DIVERSITY AND DISTRIBUTION OF POLYPORES IN THE WET EVERGREEN AND SHOLA FORESTS OF SILENT VALLEY NATIONAL PARK, KERALA

By

ADARSH, C. K.

(2013-17-107)

THESIS

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COLLEGE OF FORESTRY

KERALA AGRICULTURAL UNIVERSITY

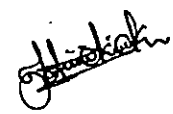
VELLANIKKARA, THRISSUR -680 656

KERALA, INDIA

2015

DECLARATION

I hereby declare that this thesis entitled "**Diversity and distribution of polypores in the wet evergreen and shola forests of Silent Valley National Park, Kerala**" is a bonafide record of research done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree, diploma, fellowship or other similar title, of any other University or Society.



Vellanikkara,
Date: 13/08/2015

ADARSH, C. K.
(2013-17-107)

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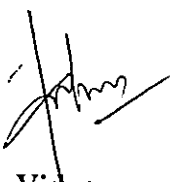
Vellanikkara,
Date: 13/08/15

Dr. K. Vidyasagaran
Chairman
Advisory committee

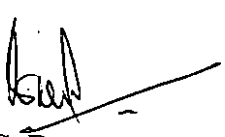
CERTIFICATE

We, the undersigned members of advisory Committee of **Mr. Adarsh, C. K. (2013-17-107)** a candidate for the degree of **Master of Science in Forestry** agree that this thesis entitled **"Diversity and distribution of polypores in the wet evergreen and shola forests of Silent Valley National Park, Kerala"** may be submitted by **Mr. Adarsh, C. K. (2013-17-107)**, in partial fulfillment of the requirement for the degree.

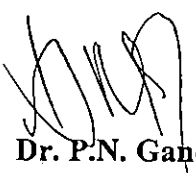


Dr. K. Vidyasagaran
Dean
Associate Professor and Head
Dept. of Forest Management and Utilization
College of Forestry,
Vellanikkara, Thrissur, Kerala-680656
(Chairman)

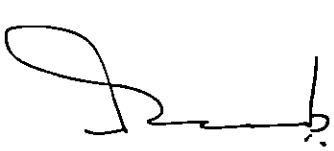
Dr. S. Gopakumar
Associate Professor
Dept. of Forest Management and Utilization
College of Forestry,
Vellanikkara, Thrissur, Kerala-680656
(Member)



Dr. S. Beena
Professor
Dept. of Plant Pathology
College of Horticulture,
Vellanikkara, Thrissur, Kerala-680656
(Member)



Dr. P.N. Ganesh
Associate Professor
Dept. of Botany
Sree Krishna College,
Guruvayur, Thrissur, Kerala-680602
(Member)



EXTERNAL EXAMINER

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ADARSH, C.K.

DEDICATED

TO

GLISTENING DEW DROPS OF SILENT VALLEY

AND ALL THOSE ADMIRE IT,

SPECIALLY

TO

Dr. P.N. GANESH

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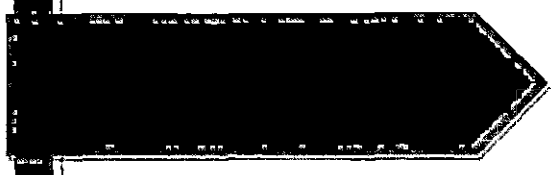
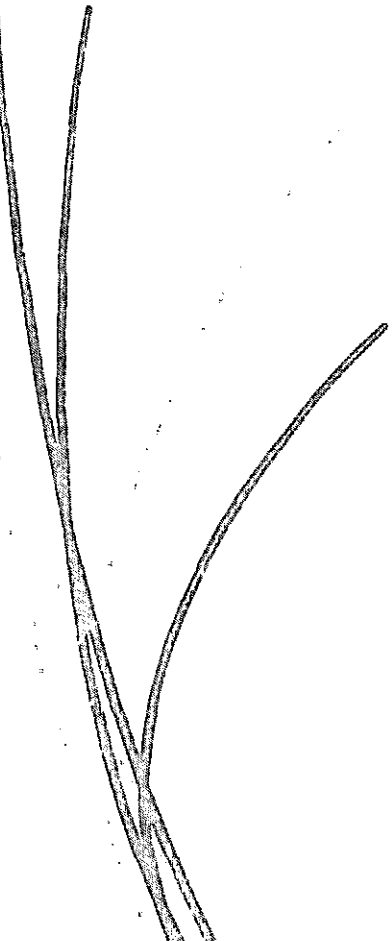


INTRODUCTION



INTRODUCTION

The exercise of classifying biodiversity is of great importance because we need to know what's out there and how they are related to each other. This information in turn can be used to our benefit and moreover it is central for the management and conservation of our biological heritage. Autotrophic producer, and woody plants in particular, support very high diversity of consumers and decomposers representing several trophic levels and specializations. Decaying wood is an essential multifunctional, spatially and temporally discrete terrestrial habitat where Animalia, Plantae, Fungi, Protista and Prokaryota co-occur and interact in forest ecosystem. Deadwoodology, the ecology of deadwood is a thriving research field, with wood-decaying fungi has a major role in it. Wood-decaying fungi are excellent ecosystem engineers, because they directly modulate resource availability other than themselves for several other functional groups. One group of deadwood-dependent species that has gained special attention is the polypores (Basidiomycota: Polyporales) (Lonsdale *et al.*, 2008).

