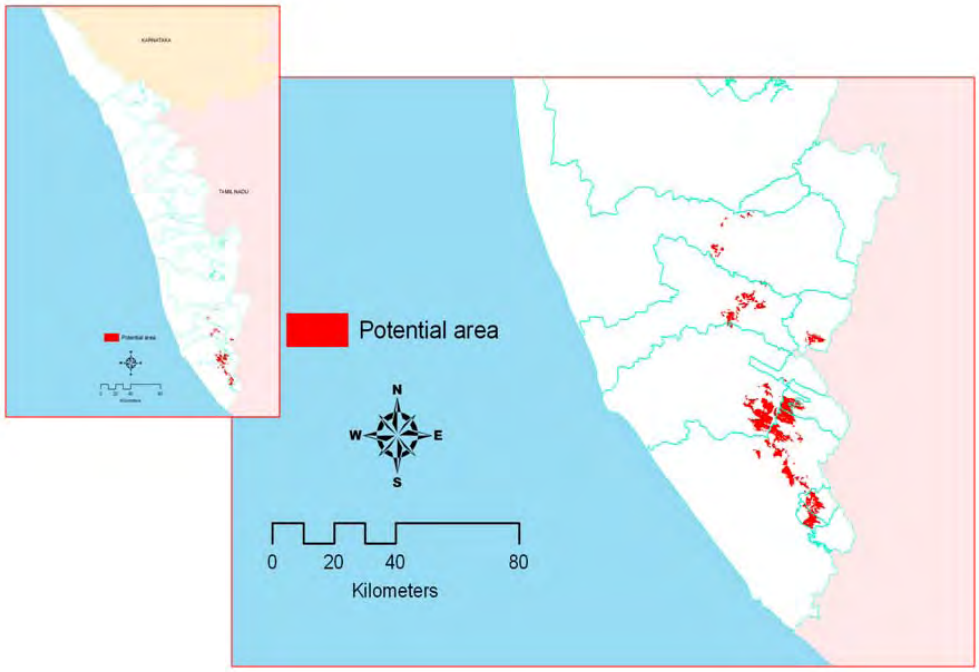

Fig 3.4.35 Areas with potential for *Myristica* swamps restoration

Tree composition may take many years to alter but the composition of animal communities such as amphibians which are highly selective in terms of habit and habitat and susceptible to edge effects caused by increased ecotone area as a result of fragmentation of specialized ecosystems indicate that *Myristica* swamps may be on the route to eventual desiccation. Prioritization of site specific conservation and management strategies to reverse this trend is suggested.

3.5 SOIL PROFILES AND PROPERTIES

Myristica swamps spread as it is in small patches in depressions and valleys of evergreen forests of Anchal, Kulathupuzha, and Shendurney forest areas of Kerala, exhibit diversity in soil and hydrology - from sandy to sandy clay loam soils and mineral to organic soils and experience frequent seasonal fluctuations in water table leading to alternating oxidizing and reducing conditions. These aspects were explored with in limits to reveal some of the properties and are presented in this part of the report.

Soil samples were collected with the aid of mud augur, air dried in shade, processed and analyzed following the procedures given in ASA monograph (1965) and Jackson (1958). Sand, silt and clay were determined by hydrometer method, P^H in 20:40 soil: water suspension, organic carbon (OC) by potassium dichromate- sulphuric acid wet digestion, electrical conductivity (EC) by conductivity meter, exchange acidity by 0.5N barium acetate method and exchangeable bases (EB) by 0.1N HCl method. Soils of different *Myristica* swamps are described below with respective tables.

1. Chettadi

Chettadi site had coarse sandy soil varying in texture from sand to loamy sand. The soil was moderately acidic in reaction with p^H value above 5.0, had low electrical conductivity (EC), organic carbon (OC), exchange acidity (EA), exchangeable bases (EB) and cation exchange capacity (CEC) There was no definite trend down the soil except in the case of organic carbon which decreased down the soil from 1.11 % in the top layer to 0.3 percent at 120-135 cm depth.

Table 3.5.1 Soil properties of Chettadi swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	cmol kg^{-1}		
000-023	06.83	90	4	6	S	5.28	110	1.11	1.8	1.0	2.8
023-045	09.59	87	7	6	LS	5.02	85	1.11	1.7	1.0	2.7
045-060	12.31	85	8	7	LS	4.94	79	0.81	1.8	1.0	2.8
060-075	07.88	88	5	7	LS	5.16	80	0.62	2.2	1.0	2.2
075-090	12.00	87	8	5	S	5.37	64	0.65	1.3	1.0	2.3
090-105	04.23	89	6	5	S	5.45	70	0.18	1.2	1.0	2.2
105-120	09.31	89	4	7	LS	5.14	73	0.42	1.0	1.0	2.0
120-135	11.31	88	5	7	LS	5.32	60	0.30	1.1	1.0	2.1

2. Chekidi Chal

Chekidi Chal was less coarse textured with textures varying from loamy sand to sandy loam, severely acidic (p^H 4.2-5.0), had low values of EC, EA, EB, and CEC. Organic carbon content was higher with the surface soil recording 2.34 percent which progressively declined down the soil to 0.7 percent at 120-130cm depth.

Table 3.5.2 Soil properties of Chekidi Chal swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	$cmol\ kg^{-1}$		
000-023	23.33	81	13	6	LS	4.96	56.60	2.34	1	1	2
023-045	13.31	76	12	12	SL	4.83	54.00	1.50	2	4	6
045-060	10.08	71	13	16	SL	4.90	70.60	1.30	3	2	5
060-075	07.88	71	12	17	SL	4.91	42.00	0.96	1	3	4
075-090	18.05	81	6	13	LS	4.95	15.00	0.80	2	1	3
090-105	20.45	84	8	8	LS	4.92	39.00	0.74	2	2	4
105-120	07.51	89	2	9	LS	4.18	10.00	0.36	3	1	4
120-135	11.15	81	10	9	LS	4.49	42.00	0.72	3	1	4

3. Emponge

Emponge swamp had comparatively finer soil (sandy loam texture) upto 105cm that was overlying coarser loamy sand. Acidity was high (ph< 5.0) and EC, OC, EA, EB and CEC values were very low.

Table 3.5.3 Soil properties of Emponge swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	$cmol\ kg^{-1}$		
000-023	02.86	76	14	10	SL	5.18	54.20	0.24	2	3	5
023-045	00.00	78	12	10	SL	5.13	42.90	0.21	3	3	6
045-060	00.50	74	12	14	SL	4.82	36.10	0.81	2	2	6
060-075	01.43	78	7	15	SL	4.66	40.00	1.00	2	4	6
075-090	02.50	80	5	15	SL	4.68	23	0.48	4	2	6
090-105	00.00	78	4	18	SL	4.82	37	0.24	2	3	5
105-120	01.00	81	6	13	LS	4.83	12	0.29	3	1	4
120-135	00.77	80	9	11	LS	4.80	20	0.30	3	1	4

4. Karinkurinji

Soil of Karinkurinji swamp varied in texture form loamy sand to sandy loam, was moderately acidic (P^H around 5.0) with fairly high organic carbon in the top soil (2.3 percent) that progressively diminished to 0.2 % at 120 – 135 cm depth. EC, EA, EB and CEC values were low.

Table 3.5.4 Soil properties of Karinkurinji swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	$cmol\ kg^{-1}$		
000-023	15.53	84	9	7	LS	4.80	65	2.28	6	1	7
023-045	15.66	79	9	12	SL	4.92	40	1.05	3	2	5
045-060	10.97	68	14	18	SL	5.33	25	0.48	3	2	5
060-075	12.74	80	8	12	LS	5.54	14	0.33	3	2	5
075-090	05.46	84	7	9	LS	5.46	37	0.15	3	3	6
090-105	04.44	74	12	14	SL	5.31	23	0.29	2	2	4
105-120	04.69	76	12	12	SL	5.44	12	0.44	3	2	5
120-135	00.77	80	9	11	LS	4.80	20	0.30	3	1	4

5. Marappalam Major

Marappalam Major swamp had loamy sand in the surface layer that was overlying sandy loam texture. Acidity was moderate (pH 5.0 – 5.5) and EC, EA, EB and CEC values low. Organic carbon was moderate in the surface (1.9%) which decreased down the profile.

Table 3.5.5 Soil properties of Marappalam Major swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	$cmol\ kg^{-1}$		
000-023	03.46	86	6	6	LS	5.06	58	1.88	1	2	3
023-045	13.38	76	12	12	SL	5.01	63	0.60	1	3	4
045-060	09.04	71	15	14	SL	5.23	48	0.60	2	4	6
060-075	14.19	74	14	12	SL	5.45	17	0.57	2	3	5
075-090	08.00	75	13	12	SL	5.03	20	0.50	1	4	5
090-105	13.76	73	14	13	SL	5.49	42	0.45	2	3	5
105-120	17.27	70	13	17	SL	5.12	10	0.60	1	2	3
120-135	19.20	71	16	13	SL	5.30	12	0.33	2	2	4

6. Marappalam Minor

Marappalam Minor swamp was not much different from Marappalam major in soil properties. The soil texture was loamy sand up to 45cm and sandy loam thereafter. It was less acidic with most p^H values around 5.5 except the top soil that was slightly more acidic. EC, OC, EA, EB and CEC values were low as in other sites.

Table 3.5.6 Soil properties of Marappalam Minor swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	$cmol\ kg^{-1}$		
000-023	11.06	81	9	10	LS	5.18	58	0.78	3	1	4
023-045	12.51	79	11	10	LS	5.68	51	0.51	2	1	3
045-060	09.83	76	13	11	SL	5.62	31	0.53	4	2	6
060-075	10.37	75	13	12	SL	5.46	23	0.44	5	2	7
075-090	05.23	75	13	12	SL	5.40	26	0.59	4	3	7
090-105	13.21	73	13	14	SL	5.72	20	0.56	2	4	6
105-120	06.50	71	15	14	SL	5.45	20	0.54	2	4	6
120-135	09.59	75	12	13	SL	5.28	34	0.47	2	4	6

7. Mottal Mood

Mottal Mood swamp had coarser soil with loamy sand texture, was moderately acidic (p^H above 5.0) and had low values of OC, EC, EA, EB and CEC. The OC content of 1.2% in the surface soil progressively decreased to 0.15% in the deepest layer studied.

Table 3.5.7 Soil properties of Mottal Mood swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	$cmol\ kg^{-1}$		
000-023	07.36	89	6	5	LS	5.45	71	1.18	2	1	3
023-045	11.74	88	2	10	LS	5.45	49	0.57	1	1	2
045-060	07.15	83	8	9	LS	5.38	43	0.42	3	2	3
060-075	10.24	81	10	9	LS	5.29	32	0.60	2	1	2
075-090	05.85	80	8	12	SL	5.67	40	0.45	3	3	6
090-105	07.16	80	8	12	SL	5.41	45	0.18	3	4	7
105-120	06.73	81	8	11	LS	5.24	21	0.14	2	2	4
120-135	05.11	83	7	10	LS	5.14	20	0.15	4	1	5

8. Muppathadi

Muppathadi swamp soil was similar to Mottal Mood in most of the properties except that it was more acidic. The soil texture was loamy sand throughout the depth, the P^H was less than 5.5, and the EC, EA, EB and CEC values were low. OC was also low with 1.1% in the surface that decreased down the soil.

Table 3.5.8 Soil properties of Muppathadi swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	cmol kg^{-1}		
000-023	17.03	88	5	7	LS	5.09	63	1.09	3	1	4
023-045	08.25	85	8	7	LS	5.06	55	0.82	2	2	4
045-060	09.33	85	8	7	LS	5.12	44	0.72	1	1	2
060-075	04.67	84	9	7	LS	5.07	20	0.74	2	1	3
075-090	03.22	87	5	8	LS	5.14	16	0.50	2	2	4
090-105	05.38	89	4	7	LS	5.30	12	0.39	3	4	7
105-120	10.18	84	5	11	LS	5.50	17	0.30	1	3	4
120-135	15.18	84	8	8	LS	5.32	15	0.74	2	5	7

9. Poovanathu Mood -1

Poovanathu Moodu-1 swamp site was also coarse textured with loamy sand texture throughout the profile. It was very acidic with p^H around 4.5 – 4.8 and had very low organic carbon of less than 0.7 percent. The EC, EA, EB and CEC values were also very low.

Table 3.5.9 Soil properties of Poovanathu Mood -1 swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	cmol kg^{-1}		
000-023	2.50	87	7	6	LS	4.83	59	0.69	4	1	5
023-045	3.50	88	5	7	LS	4.58	52	0.56	3	2	5
045-060	5.56	86	7	7	LS	4.7	49	0.69	4	1	5
060-075	1.00	85	6	9	LS	4.65	38	0.44	4	1	5
075-090	2.50	85	6	9	LS	4.71	42	0.63	3	2	5
090-105	1.00	87	3	10	LS	4.58	30	0.69	4	1	5
105-120	5.00	85	6	9	LS	4.68	24	0.54	5	1	6
120-135	1.67	87	7	6	LS	4.6	40	0.62	5	1	6

10. Poovanatu Mood - 3

Poovanathu Mood-3 swamp soil was coarser textured (sandy) except the top layer that was loamy sand. It was moderately acidic (p^H 5.0 – 6.2) with low EC, OC, EA, EB and CEC. The OC content of 1.74% in the top layer decreased down the profile.

Table 3.5.10 Soil properties of Poovanathu Mood-3 swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	cmol kg^{-1}		
000-023	1.00	88	5	7	LS	5.06	61	1.74	1	2	3
023-045	5.00	90	4	6	S	5.62	31	0.39	1	5	6
045-060	0.05	90	2	8	S	5.32	22	0.36	2	3	5
060-075	3.00	90	2	8	S	5.51	16	0.33	2	4	6
075-090	1.00	90	4	6	S	5.45	20	0.30	1	2	3
090-105	5.00	90	4	6	S	5.72	31	0.14	1	6	7
105-120	2.00	90	2	8	S	5.65	34	0.15	2	5	7
120-135	5.00	91	2	7	S	6.15	46	0.29	1	5	6

11. Poovanathu Mood - 4

Poovanathu Mood-4 swamp site had loamy texture throughout the profile with p^H around 5.0 -5.3 and low OC of 0.9% in the surface that decreased further down the soil. The values of EC, EA, EB and CEC were also very low.

Table 3.5.11 Soil properties of Poovanathu Mood-4 swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	cmol kg^{-1}		
000-023	3.88	89	2	9	LS	5.26	48	0.91	2	1	3
023-045	3.61	88	3	9	LS	5.08	50	0.66	3	1	4
045-060	8.94	89	2	9	LS	5.14	43	0.45	1	2	3
060-075	3.29	88	3	9	LS	5.05	34	0.44	2	1	3
075-090	5.27	88	3	9	LS	5.03	21	0.56	2	1	3
090-105	10.81	85	9	6	LS	5.24	30	0.45	1	2	3
105-120	8.43	85	9	6	LS	5.26	25	0.30	2	2	4
120-135	5.37	87	3	10	LS	5.26	22	0.57	2	2	4

12. Pillekode

Pillekode swamp had fine textured soil ranging from sandy loam to sandy clay loam down the soil profile. It was very acidic with p^H greater than 5.0 in most depths. There was 1.44% OC in the surface layer and it decreased down the soil profile. EC, EA, EB and CEC values were very low.

Table 3.5.12 Soil properties of Pillekode swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	$cmol\ kg^{-1}$		
000-023	8.81	72	15	13	SL	4.85	52	1.44	3	3	6
023-045	9.84	71	14	15	SL	4.90	43	0.78	2	2	4
045-060	4.43	73	15	12	SL	4.98	31	0.29	4	4	8
060-075	7.21	71	15	14	SL	4.84	16	0.51	2	3	5
075-090	5.49	64	12	24	SCL	5.01	28	0.41	2	5	7
090-105	4.49	66	13	21	SCL	4.97	12	0.45	4	7	11
105-120	10.68	63	14	23	SCL	5.10	24	0.48	2	6	8
120-135	8.50	65	12	23	SCL	5.07	20	0.6	2	7	9

13. Poovanathu Mood - 0

Poovanathu Mood-0 swamp site was coarse textured with loamy sand texture throughout the depth and it was very acidic with p^H below 5.0. Organic carbon status in this site was remarkable with the surface layer recording 2.0% and the next layer 1.4%; the values progressively decreased down the soil profile. EC, EA, EB and CEC values were very low.

Table 3.5.13 Soil properties of Poovanathu Mood-0 opposite swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						μscm^{-1}	%	$cmol\ kg^{-1}$		
000-023	0.56	87	5	8	LS	4.17	64	2	4	2	6
023-045	0.5	85	6	9	LS	4.34	31	1.47	3	1	4
045-060	1	84	9	7	LS	4.89	28	0.71	3	1	4
060-075	0.5	84	8	8	LS	4.93	14	0.6	2	1	3
075-090	1	85	6	9	LS	4.98	22	0.48	2	1	3
090-105	4	84	8	8	LS	4.72	12	0.69	3	1	4
105-120	1	85	7	8	LS	4.77	10	0.75	3	1	4
120-135	1.25	85	7	8	LS	4.9	13	1.32	2	1	3

14. Sastha Nada

Sastha Nada swamp had alternating loamy sand and sandy loam textures down the profile and it was moderately acidic with p^H ranging from 5.32 to 5.5 values. OC, EC, EA, EB and CEC values were very low. The OC content of 0.9% in the top soil decreased progressively to 0.1% in lower horizons.

Table 3.5.14 Soil properties of Sastha Nada swamp

Depth	Properties										
	Gravel	Sand	Silt	Clay	Texture	p^H	EC	OC	EA	EB	CEC
cm	%						µscm^{-1}	%	cmol kg^{-1}		
000-023	3.26	87	5	8	LS	5.25	84	0.9	4	3	7
023-045	1.25	81	10	9	LS	5.31	40	0.33	3	2	2
045-060	2.5	76	10	14	SL	5.31	31	0.29	2	4	6
060-075	0.9	75	11	14	SL	5.33	29	0.39	3	5	8
075-090	1.35	81	4	15	LS	5.33	25	0.3	5	2	7
090-105	3.75	87	5	8	LS	5.49	31	0.12	4	1	5
105-120	0.12	85	5	10	LS	5.42	30	0.15	2	2	4
120-135	1.81	84	8	8	LS	5.4	10	0.09	3	2	5

In the tables 1-14, of this section

S=Sand, LS=Loamy sand, SL=Sandy Loam, SCL=Sandy Clay Loam

15. Uthiran Chira

Uthiran Chira swamp was a peculiar site with peat like substrata that had very little soil perse. The organic carbon content was very high (12 - 29%) and p^H values were very low (2.8 - 4.4). EC values were also very low.

Table 3.5.15 Soil properties of Uthiran Chira swamp

S.no	Depth	properties		
		p^H	EC	OC
	cm		µscm^{-1}	%
1	000-023	4.37	96	11.67
2	023-045	4.37	88	18.00
3	045-060	3.99	68	15.75
3	060-075	3.83	30	9.00
5	075-090	4.15	42	12.27
6	090-105	3.24	24	17.70
7	105-120	2.82	16	28.50
8	120-135	3.21	23	18.67

All the sites studied varied in soil properties both within and between, though they had many common features. All of them were coarse textured, most of them being sandy to loamy sand and sandy loam; only one site had sandy clay loam texture. All the swamps had acidic soil; most were moderately acidic with p^H value of 5.0 – 5.5 except a few values below 5.0 and one peculiar site with p^H going as low as 2.8 due to peat like deposits. The swamp soils were also non saline recording very low EC values of < 100 μscm^{-1} and exchange acidity and exchangeable base status were also very low.

Chapter 4

CONCLUSIONS

Documentation of biodiversity and demarcation of ecosystems is the first step towards conservation and management for judiciously selecting man-ecosystem interactions to be allowed in the area. The outcome of this study is discussed under four heads.

Mappings

Sixty individual swamp *Myristica* patches have been mapped. A major error in the Survey of India topo sheet concerning the direction of a stream was corrected. Boundary mapping has revealed that the total area of *Myristica* swamps in Kerala is about 1.5 km^2 which hardly make up 0.004% of the total land area of Kerala (38,864 km^2) and 0.014% of the total forest area of Kerala (11,126 km^2). GIS based maps of the swamps have been prepared. The boundary of the swamps have been surveyed and plotted over topo sheets. The accompanying CD gives geographical coordinates of each and every boundary point.

Mapping of a few small swamps could not be completed; exact boundary mapping was not attempted in few swamps at Anchal, Sankli and Munnam Chal. Further work, possible in mapping is contour mapping at 1 m interval.

Vegetation

Trees, herbs, shrubs and regeneration in swamps of Kulathu Puzha range were enumerated. A total of 94 species of herbs/shrubs, 49 species of climbers and 82 tree species were enumerated. The swamps contain 12 red listed plants and 28 plants endemic to Western Ghats. We recorded a variant colour pattern of *Myristica fatua var. magnifica*.

Further vegetation studies can include vegetation enumeration for swamps in Shendurney and Anchal in the pattern of present study. Identification of about 60 species of mushrooms photographed during this study prompt further fungal studies for species level identification. Woody lianas seem to play a major role in the ecological dynamics of these swamps and therefore may be subjected to in depth study.

Animals

The present study highlights the enormous faunal wealth of the *Myristica* swamp forests. The study also indicates that there are gaps in information which can be filled up only with further studies in this region.

The faunal diversity of the swamps include 3 species of flatworms, 1 species of roundworm, 4 species of annelids, 10 species of molluscs, 281 species of insects, six species of myriapods, 54 species of arachnids, 14 species of fishes, 56 species of amphibians, 55 species of reptiles, 129 species of birds and 27 species of mammals. Further faunal studies can include studies on invertebrate's diversity, ecological studies for fishes, birds and mammals. The nutrient and energy cycling and food web systems, plant-animal interactions and hydrology processes pertaining to the swamps are to be studied. How the loss and desiccation of the *Myristica* swamps and the accompanied alteration in vegetation will eventually affect the composition and structure of animal populations is also to be studied. The role of the ecotone between the swamp and adjacent forests also demand investigation.

Molecular level studies for resolving taxonomical ambiguities of both animals and plants can also be thought about.

Conservation Strategies for *Myristica* swamps

A Multi Level approach which conserves the *Myristica* swamps of the present, facilitates the extension of *Myristica* swamp area in the future, integrates the interests of local population with the interests of conservation and provides for long-term monitoring of all conservation and management activities is needed.

To formulate such strategies data such as location, size, jurisdiction, biodiversity and environmental parameters, anthropogenic disturbances of *Myristica* swamps; location of *Myristica* swamps destroyed but still feasible for replanting; disturbances inside the swamps and near the swamps which may affect the well being of the swamps; status of land surrounding swamps; human settlements in vicinity; demographic details like occupation, ethnicity of individuals, dependency on swamp and adjacent forests; are needed.

