

Phytosociological studies on kizhakkum kavu bhagavathi kottam: A sacred grove, Kannur district, Kerala

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Abstract

Groves contains natural forest and also rich in biodiversity. They are protected by local communities because of their deities linked with these forest patches. The present study was conducted in Kizhakkum kavu Bhagavathi kottam, a sacred grove of Kannur district to know the plant diversity and their structural parameters. Floristic composition of Kizhakkum kavu Bhagavathi kottam sacred grove revealed that the occurrence of 78 species of angiosperms belonged to 75 genus and 45 families. Among them 75 plants, 72 are angiosperm, 5 were pteridophytes, and a single gymnosperm. The parameters like frequency, relative frequency, density, relative density and importance value index were estimated by using standard procedures. *Strychnos nux-vomica* was recorded as the most dominant species in the community as it constituted highest IVI.

Keywords: sacred grove, plant diversity, dominant, frequency, importance value index

1. Introduction

Sacred groves are small patches (from less than a hectare to up to few km²) of native vegetation types traditionally protected and managed by the local communities, though a wide range of management practices are possible (Ramakrishnan, 1997) [12]. Sacred groves act as abodes of gods, protected by local communities, exist all over the world. These are known as “Kavu” or “Sarpakavu” in Kerala. These have immense value from genetic diversity as well as ecological point of view and rich in flora. They are the repository of several medicinal and economically important plants. Attached with socio-cultural and religious sentiments these exist as undisturbed islands. But today these are adversely affected by human activities. These sacred groves are protected usually through taboos and sanctions with cultural and ecological implications. These Sacred Groves are reported to provide all the ecosystem Services like Provisioning, Supporting, Regulation, and Cultural. These Groves also improve soil fertility and are recorded to be good carbon sinks. There are more than 2000 sacred groves occur in Kerala (Pushpangadan *et al.*, 1998) [10]. These acts as treasure houses of plants and animals and can satisfy scientific, cultural and aesthetic needs of mankind. In Kerala groves are mainly dedicated to Serpant gods and Folk deities. Many threatened species existed in the sacred groves of Kerala (Nair and Mohanan, 1981) [9] and it preserving unique species of plants, insects and animals therefore it acts as a tool for biodiversity conservation (Venkatachalam *et al.*, 2005) [17].

2. Materials and Methods

Study Area

The study area is concentrated in Kannur district, which is located in northern part of Kerala (Fig-1). Kizhakkum Kavu Bhagavathi Kottam is a famous Hindu temple is situated at called Chekkikulam, Mayyil which is about 16 km from Kannur town. Chekkikulam lies between 11.9497622° N latitude and 75.4528847° E longitude. The climate is very hot and humid with maximum and minimum temperature ranging from 26°C to 30°C. The total annual rainfall is 3438 mm. This grove is spread about 2 acres. There is a beautiful pond in front of the kottam.



Fig 1: Study area: Kizhakkumkavu Bhagavathi Kottam, Mayyil, Kannur

Kizhakkum Kavu is the worship of Bhagavathi. This kavu is associated with Parvathi and Subrahmaniya temples and this area is surrounded by wetland, paddy field and marshy areas. Near this Kavu there is one Bhootha thara which is associated with story of Parvathi. This Kavu is saved from destruction by the local people. Thottam paattu and Bhagavathi theyyam are the ritual forms associated with the festival.

Floristic Survey

Field surveys were carried out to know their exact location, extent, presiding deity etc. Whenever any sacred groves visited the neighbouring people and temple worshippers were interviewed to confirm the above facts and also to elicit information about the presence other groves in the vicinity. The extent each grove was ascertained by discussion with local people and latter confirmed with temple records. Plants are identified with the help of Madras Presidency (Gamble, 1915-1936) [5], Flora of Cannanore (Ramachandran and Nair, 1988) [11] and also by using available field keys and taxonomic bulletins. The identification was further confirmed with the help of taxonomic experts in Botany.

Phytosociological Analysis

The minimum quadrat size of 1 x 1 was fixed by the species-area curved method of phytosociological observations. Each

time 20 quadrats were laid by the randomized method in each site. The minimum number of quadrat required (ie. 20) was determined as described by Greig – Smith (1974).