Functionally polypores are wood decomposers equipped with enzymes efficient in cellulolysis and lignin degradation. Polypores are distinguished from other wood-decaying fungi by the appearance of their fruit bodies with poroid hymenial surface. The wood inhabiting polypores are able to utilize components of wood as their primary source of energy for growth and reproduction. Moreover, they play an important role in nutrient cycling process that replenish substances essential for the plant growth. The vegetative mycelium ramify the host tissue and cause decay. Wood decay is generally classified into two main groups, white rots and brown rots, based on the wood residue left behind following fungal digestion. White rot breaks down all major wood components (cellulose, hemicelluloses and lignin) more or less simultaneously. Brown rot primarily decays the cellulose and hemicelluloses in wood, leaving a brown residue of lignin (Schwarze, 2007). This information will become helpful in the adoption of better control measures in plantation diseases management through

the rot character identification and also designing better strategies for short and long term conservation of the protected areas.

Beyond the ecological roles, polypores may have diverse industrial applications due to the capability of selective delignification (Wu *et al.,* 2005). Polypores possess varying degrees of edibility and many of them are incorporated into the pharmacopeia and medicine of indigenous people worldwide. Many bioactive compounds which impart the medicinal polypore properties are still being isolated (Grienke *et al.,* 2014). Despite being an extremely diverse, relatively understudied, and ecologically and economically important group, polypore conservation lags behind protection of other taxa such as mammals, birds and plants, due to a combination of lack of knowledge of many species, their often relatively uncharismatic appearance and the difficulties of assessing polypores using established criteria. An account of frequency, diversity and dominance of polypores in the forest both in disturbed and undisturbed can be used as an indicator of forest quality.

The species richness of macrofungi, including wood-decaying polypores, is expected to be high in tropical regions. The proportion of fine woody debris is also expected to be higher in the tropical zone than in the temperate and boreal zones. The species richness of wood-decaying polypores in tropical regions may be largely underestimated without conducting field surveys on at least three occasions (Yamashita *et al.*, 2015). However in India, a total of 858 polypore species have been reported (Bakshi, 1971). Bhosale *et al.* (2005) also gave an account of 251 species polypores from Western Ghats. Leelavathy and Ganesh (2000) reported 78 polypore species from Kerala. Recently, Mohanan (2011) identified and described a total of 89 species polypores from the state. Even though, much of the forests in Kerala are unexplored and many of the polypores probably have not even been recognized, described or named.

Influences of climatic variables on polypore physiology in vitro were well studied. A wide range of environmental factors influence the timing and

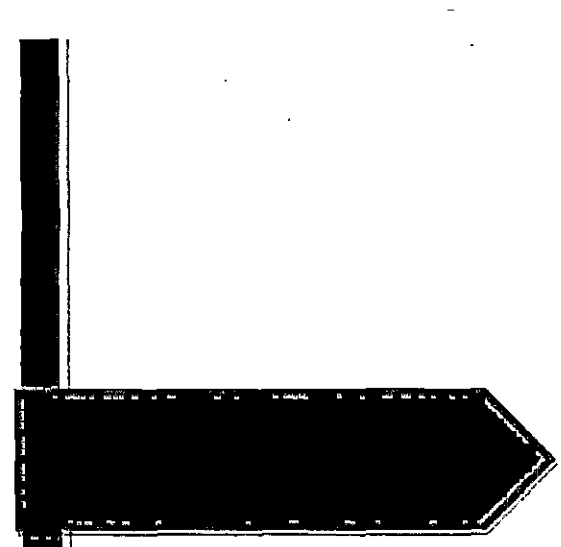
development of fruit bodies, including nutritional factors, gaseous regime, pH, light, microclimate, disturbance and mycelial interaction (Moore *et al.*, 2008). Many field studies shown that the productivity of polypore fruit body is mostly related to average monthly rainfall and temperature (Lagana *et al.*, 2002). Familiarizing these responses of the polypores will provide better strategies to adapt and mitigate the environmental consequences of climate change.

Vegetation type and elevational gradient are also important factors that are related with the occurrence of polypore communities with characteristic distribution pattern in the forests. The tree composition of a forest type has great influence on polypore communities. The host range and preference for certain polypores can be strict to either angiosperm or gymnosperm trees, or even to a single tree species. Most polypores have a broad host range and due to high tree species diversity in the tropical forests and strong host specificity of polypores and other wood-inhabiting basidiomycetes is generally considered to be low. Studies on this aspect of polypore fungi in Kerala is negligible. A detailed analysis of the polypore fungi and their host species will give a better understanding of its distribution pattern.

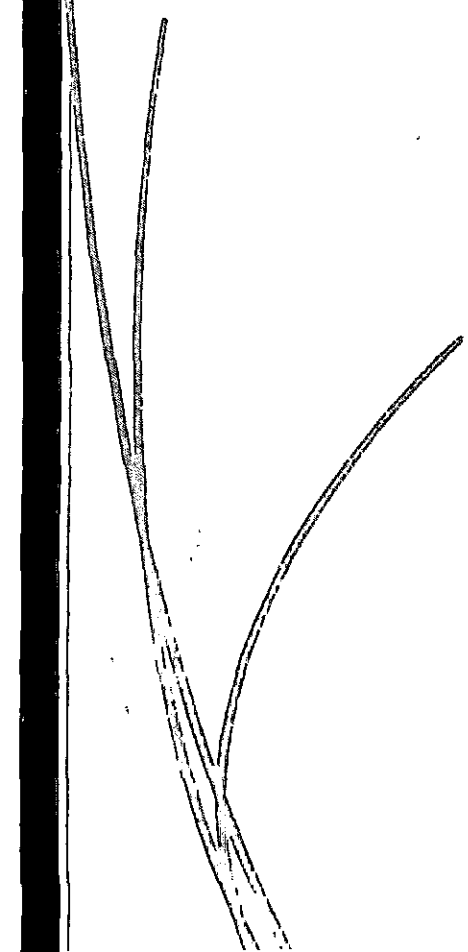
Polypore diversity is influenced by the type, size and decay stage of substrate in the forest ecosystem. Functional characteristics of different polypore species vary according to their differential decay capacity in different wood substrate conditions (e.g. living stem, standing or fallen dead stem, dead log, branches of different diameters) with different physical and chemical properties (Rayner & Todd 1979). Substrate diameter is another important factor that contribute to the occurrences of polypores. Studies have shown that these polypores have different preferences for substrate diameter. Generally the number of species per dead wood item increases with increasing diameter of the substrate. As the moisture, temperature and gaseous conditions vary during wood decay, the decay stage of the substrate act as an important variable influencing the occurrence of polypores (Rayner and Boddy, 1988). In our

country, the aspects of substrate characteristics in relation to polypore distribution is not analyzed in detail.

