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Cover: The critically endangered *Lilium polyphyllum* in watercolour and acrylics. © Aishwarya S Kumar.



# Report of new myristica swamp ecosystems from the Western Ghats at Pathanapuram, Kerala, India

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**Abstract:** We present a new distributional report of myristica swamp ecosystems in the Western Ghats at Pathanapuram, Kerala, India based on several distinct field surveys from April 2022 to June 2022. From Kerala, myristica swamp has previously been reported mainly from Shendurney Wildlife Sanctuary, Kulathupuzha Reserve Forests, and adjoining regions of the Anchal forest ranges in southern Western Ghats. The present study described and illustrated the occurrence of myristica swamp from the Pathanapuram forest range in Kerala for the first time. The observed myristica swamps from the Pathanapuram forest range are seen inside the Ambanar model forest station and Punnala forest station limits. A total of 18 myristica swamp patches from Ambanar and seven myristica swamps from Punnala were reported and captured. A pilot survey from these sites suggests they are abundant with various faunal and floral wealth. Therefore, recognition and conservation of these ecosystems are essential and vital and suggest further surveys and conservation efforts.

**Keywords:** Conservation, ecological diversity, endemic species, field survey, habitat restoration, indigenous flora new distribution records, Pathanapuram forest range, tropical freshwater swamps, wetland forest ecosystem.

2022 ഏപ്രിൽ മുതൽ 2022 ജൂൺ വരെയുള്ള നിരവധി വ്യത്യസ്തമായ ഫീൽഡ് സർവ്വേകളെ അടിസ്ഥാനമാക്കി, പശ്ചിമഘട്ടത്തിലെ പത്തനാപുരത്ത്, ഇന്ത്യയിലെ മിരിസ്റ്റിക്ക ചതുപ്പ് ആവാസവ്യവസ്ഥയുടെ ഒരു പുതിയ വിതരണ റിപ്പോർട്ട് ഞങ്ങൾ അവതരിപ്പിക്കുന്നു. തെക്കൻ പശ്ചിമഘട്ടത്തിലെ കരളേതിൽ നിന്ന്, പശ്ചാതമയും കൂളത്തുപുഴ റിസർവ് ഫോറസ്റ്റ്, ശെന്ദൂർണി വനജീവി സങ്കേതം, അഞ്ചൽ വനമേഖല തുടങ്ങിയ പരദേശങ്ങളിൽ നിന്നുമാണ് മിരിസ്റ്റിക്ക ചതുപ്പ് മുഖ് റിപ്പോർട്ട് ചെയ്യാൻ കഴിഞ്ഞിട്ടുള്ളത്. കരളേതിലെ പത്തനാപുരം ഫോറസ്റ്റ് റേഞ്ചിൽ നിന്ന് മിരിസ്റ്റിക്ക ചതുപ്പുനിലത്തിനെ കുറിച്ച് വിവരിക്കുകയും വിശദീകരിക്കുകയും ചെയ്യുന്ന ആദ്യ പഠനം ആണ് ഇത്. പത്തനാപുരം ഫോറസ്റ്റ് റേഞ്ചിൽ നിന്ന് നിരീക്ഷിക്കപ്പെടുന്ന മിരിസ്റ്റിക്ക ചതുപ്പുകൾ അപനാർ മോഡൽ ഫോറസ്റ്റ് സ്റ്റേഷൻ പരിധിയിലും പുനല ഫോറസ്റ്റ് സ്റ്റേഷൻ പരിധിയിലും കാണപ്പെടുന്നു. അപനാറിൽ നിന്ന് 18 മിരിസ്റ്റിക്ക ചതുപ്പുകളും പുനലയിൽ നിന്ന് ഏഴ് മിരിസ്റ്റിക്ക ചതുപ്പുകളും റിപ്പോർട്ട് ചെയ്തു. ഇവിടെ നിന്നുള്ള പലേറ്റർ സർവ്വേ സൂചിപ്പിക്കുന്നത് ഇവിടെയുള്ള മിരിസ്റ്റിക്ക ചതുപ്പുകൾ വിവിധ ജന്തുജാലങ്ങളും പുഷ്പ സമൃദ്ധവും കൊണ്ട് സമൃദ്ധമാണെന്നാണ്. അതിനാൽ, ഈ ആവാസവ്യവസ്ഥകളുടെ അംഗീകാരവും സംരക്ഷണവും അത്യാവശ്യമാണ്. കൂടുതൽ സർവ്വേകളും സംരക്ഷണ ശ്രമങ്ങളും നിർദ്ദേശിക്കുന്നു.