The present study has most of the above data except for demographic details which can be obtained form official records. Some areas such as the swampy areas of KFDC teak plantation enroute to Randam Mile from Kulathu Puzha, Pillecode, Chakidi Chal, and various paddy fields in the Uthiran Chira – Sastha Nada region have been located but feasibility of replanting has not been assessed.

Tentative conservation and management plan can be outlined as follows:

Level I: Conserve the *Myristica* swamps of the present

Elevation of the area to Protected Area status.

This may include integrating the swamps in Anchal and Kulathu Puzha areas to Shendurney Wildlife sanctuary or demarcating the swamp areas as an individual protected area in its own right. Invasion of non-swampy plant species into the swamp must be prevented and a monitoring system be installed to ensure that such prevention is carried out in the future. The surrounding forests should be allowed to revert to natural evergreen forests to ensure conditions for long-term health of the swamps and to ensure hydrological balance in the area. All constructions which alter the hydrology of the area, such as check dams or culverts upstream, downstream or in the swamp must be avoided. Ponds to be used as animal watering holes must not be dug inside the swamp. Research activities involving digging or drastic alteration of microhabitats in the swamp should be curtailed and tourism must be reduced to the minimum- preferably small study groups. Whether it would be good to emulate the fire-lines in Shendurney to prevent destruction by fire is debatable as there is a risk of destroying an ecotone area very rich in faunal diversity. The study shows movement of amphibians and reptiles to outside areas and fire lanes in immediate edge can be a hindrance. It would be better if a unit of the adjacent forest is also added within the circumference of the fire-line. This would not only prevent destruction by fire but also preserve a rich ecotone area. Preventing anthropogenic disturbances and reducing swamp dependency by the local population is also desirable.

Level II: Facilitate the extension of *Myristica* swamp area in the future

Areas for replanting with Myristicaceae must be identified. All feasible areas may be replanted and provided with simulated environmental needs like shade, stagnant water etc, till the saplings are established to pole stage and the surrounding forests should be maintained as an evergreen forest buffer for the swamp patches.

A monitoring system to make sure that the effort and infrastructure is not wasted and restraining anthropogenic disturbances must be installed.

Level III: Integrate the interests of local population with the interests of conservation

Spreading awareness and generating positive interest about the swamps among the local population and obtaining their goodwill will be

the key step here. Any initiative which is even perceived as in situation with the interests of the local population can lead to an embarrassing situation, with vested interests making the most of it. The local human population which is affected due to the elevation of the area to protected area can be given the choice of remaining in the protected area and becoming the part of the conservation, management and monitoring stages. The forest department and the scientific community would need a lot of manpower and local knowledge to implement any conservation measures in the area. Most of the people here depend on agriculture or on sporadic and seasonal daily wages work offered by the forest department. There is also dependency on minor forest produce collection. Poverty is the universal social status here. By involving the local population in the conservation, management and monitoring initiatives the project will gain by local know how and goodwill. The locals will be assured of a source of income. In the long run, after the ecosystem is well established the work can be decentralized and handed over to grassroots organizations like Voluntary self service and women Self Help Groups. By promoting such groups under proper supervision MAN-*MYRISTICA* conflict can be reduced to zero. In the long run after the ecosystem is restored, any scientific study or restricted ecotourism ventures can provide a livelihood for these people.

Level IV: Provide for long-term monitoring of all conservation and management activities.

Ultimately the state forest department with the involvement of the local population will be responsible for the monitoring system at all levels. Formation of an expert advisory group to assess and direct progress of the conservation project which will provide scientific monitoring and a clear plan with deadlines and flexibility to add or abandon operations according to changing needs is essential.

Recommendations for management

The study has generated information relevant to effective management of the swamps. Since the swamps are located inside reserve forests and protected areas, large scale land conversion is not expected. As mentioned before the strategy should be to conserve the *Myristica* swamps of the present, facilitate the extension of *Myristica* swamp area in the future, integrate the interests of local population with the interests of conservation and provide for long-term monitoring of all conservation and management activities. Being a very delicate system, slight disturbances can affect the swamps adversely in the long run. Natural disturbances as

heavy rain and consequent land slips and massive mud flow which can block stream flow into swamps, global phenomenon like ozone depletion, air pollution, greenhouse effect, infectious mutagens cannot be controlled by local efforts. But anthropogenic disturbances are more of local origin hence these can be effectively controlled.

Some of the disturbances are

1. Cutting of poles. The straight poles characteristic of Myristicaceae are preferred for constructing temporary sheds for illegal activities such as fishing, poaching, arrack distillation, sand mining and also for camp sheds of labourers engaged in legal forestry operations. This is more so as the importance of the swamps is not generally understood by public or law enforcing authorities.
2. MFP collection. Fruits of *Myristica fatua magnifica* and *Myristica malabarica* are collected and marketed. The low economic return from this has been a blessing from conservation point of view. Increased protection by forest department has brought down instances of MFP collectors hacking down trees for collecting fruits.
3. Green manure from the swamps is in demand where there are habitations in the vicinity. Increased protection and awareness is the only way of coping up with this problem.
4. As the price of sand for construction purpose increase, miscreants venture into forest for mining sand. Streams out side swamp are easier locations, but swamps offer cover for operations. There have been few instances of cases of digging up swamps for sand.
5. Presence of perennial water supply and secluded location attract illegal arrack brewers. Large pits are made for fermenting the brew and much wood is burned in subsequent distillation. Trampling of roots, disposal of plastic material in forest, threat of fire and pole cutting are secondary consequences.
6. Hunting / capturing of animals in public does not occur now a days due to strict vigilance by the forest department. Yet small scale and clandestine poaching cannot be ruled out.
7. There is demand for some of the rare plants and animals with commercial value. Channels spring up for such organized illegal trade when market is lucrative.

Considering the importance of the swamps many steps can be taken for its effective conservation and protection and utilization.

1. Now that the maps of the swamps are available, swamp areas could be notified and protected against pilferage. Sign boards could be put at entrance of each swamp.

2. The *Myristica* swamps are scattered over several forest administrative units. In Shendurney Wildlife Sanctuary they are within the protected area limit, but in Kulathu Puzha and Anchal they are just part of reserved forest. The swamps in Kulathu Puzha need special consideration from a management perspective. Being a very large territorial range, the swamps are least in priority for management, now. The range has high biological value even apart from the *Myristica* swamps. This range can be split into two parts, the lower reach up to Sankli region can be declared as a *Myristica* swamp sanctuary and a management plan for the *Myristica* swamps has to be prepared. The *Myristica* swamp sanctuary can be managed along with adjoining Shendurney Wildlife sanctuary or separately. The upper reaches including Ponmudi areas can be another protected area, considering its biological wealth. The swamps in Anchal also need measures for protection. The *Myristica* swamps may also be declared as natural heritage sites.

3. The swamps have to be grouped into totally protected ones, open for research only and those that has eco-tourism value. Even though areas requiring more research were pointed out earlier we feel that it is essential to limit even research activity to selected swamps.

4. All constructions which alter the hydrology of the area, such as check dams or culverts upstream, downstream or in the swamp must be avoided. Often well intentioned steps end up damaging delicate ecosystems as illustrated by two cases in the swamps. A wall made for increasing water retention in Karinkurinji swamp led to over inundation and subsequent drying up of swamp trees. The wall had to be broken up. In the second instance, more than two dozen ponds have been dug in *Myristica* swamps in Shendurney wildlife sanctuary. A visit to the locations would confirm that it has only resulted in damage to the ecosystem.

5. The swamps are a biological curiosity, and as more results come out, public interest increases. Study tours from colleges and

schools tend to collect specimens in large numbers. Only photography can be allowed.

6. Swamps such as Karinkurinji and Mottal Mood are beside the road and have high ecotourism potential. Platforms erected on pre-fabricated pillars can be made to eliminate trampling and ensure safe and comfortable viewing. All construction activities should be undertaken under scientific strict supervision.

7. There are several places of worship near the swamps. Temples at Sastha Nada, Ammayambalam, Vilaku Maram, Kodi Maram, Kattila Para and Amakulam Randam mile are some of these. Conservation efforts can run into rough weather as construction of temporary sheds using poles from surrounding forest, collection of firewood, disposal of human and plastic waste become common during festivals. Planting suitable bamboo species near the temples can solve this problem to some extend. From the germination and planting trials in the study, it is very clear that *Myristica fatua* var *magnifica* trees can be raised in large numbers near these places and they would grow to pole size in a few years. Fencing swamp periphery facing the temples may also be desirable.

8. In the list of areas needing further research, history of swamps that got submerged under reservoir, and under paddy fields, could be included. Large areas on the right side of Kulathu Puzha River from Nangachi to Kodi Maram seem to have had *Myristica* swamps before eucalyptus planting. Restoration of swamp vegetation can be attempted here.

9. The surrounding forests should be allowed to revert to natural evergreen forests to ensure conditions for long-term health of the swamps and to ensure hydrological balance in the area.

10. Install a monitoring mechanism to make sure that the effort and infrastructure is not wasted.

In a nutshell, it can be stated that, conservation of these small and scattered swamp patches must also address the contiguous areas which is again complicated as many swamps lie close to human settlements and some are contiguous to plantations and cultivated lands. The *Myristica* swamp areas may even be managed as community reserves. Upgrading the status of these swamps, preventing anthropogenic and natural disturbances and ensuring the growth of such biodiversity hot specks is essential to protect the known and unknown biodiversity of these swamps.

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Appendix I List of Swamps and area

Sl No.	Group	Group	Name Of Swamp	Area in Ha
1.	Ia 1	Poovar	Muppathadi	1.33
2.	Ia 2	Poovar	Pillekode	0.98
3.	Ia 3	Poovar	Kochamma	0.25
4.	Ia 4	Poovar	Chekidi Chal	3.61
5.	Ia 5	Poovar	Palli Thadam	3.24
6.	Ia 6	Poovar	Uthiran Chira	1.45
7.	Ia 7	Poovar	Karinkurinji Up	3.29
8.	Ia 8	Poovar	Karinkurinji Down	3.95
9.	Ia 9	Poovar	Sastha Nada	1.71
10.	Ia 10	Poovar	Ammayambalam	2.48
11.	IIa 1	Kulathu Puzha	Poovanathu Mood 0	3.24
12.	IIa 2	Kulathu Puzha	Poovanathu Mood 1	0.51
13.	IIa 3	Kulathu Puzha	Poovanathu Mood 2	0.29
14.	IIa 4	Kulathu Puzha	Poovanathu Mood 3	0.76
15.	IIa 5	Kulathu Puzha	Poovanathu Mood 4	1.22
16.	IIa 6	Kulathu Puzha	Chuvanna Karikkam	4.00
17.	IIa 7	Kulathu Puzha	Munnam Chal	10.00
18.	IIa 8	Kulathu Puzha	Plavu Chal	3.58
19.	IIa 9	Kulathu Puzha	Pullu Mala	1.50
20.	IIa 10	Kulathu Puzha	Perum Padappy	2.17
21.	IIa 11	Kulathu Puzha	Channa Mala - Up	0.31
22.	IIa 12	Kulathu Puzha	Channa Mala - Down	2.19
23.	IIb.1	Kulathu Puzha	Emponge	3.32
24.	IIc.1	Kulathu Puzha	Dali Karikkam	6.00
25.	IIc.2	Kulathu Puzha	Chithirakkala Pacha	4.00
26.	IId.1	Kulathu Puzha	Marappalam Minor	0.26
27.	IId.2	Kulathu Puzha	Mottal Mood	2.28
28.	IId.3	Kulathu Puzha	Marappalam Major	1.31
29.	IIe.1	Kulathu Puzha	Choondi Para	1.50
30.	IIe.2	Kulathu Puzha	Valavu Para Pacha	5.00
31.	IIe.3	Kulathu Puzha	Manjalu Para	3.00
32.	3a.1	Shendurney	Irrikappara	1.04
33.	3a.2	Shendurney	Kurunthotti Valavu	0.79

Sl No.	Group	Group	Name Of Swamp	Area in Ha
34.	3a.3	Shendurney	Kambakathottam	1.55
35.	3a.3	Shendurney	Choodal Se	1.77
36.	3a.4	Shendurney	Onnam Junda	1.39
37.	3a.5	Shendurney	Vilakku Maraum N	1.67
38.	3a.6	Shendurney	Vilakku Maraum S	0.71
39.	3a.7	Shendurney	Choodal S	0.53
40.	3b.1	Shendurney	Onnam Mile S	7.82
41.	3b.2	Shendurney	Munkuthu	12.50
42.	3b.3	Shendurney	Manchal	1.26
43.	3b.3	Shendurney	Kattilappara P	0.40
44.	3b.4	Shendurney	Kattilappara Se	0.22
45.	3b.5	Shendurney	Kattilappara S	2.32
46.	3b.6	Shendurney	Choodal E	2.90
47.	3c.1	Shendurney	Onammilen	0.48
48.	4a.1	Anchal	Ammbalathu Pacha(1&2)	1.75
49.	4a.2	Anchal	Chettadi(1&2)	5.00
50.	4a.3	Anchal	Anavettanchal	2.00
51.	4a.4	Anchal	Mottilam Pacha	1.00
52.	4b.1	Anchal	Kodukuthi Pacha	1.16
53.	4b.2	Anchal	Eravail Pacha	0.23
54.	4b.3	Anchal	Kalyani Up	0.66
55.	4b.4	Anchal	Kalyani Down	0.25
56.	4b.5	Anchal	Konju Kuzhi	1.12
57.	4b.7	Anchal	Kuravan Thery	2.00
58.	4b.8	Anchal	Mukkode	1.50
59.	4c.1	Anchal	Valiya Pacha	1.00
60.	4c.2	Anchal	Neerattu Thadam	16.00
			Total	149.75

Appendix II

A. List of herb/shrub species from *Myristica* swamps

Sl. No.	Scientific name	Family
1.	*Adiantum sp*	Fern
2.	*Alpinia malaccensis*	Zingiberaceae
3.	*Amomum muricatum*	Zingiberaceae
4.	*Anaphyllum wightii* *	Araceae
5.	*Angiopteris evecta*	Fern
6.	*Aphyllorchis montana*	Orchidaceae
7.	*Artanema longifolia*	Scrophulariaceae
8.	*Atalantia racemosa*	Rutaceae
9.	*Barleria courtallica* *	Acanthaceae
10.	*Begonia malabarica*	Begoniaceae
11.	*Blumea lacera*	Asteraceaae
12.	*Bolbitis appendiculata*	Fern
13.	*Calamus hookerianus**	Arecaceae
14.	*Calamus thwaitesii*	Arecaceae
15.	*Calamus trvancoricus**	Arecaceae
16.	*Canthium coromandelicum*	Rubiaceae
17.	*Carex sp*	Cyperaceae
18.	*Carex sp1*	Cyperaceae
19.	*Carex sp3*	Cyperaceae
20.	*Casearia glomerata*	Flacourtiaceae
21.	*Cayratia pedata*	Vitaceae
22.	*Ceratopteris thalictroides*	Fern
23.	*Christella parasitica*	Fern
24.	*Chromolena odoratum*	Asteraceae
25.	*Clausena austroindica**	Rutaceae
26.	*Clerodendrum viscosum*	Verbenaceae
27.	*Costus speciosus*	Zingiberaceae
28.	*Curculigo trichocarpa*	Hypoxidaceae
29.	*Curcuma ecalcarata* *	Zingiberaceae
30.	*Cyanotis sp*	Commelinaceae
31.	*Cyathula prostrate*	Amaranthaceae
32.	*Desmodium heterocarpon*	Fabaceae
33.	*Dichapetalum glenoids*	Dichapetalaceae
34.	*Dicranopteris linearis*	Fern
35.	*Dictyospermum montanum*	Commelinaceae
36.	*Dioscorea bulbifera*	Dioscoreaceae
37.	*Dracaena terniflora*	Dracaenaceae
38.	*Ecbolium viride* *	Acanthaceae
39.	*Globba ophioglossa**	Zingiberaceae
40.	*Glycosmis pentaphylla*	Rutaceae
41.	*Gomphandra tetrandra*	Icacinaceae
42.	*Grewia nervosa*	Tiliaceae
43.	*Hedyotis auricularia*	Rubiaceae
44.	*Helicteres isora*	Sterculiaceae
45.	*Hibiscus furcatus*	Malvaceae
46.	*Hoya pauciflora*	Asclepidaceae
47.	*Ixora leucantha**	Rubiaceae
48.	*Ixora nigricans*	Rubiaceae
49.	*Lagenandra ovata*	Araceae
50.	*Lantana camara*	Verbanaceae
51.	*Leptaspis urceolata*	Poaceae

Sl. No.	Scientific name	Family
52.	*Leptochilus decurrens*	Fern
53.	*Lindernia ciliata*	Scrophulariaceae
54.	*Luvunga eleutherandra*	Rutacea
55.	*Melastoma malabathricum*	Melastomataceae
56.	*Memcylon randerianum*	Melastomaceae
57.	*Memecylon umbellatum*	Melastomataceae
58.	*Mimosa diplotricha*	Mimosae
59.	*Mimosa pudica*	Mimosae
60.	*Murdania pauciflora*	Commelinaceae
61.	*Mussaenda frondosa*	Rubiaceae
62.	*Neurocalyx calycinus* *	Rubiaceae
63.	*Ochalandra trvancorica* *	Poaceae
64.	*Ophiorrhiza eriantha*	Rubiaceae
65.	*Ophiorrhiza mungos*	Rubiaceae
66.	*Osbeckia muralis*	Melastomataceae
67.	*Pandanus furcatus*	Pandanaceae
68.	*Pandanus thwaitesii**	Pandanaceae
69.	*Pellionia heyneana*	Urticaceae
70.	*Phaeanthus malabaricus*	Annonaceae
71.	*Phrynium pubinerve*	Marantaceae
72.	*Phyllanthus niruri*	Euphorbiaceae
73.	*Pogostemon paniculatus*	Lamiaceae
74.	*Pollia secundiflora*	Commelinaceae
75.	*Psychotria flavida*	Rubiaceae
76.	*Psychotria macrocarpa*	Rubuaceae
77.	*Schumannianthus virgatus*	Marantaceae
78.	*Sclreria lithosperma*	Cyperaceae
79.	*Selaginella brachystachya*	Fern
80.	*Selaginella vaginalis*	Fern
81.	*Sida rhombifolia*	Malvaceae
82.	*Sirhookera lanceolata*	Orchidaceae
83.	*Sonerila rheedei*	Melastomataceae
84.	*Spilanthes calva*	Asteraceae
85.	*Stachytarpheta jamaicensis*	Verbenaceae
86.	*Strobilanthes ciliatus*	Acanthaceae
87.	*Symplocos macrophylla*	Symplocacae
88.	*Syzygium sp.*	Myrtaceae
89.	*Thespesia lampas*	Malavaceae
90.	*Thottea siliquosa*	Aristolochiaceae
91.	*Trichopus zeylanicus*	Trichopodaceae
92.	*Turraea villosa*	Meliaceae
93.	*Urena lobata*	Malavaceae
94.	*Zingiber zerumbet*	Zingiberaceae

* Endemic to western ghats

B. List of climbers from *Myristica* swamps

Sl. No	Scentific name	Family
1.	*Abrus pulchellus*	*Fabaceae*
2.	*Acasia torta*	*Mimosaceae*
3.	*Aristolochia tagla*	*Aristolochiaceae*
4.	*Artabotrys zeylanicus*	*Annonaceae*
5.	*Asparagus recemosus*	*Liliaceae*
6.	*Bauhinia phoenicea**	*Caesalpiniaceae*
7.	*Butea parviflora*	*Feabaceae*
8.	*Calycopteris floribunda*	*Combretaceae*
9.	*Centrosema molle*	*Febaceae*
10.	*Chilocarpus denudatus*	*Periplocaceae*
11.	*Cissus latifolia*	*Vitaceae*
12.	*Clematis bourdillonii **	*Ranunculaceae*
13.	*Combretum latifolium*	*Comberetaceae*
14.	*Connarus sp*	*Connaraceae*
15.	*Coscinium fenestratum*	*Menispermaceae*
16.	*Cyclea peltata*	*Menispermaceae*
17.	*Dalbergia horrida **	*Fabaceae*
18.	*Derris canarensis*	*Fabaceae*
19.	*Diplocyclos palmatus*	*Cucurbitaceae*
20.	*Entada rheedi*	*Mimosaceae*
21.	*Gnetum edule*	*Gnetaceae*
22.	*Ipomea mauritiana*	*Convolvulavceae*
23.	*Jasminum azoricum*	*Oleaceae*
24.	*Jasminum rottlerianum*	*Oleaceae*
25.	*Kunstleria keralensis*	*Fabaceae*
26.	*Macrosolen capitellatus*	*Loranthaceae*
27.	*Marsdenia indica.*	*Asclepidaceae*
28.	*Mikania micrantha*	*Asteraceae*
29.	*Momordica dioica*	*Cucurbitaceae*
30.	*Myxospyrum smilacifolium*	*Oleaceae*
31.	*Parsonsia inodora*	*Aposcynaceae*
32.	*Piper beriberi*	*Piperaceaae*
33.	*Piper longum*	*Piperaceaae*
34.	*Piper nigrum*	*Piperaceaae*
35.	*Pothos armatus*	*Araceae*
36.	*Pothos scandens*	*Araceae*
37.	*Rhaphidophora pertusa*	*Araceae*
38.	*Smilax zeylanica*	*Smilacaceae*
39.	*Stenochlaena palustris.*	Fern
40.	*Strychnos colubrina*	*Loganiaceae*
41.	*Tetracera acara*	*Ranunculaceae*
42.	*Toxocarpus kleinii*	*Asclepidaceae*
43.	*Tylophora mollissima **	*Asclepidacea*
44.	*Uvaria narum*	*Annonaceae*
45.	*Vanilla wightiana **	*Orchidaceae*
46.	*Ventilago bombaiensis**	*Rhamnaceae*
47.	*Zehneria sp*	*Cucurbitaceae*
48.	*Zizyphus rugosa*	*Rhamnaceae*
49.	*Zizyphus oenoplia*	*Rhamnaceae*

