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Full Length Article

Phytosociological Studies of two sacred groves in Mahe, U.T. of Puducherry, India

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ABSTRACT

Mahe, a part of the U.T. of Puducherry administration encompasses an area of 9 sq. km. Of the 19 sacred groves present in the region, two major groves i.e. Pandokavu and Sri Chembra Ayyappan Kavu were selected for phytosociological studies. Studies using line transect method revealed higher extent of diversity of major species in Pandokavu with 41 species followed by Chembra Kavu with 20 species. The results of the index of similarity among the two groves were noted to be 0.2622 and with that of dissimilarity were 0.7378. This indicates that the groves under study were more dissimilar with respect to their species composition. In addition to the assessment of floristic diversity, numerical strength of individual species and growth pattern, major threats operating in and around the groves were evaluated and conservation measures proposed.

Keywords: Mahe, Sacred groves, Phytosociological studies, Conservation.

INTRODUCTION

Sacred groves are an ancient means of *in situ* conservation of genetic diversity. They are conserved through social, cultural and environmental values since time immemorial. They play an important role in the conservation of natural resources. Due to the advent of industrialization, urbanization and changing socio-economic scenario, the cultural norms and taboos were annihilated, leading to drastic deterioration of these natural resources. There need to be serious efforts to conserve these groves from further depletion.

Mahe, a province of the Union Territory of Puducherry is occupying a unique geographical position in the west coast of Peninsular India and is approximately 620 kms. away from its administrative headquarters at Puducherry. The region is falling between Kozhikode and Kannur districts of Kerala and is located at 11˚ 42' - 11˚ 43' North latitude and 75˚ 31' - 75˚ 33' East longitude. Mahe comprises of 3 major regions namely Mahe proper, Kallayi and Naluthara enclave. Mahe forms a part of the biodiversity rich Western Ghats, which in turn is one among the hottest of the hotspots of biodiversity. The phytodiversity of various regions in India have been studied by Hari Shankar Lal & Sanjay Singh (2012), Jeetendra Sainkhediya & Sudip Ray (2012) and Mary Suba *et al*. (2014). The documentation of floristic diversity of the region was carried out recently by Sasikala *et al.* (2009), Sasikala & Pradeepkumar (2012) and Sarishna *et al.* (2013).

In Puducherry region, studies on the biodiversity of sacred groves are quite extensive. Around 123 sacred groves have been subjected to in depth studies Kadamban (1998), Ramanujam and Kadamban (1999, 2002), Ramanujam *et al*. (2002), Ramanujam and Cyril (2003), Krishnan (2004), Devaraj *et al*. (2005), Parthasarathy *et al*. (2005) and Ramanujam *et al*. (2007). The studies on the phytodiversity of the sacred groves of Mahe are scanty as compared to Puducherry region. Jisha (2005) documented the phytodiversity of five groves of Mahe.

Sasikala *et al*. (2010-11, 2014) documented the phytodiversity, socio-economic status and conservation and management aspects of selected sacred groves of Mahe region. The present study is an attempt to document the phytodiversity and to analyse the phytosociological relationship of two major sacred groves i.e. Pandokavu and Sri Chembra Ayyappan Kavu of Mahe.

MATERIALS AND METHODS

Regular field trips to the groves were carried out at seasons representing pre monsoon, monsoon and post monsoon. During field visits, plant species were identified, phytosociological studies were carried out and specimens were collected. Plant materials collected were made into herbarium specimens following standard herbarium techniques (Fosberg & Sachet, 1965) and are deposited at Herbarium of the P.G. Department of Plant Science, Mahatma Gandhi Government Arts College, Mahe, for reference. Plant specimens are identified using relevant flora (Nayar *et al*., 2006; Ramachandran & Nair, 1988 and Sasidharan, 2004).

For phytosociological studies of major plants, frequency, density, abundance and thereby Importance Value Index (IVI) of species were worked out using line transect method, as proposed by Curtis (1959). This index is used to determine the overall importance of each species in the community structure. For calculating this index, percentage values of relative frequency, relative density and relative abundance are summed up. The results pertaining to Pandokavu and Chembra Kavu are depicted in Table 1 and 2 respectively. For the estimation of indices of similarity and dissimilarity, the method proposed by Misra (1989) has been used as follows.

Index of similarity (S) = 2C/A+B

Where, A = Number of species in the community A

B = Number of species in the community B

C = Number of common species in both the communities

Index of dissimilarity = 1-S.

RESULTS AND DISCUSSION

Studies on the Phytodiversity and Socio-economic status of the sacred groves of Mahe region, including the present one was worked out by Sasikala *et al*. (2010-11). Of the 19 sacred groves worked out in the region the present groves (Pandokavu and Chembra Ayyappan Kavu) were noted to be rich in species diversity. The present study has been carried out to assess the phytosociological characteristics of the two major groves (**Table 1 and 2**), together with an assessment of the indices of similarity and dissimilarity associated with the groves.

