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RESEARCH ARTICLE

Revisiting forest types of India (Champion and Seth, 1968): A case study on Myristica swamp forest in Kerala

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Abstract

The Forest types of India were classified in the Year 1936 By H.G. Champion which was later on revised in the year 1968 by Sir H.G. Champion and S.K. Seth as 'A Revised Survey of Forest Types of India'. The work of Champion and Seth (1968) although widely accepted in India but the owing to large number of subgroup types at times it is not very feasible for forest manger to manage his forest in according to forest types. Indian council of Forestry Research and Education (ICFRE, Dehradun) has decided to revisit the forest types of India through rapid assessment mode. We revisited Myristica swamp forest in Kulathupuzha range of Thiruvananthapuram Division, Kerala . From the present study it is observed that there is no change in forest type of Myristica swamp as described by Champion and Seth (1968). When compare to the study made by Vijayakumaran Nair et al. (2007), the species composition vary and the density changes have also observed. Hence, Myristica swamp forests have to be restored and conserved through Special efforts on careful planning and manipulations and watershed management. Considering its importance, UNESCO declared the Western Ghats as a World Heritage Site (Natural site) during its 36th session of 21 parties World Heritage Committee panel held at St. Petersburg in Russia on 1st July, 2012

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The Forest types of India were classified in the Year 1936 By Sir H.G. Champion which was later on revised in the year 1968 by Sir H.G. Champion and S.K. Seth as 'A Revised Survey of Forest Types of India'. The Champion and Seth's (1968) Classification is still in use while many forest types have been changed in their composition and extent due to various anthropogenic and natural factors. Champion and Seth (1968) have used temperature and rainfall data for classifying the Indian forest into five major groups and 16 type groups (climatic types) and >200 subgroup types. The work of Champion and Seth (1968) although widely accepted in India but the owing to large number of subgroup types at times it is not very feasible for forest manger to manage his forest in according to forest types. The earlier forest management was timber centric now the focus has been changed to forest conservation, increasing role of forest in environment amelioration and climate change mitigation/ adaptation has been recognized. There is need for a simple management tool for the forester to address the issues like livelihood, hydrology and climate change. Considering these facts, Indian council of Forestry Research and Education (ICFRE, Dehradun) has decided to revisit the forest types of India through rapid assessment mode.

Recently Forest Survey of India FSI (2012) has produced the forest type atlas and digitizing the forest type of India for the first time. The forest type maps according to Champion & Seth classification (1968) of the country including States and UTs and districts have been prepared on 1:50,000 scale. The output of this mapping exercise covers 178 out of 200 forest types described in the Champion & Seth classification (1968). In order to further upscale the work done by FSI, attempts have been made to revisit forest types and to reassign the forest type based on ground survey.

Based on the ground survey, attempt will be made to simplify and as far as possible to reduce the number of forest subgroup types having similar characteristics.

ICFRE with its pan India presence and a net work of eight National level Institutes involved in the extensive field studies. Institute of Forest Genetics and Tree Breeding (IFGTB) is one of the regional Institutes of ICFRE covered two south Indian states viz., Tamilnadu and Kerala; and two Union territories viz., Pondicherry and Andaman & Nicobar Islands. Within the Institute various teams have been made to entertain the task. I have been assigned to lead a team to revisit Myristica swamp forest in Kulathupuzha range of Thiruvananthapuram Division, Kerala from April 2012 to March, 2013.

Study area

FSI has provided the sample point locations (geo-coordinates) from their digitized forest type maps using stratified random sampling scheme with proportional allocation. We conducted detailed vegetation survey of these sample point locations. The geo co-ordinates given for revisiting the Myristica swamps are falling under Mayilamoodu and Sangili sections of Kulathupuzha forest range, Thiruvananthapuram Forest Division, Kollam Dt. Ten Myristica swamps were selected based on the given latitude and longitude, and had a detailed discussion with the foresters. References (latitude, longitude and other history) of the Myristica swamps studied are given in table 1. Ten points selected to cover Myristica swamp forests are falling in Sangili and Mayilamoodu sections (five points each) of Kulathupuzha range, Thiruvananthapuram Division, Kerala. 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 hill streams and are tributaries of Kulathupuzha River in Kulathupuzha forest range. For this study a uniform sampling and vegetation analysis methodology will be adopted (Schematic diagram of the sampling method). Nine quadrates were laid for each point as per the methodology provided. Data on vegetation and other history was also recorded for each point. Data sheets for each survey point are maintained separately. Samples were collected for the entire flora observed since IFGTB does not have collections of Myristica swamps. Details of the study area and the vegetation composition are given below. Ample photographs were taken for references too. Data on current vegetation status of the existing forest types will be recorded and compared with the forest types and forest vegetation/ community association therein as reported by Champion and Seth (1968).