Silent Valley is an undisturbed maiden forest located in the Palakkad and Malappuram districts of Kerala. It is one of the few biodiversity hot spots in the world with habitat of many common, vulnerable, rare, threatened, endangered and critically endangered animals and plants. The forests of Silent Valley consist of mainly of tropical evergreen, grass land and shola vegetation, with tremendous complexity as well as floral and faunal diversity. Several new species of flora and fauna including amphibian, fish, insects, mosses, ferns and flowering plants have been described from the Silent Valley. No comprehensive studies have been undertaken on the diversity and distribution of polypore fungi in Silent Valley National Park which undoubtedly is also hosting the highest mycodiversity. With this background, the objectives are framed to study the diversity and distribution of polypore fungi in the wet evergreen and shola forests of Silent Valley National Park.



REVIEW OF LITERATURE



REVIEW OF LITERATURE

Fungi have been known and used by humans for centuries, but mycology (the scientific study of fungi) traces its beginnings to the 18th century, with the development of the microscope (Ainsworth, 1976). By now, fungi are the concern of taxonomists, morphologists, geneticists, ecologists, phytopathologists, physicians, biochemists, molecular biologists, human doctors and commercial microbiologists. Fungi along with algae, lichens and bryophytes are coming under *Cryptogamae* of the plant kingdom and characterized by lacking the specialized fluid conducting tissues typical of higher or vascular plants. Their propagation is by the production of minute reproductive propagules, usually spores. Among these, fungi have a worldwide distribution, and grow in a wide range of habitats, including extreme environments such as deserts or areas with high salt concentrations or ionizing radiation, as well as in deep sea sediments but they are not autotrophs and absorb nutrients from the surrounding environment (Raghukumar and Raghukumar, 1998). Only about 6.7 per cent of 1.5 million species of fungi estimated in the world have been described and most of these are in temperate regions (Andrew *et al.*, 2013). The tropical region which is undoubtedly hosting the highest mycodiversity has been inadequately sampled and the mycoflora scarcely documented (Hawksworth, 2001). The Fungi have been very important to human being from the time immemorial. They are used traditionally in fermentation, as food, for preparation of antibiotics, as bioremediaters, biocontrol agents and for enriching the soil as bio-fertilizer.

A good number of these fungi produce large and conspicuous fruitbodies and therefore called as macrofungi. These macrofungi mainly belong to two orders, Polyporales and Agaricales, of class Basidiomycetes while a few are Ascomycetes. The polypores are Basidiomycetes producing holobasidia and ballistosporic basidiospores typically on the inside of the tubes lining the underside of the fructification (Leelavathy and Ganesh, 2000). Most of the polypores are wood inhabiting and rest are terrestrial. Wood rotting polypores are the important elements of forest ecosystem since it decompose wood and coarse woody debris, and play a primary and central role nutrient cycling in the forest ecosystem. Seventy five per cent

of the species of fungi, that plays a significant role in timber decay belong to the polyporaceae, and are probably responsible for producing ninety per cent decay of the economically important timbers (Rathod, 2011).

2.1 MODE OF ATTACK BY POLYPORES

The establishment of polypores on coarse wood debris is facilitated by the exposure of massive amount of unprotected tissues. The entry into living trees is usually effected via wounds. Other probable routes of entry include lenticels, leaf scars and tissue weakened by drought or microbial damage. The colonization of polypores is by germinating spores and migratory mycelia. The mycelium of polypores at first grows well and the hyphae can grow unhindered by cell wall barriers in vessels. The axial alignment of tracheids, vessels, fibres and the radial arrangement of the xylem ray parenchyma facilitate access into the wood and allow widespread distribution of hyphae within the xylem (Rayner and Boddy, 1988). Access to adjacent cells occurs via pit apertures, or direct penetration may take place directly through the cell wall. Radial spread takes place more slowly through disrupted pit membranes in lignified cell walls and through the cell walls of non-lignified wood parenchyma. Formation of boreholes by specialized cell wall degrading hyphae has been described in the literature (Liese, 1970). These were initiated by fine penetration hyphae, less than 0.5 mm diameter, which penetrated the cell wall by means of lignolytic enzymes, which were released at the hyphal tip (Schwarze, 2004). Subsequently, bore holes progressively get enlarged by the secretion of enzymes from the general surface of the hypha. At a more advanced stage of decay, cracks will be often developed between adjacent boreholes in the radial cell walls, and the boreholes eventually coalesce. The mycelia ramify the wood tissues and absorb nutrients after breaking the cell wall constituents by enzymatic activity resulting in decay. Most dangerous is the "heart rot" which establishes itself in the heartwood and progress with time.