* Endemic to Western Ghats

C. List of trees

Sl. No.	Species	Family	Satus
1.	*Actinodaphne malabarica*	Lauraceae	Endemic to:Southern Western Ghats Status : Rare (Nayar,1997)
2.	*Ailanthus malabarica*	Simaroubaceae	
3.	*Alstonia scholaris*	Apocynaceae	
4.	*Antidesma montanum*	Euphorbiaceae	
5.	*Aporosa acuminata*	Euphorbiaceae	
6.	*Aporosa cardiosperma*	Euphorbiaceae	
7.	*Archidendron monadelphum*	Mimosoidae	Endemic to:Southern Western Ghats
8.	*Areca catechu*	Arecaceae	
9.	*Artocarpus hirsutus*	Moraceae	Endemic to:Southern Western Ghats
10.	*Baccaurea courtallensis*	Euphorbiaceae	Endemic to:Southern Western Ghats
11.	*Bombax ceiba*	Bombacaceae	
12.	*Calophyllum polyanthum*	Clusiaceae	
13.	*Canarium strictum*	Burseraceae	
14.	*Carallia brachiata*	Rhizophoraceae	
15.	*Cinnamomum malabatrum*	Lauraceae	Endemic to:Southern Western Ghats
16.	*Croton malabaricus*	Euphorbiaceae	Endemic to:Southern Western Ghats
17.	*Dimocarpus longan*	Sapiindacea	
18.	*Diospyros buxifolia*	Ebenaceae	
19.	*Diospyros paniculata*	Ebenaceae	Endemic to:Southern Western Ghats
20.	*Dipterocarpus indicus*	Dipterocarpaceae	Endemic to: Western Ghats Status : Endangered (IUCN, 2000)
21.	*Dysoxylum malabaricum*	Meliaceae	Endemic to:Southern Western Ghats
22.	*Elaeis guineensis*	Arecaceae	
23.	*Elaeocarpus glandulosus*	Elaeocarpacceae	
24.	*Elaeocarpus tuberculatus*	Elaeocarpacceae	
25.	*Erythrina variegate*	Fabaceae	
26.	*Erythroxylum lanceolatum*	Erythroxylaceae	Endemic to:Southern Western Ghats critically endangered (IUCN, 2000)
27.	*Fagraea zeylanica*	Moraceae	
28.	*Ficus hispida*	Moraceae	
29.	*Ficus nervosa*	Moraceae	
30.	*Flacourtia montana*	Flacourtiacae	
31.	*Garcinia gummi-gutta*	Clusiaceae	
32.	*Garcinia morella*	Clusiaceae	
33.	*Glochidion ellipticum*	Euphorbiaceae	
34.	*Gymnacranthera farquhariana*	Myristicaceae	
35.	*Holarrhena pubescens*	Apocyanaceae	
36.	*Holigarna arnottiana*	Anacardiaceae	Endemic to:Southern Western Ghats Status : Vulnerable (Nayar, 1997)
37.	*Hopea parviflora*	Dipterocarpaceae	Endemic to:Southern Western Ghats
38.	*Humboldtia decurrens*	Caesalpineaceae	
39.	*Hydnocarpus pentandra*	Flacourtiaceae	Endemic to:Southern Western Ghats
40.	*Ixora brachiata*	Rubiacae	
41.	*Kingiodendron pinnatum*	Caesalpiniaceae	Endemic to:Southern Western Ghats Status : Endangered (IUCN, 2000)
42.	*Knema attenuata*	Myristicaceae	Endemic to: Western Ghats
43.	*Lagerstroemia speciosa*	Lythraceae	
44.	*Leea indica*	Leeaceae	
45.	*Lepisanthes tetraphylla*	Sapindacea	
46.	*Litsea travancorica*	Lauraceae	Endemic to:Southern Western Ghats Status : Endangered (IUCN,2000)
47.	*Lophopetalum wightianum*	Celastraceae	
48.	*Macaranga peltata*	Euphorbiaceae	
49.	*Madhuca nerifolia*	Sapotaceae	
50.	*Mallotus philippensis*	Euphorbiaceae	Endemic to: Peninsular India
51.	*Mangifera indica*	Anacardiaceae	
52.	*Mastixia arborea*	Cornaceae	Endemic to: Western Ghats
53.	*Melia dubia*	Meliaceae	
54.	*Memecylon umbellatum*	Melastomataceae	Endemic to:Southern Western Ghats

Sl. No.	Species	Family	Satus
55.	*Mesua ferrea*	Clusiaceae	
56.	*Mitragyna parvifolia*	Rubiaceae	
57.	*Myristica beddomei*	Myristicaceae	
58.	*Myristica fatua var.magnifica*	Myristicaceae	Endemic to:Southern Western Ghats Status : Endangered (IUCN,2000)
59.	*Myristica malabarica*	Myristicaceae	Endemic to:Southern Western Ghats
60.	*Neolamarckia cadamba*	Rubiaceae	
61.	*Olea dioica*	Oleaceae	
62.	*Persea macrantha*	Lauraceae	
63.	*Pinanga dicksonii*	Arecaceae	Endemic to: Western Ghats
64.	*Polyalthia fragrance*	Annonaceae	Endemic to:Southern Western Ghats
65.	*Pterygota alata*	Sterculaceae	
66.	*Schleichera oleosa*	Sapindaceae	
67.	*Semecarpus auriculata*	Anacardiaceae	Endemic to:Southern Western Ghats Status :Low risk near threatened (IUCN,2000)
68.	*Sterculia gluta*	Sterculaceae	
69.	*Strombosia ceylanica*	Olacaceae	
70.	*Swietenia macrophylla*	Meliaceae	
71.	*Symplocos cochinchinensis*	Symplocaceae	
72.	*Syzygium gardneri*	Myrtaceae	
73.	*Syzygium mundagam*	Myrtaceae	Endemic to:Southern Western Ghats
74.	*Syzygium trvancoricum*	Myrtaceae	Endemic to:Southern Western Ghats Status :Critically endangered (IUCN,2000)
75.	*Tabernaemontana alternifolia*	Apocyaanaceae	Endemic to:Southern Western Ghats Status :Low risk near threatened (IUCN,2000)
76.	*Terminalia elliptica*	Combretaceae	
77.	*Terminalia paniculata*	Combretaceae	
78.	*Tetrameles nudiflora*	Dasticaceae	
79.	*Vateria indica*	Dipterocarpaceae	Endemic to:Southern Western Ghats
80.	*Vitex altissima*	Verbenaceae	
81.	*Xanthophyllum arnottianum*	Xanthophyllaceae	Endemic to: Western Ghats
82.	*Xylopia parviflora*	Annonaceae	

Appendix III

A. List of Butterflies in Myristica swamps of Southern Kerala

No	Family	Sub -families	Scientific Name	Common name
1.	Pieridae	Pierinae	*Appias albiina*	Common Albatross
2.			*Delias eucharis*	Common Jezbel
3.			*Pareronia valeria*	Common Wanderer
4.			*Hebomoia glaucippe*	Great Orange Tip
5.			*Leptosia nina*	Psyche
6.			*Colotis eucharis*	Plain Orange Tip
7.			*Ixias pyrene*	Yellow Orange Tip
8.		Colanidae	*Catopsilia pomona*	Common Emigrant
9.			*Catopsilia pyranrhe*	Mottled emigrant
10.			*Euremia heceabe*	Common Grass Yellow
11.	Papilionidae	Papilioninae	*Papilio polymnestor*	Blue Mormon
12.			*Graphium agamemnon*	Tailed Jay
13.			*Graphium antiphates*	Five Bar Sword Tail
14.			*Graphium doson*	Common Jay
15.			*Graphium sarpedon*	Common Blue Bottle
16.			*Pachliopta aristolochiae*	Common Rose
17.			*Pachliopta hector*	Crimson Rose
18.			*Papilio dravidarum*	Malabar Raven
19.			*Papilio helenus*	Red Helen
20.			*Papilio paris*	Paris Peacock
21.			*Papilio polytes*	Common Mormon
22.			*Troides minos*	Southern Bird Wing
23.	Nymphalidae	Charaxinae	*Polyura athamus*	Common Nawab
24.			*Cupha erymanthis*	Southern Rustic
25.			*Cethosia nietneri*	Tamil Lacewing
26.			*Cirrochroa thias*	Tamil Yeoman
27.			*Charaxes bernardus*	Tawny Rajah
28.			*Libythea lepita*	Common beak
29.		Danainae	*Tirumula limniace*	Blue tiger
30.			*Tirumala septentrionis*	Dark blue Tiger
31.			*Parantica aglea*	Glassy Blue Tiger
32.			*Danaus genutia*	Painted Tiger
33.			*Danaus chrysippus*	Plain tiger
34.			*Euploea core*	Common Crow
35.			*Idea malabarica*	Malabar Tree Nymph
36.		Limenitinae	*Athyma ranga*	Black Veined Sergeant
37.			*Neptis jumbah*	Chestnut streaked Sailor
38.			*Parthenos sylvia*	Clipper
39.			*Ariadne merione*	Common Castor
40.			*Pantoporia hordonia*	Common Lascar
41.			*Tanaecia lepidea*	Grey Count
42.			Euthalia garuda	Common Baron
43.		Morphinae	*Discophora lepida*	Southern duffer
44.		Nymphalinae	*Junonia iphita*	Chocolate Pansy
45.			*Cyrestis thyodamas*	Common Map
46.			*Hypolimnas misippus*	Danaid Eggfly
47.			*Hypolimnas bolina*	Great eggfly
48.			*Junonia atlites*	Grey Pansy
49.			*Junonia orthiya*	Blue Pansy
50.			*Junonia hierta*	Yellow Pansy
51.			*Kaniska canace*	Blue Admiral
52.			*Kallima horsfieldi*	South Indian Blue Oak Leaf
53.		Satyrinae	*Mycalesis perseus*	Common bush Brown
54.			*Melanitis leda*	Common Evening Brown

No	Family	Sub -families	Scientific Name	Common name
55.			*Ypthima baldus*	Common Five Ring
56.			*Ypthima huebneri*	Common Four Ring
57.			*Elyminas hypermnestra*	Common Palmfly
58.	Lycaenidae	Polyommatinae	*Caleta caleta*	Angled Pierrot
59.			*Discolampa ethion*	Blue banded Pierrot
60.			*Jamides celeno*	Common Cerulean
61.			*Actolepis puspa*	Common Hedge Blue
62.			*Castalius rosimon*	Common Pierrot
63.			*Euchrysops cnejus*	*Gram Blue*
64.			*Zizula hylax*	Tiny Grass Blue
65.		Theclinae	*Zeltus amasa*	Fluffy Tit
66.			*Curetis thetis*	Indian Sun beam
67.			*Thaduka multicaudata*	Many Tailed Oak blue
68.				Sps 1
69.	Hesperiidae	Hesperiinae	*Ampitta discorides*	Bush Hopper
70.			*Psolos fuligo*	Coon
71.			Telicota ancilla	
72.			Lambrix salsala	
73.			Tagiades gana	
74.			*Tagiades obsurus*	Immaculate Snow Flat
75.	Doubts			1
76.				2
77.				3
78.				4
79.				5
80.				6
81.				7
Total	5	12		81

B. Insect diversity in Myristica swamps – Check list till family level. (Summary -14 orders and 83+ families)

No	Order	Suborder	Family	Species (min estimate with photos and few extras
1.	Coleoptera		Brenthidae	1
2.			Chrysomelidae	3
3.			Curculionidae	2
4.			Buprestidae	1
5.			Scarabaeidae	1
6.			Cicindelidae	3
7.		-	Unknown 2	1
8.	Embioptera		Unknown	2
9.	Dermaptera		Labiduridae ?	1
10.	Dictyoptera		Blattidae	3
11.			Mantidae	6
12.	Diptera		Tipulidae	5
13.			Asilidae	2
14.			Culicidae	3
15.			Chironomidae	1
16.			Muscidae	3
17.			Calliphoridae	3
18.			Drosophilidae	2
19.			Empididae	1
20.			Diopsidae	1
21.			Tanyderidae	1
22.			unknown	3
23.	Ephemeroptera	-	unknown	1
24.	Hemiptera	Homoptera	Derbidae	2
25.			Fulgoridiae unknown	2
26.			Fulgoridae	1
27.			Cicadidae	2
28.			Cicadellidae	3
29.			Cercopidae	1
30.		Heteroptera	Reduviidae	1
31.			Lygaeidae	1
32.			Pyrrhocoridae	2
33.			Coreidae	3
34.			Pentatomidae	4
35.			Belostomidae	1
36.			Scutelleridae	1
37.			unknown	1
38.	Hymenoptera	Apocrita	Apidae	3
39.			Sphecoidae	1
40.			Vespidae	5
41.			Mutillidae	1
42.			Formicidae	15
43.			Unknown	3
44.	Isoptera		Unknown	12
45.	Neuroptera		Unknown	1
46.	Orthoptera		Acrididae	11
47.			Grillidae	5
48.			Tettigonidae	7
49.			Tridactylidae	1
50.	Phasmida		Phasmatidae	1
51.	Lepidoptera	Rhopalocera	Hesperiidae	6
52.			Lycaenidae	11
53.			Nymphalidae	35
54.			Papilionidae	12
55.			Pieridae	10
56.			unidentified	7
57.		Heterocera	Agaristidae	1
58.			Arctiidae	4

No	Order	Suborder	Family	Species (min estimate with photos and few extras
59.			Lymantriidae	4
60.			Noctuidae	1
61.			Flattidae	1
62.			Oecophoridae	2
63.			Geometridae	8
64.			Pyraustidae	1
65.			Saturnidae	2
66.			Sphingidae	1
67.			Gelechidae	2
68.			Tineidae	1
69.			Sessidae	4
70.			Unknown	1
71.			Lasiocampidae	1
72.			Notodontidae!	3
73.			Limacodidae	1
74.			CAtepillars Unknown	1
75.			Psychidae	1
76.			Eupteroptidae	1
77.	Odonata	Zygoptera	Chlorocyphidae	2
78.			Protoneuridae	2
79.			Lestidae	1
80.			Euphaeidae	1
81.			Caloptergidae	2
82.			Platystictidae	1
83.			unknown	1
84.		Anisoptera	Libellulidae	8
Total				281

C. List of Arachnids in Myristica swamps of Southern Kerala

No	Order	Super families	Family	Scientific Name
1.	Acari		Ixodidae	Species 1
2.				Species 2
3.				Species 3
4.	Amblypygi		Phrynichidae	*Phrynichus phipsoni*, Pocock 1894
5.	Scorpiones		Buthidae	Species 1
6.	Opiliones			Species 1
7.				Species 2
8.	Araneae	Theraphosoidea	Theraphosidae	*Poecilotheria rufilata* Pocock 1899
9.				*Poecilotheria* sp.2
10.				*Haploclastus* sp.1
11.		Eresoidea	Hersiliidae	*Hersilia savignyi* Lucas, 1836
12.				*Hersilia* sp.1
13.		Araneoidea	Araneidae	*Argiope anasuja* Thorell, 1887
14.				*Gasteracantha dalyi* Pocock, 1900
15.				*Heurodes* sp.1
16.				*Neoscona* sp.
17.				*Neoscona* sp.2
18.				*Neoscona* sp.3
19.				*Eriovixia* sp.1
20.			Tetragnathidae	*Leucauge* sp.1
21.				*Opadometa fastigata* (Simon, 1877)
22.			Nephilidae	*Nephila kuhlii* Doleschall, 1859
23.				*Nephila pilipes* (Fabricius) 1793
24.				*Nephylengis malabarensis Walckenaer, 1842*
25.			Theridiidae	*Theridula angula* Tikader, 1970
26.		Lycosoidea	Ctenidae	*Ctenus* sp.1
27.			Lycosidae	*Lycosa* sp.1
28.				*Lycosa* sp.2
29.				*Pardosa* sp.1
30.				*Pardosa* sp.2
31.			Oxyopidae	*Oxyopes hindostanicus* Pocock, 1901
32.				*Oxyopes* sp.2
33.				*Oxyopes* sp.3
34.				*Oxyopes* sp.4
35.				*Oxyopes* sp.5
36.			Psechridae	*Psechrus torus*
37.				*Psechrus* sp.1
38.			Pisauridae	*Perenethis venusta* L. Koch, 1878
39.				*Thalassius albocinctus* Doleschall, 1859
40.		Sparassoidea	Sparassidae	*Heteropoda venatoria* Linnaeus, 1767
41.				*Thelcticopis* sp.1
42.		Thomisoidea	Thomisidae	Thomisidae (undescribed genus)
43.				*Monaeses* sp.1
44.				*Thomisus andamanensis* Tikader, 1980
45.		Salticoidea	Salticidae	*Hasarius adansoni* (Audouin, 1826)
46.				*Ptocasius* sp.1
47.				*Plexippus petersi* (Karsch, 1878)
48.				*Epeus indicus* Prószyn'ski, 1992
49.				*Bavia kairali* Samson & Sebastian, 2002
50.				*Telamonia* sp.1
51.				*Telamonia* sp.2
52.				*Carhottus* sp.1
53.				*Chalcotropis* sp.1
54.		*Incertae sedis*	Clubionidae	*Clubiona* sp.1

D. List of Amphibians of Myristica Swamps in Southern Kerala

No	Order	Family	Genus	Name of Amphibian	Common Name
1.	Gymnophiona	Icthyophiidae	Icthyophis	*Icthyophis cf tricolor*	Three striped caecilian
2.				*Icthyophis*	
3.	Anura	Bufonidae	Bufo	*Bufo melanostictus*	Common Indian toad
4.				*Bufo paretalis*	Ridged toad
5.				*Bufo sps*	
6.		Microhylidae	Kaloula	*Kaloula taprobanica*	Indian painted frog
7.			Ramanella	*Ramanella triangularis*	Malabar Narrow Mouthed frog
8.		Rhacophoridae	Philautus	*Philautus variabilis*	Tinkling bush frog
9.				*Philautus flaviventris*	Yellow bellied bush frog
10.				*Philautus temporalis*	Plain coloured bush frog
11.				*Philautus leucorhinus*	White nosed bush frog
12.				*Philautus charius/ bombayansis*	Sesachar's bush frog
13.				*Philautus pulcherrimus*	Pretty bush frog
14.				*Philautus tinniens*	
15.				*452 A1 Philautus*	
16.				*452A2 Philautus*	
17.				*452A6 cf bombayansis*	
18.				*Philautus sps1*	
19.				*Philautus sps 3*	
20.				*Philautus sps 4*	
21.				*Philautus sps 5*	
22.				*Philautus sps 6 452B36 cf temporalis*	
23.				*Philautus sps 8*	
24.				*Philautus sps 11 cf auromaculatus*	
25.				*Philautus sps 13 cf luteolus*	
26.			Polypedates	*Polypedates maculatus*	Yellow Tree frog
27.				*Polypedates psuedocruciger*	Common Tree Frog
28.				*Polypedates leucomystax*	Bamboo tree frog
29.			Rhacophorus	*Rhacophorus cf lateralis*	Winged gliding frog
30.				*Rhacophorus malabaricus*	Malabar Flying frog
31.				*Rhacophorus cf pleurostictis*	Spotted green Tree frog
32.				*Rhacophorus* sp.*(juvenile)*	
33.		Ranidae	Euphlyctis	*Euphlyctis cyanophlyctis*	Skipper Frog
34.				*Euphlyctis hexadactyus*	Indian Pond Frog
35.			Hoplobatrachus	*Hoplobatrachus tigerinus*	Indian Bull frog
36.			Indirana	*Indirana beddomii*	Beddome's leaping frog
37.				*Indirana brachytarsus*	Short-legged leaping frog
38.				*Indirana semipalmatus*	Brown leaping frog
39.				*Indirana leptodactylus*	
40.				*Indirana leithii*	Leith's Leaping Frog
41.			*Limnonectes*	*Limnonectes keralensis*	Verrucose frog
42.				*Limnonectes limnocharis*	Paddyfield frog
43.				*Limnonectes nilagirica*	
44.			Micrixalus	*Micrixalus fuscus*	Dusky Torrent Frog
45.			Nyctibatrachus	*Nyctibatrachus aliciae*	Alice's wrinkled frog
46.				*Nyctibatrachus major*	Large wrinkled Frog
47.				*Nyctibatrachus minor*	Small Wrinkled Frog
48.				*Nyctibatrachus sps*	
49.			Rana	*Rana aurantiaca*	Golden Frog
50.				*Rana malabarica*	Fungoid frog
51.				*Rana temporalis*	Bronzed frog
52.			Tomopterna	*Tomopterna rufescens*	Rufescent Burrowing Frog
53.			Doubts	*452A3*	
54.				*Philautus / Indirana young sps 7*	
55.				*Philautus / Indirana young sps 9*	
56.				*Philautus/ Indirana young sps 12 B31*	
Total	2	5	15	*56*	

E. List of Reptiles of Myristica Swamps in Southern Kerala

No	Order	Family	Genus	Name of Reptile	Common Name
1.	Squamata (*Serpentes)*	Colubridae	Ahaetulla	*Ahaetulla pulverulenta*	Brown Vine Snake
2.				*Ahateulla nasuta*	Common Vine Snake
3.			*Amphsiema*	*Amphsiema beddomi*	Beddome's Keelback
4.				*Amphsiema stolatum*	Striped Keelback
5.			*Atretium*	*Atretium schisotum*	Olive Keelback
6.			*Boiga*	*Boiga* sps *forstenii* ?	Forsten's Cat Snake
7.			Chrysopelea	*Chrysopelea ornata*	Ornate Flying Snake
8.			*Dendrelaphis*	*Dendrelaphis pictus*	Painted Bronzeback tree Snake
9.				*Dendrelaphis tristis*	Common Bronzeback tree Snake
10.			*Elaphe*	Elaphe / Coelognathus helena	Common Trinket Snake
11.			*Lycodon*	*Lycodon aulicus*	Common Wolf Snake
12.				*Lycodon sp1*	
13.			*Oligodon*	*Oligodon (specimen)* affinis	Western Kukri Snake
14.				*Oligodon sps1=arnesis*	Common Kukri Snake
15.				*Oligodon taeniolatus*	Russell's Kukri Snake
16.			*Ptyas*	*Ptyas mucosa*	Indian rat Snake
17.			Xenochrophis	*Xenochrophis piscator*	Checkered Keelback
18.			Xylophis	*Xylophis sternorhynchus*	Gunther's narrow Headed Snake
19.		Elapidae	*Bangarus*	*Bangarus correlius*	Common Krait
20.			Callophis	*Callophis sps=nigrescens*	Striped Coral Snake
21.				*Callophis= bibrioni*	Bibron's Coral Snake
22.			*Naja*	*Naja naja*	Spectacled Cobra
23.		Viperidae	Daboia	*Daboia russelli*	Russell's Viper
24.			*Hypnale*	Hypnale hypnale	Hump Nosed Pit Viper
25.			Trimeruserus	*Trimeruserus malabaricus*	Malabar Pit Viper
26.				*Trimeruserus strigatus*	Horseshoe Pit Viper
27.		Uropeltidae	Melanophidium	*Melanophidium cf punctatum*	Pied- Belly Shield Tail
28.			Uropeltis	*Uropeltis macrolepis ?*	Large Scaled Sheild tail
29.		Typhlopidae	Ramotyphlops	*Ramotyphlops braminus*	Brahminy blind snake
30.	*Squamata (*Lacertilia)	Agamidae	Calotes	*Calotes calotes*	
31.				*Calotes ellioti*	
32.				*Calotes versicolor*	
33.			Draco	*Draco dussumeiri*	
34.			Otocryptis	*Otocryptis beddomii*	
35.			Psamophillus	*Psamophillus sps*	
36.			Salea	*Salea horsefieldi*	
37.		Geckkonidae	Cnemaspis	Cnemaspis 1	
38.				Cnemaspis 2	
39.				*Cnemaspis3 wyanadensis*	
40.			Hemidactylus	Hemidactylus 1	
41.				Hemidactylus 2	
42.				Hemidactylus frenatus	
43.		Varanidae	Varanus	Varanus bengalensis	
44.		Chaemleonidae	Chaemleo	*Chaemleo zeylanicus*	
45.		Scincidae	Mabuya	*Mabuya beddommi*	
46.				*Mabuya carinata*	
47.				*Mabuya macularia*	
48.			Ristella	*Ristella beddommi*	
49.			Sphenomorphus	*Sphenomorphus dussumeri*	
50.				*Skink 3*	
51.				*Skink 4*	
52.	Testudines	Bataguridae	Geoemyda	*Geoemyda silvatica*	
53.			*Melanochelys*	*Melanochelys trijuga*	
54.		Trionychidae	*Lissemys*	*Lissemys punctata*	
55.		Testudinidae	Indotestudo	*Indotestudo travancorica*	
Total	2	13	37	*55*	