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.

The characteristic feature of the Myristica swamps is the abundance of trees belonging to the family Myristicaceae, particularly two species viz. *Myristica 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 *Legenandra ovata*, *Alpinia malaccensis*, *Phrynium* sp., *Desmodium motorium*, *Selaginella* sp., *Ochlandra* sp., *Gnetum* sp., *Helicteres* sp., *Bauhinia* sp., and creepers such as *Chilocarpus* sp., *Kunstelaria* sp., *Piper* sp., etc.

The Myristica swamps are swampy areas inside evergreen forests of low elevation. Earlier it was told that the entire area in Kulathupuzha and Anchal regions were described as two patches of Myristica swamps. However, in recent past, it was found that the swamps with stilt roots and knee roots could be clearly demarcated on either side of first order streams. They have also been reported from Karnataka and Goa. In Kerala, these swamps are present in Kulathupuzha and Anchal Forest Ranges and Shendurney Wildlife Sanctuary (between 77. 27° and 77. 58° E and 8.74°N and 9.03°, below 200m MSL).

A) Kulathupuzha Forest Range - Sangili section

Uthiran Chira

This is a typical *Myristica* swamp in Kulathu Puzha Forest Range, located one and a half kilometer from 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. *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.

Karinkurinji up

This is the most accessible swamp in the Sastha Nada area as it lies beside the Venkolla- Sangili 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. *Myristica* trees, mainly *Gymnacranthera farquhariana* and *Myristica fatua* var. *magnifica* dominate in the swamp. The undergrowth consists of *Lagenandra ovata*, and *Alpinia* sp. There are woody lianas present in the swamp. Anthropogenic disturbances are mainly in the form of local people's dependence on the swamps for non wood forest products and fire wood.

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. The swamp is dominated by *Myristica* trees; undergrowth consists of the herb *Lagenandra ovata* belonging to the family Araceae. Climbers are present in the swamp.

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. One side of the swamp is flanked by Sangili road beyond which are evergreen forests. *Gymnacranthera farquhariana* is being the most frequent tree in this swamp. *Myristica fatua* var. *magnifica* trees are very few in number. Non - *Myristica* trees such as *Lagerstroemia* sp. and *Mesua* sp. are well represented. Undergrowth consists of canes, *Calamus hookerianus*, *Pandanus*, and *Lagenandra ovata*. Anthropogenic disturbance is high especially in pilgrim season due to the vicinity of Sastha temple.

Pillekode

The swamp is located along a deep valley very near to Pillekode settlement. Heavy leech population was found in the swamp. Few trees of the species *Myristica fatua* var. *magnifica* are found in the swamp. The swamp is surrounded by plantations (Pala) except in the upstream end, where paddy fields are 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. 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.

B) Kulathupuzha Forest Range – Mayilamoodu section

Channa Mala

The swamp is near Amakulam junction, about 5 km from Kulathupuzha town. A right deviation road from Amakulam junction leading to Channa Mala settlement leads to 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.

Empong

Empong swamp is situated about one km from the KulathuPuzha 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. 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. Anthropogenic disturbance is high and is in the form of local dependence upon the swamp for fire wood, non wood forest products etc.

Marappalam

This swamp is situated in the right side of the Amakulam – Rockwood road. Edges of the swamp are very steep. The swamp is surrounded by evergreen forests and degraded forests developed after plantation logging. 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*, etc. Anthropogenic disturbance is high since it is found in the road side.

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. The swamp is almost flat and is separated from its downstream end extension called Manchal by the road. The upstream end of the swamp is flanked by forest plantations; the remaining adjoining areas are covered by evergreen forests. 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*, climbing ferns, etc. *Myristica fatua* var. *magnifica* and *Gymnacranthera farquhariana* are the dominant trees followed by *Syzygium trvancoricum*, *Vateria indica*, *Lophopetalum wightianum*, *Holigarna arnottiana* and *Hopea parviflora*.

Onnam Mile

The swamp is situated very near to Onnam mile along a mud road deviating right from Onnam mile. The swamp is big, almost flat. The swamp has many *Myristica* trees and *Syzygium trvancoricum* trees. The swamp is surrounded by evergreen forests. 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*, 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.

