



# COMPARATIVE STUDY OF BRYOFLORA FROM SELECTED SACRED GROVES OF KANNUR, KERALA, INDIA

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**Abstract:** Sacred groves are the storehouse of rare and endemic species & maintain several ecological functions. This paper enumerates the bryophyte diversity of two sacred groves of Kannur district. Collection were made before and after the monsoon. Around 18 species were collected from the sacred groves and 6 species were common in both sites. Among the collected specimens 8 belongs to liverwort, 2 were hornwort and 8 mosses. This study has added 4 species to the flora of Kannur district and one species to the flora of Kerala. Further investigation on ecological aspects of these plants are also recommended. Since the area was not well explored, it helps to thrive light on future studies on the bryophytes in the district, Kannur.

**Index Terms -** Sacred groves, bryophyte, ecological aspects.

## I. INTRODUCTION

Sacred groves are reserve forests of the local or rural communities who conserve these patches of vegetation in a religious faith. These groves act as 'natural vegetation preserve' and serve as an example of habitat preservation through community participation. Every sacred grove carries its own legends, lores and myths which form the integral part of the sacred grove. They are traditionally conserved as a part of natural worship and these practices have played an important role in protection of biodiversity (Bhagawat et.al.,2005). Sacred groves are the storehouses of rare and endemic species. Despite the fact that many sacred groves are still well preserved, many have also been destroyed and others are now threatened by anthropogenic activities. A number of studies have been conducted on the floristic diversity and ecological aspects of sacred groves of Southern India such as Gadgil (1987), Chandran and Hughes (1998), Godbole (1996), etc.

The sacred grove performs several ecological functions, which directly or indirectly helps the ecosystem to maintain its stability. It provide a moist atmosphere which favours the growth of bryophyte. At the same time bryophytes protect the soil against erosion due to their netted and webbed protonemata and gametophores to cover the exposed substrata and help in increasing water-holding capacity as well as plays an important role in nutrient cycling. They also act as pollution indicator. Though the urgent need to study the bryoflora is felt by the scientific community, absence of enough literature and guidelines remain a sporadic one. There was only a single report on the bryophytes of sacred groves in Kerala (Jyothilakshmi et.al.,2016). The present study was an attempt to compare diversity of bryophytes in Madayi kavu (laterite) and Konginichal kavu (tropical) of Kannur district.

## II. STUDY AREA

Both the sacred groves are located in Kannur district of Kerala (Fig 1. Map), well known for their rituals and tradition. Madayi kavu, about 4000 years old, mid-land laterite sacred grove also known as Thiruvarkadu Bhagavathi temple) the famous Hindu temple is situated in Madayi Village of Payangadi Panchayath (Fig2). The Kavu has an area of 6.0705 acres it is situated as a patch of forest in "Madayi para". Bhadrakali (Devi) is the deity worshipped here. There was a significant change in flora diversity of this kavu and Madayi para as a part of anthropogenic activities. Konginichal kavu, a tropical sacred grove, about 3.2578 acres and was situated in Kankol-Alappadamba panchayath (Fig.3). Here also the main deity was Devi, and yearly they celebrate the festival on February month. Kavu has an associated pond and also a small stream of lake. The grove was well protected and also rich in flora. The diversity study of the kavu was not well explored till now.



### III. MATERIALS AND METHOD

Periodic explorations from June 2019 to February 2020 were carried out, particularly during and after the monsoon showers, so as to collect fertile specimens. Details on the occurrence, habit, habitat and host plants, wherever possible, were noted. Three major substrates viz. Soil, rock and wood were classified as micro habitats. Wood substrate includes tree trunks, branches and twigs, logs and stumps, the bryophytes were collected from all these microhabitats. Plants growing firmly adhered to their substrata were scraped with the help of a knife or cut along with the substratum with a chisel. Any adhering extraneous material was washed off with care, without damaging the reproductive structures particularly in hepatics. Zipper bags (5x7 inch size) were used for keeping the collections and were stored in a refrigerator. Refrigerating them helped to keep them fresh for at least a couple of months. Plants were not pressed when they were being dried because such pressure can often rupture sporophytes and destroy some of their critical morphological features. Photographs were taken whenever necessary to show their habit and habitat using a Nikon digital camera. Morphological characters were studied using Leica stereo microscope anatomical studies were carried out using Magnus camera. Identification was made with the help of Gangulee's Mosses of Eastern India and Adjacent Regions (1969 - 1980) and other related works. Materials that could not be determined were referred to experts. The collected specimens were deposited in the Sir Syed college herbarium.