2.2 ECONOMIC IMPORTANCE OF POLYPORES

The polypores capable of selective delignification may have diverse industrial applications like waste water treatment, wood treatment to improve digestibility of lignocellulose materials for cattle feed and for bio pulping wood in paper industry, thus reducing the energy cost (Wu *et al.,* 2005). Polypores possess varying degrees of edibility and many of them are used as food by indigenous people worldwide and some are cultivated commercially (Essien and Akpan, 2014). Polypores have a long history in disease treatment in various folk medicines in Asia, Russia, USA, Canada, Mexico and Venezuela and are extensively used in Traditional Chinese Medicine up to the present day. The bioactive compounds which impart the medicinal properties are triterpenoids, benzofurans, coumarins, glycosidic triterpenes, flavonoids, polysaccharides, proteins, nucleic acids and dietary fibers etc. (Grienke *et al.,* 2014). The polypores have some negative aspects also since some species cause disease and economic loss in plantations (Oghenekaro *et al.,* 2014).

2.3 SYSTEMATIC ACCOUNT OF POLYPORES

Polypores belong to order Polyporales, class Agaricomycetes, division Basidiomycota in phylum Fungi. The members are mainly distributed in three families namely Ganodermataceae, Hymenochaetaceae and Polyporaceae. The family Ganodermataceae is characterized by species with spores which are invariably double walled with an inner verrucose to ornamented, thickened and usually coloured wall over which there is a thin hyaline outer wall. It was the unique structure of the spore wall, which prompted Donk (1948) to establish this family. This family include genera *Amauroderma, Elfvingia, Ganoderma, Haddowia, Humphreya,* and *Magoderna.* The members of this family are characterized by annual or perennial fruit body; one sided, tabulate or often stratified hymenophore; small to minute pores; dissepiments with sterile edges; pallid to dark brown or purplish context; trimitic hyphal system; branching of skeletal hyphae at extremities; rare presence of binding hyphae; absence of cystidia and setae; short, swollen and 4-spored basidia; an outer very thin, hyaline,

membrane-like exosporium covering an ornamented thick-walled and often brownish endosperm.

The Hymenochaetaceae is a well-marked family of Polyporales characterized by species having setae and or dark coloured context becoming irreversibly black in KOH solution and generative hyphae without clamps. Donk (1948) established this family based on the absence of clamps. The absence of clamps emphasized by Donk (1948) was supported by the Corner (1953) who opined that "the absence of clamps so distinguishes the xanthochroic series and their presence is the proof that a species does not belong." The presence of setae is a unique character of Hymenomysetes (Donk, 1964). The study of the cultural characters of about forty polyporoid species by Nobles (1958) supported the naturalness and homogeneity of this group. The family Hymenochataceae as conceived by Donk (1964) consisted of three sub-families viz. Asterostromatoideae, Hymenochaetoideae and Vararioideae with a total of eighteen genera. Pegler (1973a) also recognized eighteen genera in Hymenochaetaceae, distributed in three sub families viz., Asterostromatoideae, Hymenochaetoideae and Vararioideae. However, all the genera in this Hymenochaetaceae are not the same as those of Donk (1964). In his key to world genera of polypores, Pegler (1973b) has accepted only 12 genera in Hymenochaetaceae.

The term Polyporaceae has been used with different connotations varying from a diverse assemblage of poroid species to the family Polyporaceae sensu stricto, which includes only poroid genera not included in other families of Aphyllophorales. According to Donk (1964), poroid genera in the order Aphyllophorales are distributed in about ten families and Polyporaceae is only one among ten families. Several efforts have been made since early times to divide Polyporaceae into smaller families and one result of these efforts was that some members of this family were assigned to the Agaricales (Leelavathy and Ganesh, 2000). Fries (1825, 1874) gave much importance to hymenial configuration. Polyporaceous genera with more or less typically lamellate hymenophore such as *Lenzities* and some of the tabulate genera such as *Favolus* (P. Beauv) Fr. were shifted to agarics. The relation of *Polyporus* sensu stricto to agaricales was also supported based on the observations on the similarity in hyphal system of

Pleurotus (Fr.) P. Kumm. and *Polyporus squamosus* (Huds.) Fr. (Corner, 1953). Authors like Singer (1962) and Kriesel (1969) have transferred *Polyporus* sensu stricto to Agaricales. Donk (1964) criticized these transfers on the ground that they were not based on redefinition of the generic and family characters and preferred to maintain the artificial family Polyporaceae in a broader sense among Aphyllophorales until better solutions was found. Taxonomic studies carried out by Pegler (1973a; 1973b), Ryvarden and Jonansen (1980) and Gilbertson and Ryvarden (1986) used the term Polyporaceae in the sense used by Donk (1964), and by interpreting the same definition the term Polyporaceae has been used in the present study also.

In Europe and North America, detailed studies on wood decaying fungi have been performed for a long time and many taxonomic monographs based on morphology have been published (Gilbertson and Ryvarden, 1986; 1987, Ryvarden and Gilbertson, 1993; 1994). Polypore taxonomy is in a state of constant flux. New orders like the Amylocorticiales are still being generated based on DNA phylogenies (Binder *et al.*, 2010). Within the established orders, our understanding of classification, ecological aspects and evolutionary relationships is still fragmentary and much work remains to be done.

After the introduction of molecular techniques in species identification, the phylogeny and taxonomy of wood decaying fungi were modified to a great extent and many higher-level taxonomic ranks were put forward or established (Binder *et al.*, 2010). Comprehensive research on wood decaying fungi carried out in Europe and North America has attracted much attention on their ecological pattern (Junninen and Komonen, 2011), pathogenic potential (Asiegbu *et al.*, 2005) and industrial application (Cohen *et al.*, 2002).