Tree species in Myristica swamps			
1.	<i>Actinodaphe maderaspatana</i>	22	<i>Lophopetalum wightianum</i>
2.	<i>Anacolosa densifolia</i>	23	<i>Macaranga peltata</i>
3.	<i>Antidesma montanum</i>	24	<i>Mesua ferrea</i>
4.	<i>Aporusa lindleyana</i>	25	<i>Myristica fatua</i> var. <i>magnifica</i> *
5.	<i>Artocarpus heterophyllus</i> *	26	<i>Neolamarckia cadamba</i>
6.	<i>Baccaurea courtallensis</i> *	27	<i>Olea dioica</i>
7.	<i>Bombax Ceiba</i>	28	<i>Otonephelium stipulaceum</i>
8.	<i>Bridelia retusa</i>	29	<i>Persea macrantha</i>
9.	<i>Cinnamomum malabratrum</i> *	30	<i>Polyalthia fragrans</i> *
10.	<i>Croton malabaricus</i> *	31	<i>Pterygatta alata</i>
11.	<i>Elaeocarpus tuberculatus</i>	32	<i>Scolopea crenata</i>
12.	<i>Fagraea ceilanica</i>	33	<i>Sterculia urens</i>
13.	<i>Flacourtia jagnum</i>	34	<i>Swietenia mahagoni</i>
14.	<i>Flacourtia jagnum</i>	35	<i>Syzygium cuminii</i>
15.	<i>Gymnacranthera fraquehariana</i>	36	<i>Syzygium mundagam</i> *
16.	<i>Holigarna arnottiana</i> *	37	<i>Syzygium travancoricum</i> *
17.	<i>Hopea parviflora</i> *	38	<i>Terminalia paniculata</i>
18.	<i>Hydnocarpus pentandra</i> *	39	<i>Terminalia tomentosa</i>
19.	<i>Knema attenuate</i> *	40	<i>Vateria indica</i> *
20.	<i>Lagerstroemia speciosa</i>	41	<i>Xanthophyllum falvescens</i> *

21.	<i>Litsea wightiana</i> *		
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*Endemic to western ghats

Understory vegetation			
1.	<i>Abrus pulchellus</i>	30	<i>Lophopetalum wightianum</i>
2.	<i>Acacia tora</i>	31	<i>Madhuca nerifolia</i>
3.	<i>Actinodaphne maderaspatana</i>	32	<i>Mesua ferrea</i>
4.	<i>Alpinia</i> sp.,	33	<i>Ochlandra travancorica</i> *
5.	<i>Anacolosia densifolia</i>	34	<i>Olea dioica</i>
6.	<i>Aporosa lindleyana</i>	35	<i>Ophiorhiza</i> sp.,
7.	<i>Artocarpus hirsutus</i>	36	<i>Otonophelium stipulaceum</i>
8.	<i>Bauhinia phoenicea</i> *	3	<i>Pandanus thwaitesii</i> *
9.	<i>Calamus hookerianus</i> *	38	<i>Pchumianthus</i> sp.,
10.	<i>Chromolaena odorata</i>	39	<i>Persea machrantha</i>
11.	<i>Cinnamomum malabattrum</i>	40	<i>Piper betel</i>
12.	<i>Clerodendrum</i> sp.	41	<i>Piper nigrum</i>
13.	<i>Croton malabaricus</i>	42	<i>Pleopeltis</i> sp.,
14.	<i>Cryptolepis buehananii</i>	43	<i>Polyalthia fragrans</i>
15.	<i>Debregiasia velutina</i>	44	<i>Pothos scandens</i>
16.	<i>Dracaena terniflora</i>	45	<i>Psychotria flavida</i>
17.	<i>Eleocarpus tuberculatus</i>	46	<i>Pterygota alata</i>
18.	<i>Fagraea ceilanica</i>	47	<i>Rauwalfia serpentine</i>
19.	<i>Flacouurtia jagnum</i>	48	<i>Schleichera oleosa</i>
20.	<i>Garcinia morella</i>	49	<i>Scolopia crenata</i>
21.	<i>Helictre isora</i>	50	<i>Selaginella brachystachya</i>
22.	<i>Humboldtia vahliana</i>	51	<i>Semecarpus auriculatus</i>
23.	<i>Hydnocarpus pentandra</i>	52	<i>Stereospermum</i> sp.,
24.	<i>Ixora</i> sp.,	53	<i>Symplocos cochinchinensis</i>
25.	<i>Kunstler keralensis</i>	54	<i>Syzygium travancoricum</i>
26.	<i>Lagenandra ovata</i>	55	<i>Vitex altissima</i>
27.	<i>Leea indica</i>	56	<i>Xanthophyllum flavescens</i>
28.	<i>Lindernia hyssopioides</i>	57	<i>Zingiber zerumbet</i>
29.	<i>Litsea</i> sp.,	58	<i>Zizyphus rugosa</i>