### IV. RESULTS AND DISCUSSION

Both the sacred groves were flourished with rich bryoflora. This was the pioneer work describing and identifying bryophyte diversity. A total of 18 species collected from both area and 6 species are common in both sites (**Table 1**). Among the collected specimens 8 belong to liverwort, 2 were hornwort and 8 were mosses. Diversity was high in Madayi kavu when compared to that of Konginichal kavu. Out of the collected specimens 4 species was added to the flora of Kannur district and 1 species added to the flora of Kerala. Most widely distributed species among the study site were *Cyathodium cavernarum*, *Barbula indica*, *Hyophila involuta* and *Bryum coronatum* (**Fig.4**).

#### List of Identified Bryoflora:

##### MARCHANTIOPHYTA (LIVERWORTS)

##### LEJEUNEACEAE

*Cheilolejeunea intertexta* (Lindenb.) Steph., It was seen on rocky patches of Madayi kavu. It spreads around an area of 3 cm on rock. The thallus is strongly adhered to the surface and is very delicate. Small piece of rock having the thallus is collected and determined from the laboratory. It is mainly distributed in South India (Kerala, Tamil Nadu), Andaman & Nicobar Islands, Sri Lanka, Java, Japan, Malaya, Philippines, Samoa, Sumatra and Tahiti.

\**Cheilolejeunea serpentina* (Mitt.) Mizut.; Epiphytic on bark of the tree. Collected from Madayi kavu, thallus is pale green in colour, have lobule like leaf structure which is branched and covers an area about 3.6 cm. Distributed in Kerala (Wayanad, Kozhikode, Idukki); Eastern Himalaya (Meghalaya: East Khasi Hills; West Khasi Hills). This is new record to Kannur flora.

\**Cololejeunea lanciloba* Steph.; Epiphyllous, leafy thallus is closely appressed to the angiosperm leaf surface. Collected from Konginichal kavu. It is distributed in India (Kerala-Kozhikode), Nicobar Islands; Japan, China, Borneo, Philippines, Hawaii, Java, Malaya, Bangladesh, Thailand, Cambodia, Indonesia, Malaysia, Polynesia, New Caledonia, Australia and Africa. This is new record to Kannur flora.

*Cololejeunea latilobula* (Herzog) Tixier, Bryophyt. Biblioth. Found only on the leaves of *Mangifera indica*, collected from Madayi kavu. Covers an area about 2.4 cm on leaf. Thallus arranged as a rosette. It is palaeotropic species which is distributed from Africa to China and Vietnam and Fiji Islands, widespread in India.

\*\**Mastigolejeunearepleta* (Taylor) A. Evans; It was found on bark of *Plumeria* tree collected from Konginichal kavu. Widely spread on the bark of tree which covers about 10.6 cm. Thallus is olive green to brownish green in colour and is about 1-2 cm long. Widely distributed in South and South-East Asia, New Guinea, India; Eastern Himalaya and Western Ghats of Tamil Nadu. This is a new record to the flora of Kerala and Kannur.

##### TARGIONIACEAE

*Cyathodium cavernarum* Kunze; It is the most common and widely seen species, found on both sacred groves. The main habitat include soil cuttings and on concrete walls. Thallus is very delicate and bright yellowish green in colour. It is distributed in Peninsular India (Kerala, Gujarat); Central India (Maharashtra, Madhya Pradesh, Rajasthan); North-East India (Uttaranchal, Uttar Pradesh, West Bengal); Cuba, Africa, Indonesia, Mexico and America (**Fig.6**).