2.4 INTERNATIONAL EXPLORATIONS AND TAXONOMIC CONSIDERATION OF POLYPORES

The earliest record of both poroid and non-poroid fungi goes back to "Nova Plantarum Genera" published by Micheli, an Italian botanist in 1729. Persoon (1801) published the first systematic arrangement of the fungi as "Synopsis Methodica Fungorum". Seventy one genera of fungi were recognized by him and distributed them in orders and classes. He divided fungi into two classes "*Angiocarpii* and *Gymnocarpii*". Class *Gymnocarpii* was further subdivided into three orders *Lytothecii*, *Hymenothecii* and *Naematothecii*. The resupinate members belonging to order *Polyporales* were placed under order *Hymenothecii*.

Fries (1821) classified and gave a complete account of fungi known at that time as "Systema Mycologicum" under three volumes. He divided fungi into four classes, viz. *Coniomycetes, Hyphomycetes, Gasteromycetes* and *Hymenomycetes*. The *Hymenomycetes* was further divided into 6 orders i.e. *Pileati*, *Clavati, Mitrati, Cupulati, Tremellinae* and *Sclerotiaceae* on the basis of a single character, "Hymenium nudum" (exposed hymenium). He recognized eight genera of polypores based on the hymenial configuration and macro morphological characters of basidiocarps (Fries, 1874). Persoon (1801) placed the poroid fungi with basidia lining the interior surface of the tubes into group "*Porodermei*". Leveille (1846) divided the *Hymenomycetes* into 2 subclasses: *Basidiosporii* and *Thecosporii* (*Ascomycetes*) based on the internal structure of the basidiocarp. Fries (1874) divided *Hymenomycetes* into 6 orders on the basis of hymenial configuration in "*Hymenomycetes* Europaei". Hymenium and internal structure of the basidiocarp were taken as the basis for the classification of *Basidiomycetes* by Berkeley (1839-67), Tulasne (1853, 1872) and Massee (1889-1910). Fries (1855) subdivided genus *Polyporus* into three subgenera - *Eupolyporus*, *Fomes* and *Poria* in his "Novae Symbolae Mycologici". Later the *Polyporus* was divided into *Merisma* (for branched stipitate species), *Physisporus* (for resupinate species) and *Fomes* (for woody perennial species) by Gillet (1878). Cooke (1884-1886) raised *Poria* to generic rank for resupinate poroid species. Saccardo and

Sydow (1899) placed resupinate poroid and non-poroid fungi under families *Polyporaceae* and *Thelephoraceae* of group *Gymnocarpi.*

Karsten (1879, 1881, 1889) divided the Friesian genera into many smaller genera based on the consistency, pigmentation of basidiocarp, context, color of basidiospores, characters of the upper surface and presence or absence of stipe etc. Murrill (1907) largely followed the Karsten's system and divided *Polyporaceae* into 4 tribes: *Porieae* (for resupinate species), *Polyporeae, Fomiteae* and *Daedaleae* in his "North American Flora" (*Polyporaceae*).

Smith (1908) divided *Basidiomycetes* into *Hymenomycetes* and *Gasteromycetes* in his "British *Basidiomycetes*". He further divided *Hymenomycetes* into six families- *Agaricaceae, Polyporaceae, Hydnaceae, Thelephoraceae, Clavariaceae* and *Tremellinaceae.* The resupinate members of order *Polyporales* were placed under families *Agaricaceae, Polyporaceae* and *Thelephoraceae.*

Patouillard (1900) in his outstanding contribution "Essai Taxonomique surles families et les generes des *Hymenomycetes*" revised the system to classify *Hymenomycetes* based on microscopic characters and divided *Basidiomycetes* into "*Basidiomycetes Heterobasidies*" and "*Basidiomycetes Homobasidies*". The "*Basidiomycetes Homobasidies*" was further divided into four families i.e. *Exobasidiaces, Aphyllophoraces, Agaricaces, and Gasteromycetes.* Majority of the resupinate members were placed under *Aphyllophoraces.*

Burt (1914-1926) followed the Friesian system and described 600 resupinate, non-poroid species belonging to 30 genera of Agaricomycetous fungi in a series of papers "The *Thelephoraceae* of North America". Rea (1922) divided *Basidiomycetae* into *Homobasidiae* and *Heterobasidiae.* The *Homobasidiae* was divided into 2 subdivisions (*Exobasidiinae* and *Eu-homobasidiinae*) in his monograph "British *Basidiomycetae*". He listed 3 orders i.e. *Gasteromycetales, Agaricales* and *Aphyllophorales* under *Euhomobasidiinae.* Order *Aphyllophorales* was divided into two i.e. *Porohydnineae* with pileate, stipitate, sessile or resupinate members and

Clavarniineae with erect, dendroid, coralloid, simple or branched never pileate members. Seven families were placed under *Porohydnineae.*

Following Patouillard's classification in general, the monumental work "*Hymenomycetes* de France" by Bourdot and Galzin (1928) gave stress on the importance of microscopic features such as arrangement of hyphae in the context, presence or absence of clamp connections, shape of basidia and presence of modified structures in basidiocarp and amyloid reaction of spore wall. Corner (1932a, 1932b, 1932c) explained the occurrence of different types of hyphae in the basidiocarps of poroid fungi and introduced the concept of hyphal systems.

Bondartsev and Singer (1941) arranged 60 poroid genera in 6 suborders and 8 families. Five subfamilies were placed under family *Polyporaceae*, one of which was *Porioideae* which included most of the resupinate species under 8 genera. Based upon the type of thickening of hyphae as they mature and presence or absence of clamp connections, Pinto-Lopes (1952) proposed a new system. Eriksson (1958) studied resupinate fungi from Sweden and introduced 7 new genera. Bondartsev (1953) divided the artificial group "*Polyporineae*" into 5 suborders and 6 families in his monograph "The *Polyporaceae* of the European U.S.S.R. and Caucasia". He included 54 genera in family *Polyporaceae*, which was further divided into five subfamilies and 10 tribes. Christiansen (1960), in his monograph "Danish Resupinate Fungi Part II, *Homobasidiomycetes*" described seven families of resupinate Aphyllophoraceous fungi. Cunningham (1963) studied and gave a consolidated account of the resupinate fungi of Australia and New Zealand. Later he divided the family *Polyporaceae* into two subfamilies i.e. *Polyporoideae* and *Fomitoideae* in his monograph "*Polyporaceae* of New Zealand" (Cunningham, 1965).