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**Author details:** NIJI JOSEPH, a PhD scholar, has a fundamental interest in benthic macroinvertebrates and forest ecosystems. SREEJAI R holds the position of a professor at St. Stephen's College, Pathanapuram, while M. AJAYAKUMAR serves as the Deputy Forest Range Officer at Ambanar Forest Station, Pathanapuram.

**Author contributions:** NJ conceived the concept of the work, conducted the fieldwork, and wrote the manuscript. Revisions and editing of the work were done by SR. MA assisted in preparing the map for the article.

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Myristica swamps are the wetland forest ecosystems that are inundated fully or partially for the greater part of the year. These tropical freshwater swamps are characterized by the dominance of Myristicaceae family members like *Myristica fatua* var. *magnifica* (Bedd.) Sinclair and *Gymnacranthera farquhariana* (Wall. ex-Hook. fil. & Thomson) Warb. (Varghese & Menon 1999; Bhat & Kaveriappa 2009; Jose et al. 2014a; Sujitha et al. 2019). Myristica swamps are confined to valleys with flat bottoms and slow-moving streams in the altitude range of 100–200 m. Myristica swamps shelter several rare and threatened floral–faunal species (Vasudeva et al. 2001; Ganesan 2002; Ranganathan et al. 2022). Over six decades ago, myristica swamps were initially described by Krishnamoorthy (1960) from the Travancore region in Kerala State of southern Western Ghats. Champion & Seth (1968) named these tropical swamps as ‘Myristica Swamp Forest’ and categorized them under the sub group 4C. Rodgers & Panwar (1988) emphasized the importance of conservation of the vegetation. According to the data so far, in Kerala these swamps were mainly spanned in the valleys of Shendurney Wildlife Sanctuary, in Kulathupuzha Reserve Forests, and adjoining regions of the Anchal forest ranges in the southern Western Ghats (Krishnamoorthy 1960; Varghese & Kumar 1997; Varghese & Menon 1999; Nair et al. 2007; Roby 2011; Jose et al. 2014b). In addition to Kerala, myristica swamps have also been reported from Goa, Karnataka, and Maharashtra (Santhakumaran et al. 1995; Chandran et al. 1999; Sreedharan & Indulkar 2018). However, the once-pristine myristica swamps in the Western Ghats are presently encountering disruption and fragmentation due to increasing growing demands for land and water (Champion & Seth 1968; Chandran et al. 1999; Chandran & Mesta 2001; Ranganathan et al. 2022). Increasing forest surveys in recent times have led to the documentation of a few myristica swamps across Western Ghats (Sreedharan & Indulkar 2018). This paper reports the identification of a new myristica swamp ecosystems from Pathanapuram forest range in the southern part of the Western Ghats.

We have been sampling myristica swamp forests in southern Kerala for a proposed study on *Myristicaceae* members. On 20 April 2022, we found some canopy of *Myristicaceae* members in Pathanapuram forest range (9.08534°N, 76.8551°E) of Punalur division in Kollam District, Kerala, India (Figure 1). The observed *Myristica* swamps from Pathanapuram Forest Range fall within Ambanar Model Forest Station and Punnala Forest Station limits. During our first visit, we noticed the swampy habitat, as well as the occurrence of ‘knee roots’ and ‘stilt roots’ both of which are characteristics