The number and type of each species occurring in each quadrat were recorded. For grasses, each tiller was counted as an individual because it is impossible to decide from aerial shoots whether it is separated or connected in the subterranean region, especially in perennial grasses. Different workers have used arbitrary units to represent individual. Armstrong (1907) [1] and Stapledon (1913) have counted the entire individuals as far as possible in the case of erect plants, but in creeping grasses each grasses each rooting units has taken as an individual. Stove and Fryer (1935) [15] have considered an independent root system, as nearly as this could be determined without actually lifting the plant, to be a unit for counting. In the case of creeping plants, any portion of the plant upto 5 cm in length and having functional root was counted as one plant. Only the plants beyond seedling stage (ie. more than 2 cm height in case of monocots and beyond first leaf stage in dicots) were counted. The basal areas at the point of emergence for the constituent species were measured. From the observations, the quantitative characters such as frequency, density, abundance, relative frequency, relative density, relative dominance, importance value index and relative value of importance were calculated (Shukla and Chandel, 1982; Misra, 1980) [14, 7, 8].

Frequency, density and abundance were calculated using the following formulae:

$$\text{Frequency} = \frac{\text{Number of quadrats in which the species present}}{\text{Total number of quadrats studied}} \times 100$$

$$\text{Density} = \frac{\text{Total number of individuals of the species in all quadrats}}{\text{Total number of quadrats studied}}$$

$$\text{Basal area} = \Pi r^2$$

($\Pi = 3.14$ and 'r' is the radius of the stem at the point of emergence.)

Relative frequency, relative density and relative dominance were calculated from the following formulae:

$$\text{Relative Frequency} = \frac{\text{Number of occurrence of the species}}{\text{Number of occurrence of all species}} \times 100$$

$$\text{Relative density} = \frac{\text{Number of individuals of the species}}{\text{Number of individuals of all species}} \times 100$$

$$\text{Relative dominance} = \frac{\text{Total basal area of the species}}{\text{Total basal area of all species}} \times 100$$

$$\text{IVI} = \text{RD} + \text{RF} + \text{RDo}$$

$$\text{RIVI} = \text{IVI} / 3$$

Result and Discussion

Present study on the ethnobotanical and sociological attributes of various plant species was carried out in sacred grove, Kizhakkum Kavu Bhagavathi Kottam, Kannur district, Kerala. Man's belief in supernatural forces can be traced back to time immemorial. Behind each belief we can find stories connecting it with the purpose of pleasing someone or the fear of something. Although the sacred groves are protected by social taboos, they are not immune to anthropogenic influences like developmental activities, grazing, poaching, weed invasion, collection of wood and timber etc. The present work revealed that sacred groves act as a gene pool or preservation plots and many of them harbour rare, endemic, endangered and economically and ethno medicinally very important plants because of the restraints exercised due to the fear of deities/spirits residing in these groves. The most of the groves of present study were small in size. Neglecting the smaller groves will lead to the disappearance of both vegetation and cultural diversity (Sujana and Sivaperuman, 2008) [16].

Phytosociological analysis of a plant community is the first and foremost basis of the study of any piece of vegetation as it is a pre-requisite for the understanding of community structure and organization. For understanding the community structure and organization, species composition is foremost requisite. Species composition is one of the major characters of plant community (Dansereau, 1960) [3]. During the study in the sacred grove a total of 78 vascular plants falling under 75 genera and 45 families were documented. Out of which, the angiosperms dominate with 72 members, while 5 were peridophytes and *Gnetum ula* the lone Gymnosperm. With respect to their habit, there are 27 herbs, 19 shrubs, 16 trees, 14 climbers, 1 woody climber and 1 epiphyte. Among angiosperms dicots comprises 34 families 59 genera and 62 species while monocot 5 families 11 genera and 11 species. The relative proportion of dicot with monocot species are shown in Table 1. The dominant families are Poaceae, Rubiaceae, Fabaceae, Acanthaceae and Asteraceae with 6,6,6,5 and 4 species respectively. It may be explained that the sacred groves are rich collection of conserved medicinal plants (Vinothkumar *et al.*, 2011) [18]. The uses of species for diverse medicinal purposes show the production of different kinds of secondary metabolites with rich varieties of bioactive compounds in the study sites.