Donk (1960) gave a detailed annotated nomenclatorial enumeration of polyporoid genera in "The generic names proposed for *Polyporaceae*". He published his most outstanding work "A conspectus of the families of *Aphyllophorales*" and recognized 21 families in 1964.

Locquin (1974) introduced a new system of classification for fungi in his "De Taxie Fungiorum I- syllabus". He divided the fungi into 11 subdivisions on the basis of thallus organization, septation and nature of septa. The subdivision *Acromycotina* was divided into two classes: *Endomycetes* and *Basidiomycetes.* The class *Basidiomycetes* was further divided into three subclasses on the basis of spore character. The subclass *Basidiomycetidae* was subdivided into 9 orders and 95 families. Further, Ryvarden (1976) described 78 poroid species under 31 genera in his manual "The *Polyporaceae* of North Europe" Vol. I.

Gilbertson *et al.* (1976), Gilbertson and Budington (1970), Gilbertson and Lindsey (1975), Gilbertson and Blackwell (1984, 1988), Gilbertson and Adaskaveg (1993) and Gilbertson and Nakasone (2003) contributed to the study of polypores from Arizona, Gulf-coast region, Hawaii and North America in a series of papers.

Hallenberg (1978-1998), Hallenberg and Ryvarden (1975), Hallenberg and Hjortstam (1988), Hallenberg and Larsson (1993), Hallenberg and Kuffer (2001), and Hallenberg *et al.* (2007) studied agaricomycetous fungi from Sweden, Romania, Austria, U.S.S.R, America, Africa, Europe, Spain, New York, U.S.A, Germany, Argentina and Canada. In "Dictionary of the Fungi" Hawksworth *et al.* (1983) listed 1200 species under the order *Aphyllophorales.* Following Donk's classification in general, Ryvarden and Gilbertson (1993, 1994) published their monograph "European Polypores" under two volumes.

Hawksworth *et al.* (1995) divided *Basidiomycetes* into *Phragmo-basidiomycetideae* and *Holobasidiomycetideae. Phragmobasidiomycetideae* and *Holobasidiomycetideae* were further divided into five and twenty-seven orders, respectively. Resupinate members of *Polyporales* were mainly included under orders *Stereales* and *Poriales* of *Holobasidimycetidae.* Kirk *et al.* (2001) divided the class *Basidiomycetes* into two sub classes *Tremellomycetidae* and *Agaricomycetidae.* The *Agaricomycetidae* was further divided into 8 orders and 94 families.

Recently Kirk *et al.* (2008) divided *Basidiomycota* into 3 subphyla: *Pucciniomycotina, Ustilaginomycotina* and *Agaricomycotina. Agaricomycotina* was divided into 3 classes: *Tremellomycetes, Dacrymycetes* and *Agaricomycetes. Agaricomycetes* was divided into 17 orders: *Agaricales, Atheliales, Boletales, Geastrales, Gomphales, Hysterangiales, Phallales, Auriculariales, Cantharellales, Corticiales, Gloeophyllales, Hymenochaetales, Polyporales, Russulales, Sebacinales, Thelephorales* and *Trechisporales*.

2.5 STUDIES IN INDIA

Studies on polyporales were initiated along with the explorations of Indian fungi. The first Indian record of a member of polyporales was by Klotzsch (1832) when he described a total of four polypores from India. In 1833 Klotzsch described 25 polypores from the Himalayan valleys. Berkeley (1839) described a few Indian polypores which were collected by W.J. Hooker. Cooke (1876, 1891a, 1891b) described many Indian fungi from Kew collections in a series of papers. Later Hennings (1900, 1901) described considerable number of the specimens collected from United Provinces collected by Gollan. Massee (1901, 1906, 1908, 1910) described many Indian species in his outstanding contribution "Fungi Exotici" in the Kew Bulletin. Theissen (1913a, 1913b) reported many poroid Aphyllophorales collected from the Bombay presidency by Blatter. Sundararaman and Marudarajan (1925) reported 11 species of polypores from Chennai.

Bose (1918-46) was the first Indian mycologist to provide a comprehensive account of the Indian polypores which he collected from Bengal and its surroundings. He described 143 species including nine new species in a series of papers "*Polyporaceae* of Bengal" I-XI. He made a valuable contribution on the geographical distribution and history of polypores in Bengal (Bose, 1922 b). He studied the Polyporaceae from Lokra Hills (Assam) in 1937. Bose (1944) stressed the importance of anatomy in systematics of Polyporacea and suggested the use of certain characteristic anatomical features in addition to the characters of basidia and spores for the specific identification of these fungi.

Butler and Bisby (1931) brought together all the records of Indian fungi in their valuable compilation, "The Fungi of India" which includes 293 polyporoid species under 16 genera. Banerjee (1935a, 1935b, 1935c) made a comprehensive account of Indian Thelephoroid fungi from West Bengal in which he reported 24 species belonging to 4 genera. Banerjee and Bakshi (1945) published a detailed account of the life history, cultural characters, geographical distribution, host plants and influence of several external factors of six wood-rotting polypores of Bengal. Later Banerjee and Chakravarthy (1945), and Banerjee and Chatterjee (1945a, 1945b, 1945c continued the works on polypores of Bengal through a series of comprehensive investigations on its diversity and distribution. Further, Banerjee and Ghosh (1945) and Banerjee (1946) made a remarkable contribution on the polypores of Sikkim-Himalayas.