of myristica swamps. We have conducted 11 field surveys during the period from April 2022–June 2022. For the systematic study of vegetation, we chose 25 sample plots from both Ambanar and Punnala. Quadrats of 20 × 20 m were laid along the linear course of the swamps from Ambanar and Punnala respectively for the enumeration of trees having minimum girth ≥30 cm. Girth of all trees and shrubs was calculated using a measuring tape. For swamps smaller than 400 m<sup>2</sup> no quadrats were placed; instead, the species were simply listed. Both trees and underground vegetation were taken into consideration. Two sub-quadrats of 5 × 5 m were laid for the shrub layer within each tree quadrat (plants above one meter height). Within each of the 5 × 5 m quadrats, two smaller quadrats of 1 × 1 m were laid for the herb layer (plants less than one meter height). The plant species were identified by an expert and also by comparing pictures from published sources including the internet (Gamble & Fischer 1936; Varghese & Menon 1999; Sasidharan 2006; Nair et al. 2007). Geographic coordinates were recorded at each sampling point using Garmin® eTrex® 20x GPS. Image 1 shows some individual photographs of myristica swamps from both Ambanar and Punnala Forest Station.

The Ambanar Forest Station covers an area of 89.22587 km<sup>2</sup>. The area of research is 0.86 ha of the total forest area. The topographic conditions of Ambanar vary from 75–1,050 m asl. In general, red loamy soil which is rich in minerals is found. Apart from this, alluvial soil is also found in river banks and valleys. The degree of soil pH is 4.48–6.10. The climate of this forest area has an air temperature of 29<sup>o</sup>–31<sup>o</sup> C. Ambanar receives annual rainfall of 2,400 mm. Humidity is highest in the months of June, July, and August and lowest in February. The noted measures of general relative humidity at 0830 h IST and 1730 h IST from February to March are about 52% and 98%, respectively.

The Punnala Forest Station covers an area of 49.85 km<sup>2</sup> Compared to the surrounding level, this region has an elevation of about 10–400 m. In terms of climate, it experiences both moderately hot as well as humid conditions. The hottest period is from February–May and the coldest in December and January. The maximum and minimum reported temperatures are 37<sup>o</sup>C and 20<sup>o</sup>C, respectively. The area receives an average annual rainfall of 2,400 mm. The plants growing on the hills at higher altitudes are prone to severe damage made by the dry easterly winds. Humidity is highest in the months of June, July, and August and lowest in February. General relative humidity at 0830 h IST and 1730 h IST during February to March are about 52% to 98%, respectively.

All 18 patches of myristica swamps and the





geographical coordinates of the sampling points in the Ambanar area are presented in Table 1. Geographically, all these 18 patches are located in Manthadam region of the Ambanar. The region Manthadam comprises a small stream that maintains the distinctive swampy ecosystem. Olappara and Minnaminni are the places near Manthadam in which saplings of Myristicaceae family members are found.

In the Punnala Forest Station range, there are seven *Myristica* swamps present with a total area of 26.9 ha. They are Elappakkodu Bit 1, Elappakkodu Bit 2, Elappakkodu Bit 3, Pezhummodu, Verukuzhypacha Bit 1, Verukuzhypacha Bit 2, and Pannamood pacha. Most of the swamps in Punnala are inundated throughout the year due to the presence of three rivulets – Elappakkodu Thodu, Pezhummodu Thodu, and Mukkalampadu Thodu. These three rivulets flow into the Kallada river. Table 2 shows the geo-coordinates of locations and the total

**Table 1. List of myristica swamps under Ambanar model forest area, Pathanapuram range.**

	Name of the swamp	Geocoordinates of the swamps		Area (Ha)
		Latitude (°N)	Longitude (°E)	
1	Manthadam Bit 1	90.05375	76.99838	0.8
2	Manthadam Bit 2	90.05477	76.99887	
3	Manthadam Bit 3	90.05361	76.99866	
4	Manthadam Bit 4	90.05344	76.99830	
5	Manthadam Bit 5	90.05333	76.99913	
6	Manthadam Bit 6	90.05327	76.99897	
7	Manthadam Bit 7	90.05336	76.99883	
8	Manthadam Bit 8	90.05322	76.99855	
9	Manthadam Bit 9	90.05316	76.9985	
10	Manthadam Bit 10	90.05336	76.99811	
11	Manthadam Bit 11	90.05347	76.99772	
12	Manthadam Bit 12	90.05344	76.99755	
13	Manthadam Bit 13	90.05369	76.99730	
14	Manthadam Bit 14	90.05375	76.99727	
15	Manthadam Bit 15	90.05383	76.99736	
16	Manthadam Bit 16	90.05383	76.99738	
17	Manthadam Bit 17	90.05372	76.99736	
18	Manthadam Bit 18	90.05363	76.99805	