Table 1: Vascular flora of Kizhakkum Bhagavathi Kottam, Chekkikulam, Kannur.

S. No	Species	Family	Habit	Medicinal/food/endangered	Common name
1	<i>Abrus precatorius</i> L.	Fabaceae	Climber	Traditional medicine	Kunnikuru
2	<i>Abrus pulchillus</i> Wall.	Fabaceae	Climber	Medicinal	Kunnikuru
3	<i>Acanthus ilicifolius</i> L.	Acanthaceae	Shrub	Medicinal	Vayal chulli
4	<i>Adiantum lunulatum</i> Burm. f.	Adiantaceae	Herb	Medicinal ornamental	Maidenhair Fern
5	<i>Ampelocissus latifolia</i> (Roxb.)	Vitaceae	Climber	Medicinal	Wild grape
6	<i>Anamirta cocculus</i> (L.) Wight & Arn.	Menispermaceae	Climber	Medicinal	Fish Berry
7	<i>Ancistrocladus heyneanus</i> Wall.ex J.Graham	Ancistrocladaceae	Climber	Nearly endemic & Medicinal	Modira-valli
8	<i>Areca catechu</i> L.	Arecaceae	Tree	Seed crop and Medicinal	Adakka
9	<i>Artocarpus heterophyllus</i> Lam.	Moraceae	Tree	Medicinal & food	Jack fruit
10	<i>Axonopus compressus</i> (Sw.) P.Beauv.	Poaceae	Herb	Erosion control	Blanket grass
11	<i>Bryophyllum pinnatum</i> (Lam.)Oken	Crassulaceae	Shrub	Medicinal & garden plant	Life plant
12	<i>Canthium coromandelicum</i> (Burm.f.) Alston	Rubiaceae	Shrub	Functional food	Coromandel
13	<i>Caryota urens</i> L.	Arecaceae	Tree	Ornamental tree & food (baster beer)	Choondappana
14	<i>Centella asiatica</i> (L.)	Apiaceae	Herb	Threatened Medicine & used in drinks	Centella