F. List of Birds of *Myristica* Swamps of Southern Kerala

	Order	Family	*Name of Bird*	Common English Name
1.	Pelecaniformes	Anhingidae	*Anhinga melanogaster*	Oriental Darter
2.	Ciconiiformes	Ardeidae	*Ardeola grayii*	Indian Pond Heron
3.			*Bubulcus ibis*	Cattle Egret
4.			*Butorides striatus*	Little Green heron/ STRIATED HERON (E)
5.			*Casmerodius albus*	Large Egret
6.			*Egretta garzetta*	Little Egret
7.			*Nycticorax nycticorax*	Black crowned night heron
8.			*Dupetor / Ixobrychus flavicollis*	Black Bittern
9.	Falconiformes	Accipitridae	*Accipiter virgatus*	Besra Sparrow hawk
10.			*Accipter nisus*	Eurasian Sparrow Hawk
11.				Eagle 1
12.				Eagle 2
13.			*Aviceda jerdoni*	Jerdon's Baza
14.				Kite
15.			*Buteo buteo*	Common Buzzard
16.			Haliastur indus	Brahminy kite
17.			Hieraaetus kienerii	Rufous bellied Eagle
18.			Spilornis cheela	Crested Serpent eagle
19.			*Spizaetus nipalensis*	Mountain Hawk Eagle
20.		Falconidae	Falcon	
21.			*Falco peregrinus*	Peregrine Falcon
22.	Galliformes	Phasianidae	*Gallus sonneratti*	Grey Jungle Fowl
23.			*Perdicula erythrorhyncha*	Painted Bush Quail/ Patridge
24.			*Pavo cristatus*	Common peafowl
25.	Columbiformes	Columbidae	*Chalcophaps indica*	Emerald dove
26.			*Ducula aenea*	Green Imperial pigeon
27.			*Ducula badia*	Mountain imperial pigeon
28.			*Columba livia*	Blue Rock Pigeon
29.			*Streptopelia chinensis*	Spotted dove
30.			*Treron pompadora*	Pompadour green pigeon
31.			*Treron bicinctus*	Orange breasted Green pigeon
32.	Piciformes	Picidae	*Picus xanthopygeaus*	Little scaly bellied green woodpecker
33.			*Picumnus innominatus*	Speckled Piculet
34.			*Dinopium javanese*	Common golden backed woodpecker
35.			*Dinopium bengalensis*	Lesser golden backed woodpecker
36.			*Dryocopus javensis*	Great black woodpecker
37.			*Hemicircus canente*	Heart spotted Woodpecker
38.		Capitonidae /Ramphastidae	*Megalaima viridis*	White cheeked barbet
39.			*Megalaima rubricapilla*	Crimson throated barbet
40.			*Megalaima zeylanica*	Brown headed barbet
41.	Coraciiformes	Bucerotidae	*Buceros bicornis*	Great pied hornbill
42.			*Tockus griseu / Ocyceros griseus*	Malabar grey hornbill
43.		Alcedinidae	*Alcedo atthis*	Small Blue Kingfisher
44.			*Ceryle rudis*	Lesser Pied Kingfisher
45.			*Ceyx erithacus*	Oriental dwarf kingfisher
46.			*Halcyon capensis/* Pelargopsis capensis	Stork billed kingfisher
47.			*Halcyon snyrnesis*	White breasted kingfisher
48.		Meropidae	*Nyctyornis athertoni*	Bluebearded Bee-eater
49.			*Merops leschenaulti*	Chest nut headed Bee eater
50.		Coraciidae	*Coracias garrulus*	Indian Roller
51.			*Eurystomus orientalis*	Oriental Broad billed Roller
52.	Psittacciformes	Psittacidae	*Loriculus vernalis*	Indian Hanging parrot
53.			*Psittacula 1*	
54.			*Psittacula 2*	
55.			*Psittacula krameri*	Rose ringed parakeet
56.	Cuculiformes	Cuculidae	*Centropus sinensis*	Crow pheasant
57.			*Cuculus canorus*	Common cuckoo/Indian cuckoo
58.			*Surniculus lugubris*	Drongo Cuckoo
59.			*Cuculus varius*	Hawk Cuckoo
60.			*Eudynamys scolopaceus*	Asian koel
61.	Strigiformes	Strigidae	*Bubo nipalensis*	Forest Eagle Owl
62.			*Athene brama*	Spotted owlet
63.			*Strix leptogrammica*	Brown Wood Owl

64.			*Strix ocellata*	Mottled Wood Owl
65.			*Glaucidium radiatum*	Jungle Owlet
66.			*Ketupa zeylonensis*	Brown Fish Owl
67.			*Otus bakkamoena*	Collard Scops Owl
68.			*Ninox scutulata*	Brown hawk Owl
69.	Trogoniformes	Trogonidae	*Harpactes fasciatus*	Malabar trogon
70.	Passiformes	Pittidae	*Pitta brachyura*	Indian Pitta
71.		Campephagidae	*Coracina macei*	Large cuckoo shrike
72.			Shrike	
73.			Pericrocotus flammeus	Scarlet minivet
74.		Oriolidae	*Oriolus chinensis*	Black napped oriole
75.			*Oriolus xanthornus*	Black headed oriole
76.		Dicruridae	*Dicrurus leucophaeus*	Ashy Drongo
77.			*Dicrurus macrocercus*	Black drongo
78.			*Dicrurus paradiseus*	Greater racket tailed drongo
79.		Sturnidae	*Acridotheres tristis*	Common Myna
80.			*Gracula religiosa*	Common Hill Mynah
81.		Hirundinidae	*Delichon urbica*	Northern House Martin
82.			*Hirundo tahitica?*	House Swallow
83.			Swallow?	
84.		Corvidae	*Corvus macrorhynches*	Jungle Crow
85.			*Corvus splendens*	House Crow
86.			*Dendrocitta leucogastra*	White bellied tree pie
87.			*Dendrocitta vagabunda*	Indian tree pie
88.		Aegithinidae	*Aegithina tiphia*	Iora
89.		Chloropseidae	*Chloropsis cochinchinensis*	Jerdon's Chloropsis
90.		Irenidae	*Irena puella*	Fairy blue bird
91.		Pycnonotidae	Hypsipetes leucocephalus	Black Bulbul
92.			*Iole indica*	Yellowbrowed Bulbul
93.			*Pycnonotus jocosus*	Red whiskered bulbul
94.			*Pycnonotus priocephalus*	Grey headed Bulbul
95.			*Pycnonoyus cafer*	Red Vented Bulbul
96.		Muscicapidae	Babbler	
97.			Babbler	
98.			*Turdoides affinis*	White headed babbler
99.			*Turdoides striatus*	Jungle babbler
100.			Warbler	
101.			*Acrocephalus stentoreus*	Indian great reed warbler
102.			*Culicicapa ceylonensis*	Greyheaded Flycatcher
103.			*Cyornis pallipes*	White bellied Blue Flycatcher
104.			*Cyornis rubeculoides*	Bluethroated Flycatcher
105.			Cyornis tickelliae	Tickell's blue flycatcher
106.			*Eumyias albicaudata*	Nilgiri Flycatcher
107.			*Muscicapa muttui*	Brown breasted Flycatcher
108.			*Terpsiphone paradisi*	Asian paradise fly catcher
109.			*Copsychus saularis*	Oriental Magpie Robin
110.			*Garrulax delesserti*	Wayanadu Laughing Thrush
111.			*Monticola cinclorhynchus*	Blueheaded Rock Thrush
112.			*Hypothymis azurea*	Black napped monarch fly catcher
113.			*Myiophonus horsfieldi*	Malabar whistling thrush
114.			*Zoothera citrina cyanotus*	White throated thrush
115.		Sittidae	*Sitta frontalis*	Velvet fronted Nuthatch
116.		Motacillidae	*Anthus rufulus*	Paddyfield Pipit
117.			*Dendronanthus indicus*	Forest Wagtail
118.			*Motacilla flava*	Yellow Wagtail
119.			*Motacilla maderaspatensis*	Large pied Wagtail
120.		Dicaeidae	*Dicaem erythrorhynchos*	Tickell's Flower Pecker
121.		Nectariniidae	*Nectarina zeylanica*	Purple rumped sunbird
122.			*Nectarinia asiatica*	Purple Sunbird
123.			*Nectarinia lotenia*	Loten's Sunbird
124.			*Nectarinia minima*	Small Sunbird
125.		Ploceidae	*Lonchura malaca*	Black headed munia
126.	Gruiformes	Rallidae	*Amourornis phoenicurus*	White breasted water hen
127.	Charadriiformes	Charadridae	*Vanellus indicus*	Redwatttled Lapwing
128.		Scolopacidae	Sandpiper	
129.	Caprimulgiformes	Podargidae	Batrachostomus moniliger	Ceylon Frogmouth

G. List of Mammals in Myristica swamps of southern Kerala

No	Order	Family	Genus	Name of Mammal	Common Name
1.	Artiodactyla	*Bovidae*	Bos	*Bos gaurus/frontalis*	Bison/ gaur
2.		*Cervidae*	Cervus	*Cervus unicolor*	Sambar
3.			*Muntiacus*	*Muntiacus muntjack*	Barking Deer
4.		Tragulidae	*Tragulus Moschiola*	*Tragulus meminna Moschiola*	Mouse Deer
5.		Suidae	Sus	*Sus scrofa*	Wild Pig
6.	*Carnivora*	*Canidae*	*Cuon*	*Cuon alpinus*	Dhole
7.		Felidae	*Felis*	*Felis chaus*	Jungle cat
8.			Panthera	*Panthera pardus*	Panther/ Leopard
9.		Felidae	*****	*****	Nayi Pulli
10.		Herpestidae	*Herpestes*	*Herpestes edwardsii*	Common Mongoose
11.				*Herpestes fuscus*	Mongoose
12.		Ursidae	*Melursus*	*Melursus ursinus*	South Indian Sloth Bear
13.		Viverridae	*Viverriculla*	Civet cat (Viverriculla indica)	Common Indian Civet
14.			Paradoxurus	*Paradoxurus hermaphrodites*	Common Palm Civet
15.	Chiroptera	*****	*****	*****	*Bat*
16.	Lagomorpha	Leporidae	*Lepus*	*Lepus nigricollis*	Black Naped hare
17.	Primata	Cercopithecidae	*Macaca*	*Macaca radiata*	Bonnet maccaque
18.				*Macaca silensis*	Lion tailed macaque
19.			*Semnopithecus*	*Semnopithecus johnii*	Nilgiri langur
20.	*Proboscidea*	*Elephantidae*	Elephas	*Elephas maximus indica*	Elephant
21.	Rodentia	Hystricidae	*Hystrix*	*Hystrix indica*	Indian Porcupine
22.		Muridae	Platocanthomys	*Platocanthomys lasiurus*	Spiny dormouse
23.			*Bandicota*	*Bandicota indica*	Greater Bandicoot Rat
24.		Sciuridae	Funambulus	*Funambulus palmarum*	Three Striped Squirrell
25.				*Funambulus sps triatatus*	
26.			*Ratufa*	*Ratufa indica maxima*	Malabar Giant Squirell
27.			*Petaurista*	*Petaurista petaurista*	Flyig Squirell
Total	7	16	*24*	*27*	

Appendix IV Transect Tables A. Herbs inside

Species	Chekidi Chal	ChannaMala	Empong	Karinkurinji	Marappalam Major	Marappalam Minor	Mottal Mood	Muppathadi	Neerattu Thadam1	Neerattu Thadam2	PerumPadappy	Pillekode	Plavu Chal	Poovanathu Mood-0	Poovanathu Mood-3	Poovanathu Mood-4	Pullu Mala	Sastha Nada	Uthiran Chira	Total
Total	160	38	71	50	39	53	38	40	41	6	71	102	37	127	82	45	63	35	50	1148
Lagenandra ovata	63	26	0	44	34	14	31	23	0	0	35	36	21	17	0	0	0	5	50	399
Psychotria flavida	87	3	0	0	0	0	0	0	0	0	0	1	0	31	2	0	14	0	0	138
Grass	0	0	47	0	0	0	0	0	40	1	18	0	0	0	0	0	9	0	0	115
Cyanotis sp	0	5	3	0	0	0	0	8	0	0	14	28	8	44	0	0	0	0	0	110
Selaginella brachystachya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	35	0	0	0	84
Carex sp	0	0	0	1	0	0	0	1	0	1	1	0	0	0	12	9	31	1	0	57
Barleria courtallica	0	0	0	0	0	10	0	0	0	0	0	1	0	0	0	0	0	16	0	27
Christella parasitica	3	2	5	0	0	0	0	0	0	0	0	5	0	4	0	0	4	0	0	23
Pellionia heyneana	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	18
Phrynium pubinerve	0	0	10	2	0	0	0	0	0	0	0	1	0	0	0	0	0	4	0	17
Hedyotis auricularia	0	0	0	0	0	0	0	0	1	4	0	0	0	5	0	0	5	0	0	15
Pothos scandens	0	0	0	0	0	1	0	0	0	0	0	11	1	0	0	0	0	0	0	13
Selaginella brachystachya	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	12
Dracaena terniflora	0	0	0	0	4	0	0	0	0	0	0	0	2	0	4	1	0	0	0	11
Myxospyrum smilacifolium	0	0	0	0	1	0	1	0	0	0	0	9	0	0	0	0	0	0	0	11
Piper nigrum	0	0	1	0	0	0	0	3	0	0	0	0	1	0	0	0	0	5	0	10
Pandanus thwaitesii	0	0	3	0	0	0	0	0	0	0	0	0	0	0	4	0	0	2	0	9
Chilocarpus denudatus	0	0	0	0	0	0	4	0	0	0	1	0	1	0	2	0	0	0	0	8
Selaginella brachystachya	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Connarus sp	0	0	1	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	8
Selaginella brachystachya	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	7
Leptochilus decurrens	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	7
Selaginella brachystachya	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Combretum latifolium	0	0	0	0	0	0	2	3	0	0	1	0	0	0	0	0	0	0	0	6
Ophiorrhiza mungos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4
Bauhinia phoenicea	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	3
Ventilago bombaiensis	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0	3
Angiopteris evecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
Kunstleria keralensis	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Schumannianthus virgatus	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Tetracera acara	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
Myxospyrum smilacifolium	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	2
Rhaphidophora pertusa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Selaginella brachystachya	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Gomphandra tetrandra	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Jasminum azoricum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Leptaspis urceolata	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lindernia ciliata	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Neruocalyx calycinus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Pogostemon paniculatus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Strychnos colubrina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1

B. Shrubs Inside

Species	Chekidi Chal	Channa Mala	Empong	Karinkurinji	Marappalam Major	Marappalam Minor	Mottal Mood	Muppathadi	Neerattu Thadam 1	Neerattu Thadam 2	Perum Padappy	Pille Code	Plavu Chal	Poovanathu Mood-0	Poovanathu Mood-3	Poovanathu Mood-4	Pullu Mala	Sastha Nada	Uthiran Chira	Total
Total	1220	352	189	552	278	146	308	234	38	35	328	299	342	234	113	100	153	258	103	5282
Lagenandra ovata	534	263	0	492	226	73	228	132	0	2	244	80	196	86	0	0	0	48	28	2632
Ochlandra travancorica	391	11	0	0	4	3	2	0	0	0	0	0	0	36	0	0	38	0	0	485
Christella parasitica	164	26	30	0	1	0	0	3	0	0	1	1	0	17	12	0	26	0	4	285
Carex sp	1	1	10	2	0	2	0	2	1	13	7	21	0	10	30	47	71	13	0	231
Piper nigrum	0	16	26	1	10	7	11	20	2	0	1	25	6	20	1	3	1	43	2	195
Barleria courtallica	0	0	0	0	0	12	0	0	0	0	0	75	0	0	0	0	0	58	0	145
Chilocarpus denudatus	7	0	0	25	0	0	8	6	3	2	4	11	21	10	6	6	5	1	12	127
Phrynium pubinerve	0	0	37	15	5	6	1	0	0	2	8	13	5	1	0	0	1	30	0	124
Pandanus thwaitesii	2	1	25	0	0	8	0	0	0	8	1	3	0	13	36	17	0	6	0	120
Calamus hookerianus	1	4	5	2	0	17	3	3	5	0	13	16	5	0	4	17	0	13	0	108
Schumannianthus virgatus	88	0	2	4	0	0	0	0	0	0	0	1	6	0	0	0	0	0	0	101
Combretum latifolium	11	0	2	7	8	0	15	12	7	2	1	1	1	0	0	0	0	0	6	73
Pothos scandens	1	1	0	1	10	2	10	3	9	2	0	5	4	1	2	1	0	2	18	72
Cyanotis sp	0	16	0	0	0	0	0	0	0	0	0	0	49	0	0	0	0	0	0	65
Myxospyrum smilacifolium	0	1	0	0	10	5	12	1	1	0	9	4	4	1	0	1	2	0	3	54
Kunstleria keralensis	3	0	0	2	2	3	0	7	2	2	1	1	0	7	2	2	6	0	13	53
Psychotria flavida	0	3	1	0	0	5	0	16	0	0	0	5	0	2	5	0	0	0	0	37
Pandanus furcatus	0	1	0	0	0	0	5	0	0	0	27	0	0	0	0	0	0	0	0	33
Tetracera acara	0	0	5	0	0	0	0	0	1	0	0	0	0	14	2	2	0	6	0	30
Bauhinia phoenicea	0	0	0	0	0	0	0	0	0	0	0	21	0	6	1	0	0	0	0	28
Gomphandra tetrandra	0	1	26	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	28
Thottea siliquosa	11	0	0	0	0	0	0	0	0	0	4	0	0	0	4	1	0	1	6	27
Alpinia Malaccensis	0	1	0	1	0	0	6	0	0	0	1	0	12	0	0	0	2	2	0	25
Connarus sp	0	0	2	0	0	0	0	0	3	0	0	11	1	0	1	1	0	1	0	20
Ventilago bombaiensis	0	0	0	0	0	1	0	0	0	0	0	0	16	2	0	0	0	0	0	19
Rhaphidophora pertusa	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	8	9	18
Leptochilus decurrens	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	16
Jasminum azoricum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	13
Symplocos cochinchinensis	2	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Selaginella brachystachya	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	11
Dracaena terniflora	0	1	0	0	0	1	0	0	0	0	0	0	7	0	0	1	0	0	0	10
Angiopteris evecta	2	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	8
Zingiber zerumbet	0	0	2	0	1	0	0	0	0	0	0	1	0	3	0	0	0	0	0	7
Jasminum azoricum	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	5
Diplocyclos palmatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5
Anaphyllum wightii	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	4
Stenochlaena palustris	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	2	0	4
Pinanga dicksonii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	4
Unknown cli	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0	0	4
Pogostemon panniculatus	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Pogostemon panniculatus	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Strychnos colubrina	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	3
Uvaria narum	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3
Syzygium sp	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	3
Begonia Malabarica	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Casearia glomerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
Zehneria sp	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Atalantia racemosa	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	2
Luvunga eleutherandra	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2
Ipomea mauritiana	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2

Species	Chekidi Chal	Channa Mala	Empong	Karinkurinji	Marappalam Major	Marappalam Minor	Mottal Mood	Muppathadi	Neerattu Thadam 1	Neerattu Thadam 2	Perum Padappy	Pille Code	Plavu Chal	Poovanathu Mood-0	Poovanathu Mood-3	Poovanathu Mood-4	Pullu Mala	Sastha Nada	Uthiran Chira	Total
Mussaenda frondosa	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
Tylophora mollissima	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
Abrus pulchellus	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Artanema longifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Asparagus recemosus	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Chromolena odoratum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Selaginella brachystachya	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Dicranopteris linearis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Hibiscus furcatus	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Ixora nigricans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Jasminum azoricum	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Mikania micrantha	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Symplocos macrophylla	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Unknown speices	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Melastoma Malabathricum	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1