##### RICCIACEAE

*Riccia billardieri* Mont. & Nees; collected from both sacred groves, this is the most common species of riccia found. Thallus deep green, dichotomously branched, 1-2 furcate; 0.5-1 cm long, about 2 mm broad, ventral surface with prominent purple scales along the margin. Mainly seen on moist-soil, pebbles and stones (**Fig.5**). Distributed in India (Western Himalaya: Uttarakhand; Eastern Himalaya: West Bengal-hills, Assam; Punjab & West Rajasthan: Rajasthan; Central India: Madhya Pradesh; Gangetic Plains: Uttar Pradesh, Bihar, West Bengal-plains; Western Ghats: Maharashtra, Karnataka; Andaman & Nicobar: Andaman Island), Pakistan, Sri Lanka, Indonesia.

***Riccia gangetica* Ahmad;** Found in moist soil patches inside the Madayi kavu where waterfalls every day after the diety pooja. Tallus is dark green, dichotomously branched, 1-2 furcate; thalli oblong to oblong-obovate, 0.3-0.9 cm long, 2-3 mm broad; ventral surface with small, purple, semilunate scales along the margin. It is distributed in India: Kerala, Eastern Himalayas; Meghalaya, East Khasi Hills and Shillong.

## **ANTHOCEROTOPHYTA (Hornworts)**

### **ANTHOCEROTACEA**

\****Anthoceros subtilis* Steph.**, Largely spread on mud walls of Konginichal kavu, thallus found overlapping, crenulate to deeply dissected at margin, with around 2-3cm long sporophyte, cells with single, irregularly rounded chloroplast and a central, dark pyrenoid region; mucilage cavities 1-3 layered in cross section. The species is distributed in Vietnam and India: Gujarat and W. Ghats of Kamataka, Maharashtra, Tamil Nadu and Kerala (Palakkad, Thiruvananthapuram, Wayanad). This is new record to Kannur flora.

***Phaeoceros laevis* (L.) Prosk.** Found in isolated patches on rocks of Madayi kavu. Thalli is green and crenulate at margin, sporophyte around 1-2 cm long, cells with a single, irregularly globose chloroplast and central, dark pyrenoids without mucilage cavities. Nostoc colonies, if present, scattered. It is a widely distributed species in South India (Tamil Nadu, Kerala, Karnataka) and Northern India (Eastern & Western Himalayas).

## **BRYOPHYTA (MUSCI)**

### **LEUCOBRYACEAE Schimp.**

***Octoblepharum albidum* Hedw.**, It is a widely distributed species seen in a variety of habitats such as on exposed roots, branches, logs, on soil and rocks in scattered colonies, from lower to medium altitude (up to 900 m) mostly in all type of vegetations and collected from both sacred groves. It is a common species found in low altitude to higher altitudes and it has earlier reported from South India (Kerala, Karnataka, Tamil Nadu) North-east India (Kumaon, Sikkim), Sri Lanka, Java, New Guinea, China, Bolivia, Columbia, Indo-Malayan region, Madagascar, Myanmar, Nepal, Peru, Philippines and Venezuela.

### **FISSIDENTACEAE Schimp.**

***Fissidens taxifolius* Hedw.**; Collected from Konginichal kavu, which grow firmly in moist soil. Yellow-green to dark green in colour, Stems known to be up to 2cm long with 15-18 pairs of leaves but up to 7.2mm long and 3.5mm wide. Leaves not much crumpled but curled circinate at the top of the shoot when dry; oblong-lingulate, broadly acuminate. Sheathing lamina usually unequal ('open'). It is almost cosmopolitan in distribution; East Nepal (600 to 3,000 m.), Darjeeling (2,800 m.), Khasia Hills, Western Himalaya (West Nepal, Ranikhet, Nainital, Simla, Kashmir), Europe, Caucasus, Canary Is., Madeira, Azores, North Africa, Central Asia, Persia, Korea, Sakhalin, Japan (widespread), Ryukus; North, Central and South America.