15	<i>Chassalia curviflora</i> (Wallich)	Rubiaceae	Shrub	Medicinal	Karutha-amalppori
16	<i>Clerodendrum vicosum</i> Vent.	Verbinaceae	Shrub	Ornamental plant	Bleeding heart vine
17	<i>Costus speciosus</i> Koen ex. Retz.	Zingiberaceae	Herb	Medicinal	Narum canna, Cannakkuvva, Cannukkilannu
18	<i>Cyclea peltata</i> L.	Menispermaceae	Climber	Medicinal	Padathaali
19	<i>Dactyloctenium aegypticum</i> (L.) Willd.	Poaceae	Herb	Medicinal	Crowfoot
20	<i>Dendrophthoe falcata</i> (L.f)	Loranthaceae	Sub shrub	Medicinal	Bara Manda
21	<i>Desmodium triflorum</i> (L.)DC.	Fabaceae	Herb	Medicinal	Nilam paranda
22	<i>Digitaria bicornis</i> (Lam.) Roem. & Schult.	Poaceae	Herb	Medicinal	Crabgrass
23	<i>Drynaria quercifolia</i> (Linn.) J. Smith.	Polypodiaceae	Epiphyte	Endangered & Medicinal	Basket fern
24	<i>Elephantopus scaber</i> Linn.	Asteraceae	Herb	Medicinal & Ornamental plant	Anachuvadi
25	<i>Ervatamia heyneana</i> (Wall.)	Apocynaceae	Tree	Endangered & Medicinal	Nag Kuda
26	<i>Euodia lunu-ankenda</i> (Gaertn.)	Rutaceae	Tree	Endangered & Medicinal	Kaneli
27	<i>Eupatorium perfoliatum</i> L.	Asteraceae	Shrub	Traditional medicine & larval food	American boneset
28	<i>Evolvulus nummularius</i> L.	Convolvulaceae	Herb	Medicinal	Musakarni
29	<i>Ficus microcarpa</i> L.f.	Moraceae	Tree	Indoor bonsai & medicinal	Chinese banyan/Indian laurel
30	<i>Glycosmis pentaphylla</i> (Retz).	Rutaceae	Shrub	Medicinal	Kurumpannal /Orange berry
31	<i>Gnetum ula</i> L.	Gnetaceae	Woody climber	Endangered & medicinal	Odal
32	<i>Hibiscus surattensis</i> Linn.	Malvaceae	Shrub	Medicine & ornamental	Bush Sorrel
33	<i>Ixora coccinea</i> L.	Rubiaceae	Shrub	Medicinal	Chekki
34	<i>Ixora leucantha</i> B.Heyne ex G.Don	Rubiaceae	Shrub	Least concerned & Medicinal	Chekki
35	<i>Jasminum malabaricum</i> Wight	Oleaceae	Climber	Endangered & Medicinal	Pichii
36	<i>Justicia japonica</i> Thunb., Fl. Jap.	Acanthaceae	Herb	Medicinal	Brazilian Plume
37	<i>Justicia simplex</i> L.	Acanthaceae.	Herb	Medicinal	Pink plume
38	<i>Kyllinga nemoralis</i> L.	Cyperaceae	Herb	Medicinal	White-flowered kyllinga
39	<i>Lantana camara</i> L.	Verbeneceae	Shrub	Herbal medicine	Aripoo
40	<i>Leea indica</i> (Burm.f.)	Leeaceae	Shrub	Medicinal	Bandicoot berry
41	<i>Lindernia crustacea</i> (L.) F.Muell.	Scrophularaceae	Herb	Medicinal	Hard slitwort
42	<i>Ludwigia hyssoipifolia</i> (G.Don) Exell	Onagraceae	Herb	Medicinal	Water primrose
43	<i>Lygodium flexuosum</i> Linn.	Lygodiaceae	Climber	Herbal medicine	Maidenhair creeper
44	<i>Macaranga peltata</i> Roxb. Mueller	Euphorbiaceae	Tree	Medicinal	Uppila