C. Saplings-inside

Species	Chekidi Chal	Channa Mala	Empong	Marappala m Major	Marappala m Minor	Mottal Mood	Muppatha di	Neerattu Thadam1	Neerattu Thadam2	Perumpad appy	Pillekode	Plavu kidna chal	Poovanath u Mood-3	Poovanthu Mood-4	Pullu Mala	Sastha Nada	Uthiran Chira	Total
Total	238	544	514	354	834	604	333	317	345	387	377	558	487	315	346	60	451	7064
Myristica fatua var.magnifica	79	258	157	208	28	199	183	52	20	16	0	77	172	61	34	0	218	1762
Vateria indica	0	2	0	11	479	126	0	112	72	0	39	251	0	0	167	0	1	1260
Gymnacranthera farquhariana	22	137	66	50	22	150	44	54	35	92	36	58	96	83	6	9	84	1044
Holigarna arnottiana	50	16	14	52	76	28	0	4	122	58	65	9	10	74	36	0	48	662
Xanthophyllum arnottianum	26	19	41	14	63	19	29	42	92	25	51	9	3	7	29	0	34	503
Lophopetalum wightianum	10	8	115	0	6	8	26	32	1	6	57	68	119	2	23	9	12	502
Uvaria narrum	26	4	6	0	9	4	5	1	0	38	0	2	11	14	0	0	0	120
Mastixia arborea	5	8	2	7	10	3	4	0	0	33	9	0	3	2	16	0	3	105
Symplocos cochinchinensis	0	0	25	0	0	0	0	0	0	2	21	0	0	1	2	37	15	103
Semecarpus auriculata	1	32	8	2	1	18	3	5	0	0	4	6	5	5	0	0	3	93
Baccaurea courtallensis	0	9	1	0	32	3	5	0	1	5	7	10	4	9	3	0	1	90
Hydnocarpus pantandra	2	2	0	1	16	2	8	4	1	18	5	14	3	3	0	2	1	82
Kingiodendron pinnatum	0	0	1	0	30	0	0	1	0	2	25	7	1	5	0	0	0	72
Pinanga dicksonii	0	17	2	0	1	15	0	0	0	0	1	0	23	4	0	0	0	63
Hopea parviflora	0	0	13	1	0	5	0	0	0	4	26	2	0	10	0	0	0	61
Mesua ferrea	0	3	4	0	3	4	0	0	0	18	0	6	5	2	5	0	0	50
Leea indica	0	1	14	0	1	7	1	1	0	5	0	8	0	1	1	0	4	44
Strombosia ceylanica	3	2	0	0	18	0	6	0	0	1	0	4	6	0	0	0	0	40
Polyalthia fragrans	0	4	0	0	0	0	9	0	0	5	0	7	0	5	0	0	1	31
Syzygium travancoricum	3	2	6	1	0	0	0	0	0	1	5	3	0	0	8	1	1	31
Cinnamomum Malabatrum	3	2	5	0	2	0	0	0	1	7	3	0	3	1	0	1	0	28
Dimocarpus logan	3	1	1	0	10	0	8	0	0	0	0	2	0	0	1	0	0	26
Artocarpus hirsutus	0	2	4	0	2	1	0	0	0	1	4	6	1	0	3	0	1	25
Ixora brachiata	0	0	0	1	9	0	0	2	0	9	0	2	0	2	0	0	0	25
Persea macrantha	2	2	6	0	0	0	1	3	0	1	0	2	0	1	7	0	0	25
Carallia barchiata	0	0	1	1	3	1	0	0	0	8	0	0	8	0	0	0	0	22
Diospyros buxifolia	0	0	7	0	0	0	0	0	0	2	3	0	0	1	0	0	6	19
Dysoxylum Malabaricum	0	2	0	0	5	0	0	0	0	7	0	0	3	2	0	0	0	19
Erythroxylum lanceolatum	0	0	0	0	0	0	0	0	0	6	1	0	3	6	0	0	0	16
Aporosa cardiosperma	1	0	0	2	0	0	0	0	0	5	3	0	0	0	1	1	2	15
Elaeocarpus tuberculatus	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	12	13
Varunaag	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Ficus hispida	0	1	0	0	0	3	0	1	0	0	6	0	0	0	0	0	0	11
Syzygium cumini	0	2	0	0	1	0	0	0	0	1	0	0	4	2	0	0	0	10
Syzygium mundagam	0	0	2	0	2	0	0	0	0	1	0	0	2	3	0	0	0	10
Mangifera indica	0	0	1	0	1	0	0	0	0	0	0	2	1	4	0	0	0	9
Actinodaphne Malabarica	0	2	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	6
Unknown species	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	5
Syzygium cumini	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5
Calophyllum	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	4

Species	Chekidi Chal	Channa Mala	Empong	Marappalam Major	Marappalam Minor	Mottal Mood	Muppathadi	Neerattu Thadam1	Neerattu Thadam2	Perumpadappy	Pillekode	Plavu kidna chal	Poovanthu Mood-3	Poovanthu Mood-4	Pullu Mala	Sastha Nada	Uthiran Chira	Total
polyanthum																		
Glochidion ellipticum	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	4
Syzygium cumini	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	4
Flacourtia montana	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	3
Pterygota alata	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	3
Sterculia guttata	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	3
Aporosa cardiosperma	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
Pajanelia longifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Elaeocarpus glandulosus	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	2
Garcinia gummi-gutta	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2
Atalantia racemosa	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Macaranga peltata	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
Archidendron monadelphum	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Casearia glomerata	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Diospyros paniculata	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Dipterocarpus indicus	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Garcinia morella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Syzygium cumini	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Marotty like	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Memecylon randerianum	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Aporosa acuminata	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Sapindus trifoliatus	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Pterospermum reticulatum	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Pterospermum reticulatum	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1

D. Trees_inside

Species	Chekidi Chal	Chan naMal a	Empo ng	Karinku rinji	Marapp alam Major	Mara ppala m Minor	Mottal Mood	Muppat hadi	Neera ttu thada m1	Neera ttu thada m2	Peru mpad appy	Pillek ode	Plavu kidna chal	Poov anath u Mood -0	Poovan athu Mood-3	Poovanth u Mood-4	Pullu Mala	Sastha Nada	Uthiran Chira	Total
Total	89	128	109	179	134	110	131	149	389	364	149	110	149	131	129	119	92	241	201	3103
Myristica fatua var.magnifica	39	46	42	55	50	7	53	61	187	35	14	0	37	44	77	28	18	4	116	913
Gymnacranthera farquhariana	22	54	7	67	64	20	36	70	7	1	35	45	40	70	30	48	6	67	79	768
Vateria indica	0	2	0	4	1	21	24	0	135	95	0	20	32	0	0	1	39	0	0	374
Holigarna arnottiana	5	3	6	7	7	4	1	1	6	205	3	5	0	4	6	13	11	2	1	290
Lophopetalum wightianum	0	6	25	18	2	15	4	4	20	2	44	17	2	5	10	14	4	28	0	220
Xanthophyllum arnottianum	2	7	5	0	0	8	0	0	1	10	10	2	2	0	1	4	0	15	2	69
Hydnocarpus pentandra	4	0	3	6	1	3	1	1	2	1	9	2	18	2	0	0	1	13	0	67
Mastixia arborea	2	3	0	0	1	1	0	1	5	0	10	2	0	0	3	0	2	3	1	34
Baccaurea courtallensis	0	1	1	0	0	8	0	4	0	0	4	3	3	0	0	0	0	3	0	27
Macaranga peltata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	25
Semecarpus auriculata	0	0	2	0	0	0	2	0	13	1	0	0	0	0	0	1	0	0	2	21
Elaeocarpus tuberculatus	3	0	0	3	1	4	0	2	0	0	0	1	0	0	0	0	0	6	0	20
Syzygium tarvancoricum	0	0	5	2	4	0	0	0	0	0	5	0	3	0	0	0	1	0	0	20
Knema attenuata	0	0	0	10	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	15
Aporosa cardiosperma	2	1	3	0	0	1	0	1	1	0	0	3	0	0	0	0	2	0	0	14
Hopea parviflora	1	1	0	0	0	4	2	0	0	0	1	1	2	0	0	2	0	0	0	14
Tabernaemontana alternifolia	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	13	0	14
Unknown	0	2	3	0	0	0	2	0	1	0	3	0	0	2	0	0	0	0	0	13
Helicteres isora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	12
Aporosa cardiosperma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	11
Actinodaphne Malabarica	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	8	0	10
Diospyros buxifolia	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	7	0	9
Strombosia ceylanica	1	0	1	0	0	0	2	0	0	2	0	1	1	0	0	0	0	1	0	9
Artocarpus hirsutus	0	1	0	2	0	0	0	1	0	1	1	1	0	0	0	1	0	0	0	8
Cinnamomum Malabatrum	1	0	0	0	0	2	0	0	0	0	3	0	1	0	0	0	0	1	0	8
Persea macrantha	0	0	1	0	0	1	0	0	0	0	1	0	1	1	0	0	1	1	0	7
Unknown speceis	1	0	0	0	0	1	0	2	0	0	0	0	1	0	0	0	1	1	0	7
Glochidion ellipticum	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	3	1	0	6
Neolamarckia cadamba	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	5
Ficus nervosa	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	1	0	5
Lagerstroemia speciosa	0	0	0	0	0	1	0	0	0	1	0	0	0	2	0	0	0	1	0	5
Macaranga peltata	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	1	0	5
Myristica Malabarica	3	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	5
Mesua ferrea	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	4
Polyalthia fragrans	0	0	0	0	0	2	0	0	0	0	1	0	1	0	0	0	0	0	0	4
Syzygium sp	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	1	0	0	0	4
Dipterocarpus indicus	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	3
Dysoxylum Malabaricum	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	3
Leea indica	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	3
Pinanga dicksonii	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Erythroxylum lanceolatum	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	3
Terminalia paniculata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
Pajanelia longifolia	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
Calophyllum polyanthum	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	2
Carallia brachiata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2
Dillenia pentagyna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
Dimocarpus logan	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Mitragyna parvifolia	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2

Species	Chekidi Chal	Chan naMal a	Empo ng	Karinku rinji	Marapp alam Major	Mara ppala m Minor	Mottal Mood	Muppat hadi	Neera ttu thada m1	Neera ttu thada m2	Peru mpad appy	Pillek ode	Plavu kidna chal	Poov anath u Mood -0	Poovan athu Mood-3	Poovanth u Mood-4	Pullu Mala	Sastha Nada	Uthiran Chira	Total
Pterygota alata	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Terminalia elliptica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
Tetrameles nudiflora	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Racosperma auriculiformis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Mitragyna parvifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Alstonia scholaris	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Annakombi	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Aranjal	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Ixora brachiata	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Dalbergia latifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Diospyros paniculata	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Elaeocarpus glandulosus	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Flacourtia montana	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Garcinia gummi-gutta	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Litsea travancorica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Mangifera indica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Memecylon randerianum	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Myristica beddomei	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Olea dioica	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Olea dioica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Phyllanthus emblica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Scolopia crenata	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Stereospermum colais	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Swietenia macrophylla	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Symplocos cochinchinensis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Syzygium cumini	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Syzygium gardneri	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Syzygium mundagam	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1

E. Herbs_outside

Species	Chekidi Chal	Channa Mala	Empong	Karinkurinji	Marappalam Major	Marappalam Minor	Mottal Mood	Muppathadi	Perumpadappy	Plavu Chal	Poovanathu Mood-3	Pullu Mala	Sastha Nada	Uthiran Chira	Total
Total	39	19	64	93	22	48	31	13	15	35	84	14	46	200	723
Ventilago bombaiensis	0	0	6	0	0	0	0	0	8	26	0	0	0	0	40
Dracaena ternifolra	0	9	10	0	10	13	10	13	2	2	16	0	1	0	86
Phaeanthus Malabaricus	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
Strychnos colubrina	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
Christella parasitica	0	4	0	0	0	0	0	0	0	1	0	0	0	17	22
Gnetum edule	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Myxospyrum smilacifolium	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Grass	17	0	0	38	0	0	0	0	0	0	0	8	15	127	205
Zingiber zerumbet	20	0	0	28	0	0	0	0	0	0	9	5	21	29	112
Ochlandra travancorica	0	0	0	0	3	0	0	0	0	0	0	1	0	1	5
Psychotria flavida	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4
Piper nigrum	0	1	2	0	0	1	0	0	1	0	0	0	0	1	6
Barleria courtallica	0	0	0	3	1	0	6	0	0	0	0	0	0	0	10
Combretum latifolium	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5
Carex sp	0	0	2	0	2	2	4	0	0	0	22	0	0	0	32
Unknown	0	0	4	0	0	0	2	0	0	0	0	0	0	0	6
Pandanus furcatus	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
Jasminum azoricum	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Luvunga eleutherandra	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Chromolena odoratum	0	0	0	10	0	0	0	0	0	0	0	0	0	1	11
Curculigo trichocarpa	0	0	0	5	0	0	0	0	0	0	0	0	0	0	5
Abrus pulchellus	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3
Schumannianthus virgatus	0	3	0	2	0	0	0	0	0	0	0	0	9	14	28
Thespesia lampas	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
Globba ophioglossa	1	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Ixora nigricans	0	0	0	1	0	0	0	0	0	0	0	0	0	5	6
Ixora nigricans	0	1	2	0	0	0	0	0	0	0	0	0	0	0	3
Clausena austroindica	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Hedyotis auricularia	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Pellionia heyneana	0	0	0	0	0	22	0	0	0	0	0	0	0	0	22
Selaginella brachystachya	0	0	0	0	0	10	0	0	0	0	17	0	0	0	27
Pandanus furcatus	0	0	28	0	3	0	0	0	0	0	4	0	0	0	35
Calamus hookerianus	0	0	8	0	0	0	0	0	0	0	0	0	0	0	8
Selaginella vaginalis	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Kunstleria keralensis	0	0	0	0	1	0	0	0	0	0	15	0	0	0	16
Pterospermum reticulatum	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Helicteres isora	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Acacia torta	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Mimosa pudica	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Zizyphus rugosa	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Atalantia racemosa	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Smilax zeylanica	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1

F. Shrubs_outside

Species	Chekidi Chal	Channa Mala	Empong	Karinkurinji	Marappalam Major	Marappalam Minor	Mottal Mood	Muppathadi	Perum padappy	Plavu Chal	Poovanathu Mood-3-	Pullu Mala	Sastha Nada	Uthiran Chira	Total
Total	605	256	312	395	188	111	233	439	206	489	375	291	192	361	4453
Zingiber zerumbet	221	6	0	170	0	7	1	0	0	0	0	5	60	167	637
Helicteres isora	3	0	0	60	0	0	0	0	0	0	0	0	46	34	143
Schumannianthus virgatus	0	5	12	11	0	0	16	0	0	0	0	2	21	32	99
Alpinia Malaccensis	0	0	0	52	1	0	0	3	0	0	28	0	6	26	116
Ochlandra travancorica	315	0	0	0	7	0	0	1	0	0	0	5	0	19	347
Piper nigrum	3	4	4	0	0	0	3	5	2	9	0	11	10	15	66
	2	3	0	5	1	0	1	0	0	1	0	2	5	12	32
Christella parasitica	0	8	1	1	3	2	1	1	7	47	0	0	0	8	79
Thespesia lampas	0	0	0	10	0	0	0	0	0	0	0	0	2	7	19
Calycopteris floribunda	0	1	0	2	0	0	0	2	0	0	0	3	5	5	18
Zizyphus rugosa	4	0	0	10	0	0	0	0	0	1	0	5	0	5	25
Phrynium pubinerve	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
Abrus pulchellus	3	0	1	2	0	1	0	0	0	0	0	4	2	4	17
Centrosema molle	1	0	0	0	0	0	0	0	0	0	0	0	0	4	5
Clerodendrum viscosum	0	0	0	3	0	0	0	0	0	0	0	0	11	3	17
Cyclea peltata	2	0	0	1	0	0	1	0	0	0	0	1	1	2	8
Desmodium heterocarpon	0	0	0	0	0	0	0	0	0	0	0	16	0	2	18
Acacia torta	0	0	0	0	0	0	0	0	1	0	0	1	0	2	4
Smilax zeylanica	8	15	1	0	7	0	4	0	0	0	0	40	3	1	79
Strychnos colubrina	0	5	17	0	0	0	1	37	0	5	0	2	1	1	69
Calamus thwaitesii	0	1	0	0	0	10	1	8	3	5	1	3	0	1	33
Myxospyrum smilacifolium	0	0	0	0	1	0	0	1	1	1	0	1	0	1	6
Unknown	0	0	0	1	14	1	6	1	0	0	2	0	0	1	26
Thottea siliquosa	8	1	0	0	3	0	1	0	2	0	1	0	0	1	17
Sida rhombifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Pterospermum reticulatum	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Urena lobata	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Cayratia pedata	0	0	0	0	0	0	0	0	0	0	0	0	6	0	6
Curcuma ecalcarata	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
Desmodium heterocarpon	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
Connarus sp	0	2	0	0	1	0	1	0	6	101	0	5	1	0	117
Asparagus recemosus	1	0	0	0	0	0	0	0	0	0	0	3	1	0	5
Unknown cli	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2
Chilocarpus denudatus	0	0	1	0	0	0	1	0	6	0	3	0	1	0	12
Chromolena odoratum	0	0	0	5	0	0	0	0	0	0	0	0	1	0	6
Uvaria narum	0	0	1	0	0	0	0	0	0	0	0	0	1	0	2
Clematis bourdillonii	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Lantana camara	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Lygodium cli	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Psychotria flavida	20	25	15	0	10	7	11	294	35	1	10	150	0	0	578
Jasminum rottlerianum	0	0	0	0	0	0	0	2	6	14	0	8	0	0	30
Butea parviflora	0	0	0	2	0	0	0	0	0	0	0	6	0	0	8
Carex sp	0	6	24	0	6	4	12	15	0	0	102	4	0	0	173
Calamus hookerianus	0	8	14	0	3	11	12	18	18	7	5	2	0	0	98
Memecylon randerianum	1	4	0	0	0	0	0	10	6	1	0	2	0	0	24
Clausena austroindica	0	8	0	0	1	4	0	17	2	1	0	2	0	0	35
Casearia glomerata	0	6	0	0	0	2	0	0	2	1	0	2	0	0	13
Atalantia racemosa	0	0	0	0	0	0	0	0	0	48	0	2	0	0	50
Phaeanthus Malabaricus	0	47	0	0	0	11	0	8	26	19	0	1	0	0	112
Ixora nigricans	0	3	6	0	0	0	0	0	0	0	0	1	0	0	10
Parsonsia inodora	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Pandanus furcatus	0	2	104	0	30	2	12	0	1	0	141	0	0	0	292

Species	Chekidi Chal	Channa Mala	Empong	Karinkurinji	Marappalam Major	Marappalam Minor	Mottal Mood	Muppathadi	Perum padappy	Plavu Chal	Poovanathu Mood-3-	Pullu Mala	Sastha Nada	Uthiran Chira	Total
psychotria flavida	0	0	0	0	0	5	0	0	0	0	49	0	0	0	54
Kunstleria keralensis	0	0	1	0	3	0	0	3	0	0	20	0	0	0	27
Dracaena terniflora	0	81	36	0	41	21	57	0	16	0	13	0	0	0	265
Ventilago bombaiensis	1	0	48	0	2	0	0	0	36	210	0	0	0	0	297
Atalantia racemosa	0	0	0	0	0	0	0	0	10	0	0	0	0	0	10
Dichapetalum glenoids	0	5	6	0	0	0	0	0	5	4	0	0	0	0	20
Atalantia racemosa	0	0	0	0	0	0	0	0	5	0	0	0	0	0	5
Tetracera acara	0	0	4	0	0	0	0	1	3	0	0	0	0	0	8
Amomum muricatum	0	0	0	0	0	0	0	1	3	0	0	0	0	0	4
Pandanus thwaitesii	0	0	0	0	0	0	1	1	1	0	0	0	0	0	3
Syzygium shrub	0	4	0	0	15	1	0	0	1	0	0	0	0	0	21
Gnetum edule	0	0	0	0	0	0	0	0	1	8	0	0	0	0	9
Atalantia racemosa	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Calamus travancoricus	0	0	4	0	0	0	0	4	0	0	0	0	0	0	8
Unknown red frt	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
Barleria courtallica	0	0	0	26	3	3	25	2	0	1	0	0	0	0	60
Canthium coromandelicum	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Combretum latifolium	0	0	5	0	0	1	29	0	0	0	0	0	0	0	35
Luvunga eleutherandra	0	0	1	0	5	0	14	0	0	2	0	0	0	0	22
Jasminum azoricum	1	1	3	4	1	0	8	0	0	0	0	0	0	0	18
Atalantia racemosa	0	0	1	0	20	9	5	0	0	0	0	0	0	0	35
Trichopus zeylanicus	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5
Symplocos macrophylla	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
Pothos scandens	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2
Stenochlaena palustris	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Like Nilapana	0	0	0	0	0	5	0	0	0	0	0	0	0	0	5
Bauhinia phoenicea	0	0	0	0	0	4	0	0	0	0	0	0	0	0	4
Gomphandra tetrandra	0	0	0	0	8	0	0	0	0	0	0	0	0	0	8
Ipomea mauritiana	4	4	0	0	1	0	0	0	0	0	0	0	0	0	9
Elemully	0	0	0	19	0	0	0	0	0	0	0	0	0	0	19
Globba ophioglossa	1	0	0	4	0	0	0	0	0	0	0	0	0	0	5
Tylophora mollissima	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4
Dioscorea alata	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
Hibiscus furcatus	3	0	0	1	0	0	0	0	0	0	0	0	0	0	4
Grass	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Leptaspis urceolata	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Zehneria sp	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Alpinia Malaccensis	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Syzygium shrub	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Melastoma Malabathricum	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Ventilago bombaiensis	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1

G. Trees outside

Species	Chekidi Chal	Channa Mala	Empong	Karikurinji	Marappalam Major	Marappalam Minor	Mottal Mood	Muppathadi	Perumpadappi	Plavu chal	Poova-3	Pullu Mala	Sastha Nada	Uthiran Chira	TOTAL
Total	140	95	88	154	86	80	70	62	87	72	113	54	93	35	1229
Helicteres isora	0	0	0	121	0	0	0	0	0	0	0	0	12	11	144
Aporosa cardiosperma	61	8	2	1	1	2	4	0	4	7	0	13	11	1	115
Xanthophyllum arnottianum	0	6	13	0	4	11	13	5	7	10	15	0	0	0	84
Ixora brachiata	0	4	2	0	4	1	0	7	4	20	0	17	0	1	60
Strombosia ceylanica	0	2	3	0	11	5	4	11	3	4	7	0	1	0	51
Baccaurea courtallensis	0	0	1	0	8	8	6	5	5	0	13	0	0	0	46
Macaranga peltata	8	0	0	3	2	2	1	0	2	0	0	0	25	0	43
Diospyros paniculata	0	2	6	0	9	1	3	5	1	4	1	1	0	0	33
Tabernaemontana alternifolia	4	9	2	3	0	0	2	0	0	0	0	0	13	0	33
Cinnamomum Malabatrum	1	5	2	0	2	3	3	0	9	1	2	4	0	0	32
Actinodaphne Malabarica	8	8	0	0	0	1	1	0	0	0	0	0	8	0	26
Unknown	1	0	5	1	1	2	3	6	0	0	6	0	0	1	26
Knema attenuata	0	1	8	0	4	3	1	1	2	0	3	0	0	0	23
Terminalia paniculata	6	4	1	5	0	0	0	0	1	0	0	2	3	1	23
Hydnocarpus pentandra	0	1	1	1	2	3	2	0	3	0	4	1	0	1	19
Litsea travancorica	0	6	3	0	2	2	1	0	0	0	5	0	0	0	19
Myristica Malabarica	0	2	1	0	1	3	2	1	3	0	6	0	0	0	19
Mallotus philippensis	1	3	0	3	1	0	8	0	1	1	0	0	0	0	18
Olea dioica	11	1	0	0	0	0	0	0	0	0	0	2	1	3	18
Terminalia elliptica	15	0	0	1	0	0	0	0	0	0	0	0	2	0	18
Syzygium mundagam	0	0	1	0	0	3	0	0	2	2	8	0	0	0	16
Dimocarpus longan	0	0	1	0	1	0	0	7	2	4	0	0	0	0	15
Erythroxylum lanceolatum	0	0	0	0	0	0	0	0	2	0	13	0	0	0	15
Dipterocarpus indicus	0	0	4	0	4	1	0	0	0	0	5	0	0	0	14
Kingiodendron pinnatum	0	0	1	0	4	2	1	0	3	0	3	0	0	0	14
Vateria indica	0	1	0	0	0	7	2	0	0	3	0	0	0	0	13
Croton Malabaricus	0	2	0	4	0	1	2	3	0	0	0	0	0	0	12
Leea indica	0	1	0	4	1	1	0	0	1	1	0	0	0	3	12
Semecarpus auriculata	0	3	2	0	0	2	1	0	0	0	2	2	0	0	12
Dysoxylum Malabaricum	0	2	1	0	2	0	0	0	4	0	2	0	0	0	11
Vitex altissima	2	0	0	0	0	3	3	1	1	1	0	0	0	0	11
Polyalthia fragrans	0	0	0	0	4	0	0	0	4	1	1	0	0	0	10
Stereospermum colais	0	5	0	0	0	0	0	1	1	1	0	0	1	1	10
Diospyros buxifolia	0	0	3	0	0	1	0	0	0	0	0	0	5	0	9
Hopea parviflora	1	2	4	0	1	0	0	0	1	0	0	0	0	0	9
Mangifera indica	0	1	4	0	1	0	0	0	1	0	1	1	0	0	9
Mitragyna parvifolia	2	0	0	0	0	0	0	1	1	3	0	0	1	0	8
Archidendron monadelphum	0	3	1	0	1	1	0	0	1	0	0	1	0	0	8
Lophopetalum wightianum	0	2	1	0	3	0	0	1	0	0	0	0	1	0	8
Mesua ferrea	0	0	0	0	1	0	0	3	2	0	1	0	1	0	8
Syzygium sp	0	0	1	0	1	0	0	0	1	1	2	2	0	0	8
	0	0	0	0	0	0	0	1	1	0	5	0	0	0	7
Dillenia pentagyna	5	0	0	0	0	0	0	0	0	0	0	0	2	0	7
Schleichera oleosa	0	0	0	0	1	0	0	1	1	1	0	1	0	2	7
Artocarpus hirsutus	0	1	0	0	1	1	1	0	0	2	0	0	0	0	6
Lagerstroemia speciosa	0	0	0	0	0	0	0	0	0	2	0	1	1	2	6
Glochidion ellipticum	1	0	0	0	0	0	0	0	3	0	0	0	1	1	6
Persea macrantha	1	2	0	0	0	0	1	0	0	0	0	0	1	1	6
Pterygota alata	0	2	0	0	0	1	0	0	0	2	0	0	1	0	6
Carallia brachiata	0	0	0	0	1	1	0	0	1	0	2	0	0	0	5
Atalantia racemosa	0	0	0	0	3	0	0	0	1	0	1	0	0	0	5
Symplocos cochinchinensis	0	1	3	0	0	0	1	0	0	0	0	0	0	0	5