**Table 2. List of myristica swamps under Punnala forest area, Pathanapuram range.**

	Name of swamp	Geo coordinates of the swamps		Area (ha)
		Latitude (°N)	Longitude (°E)	
1	Elappakkodu Bit 1	09.08762	076.95453	0.87
2	Elappakkodu Bit 2	09.08762	076.95470	1.66
3	Elappakkodu Bit 3	09.08922	076.95295	0.38
4	Pezhummodu	09.09545	076.94337	1.99
5	Verukuzhypacha Bit 1	09.05970	076.97498	3.7
6	Verukuzhypacha Bit 2	09.06812	076.97509	5.8
7	Panamoodupacha	09.07138	076.69757	12.5

area occupied by the myristica swamp in the Punnala region. There were large numbers of *Myristica* trees in Elappakkodu swamps. Along with these seven sites, saplings of *Myristica* trees grow at Choorapacha, Thulasithara, and Therdhakkara in Punnala Forest Station. The neighbouring forest of these swamps is semi-evergreen in nature. The Kerala Forest Development Corporation (KFDC) Limited, Punalur Division is situated nearest to the Elappakkodu swamp. Elappakkodu and Pezhummod pacha are the reserved forests in Punnala. However, some regions of Elappakkodu swamp are disturbed due to locally originated anthropogenic activities like fishing and crabbing. In Punnala Station limits, reserve forest is much smaller and therefore more vulnerable to local disturbances. Hence the swamps in Punnala need special attention from a management perspective.

When examining the vegetation listed in Table 3, *Gynacranthera farquhariana*, *Myristica fatua* var. *magnifica*, and *Knema attenuata* (Hook.f. & Thoms.) Warb. consistently appear in both the Ambanar and Punnala regions. These species seem to thrive in diverse environmental conditions represented in both the areas. However, *Myristica dactyloides* (Gaertn.) displays a distinct pattern, being present in Ambanar but remarkably absent in Punnala. Our observations suggest disparities in species distribution within Ambanar and Punnala highlight the intricate interplay of ecological forces, suggesting a dynamic and diverse nature shaped by a combination of microclimatic variations, historical influences, and human activities. A comparison of the distribution of non-Myristicaceae trees between Ambanar and Punnala shows notable differences in species presence. Based on our preliminary findings, we recognize the need for further investigation to better understand the disparities in species distribution among these sites.

*Myristica* swamps are rich with numerous invertebrates and vertebrates, both terrestrial and



**Image 1. Myristica swamps: A—In Manthadam with the occurrence of pneumatophores | B—rivulet that flows through Elappakodu swamp | C—In Elappakodu Bit 1 | D—water inundation of Myristica swamp with the presence pneumatophores. © Niji Joseph.**

aquatic (Jose et al. 2014b; Sinu & Sharma 2013; Sujitha et al. 2019; Ranganathan et al. 2022). A pilot survey from these sites suggests they are abundant with various faunal and floral wealth. Studies documenting the biodiversity of flora and fauna, climatic factors, hydrology, and soil, and so forth of these ranges are not well studied and documented. For this reason, a clear picture of these factors is not available yet. As per the pilot study, we noticed plenty of juveniles of ecologically significant species present in these swamp forests. This indicates that numerous species use the *Myristica* swamps as breeding grounds (Abraham et al. 2018; Ranganathan et al. 2022). Mapping and documenting the specifics of these swamp forests is both important and potent for further research. Preventing the incursion of non-swampy plant species into the swamp helps to maintain the swampy habitat. Raising the status of these swamps will restrict the anthropogenic and natural disturbances. In order to ensure a long-term monitoring, incorporating

the interests of local communities in the conservation and management activities are also desirable. With this new reporting, the revised Indian distribution of myristica swamps should include Ambanar and Punnala of Pathanapuram forest range.