45	<i>Mallotus philippensis</i> (Lam.) Muell.Arg.	Euphorbiaceae	Tree	Medicinal	Kamala Tree
46	<i>Mangifera indica</i> L.	Anacardiaceae	Tree	Medicinal and edible	Mavu
47	<i>Melastoma malabathricum</i> L.	Melastomaceae	Shrub	Medicinal	Indian-rhododendron
48	<i>Merremia umbellata</i> (Linn.)	Convolvulaceae	Herb	Medicinal	Prasarini.
49	<i>Mikania micrantha</i> Kunth	Asteraceae	Climber	Medicinal	Dhrudharashra pacha
50	<i>Mimosa pudica</i> L.	Fabaceae	Herb	Medicinal	Thottavadi
51	<i>Mimusops elengi</i> L.	Sapotaceae	Tree	Medicinal	Elangi
52	<i>Mukia maderaspatana</i> (L.)	Cucurbitaceae	Climber	Medicinal	Kurukkan vellari
53	<i>Murraya koenigii</i> (L.)	Rutaceae	Tree	Medicinal	Kariveppila
54	<i>Naregamia alata</i> Wight & Arn.	Meliaceae	Herb	Endangered & Medicinal	Nelanarium
55	<i>Nephrolepis cordifolia</i> (L.)	Nephrolepidaceae	Herb	Fertilizer and ornamental	Sword fern
56	<i>Ochlandra travancorica</i> Benth. ex Gamble	Poaceae	Shrub	Endangered & Commercial	Bamboo
57	<i>Olea dioica</i> Roxb	Oleaceae	Tree	Medicinal	Karivetti
58	<i>Panicum repens</i> L.	Poaceae	Herb	Fodder	Torpedograss
59	<i>Pavelta indica</i> L.	Rubiaceae	Shrub	Herbal medicine	Papata
60	<i>Pennisetum polystachion</i> (L.) Schult.	Poaceae	Herb	Landscaping	Napiergrass
61	<i>Phaulopsis imbricata</i> (Forssk.)	Acanthaceae	Herb	Fodder	Umhloniyane
62	<i>Piper trioicum</i> L.	Piperaceae	Climber	Medicinal	Kerumulakku
63	<i>Plumbago zeylanica</i> L.	Plumbaginaceae	Shrub	Endangered & Medicinal	Vellakkoduveli
64	<i>Pogostemon patchouli</i> (Pill.)	Lamiaceae	Herb	Medicinal	Patchouli
65	<i>Pongamia pinnata</i> (L.)	Fabaceae	Tree	Medicinal	Pongam Tree
66	<i>Pothos scandens</i> L.	Araceae	Climber	Medicinal	Anaparua
67	<i>Rungia pectinata</i> (L.)	Acanthaceae	Herb	Medicinal	Punakapundu
68	<i>Santalum album</i> L.	Santalaceae	Tree	Endangered & medicinal and commercial	chandanum
69	<i>Saraca indica</i> L.	Fabaceae	Tree	Vulnerable & Medicinal	Asoka
70	<i>Sarcostigma kleinii</i> Wight & Arn.	Icacinaceae	Climber	Medicinal	Vellodal
71	<i>Selaginella delicatula</i> (Desy. Ex Poir) Alston	Selaginellaceae	Herb	Medicinal	Cheevothi
72	<i>Sida acuta</i> Burm.f.	Malvaceae	Shrub	Medicinal	Kurumthotti
73	<i>Spermacoce latifolia</i> Aubl.	Rubiaceae	Herb	Medicinal	Buttonweed
74	<i>Strychnos nux-vomica</i> L.	Loganiaceae	Tree	Medicinal	Kanjiram
75	<i>Torenia bicolor</i> Dalz.	Scrophulariaceae	Herb	Medicinal	Clown Flower
76	<i>Uvaria narum</i> Wall.	Annonaceae	Shrub	Medicinal	Narumpanal
77	<i>Verninia cinerea</i> (L.)	Asteraceae	Herb	Medicinal	Poovam kurumthala
78	<i>Wattakakka volubilis</i> (L.f.)Stapf	Asclepidaceae	Climber	Medicinal	Titakunga