Species	Chekidi Chal	Channa Mala	Empong	Karikurinji	Marappalam Major	Marappalam Minor	Mottal Mood	Muppathadi	Perumpadappi	Plavu chal	Poova-3	Pullu Mala	Sastha Nada	Uthiran Chira	TOTAL
Syzygium gardneri	0	0	1	0	1	0	1	0	1	0	1	0	0	0	5
Bombax ceiba	0	0	0	0	0	0	2	0	0	0	0	0	0	2	4
Dalbergia latifolia	0	0	0	3	0	0	0	0	0	0	0	0	1	0	4
Myristica beddomei	0	0	0	0	1	1	0	0	0	0	2	0	0	0	4
Hopea utilis	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4
Sapindus trifoliatus	0	0	1	0	0	1	1	0	0	0	0	1	0	0	4
Annakombi	0	0	1	0	0	1	0	0	0	0	0	0	0	1	3
Elaeocarpus glandulosus	2	1	0	0	0	0	0	0	0	0	0	0	0	0	3
Elaeocarpus tuberculatus	0	1	0	0	0	0	0	0	2	0	0	0	0	0	3
Flacourtia montana	0	0	1	0	0	2	0	0	0	0	0	0	0	0	3
Ventilago bombaiensis	0	0	0	2	0	0	0	0	0	0	0	0	0	1	3
Tetrameles nudiflora	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3
Alstonia scholaris	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Calophyllum polyanthum	1	0	0	0	0	0	0	0	0	0	1	0	0	0	2
Careya arborea	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2
Casearia glomerata	0	0	0	0	0	1	0	0	0	0	1	0	0	0	2
Cassia fistula	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2
Erythrina variegata	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Melia dubia	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Mitragyna parvifolia	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Phyllanthus emblica	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Scolopia crenata	1	0	0	0	0	0	0	0	0	0	0	1	0	0	2
Syzygium travancoricum	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
Terminalia bellirica	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Briedelia retusa	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Canarium strictum	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Glochidion ellipticum	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Holarrhena pubescens	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Holigarna arnottiana	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Kadakonna	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Symplocos macrophylla	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Memecylon randerianum	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Pterygota alata	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Polyalthea sp	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Pterospermum reticulatum	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Strychnos nux-vomica	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Swietenia macrophylla	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Aporosa acuminata	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1

H. Amphibians_Inside_I year

Name of Amphibian	Marappal am Major	Marappal am Minor	Mottal Mood	Empong	Poova 1	Poova 3	Poova 4	Poov 0	Ammaya mbalam	Kari kurinji	Sastha Nada	Uthiran Chira	Pille code	Chekidi Chal	Muppa thadi	Total
Total	533	*643*	646	1305	404	443	417	392	506	742	258	2210	608	799	515	10421
Limnonectes keralensis	153	*117*	127	447	100	60	78	106	197	219	138	723	371	319	187	3342
Rana temporalis	116	*149*	160	429	77	91	108	125	140	285	55	953	57	205	100	3050
Nyctibatrachus Major	177	*188*	229	135	98	167	133	43	29	50	2	40	14	74	76	1455
Euphlyctis cyanophlyctis	6	*4*	32	54	21	5	5	15	37	17	0	150	92	16	17	471
Polypedates psuedocruciger	19	*48*	18	55	9	12	17	4	7	18	24	145	16	14	5	411
Limnonectes limnocharis	7	*5*	5	54	22	6	1	27	17	37	10	14	29	7	24	265
Hoplobatrachus tigerinus	3	*1*	15	46	2	17	12	5	11	6	0	77	5	8	0	208
Micrixalus fuscus	0	*19*	0	0	0	5	4	1	10	0	0	0	0	121	7	167
Indirana beddomei	10	*30*	2	9	12	9	5	6	7	2	7	13	2	3	25	142
Rana aurantiaca	9	*1*	9	3	5	5	3	0	17	49	0	39	0	0	0	140
Nyctibatrachus Minor	3	*7*	3	9	17	19	11	16	0	0	1	2	4	1	8	101
Bufo melanostictus	1	*3*	12	13	4	2	2	4	10	27	5	2	3	7	2	97
Nyctibatrachus aliciae	5	*11*	5	0	9	10	15	6	1	0	0	3	0	0	13	78
Rhacophorus Malabaricus	8	*2*	4	9	5	10	1	9	2	6	1	3	1	1	4	66
Polypedates maculatus	4	*1*	4	24	1	0	0	2	5	0	1	6	3	6	1	58
Philautus temporalis	2	*8*	6	3	3	5	3	1	2	5	2	4	2	0	4	50
Philautus *variabilis*	0	15	0	0	4	2	3	1	6	2	1	1	4	0	9	48
Rana Malabarica	0	*4*	8	6	1	0	1	0	0	14	0	1	0	8	2	45
Philautus femoralis	2	*1*	0	2	1	5	5	3	3	0	0	3	1	1	3	30
452 A1	1	2	1	0	4	0	0	3	0	0	0	9	0	1	0	21
Philautus flaviventris	1	*4*	0	1	3	0	0	2	0	0	0	4	0	1	5	21
Indirana brachytarsus	2	*6*	3	0	0	1	0	0	3	0	0	1	1	0	3	20
Indirana leithilike	3	*4*	0	0	0	1	0	0	0	0	5	2	0	0	1	16
Philautus *sps 2*	0	1	0	3	0	0	2	4	0	0	0	0	0	1	2	13
Philautus pulcherrimus	0	*0*	0	0	2	0	4	0	0	4	0	0	0	0	2	12
Philautus leucorhinus	0	*3*	0	0	0	0	0	0	0	0	5	2	0	0	1	11
Icthyophis tricolor	0	0	2	1	0	3	3	0	0	0	0	0	0	0	2	11
Indirana semipalmatus	0	*2*	0	0	0	0	0	0	0	0	1	2	0	0	4	9
Indirana leptodactylus	0	*4*	0	0	0	0	0	1	0	0	0	1	0	0	3	9
452A3	0	0	0	0	0	1	0	1	0	1	0	4	0	0	0	7
Philautus charius	0	*0*	0	0	3	0	0	4	0	0	0	0	0	0	0	7
Euphlyctis hexadactyla	0	0	1	2	0	0	0	0	0	0	0	0	3	0	0	6
Philautus *sps1*	0	0	0	0	0	0	0	2	0	0	0	0	0	2	2	6
Philautus *sps4*	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	6
Bufo pareitalis ??	0	*0*	*0*	*0*	*0*	*0*	1	1	1	0	0	0	0	1	0	4
Icthyophis sps	0	*3*	0	0	0	0	0	0	0	0	0	0	0	0	1	4
452A2	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	3
452A6	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3
Rhacophorus with white spots	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3
Tomopterna rufescens	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	2
Philautus *sps 3*	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Philautus black spots	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ramanella triangularis	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1

I Amphibians-Inside-II Year

Name of Amphibian	Marappal am Major	Marappal am Minor	Mottal Mood	Empong	Ammaya mbalam	Kari kurinji	Sastha Nada	Uthiran Chira	Pille code	Total
Total	883	975	864	818	298	460	458	2550	1021	8327
Rana temporalis	137	172	192	169	63	136	160	1167	125	2321
Limnonectes keralensis	223	83	97	288	126	155	200	436	538	2146
Nyctibatrachus Major	295	435	290	105	19	40	20	146	21	1371
Euphlyctis cyanophlyctis	4	13	78	39	43	46	2	395	268	888
Nyctibatrachus Minor	53	86	52	16	5	5	0	21	1	239
Limnonectes limnocharis	6	1	7	100	14	16	13	66	4	227
Polypedates psuedocruciger	23	10	27	41	6	14	15	69	18	223
Hoplobatrachus tigerinus	0	4	10	2	1	9	0	100	9	135
Rana aurantiaca	6	2	21	0	7	18	3	67	1	125
Micrixalus fuscus	32	67	0	7	2	3	0	2	11	124
Indirana beddomei	17	21	18	7	5	1	4	21	3	97
Nyctibatrachus aliciae	13	45	14	4	0	0	0	4	0	80
Philautus *variabilis*	15	8	12	4	5	2	15	8	4	73
Bufo melanostictus	4	6	26	8	1	7	6	0	4	62
Rhacophorus Malabaricus	20	0	1	7	0	2	3	21	3	57
Philautus flaviventris	4	2	5	8	0	0	4	0	0	23
Indirana brachytarsus	6	7	1	0	0	0	0	8	0	22
Philautus temporalis	5	1	5	0	0	0	6	1	3	21
Indirana leptodactylus	7	5	2	0	0	1	0	5	0	20
Ramanella triangularis	0	0	2	8	1	0	0	0	0	11
Indirana semipalmatus	1	3	0	0	0	0	0	5	0	9
Tomopterna rufescens	2	0	2	3	0	0	0	0	2	9
Philautus pulcherrimus	4	0	1	0	0	1	0	0	2	8
452 A1	1	0	0	0	0	0	0	6	0	7
Euphlyctis hexadactyla	0	0	1	0	0	3	0	0	0	4
Philautus femoralis	2	1	0	0	0	0	1	0	0	4
Philautus leucorhinus	0	0	0	0	0	0	4	0	0	4
Polypedates maculatus	0	0	0	1	0	0	1	0	2	4
Indirana leithilike	0	2	0	0	0	0	0	1	0	3
Philautus charius	3	0	0	0	0	0	0	0	0	3
Philautus *sps1*	0	1	0	0	0	0	1	0	0	2
Philautus *sps6*	0	0	0	0	0	1	0	1	0	2
Rhacophorus sps	0	0	0	0	0	0	0	0	2	2
Icthyophis tricolor	0	0	0	1	0	0	0	0	0	1

J Reptiles Inside I year

Name of Reptile	Marappal am Major	Marappal am Minor	Mottal Mood	Empong	Poova 1	Poova 3	Poov 4	Poov 0	Ammaya mbalam	Kari kurinji	Sastha Nada	Uthiran Chira	Pille code	Chekidi Chal	Muppa thadi	Total
total	48	*50*	41	48	44	45	40	44	49	45	20	32	14	28	28	576
Trimeruserus Malabaricus	11	*8*	15	15	21	21	14	11	8	8	0	10	1	11	4	158
Sphenomorphus dussumeri	10	*12*	5	14	4	4	1	1	12	1	6	5	2	0	4	81
Mabuya macularia	8	*15*	3	6	4	4	2	4	1	3	1	1	7	1	4	64
Xenochrophis piscator	4	2	8	2	0	1	7	8	2	14	1	1	1	1	0	52
Calotes ellioti	1	4	2	0	0	3	3	3	4	2	0	1	1	1	1	26
Hypnale hypnale	2	*0*	1	1	1	2	1	4	4	0	3	0	0	0	0	19
Cnemaspis 1	0	*1*	0	1	2	3	2	2	0	4	1	1	0	1	0	18
Ptyas mucosus	1	*1*	0	2	0	0	1	1	1	0	0	3	0	2	1	13
Cnemaspis 2	0	0	0	0	1	0	0	1	0	5	0	3	1	1	1	13
Mabuya carinata	0	*0*	3	1	0	1	1	1	1	0	1	0	0	0	2	11
Oligodon (specimen)	1	*0*	1	0	0	0	1	1	1	0	1	0	0	4	0	10
Xylophis sps	0	*0*	0	0	0	2	0	1	0	0	0	3	0	0	2	8
Draco dussumeiri	1	*1*	1	0	0	0	2	0	2	0	1	0	0	0	0	8
Riopa punctata like	1	*0*	0	0	1	0	0	1	3	0	0	0	1	0	1	8
Ahateulla nasuta	1	*1*	0	0	1	1	0	1	0	0	0	1	0	1	0	7
Dendrelaphis tristis	1	*0*	0	2	1	0	1	0	1	0	1	0	0	0	0	7
Boiga sps	0	*0*	0	1	0	1	1	1	0	1	0	1	0	1	0	7
Calotes calotes	1	1	0	0	0	0	0	0	2	2	0	1	0	0	0	7
Ahaetulla pulverulenta	1	*0*	0	1	0	0	0	2	0	0	0	0	0	0	2	6
Cnemaspis 3	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	6
Lycodon sp1	0	*0*	0	0	2	1	0	0	0	0	0	0	0	1	1	5
Oligodon sps1	0	*1*	0	1	1	0	1	0	0	1	0	0	0	0	0	5
Uropeltid macrolepis	0	*0*	0	0	2	0	0	0	2	0	0	0	0	0	1	5
Calotes versicolor	1	*0*	0	0	1	0	1	0	0	1	0	0	0	0	1	5
Amphsiema beddomi	0	*2*	0	0	0	0	1	0	0	0	0	0	0	1	0	4
Otocryptis beddomii)	2	*1*	0	0	0	0	0	0	0	0	0	0	0	0	1	4
Amphsiema stolata	0	*0*	0	0	0	1	0	0	1	0	0	0	0	1	0	3
Lycodon	0	*0*	0	1	1	0	0	0	0	1	0	0	0	0	0	3
Atretium schistosum	0	*0*	0	0	0	0	0	0	1	0	0	1	0	0	0	2
Callophis sps=nigrescens	0	*0*	1	0	0	0	0	0	0	0	0	0	0	0	1	2
Varanus bengalensis	0	*0*	0	0	0	0	0	0	0	1	1	0	0	0	0	2
Bangarus correlius	0	*0*	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Callophis bibrioni	0	*0*	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Naja naja	0	*0*	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Trimeruserus strigatus	0	*0*	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Daboia Russelli	0	*0*	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Hemidactylus 1	1	*0*	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hemidactylus sps 2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1

K Reptiles II Year Inside

Name of Reptile	Marappalam Major	Marappalam Minor	Mottal Mood	Empong	Ammaya mbalam	Kari kurinji	Sastha Nada	Uthiran Chira	Pille code	Total
Total	26	57	66	26	27	54	63	31	32	382
Mabuya macularia	7	28	7	0	4	11	16	0	3	76
Trimeruserus Malabaricus	4	2	19	15	4	5	1	7	3	60
Sphenomorphus dussumeri	3	10	5	0	2	15	0	0	5	40
Calotes ellioti	0	3	5	4	4	6	9	4	3	38
Xenochrophis piscator	1	1	9	1	1	6	0	9	5	33
Mabuya carinata	1	0	0	0	0	1	19	0	3	24
Cnemaspis 1	1	0	4	1	3	4	0	4	0	17
Otocryptis beddomii	3	7	2	0	0	0	0	0	0	12
Calotes versicolor	0	0	0	3	2	1	4	0	1	11
Ahateulla nasuta	0	1	5	0	1	0	0	1	0	8
Atretium schistosum	0	0	3	0	0	2	0	2	0	7
Cnemaspis 2	1	0	0	0	0	0	6	0	0	7
Dendrelaphis tristis	0	1	0	0	0	0	2	2	1	6
Hypnale hypnale	0	0	3	0	2	1	0	0	0	6
Calotes calotes	0	2	1	0	0	0	0	0	3	6
Riopa punctata like	2	2	1	0	0	0	0	0	1	6
Uropeltid macrolepis	0	0	0	0	3	0	2	0	0	5
Draco dussumeiri	0	0	0	0	0	1	3	0	0	4
Boiga sps	1	0	0	1	0	0	0	0	1	3
Oligodon (specimen)	2	0	0	0	0	1	0	0	0	3
Naja naja	0	0	0	0	0	0	1	1	1	3
Ahaetulla pulverulenta	0	0	1	0	0	0	0	0	0	1
Dendrelaphis picta	0	0	0	0	0	0	0	1	0	1
Oligodon sps1	0	0	0	0	1	0	0	0	0	1
Ptyas mucosus	0	0	0	0	0	0	0	0	1	1
Xylophis sps	0	0	1	0	0	0	0	0	0	1
Cnemaspis 3	0	0	0	0	0	0	0	0	1	1
chaemeleon	0	0	0	1	0	0	0	0	0	1

L Amphibians outside I year

Name of Amphibian	Marappalam Major	Marappalam Minor	Mottal Mood	Empong	Poova 1	Poova 3	Poov 4	Poov 0	Ammaya mbalam	Kari kurinji	Sastha Nada	Uthiran Chira	Pille code	Chekidi Chal	Muppa thadi	Total
total	54	15	22	26	28	54	45	13	97	27	6	133	17	16	11	564
Limnonectes keralensis	28	8	14	16	21	34	35	4	50	13	0	71	12	1	2	309
Rana temporalis	4	0	3	4	0	9	4	1	25	6	3	50	4	12	2	127
Micrixalus fuscus	15	4	0	0	0	0	0	0	0	0	0	0	0	0	0	19
Bufo melanostictus	0	1	1	4	0	0	0	1	6	1	0	0	1	0	0	15
Indirana beddomei	1	0	0	0	1	3	0	0	1	1	0	2	0	0	4	13
Philautus *variabilis*	1	0	0	0	3	1	1	3	1	0	2	0	0	0	0	12
Limnonectes limnocharis	0	0	4	0	0	0	0	0	2	2	0	3	0	0	0	11
Philautus flaviventris	1	0	0	0	0	2	3	0	0	1	0	2	0	0	0	9
Polypedates psuedocruciger	0	1	0	0	2	1	1	1	0	1	0	1	0	0	0	8
Euphlyctis cyanophlyctis	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	7
Rana aurantiaca	0	0	0	0	0	0	0	0	3	1	0	2	0	0	0	6
Rhacophorus Malabaricus	0	0	0	0	0	2	0	0	0	0	0	1	0	0	1	4
Philautus temporalis	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	3
Philautus charius	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	3
Polypedates maculatus	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	3
Indirana brachytarsus	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2
Ramanella triangularis	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Rana Malabarica	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
Tomopterna rufescens	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2
452 A1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
Indirana semipalmatus	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Nyctibatrachus Major	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Philautus *sps1*	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Philautus leucorhinus	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Philautus pulcherrimus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

M Amphibians outside II year outside

Name of Amphibian	Marappal am Major	Marappal am Minor	Mottal Mood	Empong	Ammaya mbalam	Kari kurinji	Sastha Nada	Uthiran Chira	Pille code	Total
Total	73	10	50	26	306	166	0	23	0	654
Limnonectes keralensis	30	3	20	9	*80*	*60*	0	0	0	202
Rana temporalis	30	*0*	*19*	9	*67*	*48*	0	15	0	188
Limnonectes limnocharis	4	7	0	0	*50*	*28*	0	0	0	89
Philautus charius	0	0	0	0	35	*0*	0	0	0	35
Philautus *variabilis*	0	*0*	4	0	*12*	*15*	0	0	0	31
Euphlyctis cyanophlyctis	0	*0*	*0*	0	*20*	*0*	0	0	0	20
Indirana beddomei	3	*0*	*3*	0	*4*	*6*	0	3	0	19
Rana aurantiaca	0	*0*	*0*	0	*16*	*2*	0	0	0	18
Hoplobatrachus tigerinus	0	*0*	*0*	0	*11*	*0*	0	0	0	11
Tomopterna rufescens	2	*0*	1	0	8	*0*	0	0	0	11
Bufo melanostictus	1	*0*	*0*	5	*1*	*2*	0	0	0	9
Indirana brachytarsus	2	*0*	*0*	0	0	*0*	0	5	0	7
Micrixalus fuscus	1	0	3	0	0	*0*	0	0	0	4
Philautus *sps5*	0	0	*0*	0	0	*2*	0	0	0	2
Philautus flaviventris	0	*0*	*0*	0	2	0	0	0	0	2
Polypedates psuedocruciger	0	*0*	0	0	0	*2*	0	0	0	2
Philautus temporalis	0	0	*0*	0	0	*1*	0	0	0	1
Polypedates maculatus	0	*0*	*0*	1	0	*0*	0	0	0	1
Ramanella triangularis	0	*0*	0	1	0	*0*	0	0	0	1
Rana Malabarica	0	*0*	*0*	1	0	*0*	0	0	0	1