*Endemic to western ghats

Major shrubs and herbaceous species in sample plots

Uthiran Chira: *Lagenandra ovata*, *Pothos scandens*, *Kunstleria keralensis*, *Zingiber zerumbet*

Karinkurinji up: *Lagenandra ovata*, *Phrynium pubinerve*, *Zingiber zerumbet*

Karinkurinji down: *Zingiber zerumbet*, *Helicteres isora*, *Alpinia malaccensis*

Sastha Nada: *Barleria courtallica*, *Lagenandra ovata*, *Piper nigrum*, *Phrynium pubinerve*, *Zingiber zerumbet*

Pillekode: *Lagenandra ovata*, *Barleria courtallica*, *Piper nigrum*, *Carex* sp

Channa Mala: *Lagenandra ovata*, *Christella parasitica*, *Cyanotis* sp, *Piper nigrum*, *Ochlandra Travancorica*, *Dracaena terniflora*

Empong: *Phrynium pubinerve*, *Christella parasitica*, *Piper nigrum*, *Gomphandra tetrandra*, *Pandanus thwaitesii*, *Calamus hookerianus*

Marappalam: *Lagenandra ovata*, *Calamus hookerianus*, *Barleria courtallica*, *Pandanus thwaitesii*, *Selaginella brachystachya*

Munkuthu: *Pandanus thwaitesii*, *Phrynium pubinerve*, *Schumannianthus virgatus*, *Carex* sp

Onnam Mile : *Phrynium pubinerve*, *Carex* spp., small clumps of *Pandanu*.

Major tree species in sample plots

Uthiran Chira: *Myristica fatua* var. *magnifica*, *Gymnacranthera farquhariana*, *Lophopetalum wightianum*, *Persea macrantha*

Karinkurinji up: *Myristica fatua* var. *magnifica*, *Gymnacranthera farquhariana*, *Vateria indica*, *Knema attenuata*, *Holigarna arnottiana*

Karinkurinji down: *Knema attenuata*, *Myristica fatua* var. *magnifica*, *Vateria indica*

Sastha Nada *Gymnacranthera farquhariana*, *Lophopetalum wightianum*,

Pillekode *Gymnacranthera farquhariana*, *Lophopetalum wightianum*, *Vateria indica*, *Artocarpus hirsutus*

Channa Mala *Myristica fatua* var. *magnifica* *Gymnacranthera farquhariana*, *Vateria indica*, *Lophopetalum wightianum*

Empong *Myristica fatua* var. *magnifica*, *Gymnacranthera farquhariana*, *Lophopetalum wightianum*

Marappalam *Myristica fatua* var. *magnifica*, *Gymnacranthera farquhariana*, *Holigarna arnottiana*

Munkuthu *Myristica fatua* var. *magnifica* *Gymnacranthera farquhariana*

Onnam Mile *Myristica fatua* var. *magnifica* *Gymnacranthera farquhariana*, *Vateria indica*

The species, *Gymnacranthera farquhariana* is dominated in narrow valley swamps where as *Myristica fatua* var. *magnifica* is dominated in flat valley swamps. Interestingly associated species namely, *Lophopetalum wightianum*, *Knema attenuata*, *Vateria indica*, and *Holigarna arnottiana* are common in *Myristica fatua* var. *magnifica* dominated swamps than the *Gymnacranthera farquhariana* dominated swamps. It has a genetic biodiversity tracing back to 500 million years. These treasure chests were rightly mentioned by Norman Meyer as one of the “Earth’s biologically richest and most endangered terrestrial ecosystems”. Its unique ecosystem diversity influences the Indian monsoon weather pattern.

From the present study it is observed that there is no change in forest type of *Myristica* swamp as described by Champion and Seth (1968). When compare to the study made by Vijayakumaran Nair et al. (2007), the species composition vary and the density changes have also observed.