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**Table 3. List of vegetation at Ambanar and Punnala Forest Station.**

Species	Ambanar	Punnala
<b>Myristicaceae trees</b>		
* <i>Gymnacranthera farquhariana</i> (Wall. ex-Hook. fil. & Thomson) Warb.	P	P
* <i>Myristica fatua</i> var. <i>magnifica</i> (Bedd.) Sinclair	P	P
* <i>Knema attenuata</i> (Hook.f.&Thoms.) Warb	P	P
<i>Myristica dactyloides</i> Gaertn	P	A
<b>Non Myristicaceae trees</b>		
* <i>Vateria indica</i> L.	P	A
<i>Prioria pinnata</i> (Roxb. ex-DC.) Breteler	P	A
<i>Neolamarckia cadamba</i> (Roxb.) Bosser	P	P
* <i>Semecarpus auriculata</i> Bedd.	P	A
<i>Polyalthia fragrans</i> (Dalzell) Hook. f. & Thomson	P	A
<i>Hydnocarpus pentandra</i> (Buch -Ham.) Oken	P	A
<i>Homonioia riparia</i> Lour.	P	A
<i>Schleichera oleosa</i> (Lour.) Oken	P	P
<i>Lagerstroemia speciosa</i> (L.) Pers.	P	A
* <i>Cinnamomum malabatum</i> (Burm. f.) Presl	P	A
* <i>Hopea glabra</i> Wight & Arn.	P	A
<i>Hopea malabarica</i> Bedd.	P	A
<i>Tetrameles nudiflora</i> R. Br.	P	A
* <i>Holigarna arnottiana</i> Hook.f.	P	P
<i>Diospyros buxifolia</i> (Blume) Hiern	P	A

\*Endemic to Western Ghat

Species	Ambanar	Punnala
<b>Non Myristicaceae trees</b>		
<i>Syzygium gardneri</i> Thw.	P	A
<i>Baccaurea courtallensis</i> (Wight) Müll.Arg.	P	A
<i>Persea macrantha</i> (Nees) Kosterm.	A	P
* <i>Actinodaphne bourdillonii</i> Gamble	A	P
<i>Xylia xylocarpa</i> (Roxb.) Taub.	A	P
* <i>Hydnocarpus laurifolia</i> (Dennst.) Sleum.	A	P
<i>Delonix regia</i> (Hook.) Raf.	A	P
<i>Mitragyna parvifolia</i> (Roxb.) Korth.	A	P
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	A	P
<i>Macaranga peltata</i> (Roxb.) Müll.Arg.	A	P
<i>Grewia tiliaefolia</i> Vahl	A	P
<b>Other vegetation</b>		
<i>Calamus rotang</i> L.	P	A
<i>Pandanus</i> spp.	P	A
Ferns	P	A
<i>Lagenandra ovata</i> (L.) Thwaites	P	A
<i>Cheilocastus speciosus</i> (J. Koenig) C.D. Specht	P	P
<i>Phrynium capitatum</i> Willd	A	P
<i>Carissa carandas</i> L.	A	P
<i>Colocasia esculenta</i> (L.) Schott	A	P

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**First confirmed record of Arabian Gazelle *Gazella arabica* Lichtenstein, 1827 (Mammalia: Artiodactyla: Bovidae) on Masirah Island, off the coast of eastern Oman in the Arabian Sea**  
– Taimur Al Said, Haitham Al Rawahi, Maha Al Ansari, Al Mutasim Al Hinai, Ahmed Al Amri, Ahmed Al Wahaibi, Ghasi Al Farsi, Saud Al Wihibi & Salman Al Farsi, Pp. 24443–24446

**First report of the longhorn beetle, *Rosalia (Eurybatus) formosa* (Saunders, 1839) (Insecta: Coleoptera: Cerambycidae) from Mizoram, India**  
– Amit Rana & Lobeno Mozhui, Pp. 24447–24450

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