N Reptiles outside I year

Name of Reptile	Marappalam Major	Marappalam Minor	Mottal Mood	Empong	Poova 1	Poova 3	Poov 4	Poov 0	Ammayambalam	Kari kurinji	Sastha Nada	Uthiran Chira	Pille code	Chekidi Chal	Muppathadi	Total
Total	7	9	8	4	5	7	6	5	6	11	1	4	0	3	9	85
Trimeruserus Malabaricus	1	0	1	2	4	3	3	4	1	0	0	1	0	2	2	24
Mabuya macularia	0	5	0	0	0	0	0	0	3	1	0	1	0	0	1	11
Hypnale hypnale	0	0	2	1	0	0	1	0	0	0	1	1	0	0	0	6
Sphenomorphus dussumeri	0	0	0	0	0	0	0	0	0	2	0	0	0	0	4	6
Ahateulla nasuta	2	1	0	0	0	1	1	0	0	0	0	0	0	0	0	5
Calotes ellioti	2	0	0	1	0	0	0	0	0	2	0	0	0	0	0	5
Ptyas mucosus	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	4
Hemidactylus 1	0	0	4	0	0	0	0	0	0		0	0	0	0	0	4
Mabuya carinata	0		0	0	0	0	0	0	0	4	0		0	0	0	4
Calotes calotes	0	2	0	0	0	0	0	0	0	1	0	0	0	0	0	3
Draco dussumeiri	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Amphsiema beddomi	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Dendrelaphis picta	0	0	0	0	1	0	0	0	0	0	0	0	0	0		1
Dendrelaphis tristis	0		0	0	0	1	0	0	0	0	0	0	0	0	0	1
Boiga sps	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Naja naja	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Uropeltid macrolepis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Xenochrophis piscator	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Daboia Russelli	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Xylophis sps	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Otocryptis beddomii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Varanus bengalensis	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1

O Reptiles outside II year

Name of Reptile	Marappalam Major	Marappalam Minor	Mottal Mood	Empong	Ammayambalam	Kari kurinji	Sastha Nada	Uthiran Chira	Pille code	Total
Total	8	0	40	0	4	5	0	6	0	63
Otocryptis beddomii	4	0	12	0	0	1	0	0	0	17
Mabuya macularia	0	0	11	0	1	0	0	2	0	14
Sphenomorphus dussumeri	0	0	9	0	0	0	0	1	0	10
Hypnale hypnale	1	0	1	0	0	3	0	0	0	5
Calotes versicolor	2	0	0	0	0	0	0	3	0	5
Mabuya carinata	0	0	4	0	0	0	0	0	0	4
Xenochrophis piscator	0	0	0	0	2	0	0	0	0	2
Riopa punctata	0	0	0	0	1	1	0	0	0	2
Ahateulla nasuta	0	0	1	0	0	0	0	0	0	1
Callophis sps=nigrescens	0	0	1	0	0	0	0	0	0	1
Trimeruserus Malabaricus	1	0	0	0	0	0	0	0	0	1
Cnemaspis 1	0	0	1	0	0	0	0	0	0	1

Appendix-V

A. Density and abundance of herbs in sample plots inside the swamp

Sl. No.	Species	Total	%	Occurrence in plots
1.	*Lagenandra ovata*	399	34.76	13
2.	*Psychotria flavida*	138	12.02	6
3.	*Selaginella brachystachya*	118	10.27	2
4.	Grass	115	10.02	5
5.	*Cyanotis* sp.	110	9.58	7
6.	*Carex sp*	57	4.97	8
7.	*Barleria courtallica*	27	2.35	3
8.	*Christella parasitica*	23	2.00	6
9.	*Pellionia heyneana*	18	1.57	1
10.	*Phrynium pubinerve*	17	1.48	4
11.	Hedyotis auricularia	15	1.31	4
12.	*Pothose scandens*	13	1.13	3
13.	*Dracaena teriniflora*	11	0.96	4
14.	*Myxospyrum smilacifolium*	11	0.96	3
15.	*Piper nigrum*	10	0.87	4
16.	*Pandanus thwaitesii*	9	0.78	3
17.	*Chilocarpus denudatus*	8	0.70	4
18.	*Connarus sp*	8	0.70	2
19.	*Leptochilus decurrens*	7	0.61	1
20.	*Combretum latifolium*	6	0.52	3
21.	*Ophiorrhiza mungos*	4	0.35	1
22.	*Bauhinia phoenicea*	3	0.26	1
23.	*Ventilago bombaiensis*	3	0.26	2
24.	*Angiopteris evecta*	2	0.17	1
25.	*kunstleria keralensis*	2	0.17	1
26.	*Myxospyrum smilacifolium*	2	0.17	2
27.	*Schumannianthus virgatus*	2	0.17	1
28.	*Tetracera acara*	2	0.17	1
29.	*Gomphandra tetandra*	1	0.09	1
30.	*Jasmine azoricum*	1	0.09	1
31.	*Leptaspis urceolata*	1	0.09	1
32.	*Lindernia ciliata*	1	0.09	1
33.	*Neruocalyx calycinus*	1	0.09	1
34.	*Pogostemon paniculatus*	1	0.09	1
35.	*Rhaphidophora pertusa*	1	0.09	1
36.	*Strichnose colubrina*	1	0.09	1
	Total	1148	100.00	19

B. Density and abundance of herbs in sample plots out side the swamp

	Species	Total	%	Occurrence in plots
1.	Grass	205	28.35	5
2.	Zingiber zerumbet	112	15.49	6
3.	Dracaena terniflora	86	11.89	10
4.	Ventilago bombaiensis	40	5.53	3
5.	Pandanus thawaitesii	35	4.84	3
6.	Carex sp	32	4.43	5
7.	Schumannianthus virgatus	28	3.87	4
8.	Selaginella brachystachya	27	3.73	2
9.	Christella parasitica	22	3.04	3
10.	Pellionia hyneyana	22	3.04	1
11.	Kunstleria keralensis	16	2.21	2
12.	Chromolena odoratum	11	1.52	2
13.	Barleria courtallica	10	1.38	3
14.	Calamus hookerianus	8	1.11	1
15.	Ixora nigricans	6	0.83	2
16.	Piper nigrum	6	0.83	5
17.	Unidentified sp1	6	0.83	2
18.	Combretum latifolium	5	0.69	1
19.	Curculigo trichocarpa	5	0.69	1
20.	Ochlandra travancoricca	5	0.69	3
21.	Psychotria flavida	4	0.55	1
22.	Abrus pulchellus	3	0.41	1
23.	Ixora nigricans	3	0.41	2
24.	Globba ophioglossa	2	0.28	2
25.	Helicteres isora	2	0.28	1
26.	Pandanus furcatus	2	0.28	1
27.	Phaeanthus malabaricus	2	0.28	1
28.	Selaginella brachystachya	2	0.28	1
29.	Strichnose colubrina	2	0.28	1
30.	Thespesia lampas	2	0.28	1
31.	Acasia torta	1	0.14	1
32.	Atalantia racemosa	1	0.14	1
33.	Clausena austroindica	1	0.14	1
34.	Gnetum edule	1	0.14	1
35.	Hedyotis auricularia	1	0.14	1
36.	Jasminum azoricum	1	0.14	1
37.	Mimosa pudica	1	0.14	1
38.	Luvanga eleutherandra	1	0.14	1
39.	Myxospyrum smilacifolium	1	0.14	1
40.	Smilax zeylanica	1	0.14	1
41.	Zizyphus rugosa	1	0.14	1
42.	Unidentified sp2	1	0.14	1
	Total	723	100.00	

C. Density and abundance of shrubs in sample plots inside the swamp

Sl. No.	Species	Total	%	Occurrence
1.	*Lagenandra ovata*	2632	49.83	14
2.	*Ochlandra travancorica*	485	9.18	7
3.	*Christella parasitica*	285	5.40	11
4.	*Carex sp*	231	4.37	15
5.	*Piper nigrum*	195	3.69	17
6.	*Barileria courtallica*	145	2.75	3
7.	*Chilocarpus denudatus*	127	2.40	15
8.	*Phrynium pubinerve*	124	2.35	12
9.	*Pandanus thwaitessi*	120	2.27	11
10.	*Calamus hookerianus*	108	2.04	14
11.	*Schumannianthus virgatus*	101	1.91	5
12.	*Combretum latifolium*	73	1.38	12
13.	*Pothose scandens*	72	1.36	16
14.	*Cyanotis sp.*	65	1.23	2
15.	*Myxospyrum smilacifolium*	54	1.02	13
16.	*Kunstleria keralensis*	53	1.00	14
17.	*Psychotria flavida*	37	0.70	7
18.	*Pandanus thwaitessi*	33	0.62	3
19.	*Tetracera acara*	30	0.57	6
20.	*Bauhinia phoenicea*	28	0.53	3
21.	*Gomphandra tetandra*	28	0.53	3
22.	*Thottea siliquosa*	27	0.51	6
23.	*Alpinia malaccensis*	25	0.47	7
24.	*Connaurus sp*	20	0.38	7
25.	*Ventilago bombaiensis*	19	0.36	3
26.	*Rhaphidophora pertusa*	18	0.34	3
27.	*Leptochilus decurrens*	16	0.30	1
28.	*Jasminum azoricum*	13	0.25	1
29.	*Symplocos cochinchinensis*	12	0.23	2
30.	*Selaginella brachystachya*	11	0.21	1
31.	*Dracaena terniflora*	10	0.19	4
32.	*Angiopteris evecta*	8	0.15	4
33.	*Zingiber zerumbet*	7	0.13	4
34.	*Diplocyclos palmatus*	5	0.09	1
35.	*Jasminum azoricum*	5	0.09	1
36.	*Anaphyllum wightii*	4	0.08	1
37.	*Pinanga dicksonii*	4	0.08	2
38.	*Stenochlaena palustris*	4	0.08	3
39.	*Unknown climber sp1*	4	0.08	3
40.	*Pogostemon paniculatus*	3	0.06	2
41.	*Pogostemon paniculatus*	3	0.06	1
42.	*Strychnos colubrina*	3	0.06	3
43.	*Syzygium sp*	3	0.06	3
44.	*Uvaria narum*	3	0.06	1
45.	*Atalantia racemosa*	2	0.04	2
46.	*Bigonia malabarica*	2	0.04	1
47.	*Casearia glomerata*	2	0.04	1
48.	*Ipomoea mauritiana*	2	0.04	1
49.	*Momordica diocia*	2	0.04	2
50.	Luvunga eleutherandra	2	0.04	1
51.	*Mussaenda frondosa*	2	0.04	2
52.	*Tylophora mollissima*	2	0.04	2
53.	*Abrus pulchellus*	1	0.02	1
54.	*Artanema longifolia*	1	0.02	1
55.	*Asparagus recemosus*	1	0.02	1
56.	*Chromolaena odorata*	1	0.02	1
57.	*Dicranopteris linearis*	1	0.02	1
58.	*Hibiscus furcatus*	1	0.02	1
59.	*Ixora nigiricans*	1	0.02	1
60.	*Jasminum azoricum*	1	0.02	1
61.	*Melastoma malabathricum*	1	0.02	1
62.	*Mikania micrantha*	1	0.02	1
63.	Nujuvally	1	0.02	1
64.	*Selaginella brachystachya*	1	0.02	1
65.	*Symplocos macrophylla*	1	0.02	1
	Total	5282	100.00	

D. Density and abundance of shrubs in sample plots out side the swamp

No.	Species	Total		# of plots
1.	*Zingiber zerumbet*	637	14.30	2
2.	*Psychotria flavida*	578	12.98	11
3.	*Ochlandra travancoricca*	347	7.79	5
4.	*Ventilago bombaiensis*	297	6.67	5
5.	*Pandanus furcatus*	292	6.56	7
6.	*Dracaena terniflora*	265	5.95	7
7.	*Carex sp*	173	3.89	8
8.	*Helicteres isora*	143	3.21	4
9.	*Connaurus sp.*	117	2.63	7
10.	*Alpinia malaccensis*	116	2.60	6
11.	*Phaeanthus malabaricus*	112	2.52	6
12.	*Schumannianthus virgatus*	99	2.22	2
13.	*Calamus hookerianus*	98	2.20	10
14.	*Christella parasitica*	79	1.77	10
15.	*Smilax zeylanica*	79	1.77	1
16.	*Strychnos colubrina*	69	1.55	1
17.	*Piper nigrum*	66	1.48	10
18.	*Barleria courtallica*	60	1.35	6
19.	*Atalantia racemosa*	50	1.12	4
20.	*Atalantia racemosa*	35	0.79	2
21.	*Clausena austroindica*	35	0.79	7
22.	*Combretum latifolium*	35	0.79	3
23.	*Calamus thwaitesii*	33	0.74	9
24.	*zz*	32	0.72	5
25.	*Jasminum rottlerianum*	30	0.67	4
26.	*Kunstleria keralensis*	27	0.61	4
27.	*Unknown sp1*	26	0.58	1
28.	*Zizyphus rugosa*	25	0.56	8
29.	*Memecylon umbellatum*	24	0.54	6
30.	*Luvunga eleutherandra*	22	0.49	4
31.	*Syzygium shrub*	21	0.47	1
32.	*Dichapetalum glenoids*	20	0.45	4
33.	*Elemully*	19	0.43	1
34.	*Thespesia lampas*	19	0.43	3
35.	*Calycopteris floribunda*	18	0.40	6
36.	*Desmodium pulchellum*	18	0.40	2
37.	*Jasminum azoricum*	18	0.40	6
38.	*Abrus pulchellus*	17	0.38	7
39.	*Clerodendrum viscosum*	17	0.38	3
40.	*Thottea siliquosa*	17	0.38	3
41.	*Casearia glomerata*	13	0.29	5
42.	*Chilocarpus denudatus*	12	0.27	5
43.	*Atalantia racemosa*	10	0.22	1
44.	*Ixora nigricans*	10	0.22	3
45.	*Gnetum edule*	9	0.20	2
46.	*Ipomea mauritiana*	9	0.20	3
47.	*Butea parviflora*	8	0.18	2
48.	*Calamus travancoricus*	8	0.18	2
49.	*Cyclea peltata*	8	0.18	6
50.	*Gomphandra tetrandra*	8	0.18	1
51.	*Tetracera acara*	8	0.18	4
52.	*Cayratia pedata*	6	0.13	1
53.	*Chromolena odoratum*	6	0.13	2
54.	*Myxospyrum smilacifolium*	6	0.13	6
55.	*Asparagus recemosus*	5	0.11	3
56.	*Atalantia racemosa*	5	0.11	1

No.	Species	Total		# of plots
57.	*Centrosema molle*	5	0.11	2
58.	*Globba ophioglossa*	5	0.11	2
59.	Like Nilapana	5	0.11	1
60.	*Phrynium pubinerve*	5	0.11	1
61.	*Trichopus zeylanicus*	5	0.11	7
62.	*Acasia torta*	4	0.09	3
63.	*Amomum muricatum*	4	0.09	2
64.	*Bauhinia phoenica*	4	0.09	1
65.	*Hibiscus furcatus*	4	0.09	2
66.	*Tylophora mollissima*	4	0.09	1
67.	*Pandanus thwaitesii*	3	0.07	3
68.	*Unknown sp2*	3	0.07	1
69.	*Curcuma ecalcarata*	2	0.04	1
70.	*Desmodium heterocarpon*	2	0.04	1
71.	*Dioscorea bulbifera*	2	0.04	1
72.	*Melastoma malabathricum*	2	0.04	1
73.	*Pothos scandens*	2	0.04	2
74.	*Symplocos macrophylla*	2	0.04	1
75.	*Unknown climber 3*	2	0.04	7
76.	*Uvaria narum*	2	0.04	1
77.	*Alpinia malaccensis*	1	0.02	1
78.	*Atalantia racemosa*	1	0.02	1
79.	*Canthium coromandelicum*	1	0.02	1
80.	*Clematis bourdillonii*	1	0.02	1
81.	*Grass sp*	1	0.02	1
82.	*Grewia nervosa*	1	0.02	1
83.	*Lantana camara*	1	0.02	1
84.	*Leptaspis urceolata*	1	0.02	1
85.	*Lygodium sp*	1	0.02	1
86.	*Parsonsia inodora*	1	0.02	2
87.	*Sida rhombifolia*	1	0.02	7
88.	*Stenochlaena palustris*	1	0.02	1
89.	*Pterospermum reticulaum*	1	0.02	8
90.	*Syzygium shrub*	1	0.02	8
91.	*Urena lobata*	1	0.02	1
92.	*Zehnaria sp*	1	0.02	1
	Total	*4453*	*100.00*	

E. Density and abundance of saplings in sample plots inside the swamp

	Species	Total	%	Occurrence
1.	*Myristica fatua var.magnifica*	1762	24.94	15
2.	*Vateria indica*	1260	17.84	10
3.	*Gymnacranthera farquhariana*	1044	14.78	17
4.	*Holigrana arnottiana*	662	9.37	15
5.	*Xanthophyllum arnottianum*	503	7.12	16
6.	*Lophopetalum wightianum*	502	7.11	16
7.	*Mastixia arborea*	105	1.49	13
8.	*Symplocos cochinchinensis*	103	1.46	7
9.	*Semecarpus auriculata*	93	1.32	13
10.	*Baccaurea courtallensis*	90	1.27	13
11.	*Hydnocarpus pentandra*	82	1.16	15
12.	*Kingiodendron pinnatum*	72	1.02	8
13.	*Pinanga dicksonii*	63	0.89	7
14.	*Hopea parviflora*	61	0.86	7
15.	*Mesua ferrea*	50	0.71	9
16.	*Leea indica*	44	0.62	11
17.	*Strombosia ceylanica*	40	0.57	7
18.	*Polyalthia fragrans*	31	0.44	6
19.	*Syzygium travancoricum*	31	0.44	10
20.	*Cinnamomum malabatrum*	28	0.40	10
21.	*Dimocarpus longan*	26	0.37	7
22.	*Artocarpus hirsutus*	25	0.35	10
23.	*Ixora brachiata*	25	0.35	6
24.	*Persea macrantha*	25	0.31	9
25.	*Carallia brachiata*	22	0.27	6
26.	*Diospyros buxifolia*	19	0.27	5
27.	*Dysoxylum malabaricum*	19	0.23	5
28.	*Erythroxylum lanceolatum*	16	0.21	4
29.	*Dysoxylum malabaricum*	15	0.18	7
30.	*Elaeocarpus tuberculatus*	13	0.17	2
31.	*Varunaag*	12	0.16	1
32.	*Ficus hispida*	11	0.14	4
33.	*Syzygium cumini*	10	0.14	5
34.	*Syzygium mundagam*	10	0.13	5
35.	*Mangifera indica*	9	0.08	5
36.	*Actinodaphne malabarica*	6	0.07	3
37.	*Kanjavu*	5	0.07	1
38.	*Syzygium cumini*	5	0.06	1
39.	*Calophyllum polyanthum*	4	0.06	2
40.	*Glochidion ellipticum*	4	0.06	2
41.	*Syzygium cumini*	4	0.04	2
42.	*Flacourtia montana*	3	0.04	3
43.	*Pterygota alata*	3	0.04	3
44.	*Sterculia gluta*	3	0.03	2
45.	*Aprosa cardiosperma*	2	0.03	1
46.	*Pajanelia longifolia*	2	0.03	1
47.	*Elaeocarpus glanduloses*	2	0.03	2
48.	*Garcinia gummi-gutta*	2	0.03	2
49.	*Atalantia racemosa*	2	0.03	1
50.	*Macaranga peltata*	2	0.01	2
51.	*Archidendron monadelphum*	1	0.01	1
52.	*Casearia glomerata*	1	0.01	1
53.	*Diospyros paniculata*	1	0.01	1
54.	*Dipterocarpus indicus*	1	0.01	1
55.	*Garcinia Morella*	1	0.01	1
56.	*Syzygium cumini*	1	0.01	1
57.	*Hydnocarpus macrocarpa*	1	0.01	1
58.	*Memecylon randerianum*	1	0.01	1
59.	*Symplocos macrophylla*	1	0.01	1
60.	*Sapindus trifoliatus*	1	0.01	1
61.	*Pterospermum reticulatum*	1	0.01	1
62.	*Pterospermum reticulatum*	1	0.00	1
	Total	7064	100.00	

F. Density and abundance of trees in sample plots inside the swamp

	Species	Total	%	Occurrence
1.	*Myristica fatua var.magnifica*	913	29.42	18
2.	*Gymnacranthera farquhariana*	768	24.75	19
3.	*Vateria indica*	374	12.05	11
4.	*Holigarna arnottiana*	290	9.35	18
5.	*Lophopetalum wightianum*	220	7.09	17
6.	*Xanthophyllum arnottinaum*	69	2.22	13
7.	*Hydnocarpus pentandra*	67	2.16	15
8.	*Mastixia arborea*	34	1.10	12
9.	*Baccaurea courtallensis*	27	0.87	8
10.	*Macaranga peltata*	25	0.81	1
11.	*Semecarpus auriculata*	21	0.68	6
12.	*Elaeocarpus tuberculatus*	20	0.64	7
13.	*Syzygium tarvancoricum*	20	0.64	6
14.	*Knema attenuata*	15	0.48	3
15.	*Aporosa cardiosperma*	14	0.45	8
16.	*Vateria indica*	14	0.45	8
17.	*Tabernaemontana alternifolia*	14	0.45	2
18.	*Unknown*	13	0.42	6
19.	*Helicteres isora*	12	0.39	1
20.	*Aporosa cardiosperma*	11	0.35	1
21.	*Actinodaphne malabarica*	10	0.32	3
22.	*Strombosia ceylanica*	9	0.29	7
23.	*Diospyros buxifolia*	9	0.29	3
24.	*Artocarpus hirsutus*	8	0.26	7
25.	*Cinnamomum malabatrum*	8	0.26	5
26.	*Persea macrantha*	7	0.23	7
27.	*Glochidion ellipticum*	6	0.19	4
28.	*Lagerstroemia speciosa*	5	0.16	4
29.	*Ficus nervosa*	5	0.16	3
30.	*Macrenga pelata*	5	0.16	3
31.	*Myristica malabarica*	5	0.16	3
32.	*Neolamarckia cadamba*	5	0.16	2
33.	*Mesua ferrea*	4	0.13	4
34.	*Syzygium cumini*	5	0.16	5
35.	*Polyalthia fragrans*	4	0.13	3
36.	*Dipterocarpus indicus*	3	0.10	3
37.	*Dysoxylum malabaricum*	3	0.10	3
38.	*Leea indica*	3	0.10	3
39.	*Pinanga dicksonii*	3	0.10	2
40.	*Erythroxylum lanceolatum*	3	0.10	2
41.	*Terminalia paniculata*	3	0.10	1
42.	*Calophyllum polyanthum*	2	0.06	2
43.	*Carallia brachiata*	2	0.06	2