During our present study we analyzed that there are about 13 red listed species at Kizhakkum Kavu Bhagavathi Kottam. The least concerned species in there is *Ixora leucantha*. Bhagwat *et al.*, (2005) [2] said that the sacred groves are the last home of some endangered species and also are known to represent the

only existing climax vegetation communities in Northeastern India. But the area under sacred groves is fast depleting due to the interplay of an array of factors. Sacred groves originally maintained in the form of untouched ecosystems dedicated to the deity are looked as a source of revenue. Role of sacred

groves in maintenance of biodiversity is undoubtedly significant. It is very important therefore refresh this traditional establishment and its further conservation (Sujana and Sivaperuman, 2008) [16]. The plants in endangered category in this area includes *Drynaria quercifolia*, *Ervatamia heyneana*, *Euodia lunu-ankenda*, *Gnetum ula*, *Jasminum malabaricum*,

Naregamia alata, *Ochlandra travancorica*, *Plumbago zeylanica* and *Santalum album*. *Ancistrocladus heyneanus* is the only one species belong to nearly endemic category, *Centella asiatica* belong to the threatened and *Saraca indica* is coming under vulnerable category (Table 2).

Table 2: Red listed plants at Kizhakkum Kavu Bhagavathi Kottam.

S. No	Species	Status
1	<i>Ancistrocladus heyneanus</i> Wall.ex J.Graham	Nearly endemic & endangerd
2	<i>Centella asiatica</i> (L.)	Threatened
3	<i>Drynaria quercifolia</i> (L.) J. Sm.	Endangered
4	<i>Ervatamia heyneana</i> (Wall.)	Endangered
5	<i>Euodia lunu-ankenda</i> (Gaertn.)	Endangered
6	<i>Gnetum ula</i> L.	Endangered
7	<i>Ixora leucantha</i> B.Heyne ex G.Don	Least concerned
8	<i>Jasminum malabaricum</i> Wight	Endangered
9	<i>Naregamia alata</i> Wight & Arn.	Endangered
10	<i>Ochlandra travancorica</i> Benth. ex Gamble	Endangered
11	<i>Plumbago zeylanica</i> L.	Endangered
12	<i>Santalum album</i> L.	Endangered
13	<i>Saraca indica</i> L.	Vulnerable

The quantitative ecological characters such as frequency, abundance, density and basal cover and synthetic characters such as relative frequency, relative density, relative dominance, importance value index and relative value of importance for all the study species present in Kizhakkum Kavu Bhagavathi Kottam is given in Table 1.

In Kizhakkum Kavu Bhagavathi Kottam, *Caryota urens*, *Ludwigia hyssopifolia*, *Strychnos nux-vomica* and *Uvaria narum* shows higher frequency value. According to Misra (1980) [7, 8] this may be attributed to their high reproductive capacity, quick dispersal of seeds and wind pollination to produce viable seeds. Due to the lacking of these attributes, the other constituent species may show poor distribution. These species may be less disturbed in the sacred groves may be due to the social and religious believes of people (Kulkarni and Shindikar, 2005) [6]. Their existence is also due to certain taboos, strong and supplemented mystic folklore (Gadgil and Vartak, 1975) [4]. Lowest frequency was shown by 59 species in this Kavau.

Justicia simplex, *Spermacoce latifolia*, *Centella asiatica* and *Strychnos nux-vomica* were present abundantly in Kizhakkum Kavau Bhagavathi Kottam. Lowest abundance is shown by 32 species. *Justicia simplex*, *Strychnos nux-vomica* and *Spermacoce latifolia* have higher density and 27 species represent lowest density in this area.

Based on the basal cover, *Anamirta cocculus* have got a highest basal cover of 2808 mm²/m. *Cryota urens*, *Justicia simplex* and *Anamirta cocculus* were shown highest Relative frequency, Relative density and Relative basal cover respectively.

In this study area, *Anamirta cocculus* also securing highest IVI of 26.44 like other species like *Strychnos nux-vomica* and *Justicia simplex*. In this site lowest IVI was shown by *Adiantum lunulatum*, *Ampelocissus latifolia*, *Bryophyllum pinnatum*, *Canthium coromandelicum*, *Costus speciosus*, *Euodia lunu-ankenda*, *Evolvulus nummularius*, *Ixora coccinea*, *Ixora leucantha*, *Jasminum malabaricum*, *Lantana camara*, *Leea indica*, *Lindernia crustacean*, *Merremia tridentate*, *Mukia maderaspatana*, *Murraya koenigii*, *Paveta indica*, *Piper trioicum*, *Plumbago zeylanica*, *Pongamia pinnata*, *Pothos*

scandens, *Rungia pectinata*, *Sarcostigma kleinii* and *Wattakakka volubilis*. Based on the IVI score made by these species, it is understood that these are poorly established species in the communities of studied site of sacred groves. Due to endemism, over exploitation, shifting cultivation and other socio economic activities the sacred groves are under threat. Therefore, there is urgent need for conservation and protection of sacred groves before it becomes completely disappear (Sambandan and Dhatchanamoorthy, 2012) [13].

It is suggested that the studied sacred grove, Kizhakkum Kavau Bhagavathi Kottam must be given conservation priority to protect valuable endangered medicinal species. Despite the seasonal changes, the anthropogenic were determined to be most influencing factor to affect the species composition and the quantitative ecological attributes of many sensitive species. Therefore construction activities, over grazing, collection of fire wood, tress passing, dumping of waste and many antisocial elements must be checked so as to protect the species in their habitats. Further, ecosystem- specific management plans must be developed to protect the individual species in these sacred groves. Protection of such activities aid in the regulation of ecological process like energy flow, food chain and food web and cycling of materials which would result in ecological balance and stability of ecosystem.

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