Myristica swamps are highly endangered and fragmented ecosystems and are restricted to small patches in the Western Ghats. In Kerala, these swamps make up less than 0.01% of the total land area of the state. The fate of biodiversity depends upon the existence of the ecosystem. Communities vary in level of environmental determinism and species differ in niche breadth and degree of site specificity. Therefore it is very important to conserve this ecosystem because the vegetation composition of the ecosystem is made up of Myristicaceae trees such as *Myristica fatua* var. *magnifica*, *Gymnacranthera canarica* and non *Myristica* trees such as *Lophopetalum wightianum*, *Vateria indica*, *Holigarna beddommi*, *Semecarpus auriculata*, *Syzygium travancoricum* etc having very narrow ecological amplitude they do not survive outside their niche. The studies conducted by various researchers since last half a century (Krishna moorthy, 1960; Pascal, 1988; Varghese and Kumar, 1997; Varghese and Menon, 1999; Vijayakumaran Nair et al., 2007) including our present study revealed that *Myristica* swamp forests showed low standing density, low species richness and medium diversity. The myristic swamp forests surveyed in this study are under tremendous biotic pressure because of their location in lower altitude and adjacent to city, easily accessible to public and their conservation is a challenging task. Hence, *Myristica* swamp forests have to be restored and conserved through Special efforts on careful planning and manipulations and watershed management. Considering its importance, UNESCO declared the Western Ghats as a World Heritage Site (Natural site) during its 36th session of 21 parties World Heritage Committee panel held at St. Petersburg in Russia on 1st July, 2012

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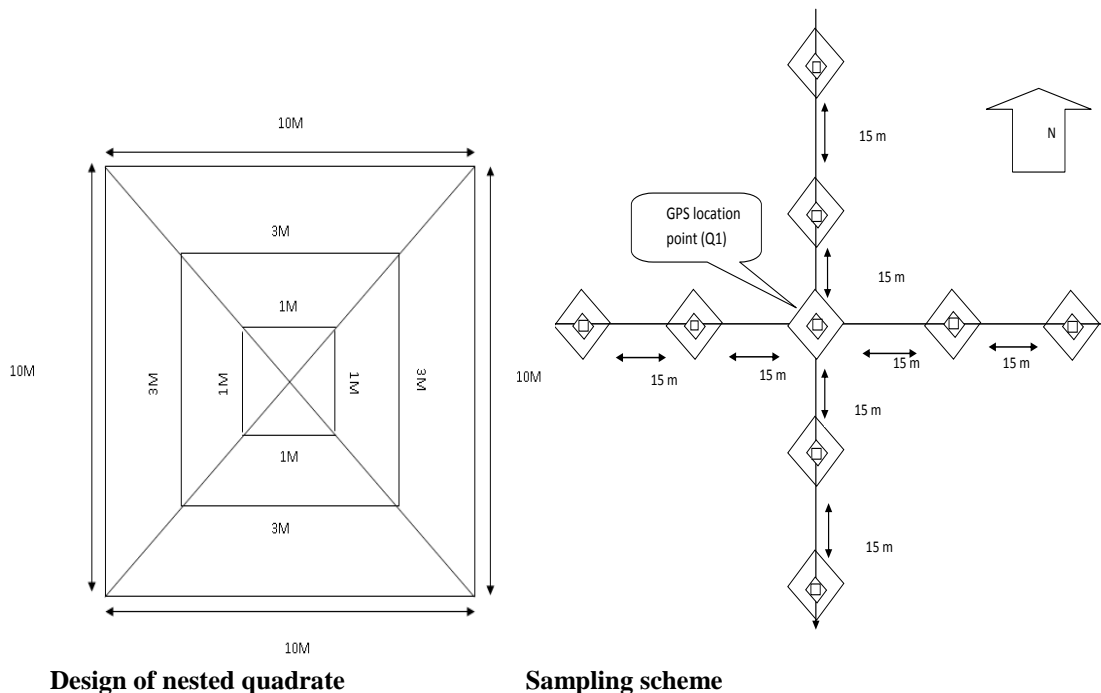
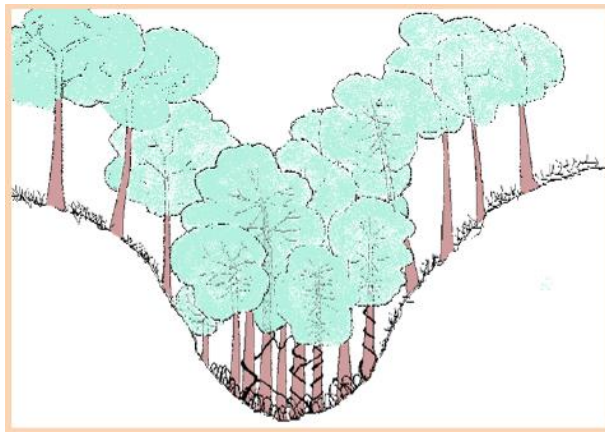