	Species	Total	%	Occurrence
44.	*Dimocarpus longan*	2	0.06	2
45.	*Mitragyna parviflora*	2	0.06	2
46.	*Pterygota alata*	2	0.06	2
47.	*Tetrameles nudiflora*	2	0.06	2
48.	*Pajanelia longifolia*	2	0.06	1
49.	*Dillenia pentagyna*	2	0.06	1
50.	*Terminalia elliptica*	2	0.06	1
51.	*Acasia auriculiformis*	1	0.03	1
52.	*Mitragyna parvifolia*	1	0.03	1
53.	*Alstonia scholaris*	1	0.03	1
54.	*Ixora brachiata*	1	0.03	1
55.	*Aranjal*	1	0.03	1
56.	*Ixora brachiata*	1	0.03	1
57.	*Dalbergia latifolia*	1	0.03	1
58.	*Diospyros paniculata*	1	0.03	1
59.	*Elaeocarpus glandulosus*	1	0.03	1
60.	*Flacourtia montana*	1	0.03	1
61.	*Garcinia compogea*	1	0.03	1
62.	*Litsea travancorica*	1	0.03	1
63.	*Mangifera indica*	1	0.03	1
64.	*Memecylon umbellatum*	1	0.03	1
65.	*Myristica beddomei*	1	0.03	1
66.	*Olea dioica*	2	0.06	2
67.	*Phyllanthus emblica*	1	0.03	1
68.	*Scolopia crenulata*	1	0.03	1
69.	*Stereospermum colais*	1	0.03	1
70.	*Swietenia macrophylla*	1	0.03	1
71.	*Symplocos cochinchinensis*	1	0.03	1
72.	*Syzygium gardneri*	1	0.03	1
73.	*Syzygium mundagam*	1	0.03	1
	Total	3103	100	

G. Density and abundance of trees in sample plots outside the swamp

	Species	Total		In Plots
1.	*Helicteres isora*	144		3
2.	*Aporosa cardiosperma*	115		12
3.	*Xanthophyllum arnottianum*	84		9
4.	*Ixora brachiata*	60		9
5.	*Strombosia ceylanica*	51		10
6.	*Baccaurea courtallensis*	46		7
7.	*Macaranga peltata*	43		7
8.	*Diospyros paniculata*	33		10
9.	*Tabernaemontana alternifolia*	33		6
10.	*Cinnamomum malabatrum*	32		10
11.	*Actinodaphne malabarica*	26		5
12.	*Unknown*	26		9
13.	*Knema attenuata*	23		8
14.	*Terminalia paniculata*	23		8
15.	*Hydnocarpus pentandra*	19		10
16.	*Litsea travancorica*	19		6
17.	*Myristica malabarica*	19		8
18.	*Mallotus philippensis*	18		7
19.	*Olea dioica*	18		5
20.	*Terminalia crenulata*	18		3
21.	*Syzygium mundagam*	16		5
22.	*Dimocarpus longan*	15		5
23.	*Erythroxylum lanceolatum*	15		2
24.	*Dipterocarpus indicus*	14		4
25.	*Kingiodendron pinnatum*	14		6
26.	*Vateria indica*	13		4
27.	*Croton malabaricus*	12		5
28.	*Leea indica*	12		7
29.	*Semecarpus auriculata*	12		6
30.	*Dysoxylum malabaricum*	11		5
31.	*Vitex altissima*	11		6
32.	*Polyalthia fragrans*	10		4
33.	*Stereospermum colais*	10		6
34.	*Diospyros buxifolia*	9		3
35.	*Hopea parviflora*	9		5
36.	*Mangifera indica*	9		6
37.	*Archidendron monadelphum*	8		6
38.	*Lophopetalum wightianum*	8		5
39.	*Mesua ferrea*	8		5
40.	*Mitragyna parvifolia*	8		5
41.	*Syzygium sp*	8		6
42.	*Dillenia pentagyna*	7		2
43.	*Schleichera oleosa*	7		6
44.	*ZUnknown*	7		3
45.	*Artocarpus hirsutus*	6		5
46.	*Glochidion ellipticum*	6		4
47.	*Lagerstroemia speciosa*	6		4
48.	*Persea macrantha*	6		5
49.	*Pterygota alata*	6		4
50.	*Atalantia racemosa*	5		3

	Species	Total		In Plots
51.	*Carallia brachiata*	5		4
52.	*Symplocos cochinchinensis*	5		3
53.	*Syzygium gardneri*	5		5
54.	*Bombax ceiba*	4		2
55.	*Dalbergia latifolia*	4		2
56.	*Hopea utilis*	4		1
57.	*Myristica beddomei*	4		3
58.	*Sapindus trifoliata*	4		4
59.	*Annakombi*	3		3
60.	*Elaeocarpus glandulosus*	3		2
61.	*Elaeocarpus tuberculatus*	3		2
62.	*Flacourtia montana*	3		2
63.	*Grewia tiliifolia*	3		2
64.	*Tetrameles nudiflora*	3		1
65.	*Alstonia scholaris*	2		1
66.	*Calophyllum polyanthum*	2		2
67.	*Careya arborea*	2		2
68.	*Casearia glomerata*	2		2
69.	*Cassia fistula*	2		2
70.	*Erythrina variegata*	2		1
71.	*Melia dubia*	2		1
72.	*Mitragyna parvifolia*	2		1
73.	*Phyllanthus emblica*	2		2
74.	*Scolopia crenata*	2		2
75.	*Syzygium travancoricum*	2		1
76.	*Terminalia bellirica*	2		2
77.	*Aporosa fusiformis*	1		1
78.	*Briedelia retusa*	1		1
79.	*Canarium strictum*	1		1
80.	*Glochidion zeylanicum*	1		1
81.	*Holarrhena pubescens*	1		1
82.	*Holigarna arnottiana*	1		1
83.	*Kadakonna*	1		1
84.	*Memecylon umbellatum*	1		1
85.	*Petygota alata*	1		1
86.	*Polyalthea sp*	1		1
87.	*Pterospermum reticulatum*	1		1
88.	*Strychnos nux-vomica*	1		1
89.	*Swietenia macrophylla*	1		1
90.	*Symplocos macrophylla*	1		1
	Total	1229		

Appenidx VI

A. Abundance, Percentage abundance of amphibian species recorded during transect sampling inside the *Myristica* swamps.

Amphbian	Abundance	%
Philautus *sps 3*	1	0.01
452A2	3	0.02
452A6	3	0.02
Philautus black spots	3	0.02
Bufo pareitalis ??	4	0.02
Rhacophorus sps	5	0.03
Icthyophis sps	5	0.03
Philautus *sps4*	6	0.03
452A3	7	0.04
Philautus *sps1*	8	0.04
Euphlyctis hexadactyla	10	0.05
Philautus charius	10	0.05
Tomopterna rufescens	11	0.06
Icthyophis tricolor	11	0.06
Ramanella triangularis	12	0.06
Philautus *sps 2*	13	0.07
Philautus leucorhinus	15	0.08
Indirana semipalmatus	18	0.10
Indirana leithilike	19	0.10
Philautus pulcherrimus	20	0.11
452 A1	28	0.15
Indirana leptodactylus	29	0.15
Philautus femoralis	34	0.18
Indirana brachytarsus	42	0.22
Philautus flaviventris	44	0.23
Rana malabarica	45	0.24
Polypedates maculatus	62	0.33
Philautus temporalis	71	0.38
Philautus *variabilis*	121	0.65
Rhacophorus malabaricus	123	0.66
Nyctibatrachus aliciae	158	0.84
Bufo melanostictus	159	0.85
Indirana beddomei	239	1.27
Rana aurantiaca	265	1.41
Micrixalus fuscus	291	1.55
Nyctibatrachus minor	340	1.81
Hoplobatrachus tigerinus	343	1.83
Limnonectes limnocharis	492	2.62
Polypedates psuedocruciger	634	3.38
Euphlyctis cyanophlyctis	1359	7.25
Nyctibatrachus major	2826	15.07
Rana temporalis	5371	28.65
Limnonectes keralensis	5488	29.27
Total	18748	100.00

B. Abundance, Percentage abundance of reptile species recorded during transect sampling inside the *Myristica* swamps.

Name of reptile	Number of abundance	%
Dendrelaphis picta	1	0.10
Bangarus correlius	1	0.10
Callophis bibrioni	1	0.10
Trimeruserus strigatus	1	0.10
Daboia Russelli	1	0.10
Hemidactylus 1	1	0.10
Hemidactylus sps 2	1	0.10
chaemeleon	1	0.10
Callophis sps=nigrescens	2	0.21
Varanus bengalensis	2	0.21
Amphsiema stolata	3	0.31
Lycodon aulicus	3	0.31
Amphsiema beddomi	4	0.42
Naja naja	4	0.42
Lycodon sp1	5	0.52
Oligodon sps1	6	0.63
Ahaetulla pulverulenta	7	0.73
Cnemaspis 3	7	0.73
Atretium schistosum	9	0.94
Xylophis sps	9	0.94
Boiga sps	10	1.05
Uropeltid macrolepis	10	1.05
Ptyas mucosus	12	1.26
Draco dussumeiri	12	1.26
Dendrelaphis tristis	13	1.36
Oligodon (specimen)	13	1.36
Calotes calotes	13	1.36
Riopa punctata like	14	1.46
Ahateulla nasuta	15	1.57
Otocryptis beddomii	16	1.67
Calotes versicolor	16	1.67
Cnemaspis 2	20	2.09
Hypnale hypnale	25	2.62
Cnemaspis 1	35	3.66
Mabuya carinata	35	3.66
Calotes ellioti	64	6.69
Xenochrophis piscator	85	8.89
Sphenomorphus dussumeri	121	12.66
Mabuya macularia	140	14.64
Trimeruserus malabaricus	218	22.80
Total	956	100.00

C. Abundance and distribution of Amphibians inside swamps during first year

	Species	Total	%	# Plots
1.	*Limnonectes keralensis*	3298	31.65	15
2.	*Rana temporalis*	3036	29.13	15
3.	*Nyctibatrachus major*	1337	12.83	15
4.	*Euphlyctis cyanophlyctis*	471	4.52	14
5.	*Polypedates psuedocruciger*	411	3.94	15
6.	*Limnonectes limnocharis*	265	2.54	15
7.	*Hoplobatrachus tigerinus*	208	2.00	13
8.	*Micrixalus fuscus*	167	1.60	7
9.	*Indirana beddomei*	142	1.36	15
10.	*Rana aurantiaca*	140	1.34	10
11.	*Nyctibatrachus tadpoles*	118	1.13	8
12.	*Nyctibatrachus minor*	101	0.97	13
13.	*Bufo melanostictus*	97	0.93	15
14.	*Nyctibatrachus aliciae*	78	0.75	10
15.	*Rhacophorus malabaricus*	66	0.63	15
16.	*Polypedates maculatus*	58	0.56	12
17.	*Philautus temporalis*	50	0.48	14
18.	*Philautus variabilis*	48	0.46	11
19.	*Rana malabarica*	45	0.43	9
20.	*Tadpoles L.keralensis*	44	0.42	2
21.	*Philautus femoralis*	30	0.29	12
22.	*Philautus flaviventris*	21	0.20	8
23.	*452 A1*	21	0.20	7
24.	*Indirana brachytarsus*	20	0.19	8
25.	*Indirana leithilike*	16	0.15	6
26.	*Tadpoles R. temporalis*	14	0.13	3
27.	*Philautus sps 2*	13	0.12	6
28.	*Philautus pulcherrimus*	12	0.12	4
29.	*Icthyophis tricolor*	11	0.11	5
30.	*Philautus leucorhinus*	11	0.11	4
31.	*Indirana leptodactylus*	9	0.09	4
32.	*Indirana semipalmatus*	9	0.09	4
33.	*452A3*	7	0.07	4
34.	*Philautus charius*	7	0.07	2
35.	*Euphlyctis hexadactyla*	6	0.06	3
36.	*Philautus sps1*	6	0.06	3
37.	*Philautus sps4*	6	0.06	1
38.	*Bufo pareitalis ??*	4	0.04	4
39.	*Icthyophis sps*	4	0.04	2
40.	*452A2*	3	0.03	2
41.	*Rhacophorus sps*	3	0.03	2
42.	*452A6*	3	0.03	1
43.	*Philautus sps*	2	0.02	2
44.	*Philautus sps*	1	0.01	1
45.	*Philautus sps 3*	1	0.01	1
46.	*Ramanella triangularis*	1	0.01	1
	Total	10421	100.00	

D. Abundance and distribution of Amphibians inside swamps during second year.

	Species	Total	%	#plots
1.	*Rana temporalis*	2321	27.87	9
2.	*Limnonectes keralensis*	2146	25.77	9
3.	*Nyctibatrachus major*	1347	16.18	9
4.	*Euphlyctis cyanophlyctis*	888	10.66	9
5.	*Nyctibatrachus minor*	239	2.87	8
6.	*Limnonectes limnocharis*	227	2.73	9
7.	*Polypedates psuedocruciger*	223	2.68	9
8.	*Hoplobatrachus tigerinus*	135	1.62	7
9.	*Rana aurantiaca*	125	1.50	8
10.	*Micrixalus fuscus*	124	1.49	7
11.	*Indirana beddomei*	97	1.16	9
12.	*Nyctibatrachus aliciae*	80	0.96	5
13.	*Philautus variabilis*	73	0.88	9
14.	*Bufo melanostictus*	62	0.74	8
15.	*Rhacophorus malabaricus*	57	0.68	7
16.	*Nyctibatrachus tadploes*	24	0.29	2
17.	*Philautus flaviventris*	23	0.28	5
18.	*Indirana brachytarsus*	22	0.26	4
19.	*Philautus temporalis*	21	0.25	6
20.	*Indirana leptodactylus*	20	0.24	5
21.	*Ramanella triangularis*	11	0.13	3
22.	*Philautus cf temporalis*	9	0.11	9
23.	*Indirana semipalmatus*	9	0.11	3
24.	*Philautus pulcherrimus*	8	0.10	4
25.	*452 A1*	7	0.08	2
26.	*Euphlyctis hexadactyla*	4	0.05	4
27.	*Philautus femoralis*	4	0.05	4
28.	*Polypedates maculates*	4	0.05	3
29.	*Philautus leucorhinus*	4	0.05	1
30.	*Indirana leithilike*	3	0.04	3
31.	*Philautus charius*	3	0.04	1
32.	*Philautus sps1*	2	0.02	2
33.	*Philautus sps6*	2	0.02	2
34.	*Rhacophorus sps*	2	0.02	1
35.	*Icthyophis tricolor*	1	0.01	1
	Total	8327	100.00	

E. Abundance and distribution of Amphibians outside swamps during first year.

	Name of organism	Total	%	#plots
1.	*Limnonectes keralensis*	309	54.79	14
2.	*Rana temporalis*	127	22.52	1
3.	*Micrixalus fuscus*	19	3.37	2
4.	*Bufo melanostictus*	15	2.66	7
5.	*Indirana beddomei*	13	2.30	7
6.	*Philautus variabilis*	12	2.13	3
7.	*Limnonectes limnocharis*	11	1.95	4
8.	*Philautus flaviventris*	9	1.60	3
9.	*Polypedates psuedocruciger*	8	1.42	3
10.	*Euphlyctis cyanophlyctis*	7	1.24	1
11.	*Rana aurantiaca*	6	1.06	2
12.	*Rhacophorus malabaricus*	4	0.71	13
13.	*Philautus charius*	3	0.53	1
14.	*Philautus temporalis*	3	0.53	1
15.	*Polypedates maculatus*	3	0.53	1
16.	*Ramanella triangularis*	2	0.35	7
17.	*Rana malabarica*	2	0.35	3
18.	*Tomopterna rufescens*	2	0.35	3
19.	*Indirana brachytarsus*	2	0.35	2
20.	*Philautus cf temporalis*	1	0.18	7
21.	*Philautus leucorhinus*	1	0.18	5
22.	*Nyctibatrachus major*	1	0.18	2
23.	*452 A1*	1	0.18	1
24.	*Indirana semipalmatus*	1	0.18	1
25.	*Philautus pulcherrimus*	1	0.18	1
26.	*Philautus sps1*	1	0.18	1
	Total	564	100.00	

F. Abundance and distribution of Amphibians outside swamps during second year.

	Name of organism	Total	%	#Plots
1.	*Limnonectes keralensis*	202	30.89	6
2.	*Rana temporalis*	188	28.75	1
3.	*Limnonectes limnocharis*	89	13.61	4
4.	*Philautus charius*	35	5.35	1
5.	Philautus *variabilis*	31	4.74	3
6.	*Euphlyctis cyanophlyctis*	20	3.06	1
7.	*Indirana beddomei*	19	2.91	5
8.	*Rana aurantiaca*	18	2.75	1
9.	*Tomopterna rufescens*	11	1.68	6
10.	*Hoplobatrachus tigerinus*	11	1.68	1
11.	*Bufo melanostictus*	9	1.38	4
12.	*Indirana brachytarsus*	7	1.07	2
13.	*Micrixalus* fuscus	4	0.61	2
14.	*Philautus flaviventris*	2	0.31	1
15.	Philautus *sps5*	2	0.31	1
16.	*Polypedates psuedocruciger*	2	0.31	1
17.	*Ramanella triangularis*	1	0.15	3
18.	*Rana malabarica*	1	0.15	2
19.	*Philautus* temporalis	1	0.15	1
20.	*Polypedates maculatus*	1	0.15	1
	Total	654	100.00	

G Abundance and distribution of reptiles inside swamps during, l year

	Name of organism	Total	In Plots
1.	*Trimeruserus malabaricus*	158	14
2.	*Sphenomorphus dussumeri*	81	6
3.	*Mabuya macularia*	64	15
4.	*Xenochrophis piscator*	52	2
5.	Calotes ellioti	26	10
6.	*Hypnale hypnale*	19	9
7.	Cnemaspis 1	18	10
8.	Cnemaspis 2	13	7
9.	*Ptyas mucosus*	11	9
10.	*Mabuya carinata*	11	8
11.	*Oligodon (specimen)*	10	7
12.	*Xylophis sps*	8	13
13.	*Draco dussumeiri* (Dumeril &Bibron,1837)	8	6
14.	*Riopa punctata like*	8	4
15.	*Ahateulla nasuta*	7	7
16.	*Boiga* sps	7	7
17.	*Dendrelaphis tristis*	7	6
18.	*Calotes calotes*	7	5
19.	*Ahaetulla pulverulenta*	6	4
20.	*Cnemaspis 3*	6	2
21.	*Calotes versicolor*	5	5
22.	*Oligodon sps1*	5	5
23.	*Lycodon sp1*	5	4
24.	Uropeltid macrolepis	5	1
25.	*Amphsiema beddomi*	4	3
26.	*Otocryptis beddomii*	4	3
27.	*Amphsiema stolata*	3	3
28.	*Lycodon aulicus*	3	3
29.	*Varanus bengalensis*	2	3
30.	*Atretium schistosum*	2	2
31.	*Callophis sps=nigrescens*	2	2
32.	*Trimeruserus strigatus*	1	1
33.	*Bangarus correlius*	1	1
34.	*Callophis bibrioni*	1	1
35.	*Daboia Russelli*	1	1
36.	Hemidactylus 1	1	1
37.	*Hemidactylus* sps 2	1	1
38.	*Naja naja*	1	1
39.	*Chaemeleon*	0	1
40.	*Dendrelaphis picta*	0	1
	Total	574	

H. Abundance and distribution of reptiles inside swamps during, II year.

	Name of Reptille	total	%	# Plots
1.	*Mabuya macularia*	76	19.90	7
2.	*Trimeruserus malabaricus*	60	15.71	9
3.	*Sphenomorphus dussumeri*	40	10.47	6
4.	Calotes ellioti	38	9.94	7
5.	*Xenochrophis piscator*	33	8.64	8
6.	*Mabuya carinata*	24	6.28	4
7.	Cnemaspis 1	17	4.45	6
8.	*Otocryptis beddomii*	12	3.14	3
9.	*Calotes versicolor*	11	2.88	5
10.	*Ahateulla nasuta*	8	2.09	4
11.	*Atretium schistosum*	7	1.83	3
12.	Cnemaspis 2	7	1.83	2
13.	*Dendrelaphis tristis*	6	1.57	4
14.	*Riopa punctata like*	6	1.57	4
15.	*Calotes calotes*	6	1.57	3
16.	*Hypnale hypnale*	6	1.57	3
17.	Uropeltid macrolepis	5	1.31	2
18.	*Draco dussumeiri*	4	1.05	2
19.	*Boiga* sps	3	0.79	3
20.	*Naja naja*	3	0.79	3
21.	*Oligodon (specimen)*	3	0.79	2
22.	*Ahaetulla pulverulenta*	1	0.26	1
23.	*Chaemeleon*	1	0.26	1
24.	*Cnemaspis 3*	1	0.26	1
25.	*Dendrelaphis picta*	1	0.26	1
26.	*Oligodon sps1*	1	0.26	1
27.	*Ptyas mucosus*	1	0.26	1
28.	*Xylophis sternorhynchus*	1	0.26	1
	Total	382	100.00	

I. Abundance and distribution of reptiles outside swamps during, I year.

	Name of organism	Total	%	#plots
1.	*Trimeruserus malabaricus*	24	28.24	2
2.	*Mabuya macularia*	11	12.94	5
3.	*Hypnale hypnale*	6	7.06	5
4.	*Sphenomorphus dussumeri*	6	7.06	1
5.	*Ahateulla nasuta*	5	5.88	4
6.	Calotes ellioti	5	5.89	2
7.	*Ptyas mucosus*	4	4.71	3
8.	Hemidactylus 1	4	4.71	1
9.	*Mabuya carinata*	4	4.71	1
10.	*Calotes calotes*	3	3.53	2
11.	*Draco dussumeiri*	2	2.35	2
12.	Uropeltid macrolepis	1	1.18	11
13.	*Amphsiema beddomi*	1	1.18	1
14.	*Boiga* sps	1	1.18	1
15.	*Daboia Russelli*	1	1.18	1
16.	*Dendrelaphis picta*	1	1.18	1
17.	*Dendrelaphis tristis*	1	1.18	1
18.	*Naja naja*	1	1.18	1
19.	*Otocryptis beddomii*	1	1.18	1
20.	*Varanus bengalensis*	1	1.18	1
21.	*Xenochrophis piscator*	1	1.18	1
22.	*Xylophis sternorhynchus*	1	1.18	1
	Total	85	100.00	

J. Abundance and distribution of reptiles outside swamps during, II year.

	Name of organism	Total	%	# Plots
1.	*Otocryptis beddomii*	17	26.98	3
2.	*Mabuya macularia*	14	22.22	1
3.	*Sphenomorphus dussumeri*	10	15.87	2
4.	*Calotes versicolor*	5	7.94	2
5.	*Hypnale hypnale*	5	7.94	3
6.	*Mabuya carinata*	4	6.35	1
7.	*Riopa punctata*	2	3.17	3
8.	*Xenochrophis piscator*	2	3.17	1
9.	*Ahateulla nasuta*	1	1.59	1
10.	*Callophis sps=nigrescens*	1	1.59	1
11.	Cnemaspis 1	1	1.59	1
12.	*Trimeruserus malabaricus*	1	1.59	2
	Total	63	100.00	