Pandokavu (Ayyappan Kavu, Pandakkal) is situated in Pandakkal, which is 4 km away from Mahe town. It covers an area of 1.2 ha and is reported to be 1200 years old. It lies between 11˚75'82'' North latitude and 75˚53'67'' East longitude. The vegetation is thick with evergreen and semi-evergreen species. A total of 214 species was recorded on enumeration, of which 95 herbs, 28 shrubs, 62 trees and 29 climbers are noted. The common shrubs include *Antidesma montanum*, *Chassalia ophioxyloides* var. *ophioxyloides*, *Flueggea leucopyrus, Ixora coccinea* and *Melastoma malabathricum*. Exotic species such as *Dalbergia sissoides* and *Tectona grandis* have been noted with the natural vegetation. Noxious weeds such as *Acasia caesia, Chromolaena odorata*, *Mikania micrantha* and *Pennisetum polystachyon* are found to dominate in certain areas, which are likely to be a threat to the native species. Pteridophytes include *Bolbitis prolifera, Christella dentata*, *Pteris quadriaurita* and *Stenochlaena palustris*. Macrofungi like *Agaricus* and *Polyporus* are also observed. *Artocarpus hirsutus*, *Holigarna arnottiana*, *Hydnocarpus pentandrus*, *Impatiens minor*, *Ixora malabaricum*, *Jasminum malabaricum*, *Justicia nagpurensis*, *Kamettia caryophyllata* and *Mussaenda bellila* are found to be endemic. *Butea monosperma* was noted only in this grove, which was indicative of the remnants of evergreen forest that must have existed in this area. The species bordering the grove include *Bridelia retusa*, *Connarus monocarpus*, *Ficus heterophylla*, *Hydnocarpus pentandra*, *Kammetia caryophyllata*, *Morinda citrifolia*, *Sterculia guttata* and *Thunbergia fragrans*. Species such as *Dracaena terniflora, Trema orientalis* and *Vitex altissisima* are found to be rare.

Chembra Ayyappan Kavu is situated in Chalakkara village and lies between 11˚72'65'' North latitude, 75˚53'01'' East longitude. The area occupied by the grove is about 1 Acre and is also reported to be about 1200 years old. A total of 87 species was reported from the grove, of which 30 are herbs, 15 shrubs, 28 trees and 14 climbers. The common shrubs include *Chassalia curviflora, Hibiscus hispidissimus, Ixora coccinia, Leea Indica,*

Naregamia alata and *Uvaria narum.* The climbers include *Abrus precatorius, Anamirta cocculus, Cissus repens, Cyclea peltata, Dioscorea bulbifera, Ichnocarpus frutescens, Jasminum angustifolium, Pothos scandens, Smilax zeylanica and Tinospora cordifolia***.** Some of the dominant trees include *Acacia auriculiformis*, *Alstonia scholaris, Anacardium occidentale, Carallia brachiata, Caryota urens, Erythrina variegata, Ficus benghalensis, Macaranga peltata, Vateria indica* and *Zanthoxylum rhetsa***.** *Artocarpus hirsutus, Cissus repens, Globba sessliflora, Holigarna arnottiana, Impatiens minor, Justicia nagpurensis, Mussaenda belila* and *Vateria indica* are found to be endemic. Noxious weeds such as *Chromolena odorata* and *Lantana camara* were found to encroach the borders of the grove. Pteridophytes include *Adiantum philippense, Bolbitis prolifera, Lygodium flexuosum,* and *Stenochlaena palustris*. Bryophytes include *Cyathodium cavernarum* and *Octoblepharum albidum*. This grove is encircled and dominated by woody evergreen species of *Vateria indica* which is not found outside the grove or elsewhere in Mahe. Natural regeneration was observed mainly for *Vateria indica*. The regeneration status of *Vateria indica* is almost 100% because of the viability of seeds.

For assessing frequency, density, abundance and thereby Importance Value Index (IVI) of the species confining to the groves, line transect method has been employed. Studies using line transect method revealed higher extent of diversity of major species in Pandokavu with 41 species followed by Chembra Kavu with 20 species. In Pandokavu, IVI was higher with *Caryota urens* (30.43), which in turn was attributed by higher frequency (100%) density (5.3) and abundance (5.3). In Pandokavu IVI was noted to be lower (2.498) with *Adenanthera pavonia*, *Bridelia retusa*, *Caesalpinia sappan*, *Canthium rheedei*, *Chrysophyllum roxburghii*, *Citrus medica*, *Ficus heterophylla, Hibiscus rosa-sinensis*, *Holigarna arnottiana*, *Ipomoea quamoclit*, *Mikania micrantha, Urena lobata and Uvaria narum.* In Ayyappan Kavu, IVI was higher with *Vateria indica* (92.02), attributed by higher frequency (100%), density (6.85) and abundance (6.85). IVI was found to be lower with *Olea dioica* and *Hyptis suaveolens* (4.1907). Higher IVI with *Vateria indica* can be attributed to the higher rate of growth and over perpetuation of their generations through viable seeds. Similarly results of the index of similarity among the two groves were noted to be 0.2622 and with that of dissimilarity were 0.7378. This indicates that the groves under study were more dissimilar with respect to their species composition.