Bagchee and Bakshi (1950, 1951) made studies on some parasitic polypores on Chir pine and other economically important forest trees. They identified a new and noteworthy disease of *Gmelina arborea* due to *Poria rhizomorpha.* Bagchee (1954, 1958) gave detailed account on the biology of parasitic polypores, especially the *Trametes incerta* which attack Sal trees causing sap and heart-rot. Later in 1961, he made a notable work on the biology, morphology, symptoms, spread and control measures of *Fomes caryophylii,* a destructive heart rot causing polypore in Sal.

Bakshi and co-workers made valuable contributions towards knowledge of polypores of India by investigating its diversity and pathogenicity through a series of works. Bakshi (1950) studied the principal diseases of oaks by polypores. In 1955 he worked on the diseases and decay of conifers with fungal pathology, cultural characters, and control measures. Other important contributions include diseases of *Acacia catechu* and its preventive measures (Bakshi, 1957 a), heart rot in relation to management of *Shorea robusta* (Bakshi, 1957 b), root-rot disease of Sal caused by *Polyporus shoreae* results in top dying and death of trees in North Bengal and Assam (Bakshi and Boyce, 1959), heart rot in *Cassia nodosa* due to *Polyporus palustris* and studies on a disease-complex in teak (Bakshi *et al.*, 1966).

An account of polypores from the Mussoorie hills was given by Thind and Adalakha (1956), Thind and Chatrath (1957, 1960), Reid *et al.* (1958, 1959), Thind *et al.* (1970), and Thind and Dhanda (1978, 1979a, 1979b, 1980). Further Thind and Rattan (1968-76), in a series of papers, published 59 species of Thelephoroid fungi from North Western Himalaya.

Vasudeva (1960) revised the Butler and Bisby's "The Fungi of India" (1931) and gave a consolidated account of most of the Indian fungi published up to 1952. He described 77 species under the traditional Friesian family *Thelephoraceae.* Later Sujan *et al.* (1961) studied the fungus flora of South Andamans. Further Sehgal *et al.* (1961) made an attempt to study the fungus flora of Nicobar Islands on a comprehensive scale. Sehgal *et al.* (1966) also studied the temperature relationships of Indian polypores.

Bakshi (1971) gave an account of 355 species of polypores belonging to 15 genera in his most outstanding work "Indian Polyporaceae (on trees and timber)". Roy (1968a, 1968b, 1969, 1971, 1972, 1975, 1976) studied the anatomical features of *Trametes cingulata, Daedalea flavida, Polyporus adustus, Polyporus anthelminticus, Hexagonia discopoda* and *Hexagonia sulcata.* Bakshi *et al.* (1970) studied the cultural diagnosis of Genera *Fomes* and *Trametes*. Later he initiated the identification of Indian polypores in culture.

De and co-workers contributed valuable accounts on the cultural characters of many polypores such as infertility of *Polyporus grammocephalus* (De, 1977), typical sporophore production of *Polyporus tricholoma* in culture (De and Roy, 1978), morphological and cultural characters of *Polyporus hirsutus* (Roy and De, 1980), taxonomy of *Polyporus osterijormis* in relation to its morphological and cultural characters (De, 1981) and morphological and cultural characters of *Polyporus grammocephalus* (De and Roy, 1981).

Rattan (1977) in his monograph, "The Resupinate *Aphyllophorales* of North Western Himalayas" gave an account of 198 taxa, of which 78 belonged to order *Polyporales.* He followed the classification given by Donk (1964) with some

modifications. Later Bilgrami *et al.* (1979) in "The Fungi of India" listed 146 species of Thelephoroid fungi from India. Natrajan and Kolandavelu (1998) gave an account of 82 species belonging to 48 genera of fungi from Tamil Nadu with 39 new reports from India.

Roy and De (1996) listed 114 poroid species in "Polyporaceae of India" based on exhaustive studies on fungi belonging to the family Polyporaceae collected from different parts of India. Later Sharma (1995) made a remarkable contribution on "Hymenochaetaceae of India". He also gave an account of 87 poroid genera in "Genera of Indian Polypores" in 2000. Further, Leelavathy and Ganesh (2000) reported 78 species of polypores from Kerala. Florence (2004) reported 555 species of basidiomycetes under 179 genera from the Kerala state.

Bhosale *et al.* (2005) gave a tabulated account of 251 species of order *Aphyllophorales* from Western Ghats. Swapna *et al.* (2008) reported 778 species of macrofungi belonging to 101 genera under 43 families from semi-evergreen and moist deciduous forest of Shimoga district, Karnataka. Later Bhosale *et al.* (2010) studied the taxonomy and diversity of *Ganoderma* spp. and reported 15 species and 3 varieties of *G. lucidum*, from Western Parts of Maharashtra. More recently, Ranadive *et al.* (2011) listed 256 species of Aphyllophoraceous fungi (170 poroid and 86 non-poroid species) from Western Ghats.