### **CALYMPERACEAE Kindb.**

***Calymperes tenerum* Müll.Hal.**, it prefers a wide range of habitat such as bark, rocks and on land cuttings and is widely distributed species collected from Konginichal kavu. Plant is about 3-7 mm high, green. Stems rounded to ovate, without a central strand; Leaves curled when dry, erect to spreading when wet.

### **POTTIACEAE Schimp.**

***Barbula indica* (Hook.) Spreng.**, It is found almost everywhere, soil cuttings, rock crevices, moist bricks, rotten logs and on concrete walls collected from both the sacred groves. Plant slender, pale green. Stems simple, reddish brown below, greenish above, with a central strand; Leaves spirally arranged, lax below, closer at apex, inrolled and curled when dry, erect when moist, sporophyte not seen. It was earlier recorded from India (Kerala), China, Japan, Korea, Myanmar, Malaysia, Papua New Guinea, Philippines, Colombia, Mexico, Africa and America.

***Hyophila involuta* (Hook.) A.Jaeger**, It is seen in a variety of habitats such as on soil, rocks, logs, crevices of rocks, walls, etc. from low to high altitudes. It is also found on Termite mount. Collected from both the study site. It forms mat, Rhizoids red. Stems branched or not, Leaves uniform, circinnately curled, inrolled at margin when dry, flat and undulate when wet, costa percurrent to excurrent, red-brown. Subcosmopolitan distribution in India, throughout the Western Ghats of Tamil Nadu and Kerala (**Fig.7**).

### **BARTRAMIACEAE**

***Philonotis mollis* (Dozy & Molk.) Mitt.**, Plants small slender, grow densely in groups which forms like a mat, stems erect, not tomentose below, brown to reddish brown, leaves lanceolate, acuminate. Found on moist rocks covered with soil in Madayi kavu. *P. mollis* was reported earlier from South India (Kerala, Karnataka), Central India (Rajasthan), Andaman Islands, Sri Lanka, Borneo, Java, Indonesia, Japan, Madagascar, Philippines, Sumatra and Tonkin.

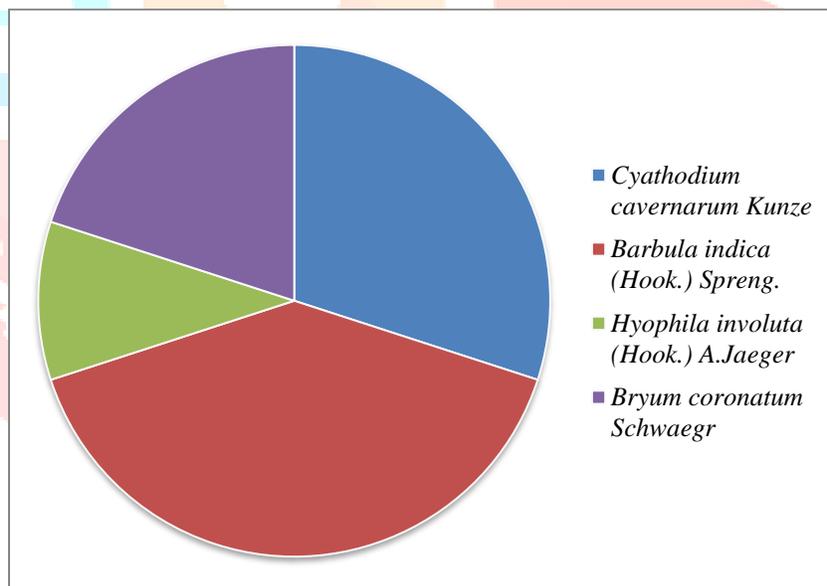
### **BRYACEAE**

***Bryum cellulare* Hook.**, Grow on soil cuttings along with other mosses in Madayi kavu. Plants 0.5-1 cm high, densely caespitose, slender, reddish-green, stem erect, branched by subfloral innovations, tomentose, leaves evenly spread, ovate-lanceolate, flat, entire, with a narrow border at margin, acute at apex; Sporophyte not seen. A wide spread species distributed in India (Kerala, Western Himalayas), Myanmar, China, Japan, Sumatra, Java, Philippines, Taiwan, Europe, North & Central Africa and Australia.