Though the groves are rich in phytodiversity, they are facing anthropogenic pressures of various sorts. Changes in socio-economic conditions and land use patterns over years threatened both the form and size of the groves. There is considerable change in the nature of vegetation and species composition in both the sacred groves, as being stated by local inhabitants. Destruction of natural resources is evident in both the groves and the reasons can be attributed to the construction of temple complexes within the sacred groves. Weakening of faith and belief on the groves, break up of joint families (Tharavadu system) into nuclear families and lack of man power to manage family sacred groves are the most important threats being faced by the sacred groves of Mahe.

Anthropogenic activities such as construction of roads or rivulets by the municipality and other developmental activities by local authorities lead to shrinkage and change in the extent of grove's vegetation. Increase in demand of land for various developmental activities has become an important aspect for the reduction in size of the grove. The situation is becoming increasingly dreadful as the population density of Mahe is drastically increasing (4659) as against the national average of 411 (2011 census). Apart from anthropogenic pressures, the sacred groves of Mahe are facing biotic pressures mainly from alien invasive species like *Chromolaena odorata*, *Lantana camara*, *Mikania micrantha, Pennisetum polystachion* etc. which are reported to be detrimental to the natural native flora worldwide (Cruz, *et. al*. (2006), Gadi (2011) and Dang *et. al*. (2012).

SUMMARY AND CONCLUSION

The present study is an attempt to assess the diversity and phytosociological associations in two major sacred groves of Mahe, i.e. Pandokavu and Sri Chembra Ayyappan kavu. The results indicate that both the groves exhibit fairly good phytodiversity. However, the diversity is more in Pandokavu as compared to Ayyappan kavu. In Pandokavu, IVI was higher with *Caryota urens* (30.43) and in Ayyappan Kavu, it was higher with *Vateria indica* (92.02).

Table 1 - Results of the Importance Value Index of Pandokavu, Mahe

Sr. No.	Name of species	Frequency	Relative frequency	Density	Relative Density	Abundance	Relative Abundance	IVI
1	*Mimusops elengi*	20	1.379	0.2	0.584	1	1.516	3.480
2	*Acacia caesia*	50	3.448	0.7	2.046	1.4	2.122	7.617
3	*Sarcostigma kleinii*	70	4.827	0.8	2.339	1.142	1.732	8.899
4	*Chassalia curviflora var. ophioxyloides*	90	6.206	4.2	12.280	4.666	7.075	25.563
5	*Antidesma montanum*	80	5.517	3.3	9.649	4.125	6.254	21.420
6	*Adenanthera pavonia*	10	0.689	0.1	0.292	1	1.516	2.498
7	*Sterculia guttata*	20	1.379	0.2	0.584	1	1.516	3.480
8	*Caesalpinia sappan*	10	0.689	0.1	0.292	1	1.516	2.498
9	*Pothos scandens*	60	4.137	0.8	2.339	1.333	2.021	8.498
10	*Canthium rheedei*	10	0.689	0.1	0.292	1	1.516	2.498
11	*Smilax zeylanica*	80	5.517	1	2.923	1.25	1.895	10.33
12	*Jasminium multiflorum*	30	2.068	0.4	1.169	1.333	2.021	5.260
13	*Caryota urens*	100	6.896	5.3	15.497	5.3	8.036	30.429
14	*Leea indica*	100	6.896	4.2	12.280	4.2	6.368	25.545
15	*Stenochlaena palustris*	100	6.896	5.2	15.204	5.2	7.884	29.98
16	*Raphidophora pertusa*	70	4.827	0.7	2.046	1	1.516	8.390
17	*Cissus repens*	50	3.448	0.5	1.461	1	1.516	6.426
18	*Ipomoea quamoclit*	10	0.689	0.1	0.292	1	1.516	2.498
19	*Artrocarpus hirisutus*	10	0.689	0.2	0.584	2	3.032	4.306
20	*Diploclisia glaucescens*	40	2.758	0.5	1.461	1.25	1.895	6.115
21	*Connarus monocarpus*	30	2.068	0.5	1.461	1.666	2.527	6.058
22	*Hibiscus rosa-sinensis*	10	0.689	0.1	0.292	1	1.516	2.498
23	*Maranta arundinacea*	40	2.758	1.1	3.216	2.75	4.169	10.144
24	*Ficus hispida*	30	2.068	0.3	0.877	1	1.516	4.462
25	*Microcos paniculata*	20	1.379	0.3	0.877	1.5	2.274	4.530
26	*Mikania micrantha*	10	0.689	0.1	0.292	1	1.516	2.498
27	*Bridelia retusa*	10	0.689	0.1	0.292	1	1.516	2.498
28	*Macaranga peltata*	20	1.379	0.2	0.584	1	1.516	3.480
29	*Holigarna arnottiana*	10	0.689	0.1	0.292	1	1.516	2.498
30	*Mallotus philippensis*	30	2.068	0.4	1.169	1.333	2.021	5.260
31	*Uvaria narum*	10	0.689	0.1	0.292	1	1.516	2.498
32	*Mussanda bellila*	20	1.379	0.2	0.584	1	1.516	3.480
33	*Chrysophyllum roxburghii*	10	0.689	0.1	0.292	1	1.516	2.498
34	*Morinda citrifolia*	40	2.758	0.4	1.169	1	1.516	5.444
35	*Zizyphus oenoplia*	50	3.448	0.5	1.461	1	1.516	6.426
36	*Cryptocoryne spiralis*	30	2.068	0.3	0.877	1	1.516	4.462
37	*Citrus medica*	10	0.689	0.1	0.292	1	1.516	2.498
38	*Triumfetta rhomboidea*	20	1.379	0.2	0.584	1	1.516	3.480
39	*Melastoma malabathricum*	20	1.379	0.3	0.877	1.5	2.274	4.530
40	*Ficus heterophylla*	10	0.689	0.1	0.292	1	1.516	2.498
41	*Urena lobata*	10	0.689	0.1	0.292	1	1.516	2.498