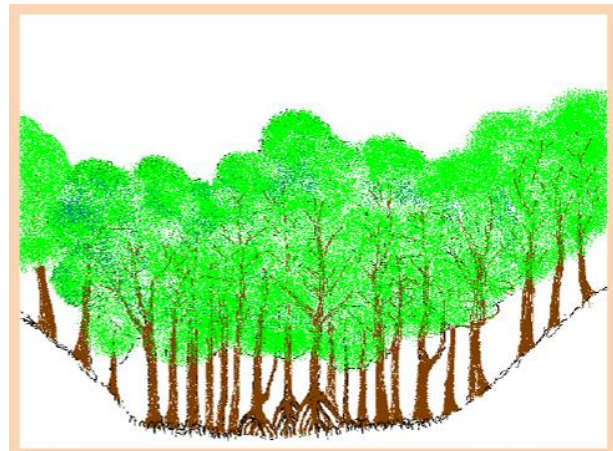
Table 1. Data taken and the details of *Myristica* swamp forests in Kulathupuzha range, Thiruvananthapuram Division, Kerala

Point_ID	Real geo co-ordinates of given forest types/plantation		Altitude	Name of the swamp (<i>Myristica</i>)	Section	Range & Division	State
	Long	Lat					
ID#127	77:02:53.1 E	8:49:09.5 N	184	Karungurunchi pacha	Sangili	Kulathupuzha & TVN	Kerala
ID#129	77:03:10.4 E	8:49:02.6 N	155	Sasthanada	Sangili	Kulathupuzha & TVN	Kerala
ID#130	77:03:31.8 E	8:48:52.6 N	150	Puliyakode	Sangili	Kulathupuzha & TVN	Kerala
ID#105	77:02:47.0 E	8:49:10.2 N	192	Karungurunchi pacha	Sangili	Kulathupuzha & TVN	Kerala
ID#135	77:02:26.1 E	8:48:03.7 N	185	Uthiranchira chathuppu	Sangili	Kulathupuzha & TVN	Kerala
ID#126	77:05:02.2 E	8:52:52.9 N	145.2	Moonumukku Pacha	Mayilamoodu	Kulathupuzha & TVN	Kerala
ID#131	77:03:48.8 E	8:53:21.6 N	154	Embongu pacha	Mayilamoodu	Kulathupuzha & TVN	Kerala
ID#132	77:04:18.9 E	8:52:50.5 N	181	Channamala chathupu	Mayilamoodu	Kulathupuzha & TVN	Kerala

ID#136	77:05:21.0 E	8:52:40.8 N	158	Marappalam	Mayilamoodu	Kulathupuzha & TVN	Kerala
ID#138	77:04:03.1 E	8:53:01.2 N	172	Onnamayil pacha	Mayilamoodu	Kulathupuzha & TVN	Kerala



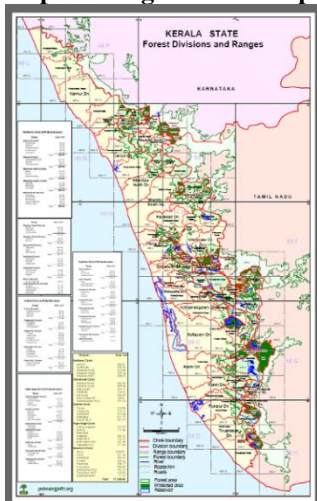
Swamp profile in narrow valley



(Courtesy: Dr. P. Vijayakumaran Nair, KFRI, Peechi)
Swamp profile in flat valley

Map showing the Kulathupuzha range,

Thiruvananthapuram Division



Myristica swamp study areas



Laganendra ovata



Pandanus thwaitesii



Selaginella brachystachya



Calamus sp.



Cinnamomum malabattrum



Madhuca neerifolia



Chromolena odorata



Piper betel



Artocarpus hirsutus



Phrynium pubinerve



Gymnacranthera fraquehariana - Knee roots



Myristica swamph forests



Myristica fatua* var. *magnifica



***Myristica fatua* var. *magnifica* Stilt roots**



***Myristica* swamp forest**



Knee roots