***Bryum coronatum* Schwaegr.**, The only moss that can be identified from field itself, seen on a variety of habitat which include soil, mud walls and also on rocks. It is common throughout both the study area, mostly in the mid 64 altitudinal range from 500-800 m. It is widely distributed in India, China, Borneo, Philippines, Thailand, Brazil, Bolivia, Peru and Mexico (Fig.8).

**TABLE1: Common species in both the sacred grove;**

FAMILY	SPECIES
TARGIONIACEAE	<i>Cyathodium cavernarum</i> Kunze
RICCIACEAE	<i>Riccia billardieri</i> Mont. & Nees
LEUCOBRYACEAE	<i>Octoblepharum albidum</i> Hedw.
POTTIACEAE	<i>Barbula indica</i> (Hook.) Spreng.
POTTIACEAE	<i>Hyophila involuta</i> (Hook.) A.Jaeger
BRYACEAE	<i>Bryum coronatum</i> Schwaegr



**Fig. 4: Widely distributed species**

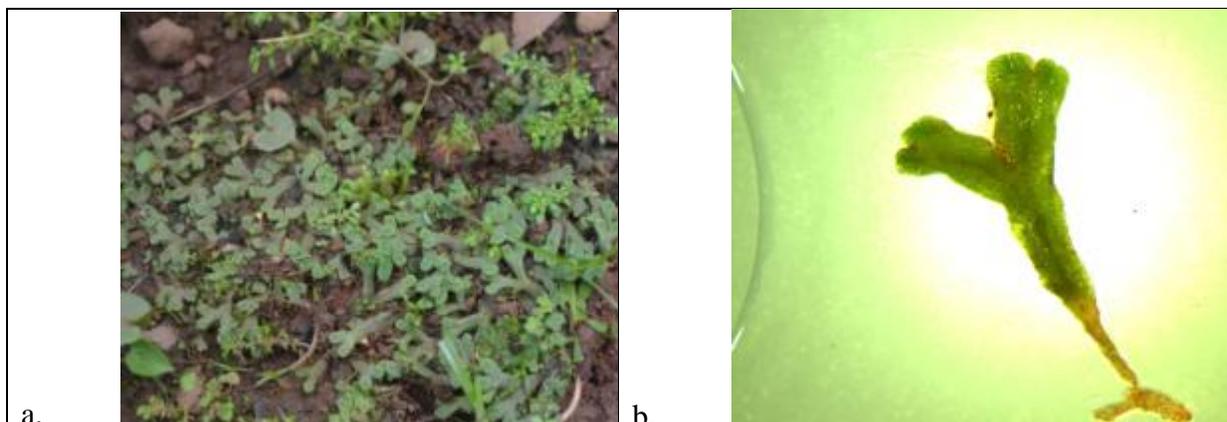
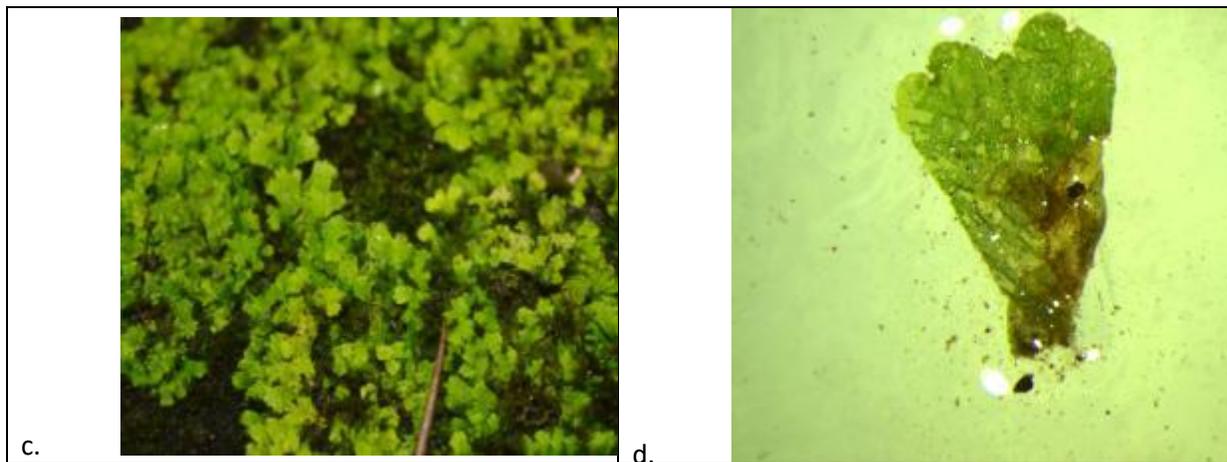
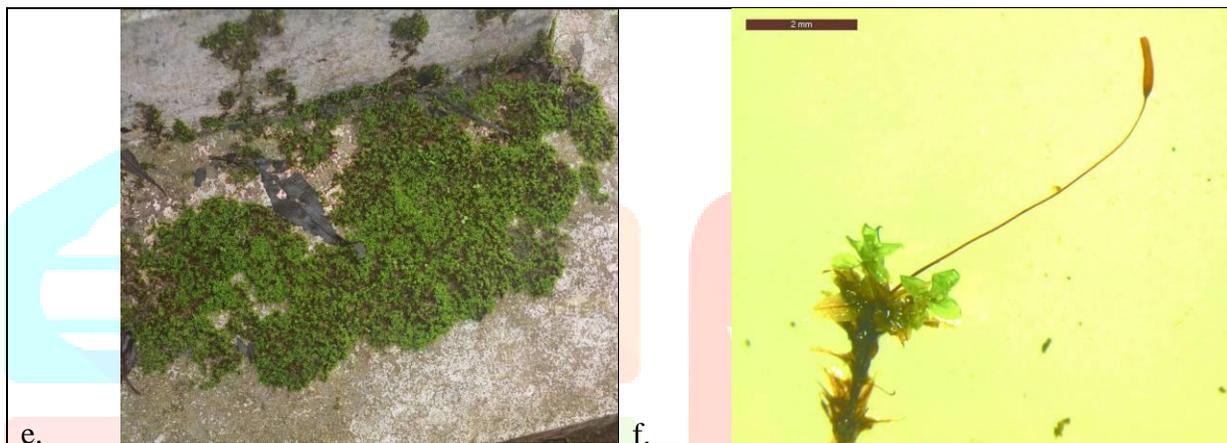


Fig.5: *Riccia billardieri* Mont. & Nees: a-habitat, b- single thallus,Fig.6: *Cyathodium cavernarum* Kunze., c- habitat, d- thallus in enlarged view,Fig.7: *Hyophila involuta* (Hook.) A.Jaeger., e- habitat, f- single thallus separated,Fig.8: *Bryum coronatum* Schwaegr., g-habitat, h- thallus separated,

## V. CONCLUSION

Sacred groves are the seat of rare and endangered species of plants. This study provides baseline information on the bryoflora of the sacred groves. The occurrence of 18 species from a comparatively a very small area of two sacred groves shows the high bryophyte diversity potential of the study site. Since the bryophytes show luxuriant growth particularly after rain, a more systematic specimen collection covering different seasons, during and after monsoon showers is needed to facilitate completeness in survey and inclusive of various stages of life-cycle. This study has added 4 species to the flora of Kannur district and one species to the flora of Kerala. Further investigation on ecological relationships of these plants is also recommended. Since the area is not well explored, it help to thrive light on future studies on the bryophytes in the district, Kannur. We must protect these type of sacred groves because they are the water reservoir and gene pool. Sacred groves might be lost forever if any further degradation is allowed to these fragile ecosystem.

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