Table 2 - Results of the Importance Value Index of ChembraKavu, Mahe.

Sl. No	Name of species	Frequency	Relative frequency	Density	Relative density	Abundance	Relative abundance	IVI
1	*Caryota urens*	30	6.896	0.35	2.592	1.16	3.116	12.6
2	*Vateria indica*	100	22.988	6.85	50.740	6.85	18.296	92.02
3	*Olea dioica*	5	1.149	0.05	0.370	1	2.670	4.19
4	*Antidesma montanum*	80	18.390	1.9	14.074	2.37	6.343	38.80
5	*Mimusops elengi*	5	1.149	0.05	0.370	1	2.670	4.19
6	*Chassalia curviflora var. ophioxyloides*	35	8.045	0.45	3.333	1.28	3.434	14.81
7	*Holigarna arnottiana*	15	3.448	0.2	1.481	1.33	3.561	8.49
8	*Microcos paniculata*	10	2.298	0.1	0.740	1	2.670	5.71
9	*Anamirta cocculus*	15	3.448	0.15	1.111	1	2.670	7.23
10	*Mallotus philippensis*	10	2.298	0.1	0.740	1	2.670	5.71
11	*Acacia auriculiformis*	15	3.448	0.2	1.481	1.33	3.561	8.49
12	*Leea indica*	15	3.448	0.4	2.962	2.66	7.122	13.53
13	*Adenanthera pavonia*	10	2.298	0.1	0.740	1	2.670	5.71
14	*Areca catechu*	5	1.149	0.1	0.740	2	5.341	7.23
15	*Carallia brachiata*	25	5.747	0.25	1.851	1	2.670	10.26
16	*Mangifera indica*	5	1.149	0.05	0.370	1	2.670	4.19
17	*Mussaenda bellila*	10	2.298	0.1	0.740	1	2.670	5.71
18	*Chromolena odorata*	35	8.045977	1.9	14.07407	5.42	14.49966	36.61
19	*Hyptis suaveolens*	5	1.149425	0.05	0.37037	1	2.670991	4.19
20	*Anacardium occidentale*	5	1.149425	0.15	1.111111	3	8.012972	10.27

This is mainly due to the fact that the latter exhibit the dominance of a single species i.e. *Vateria indica*. Endemic species such as *Hydnocarpus pentandrus*, *Ixora malabaricum*, *Jasminum malabaricum and Kamettia caryophyllata* are found only in Pandokavu where as *Globba sessliflora* and *Vateria indica* are restricted to Sri Chembra Ayyappan Kavu. Results of the index of similarity among the two groves were noted to be 0.2622 and with that of dissimilarity were 0.7378, which indicates that the groves under study were more dissimilar with respect to their species composition.

These groves are abode of various floristic elements and necessary efforts need to be taken to protect the sacred groves to prevent the loss of biodiversity. In addition regular monitoring is required to evaluate the loss of diversity. The protection of the groves and conservation of their valuable biodiversity and cultural diversity can be achieved through people's participation only. The stake holders of the groves may be provided substantial incentives for the same.

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