2.6 POLYPORE DIVERSITY IN KERALA

The studies of the polypores of Kerala was initiated by Rangaswamy *et al.* (1970). In his outstanding work "Fungi of South India", 44 polyporoid species representing 13 genera were described, of which five species were from Kerala. The studies by Mohanan (1994) on occurrence of decay in living trees in natural stands in Kerala, employing external decay indicators revealed an average incidence of 20.7 per cent and reported 44 polypores belonging to 18 genera found associated with decay in living trees. Among them nine polypores caused brown rot, while all the rest were associated with white-rot. Highest percent incidence of decay of 23.6 was recorded in

the evergreen forest at Aramba (Achenkoil Forest Divn.) and lowest in the semi-evergreen forest at Kottiyoor (Kannur Forest Divn.), while in wet-evergreen forest at Panthanthodu (Silent Valley National Park), it was 18.71 per cent. Detection and estimation of decay in standing trees in natural stands at Aramba were made by non-destructive as well as destructive methods. Ocular appraisal of 139 trees belonging to 12 species viz., *Vateria indica, Palaquium ellipticum, Dipterocarpus indicus, Disoxylum beddomei, Mesua nagassarium, Persea macrantha, Bombax ceiba, Hopea parviflora, Terminalia bellerica, Artocarpus hirsutus, Syzygium cumini* and *Bischofia javanica* revealed that 66 percent of the trees contained decay. Data on ocular appraisal on decay indicators as well as on detection of decay in the logs by destructive sampling method revealed that decay indicators such as sporophore, swollen bole, hollow bole, swollen knot, canker and open wound showed high percentage association with decay. Branch stub, rotten branches and punk knot showed only low percentage association with decay and were found least dependable variables.

Roy and De (1996) in their work "Polyporaceae of India" reported six polypore species from Kerala. Leelavathy and Ganesh (2000) in their classical work "Polypores of Kerala" reported 78 species belonging to 26 genera under families Ganodermataceae, Hymenochaetaceae and Polyporaceae. Majority of the specimens described in that treatise were collected by the authors during the period 1983-1987 from the forests as well as inhabited areas of central and northern Kerala. Florence and Yesodharan (2000) conducted a survey of macrofungi occurring in the Peechi-Vazhani Wildlife Sanctuary for a period of three years (1995-1997) and six hundred macrofungal specimens were collected. They reported 57 species of macrofungi belonging to 37 genera, out of which 35 were polypores and rest agaricales. Thirty three polypores collected were white rot polypores, while *Fomitopsis rhodophaeus* and *Nigroporus niger* were brown rot polypores. Florence (2004) recorded 93 species of polypores from the state. Imrose *et al.* (2005) studied the identification and wood decay characteristics of polypores on some selected tree species (*Albizia odoratissima, Bridelia retusa, Delonix regia, Peltophorum pterocarpum* and *Swietenia macrophylla*) of Kerala. They identified and described the decay characteristics of *Hexagonia tenuis* and *Phellinus gilvus*. Recently Mohanan (2011) identified and described a total of 89

species of polypores belonging to 32 genera from different forest ecosystems of Kerala.

2.7 FUNGAL PHENOLOGY

Fungal fruiting phenology is a new field of mycology which requires far more comprehensive studies covering various aspects of fruiting. Knowledge of fungal fruiting phenology covers numerous opportunities to improve the understanding of their community structure but the literature is still lacking. The presence of fruit bodies is direct indication of the presence of the species in the substrate, but absence of fruit bodies does not necessarily indicate absence of mycelia (Gardes and Bruns, 1996). Also, knowledge of fungal fruiting phenology is important to guide the design of fruit body surveys and a way to explain the findings. If the nature of fungal fruiting is known, the timing and intensity of surveys can be planned (Newbound *et al.*, 2010). Fruit body surveys are a basis for documenting fungal diversity, as sporocarps can be identified to the species level and recorded in a good systematic system. It can provide an insight into the characteristics of fungi and may explain their associations with their non-living environment. Apart from that, fungal-environmental associations and the effects of any changing environmental factors on fungal fruiting patterns can be predicted. Polypores play an important role in ecosystem functioning especially in the decomposition of organic matter and nutrient cycling in the soil. Therefore, any changes in polypore fruiting could reflect changes in mycelial growth and potentially affect the ecosystem services of the soil biota.

Fungal phenology has started to raise attention of several mycologists all over the world. Gange *et al.* (2007) reported advanced fruiting for autumnal species in England, while Kauserud *et al.* (2008a, 2011) studied delayed fruiting of autumnal species in Norway. Kauserud *et al.* (2009) gave comprehensive account about the advanced fruiting of spring-fruiting fungi in a 47-year survey. Recently, Sato *et al.* (2012) studied the differences in the fruiting phenology among three common fungal functional groups namely ectomycorrhizal (ECM) fungi, litter decomposers and wood decay fungi.

2.7.1. Environmental factors contributing to the production of fruit bodies

A wide range of environmental factors influence the timing and development of fruit bodies, including nutritional factors, gaseous regime, pH, light, microclimate, disturbance and inter and intra-specific mycelial interaction (Moore *et al.,* 2008). Understanding the responses of the lowest trophic level is critical if we are to adapt to and mitigate the ecological consequences of climate change (Walther *et al.,* 2002; Walther, 2010). The plant host has been identified as an influential factor in the production of fruit bodies, because of the need for some nutritional elements to build sporophores in the forest (Selosse *et al.,* 2001). Influences of climatic variables on fungal physiology in vitro are well-documented (Dickie *et al.*, 2010).

Many field studies have shown that the productivity fruit bodies is mostly related to average monthly rainfall and temperature (Lagana *et al.,* 2002; Salerni *et al.,* 2002; Aragon *et al.,* 2007; Krebs *et al.,* 2008; Pinna *et al.*, 2010). Regarding rainfall and temperature, a few attempts to explain the duration of fungal fruiting in relation to climate change have recently been discussed (Straatsma *et al.*, 2001; Mihail *et al.,* 2007; Gange *et al.*, 2007; Kauserud *et al.*, 2008b, 2011). Furthermore, the productivity of fungi is also determined by habitat characteristics. Generally, forest stands display greater epigeous mushroom productivity than mature stands (Pinna *et al.*, 2010).

2.7.2 Seasonal variation of polypore diversity

Effects of climate change on fungal distribution and activity are hard to predict because they are mediated in many different ways, including: fungal physiology, reproduction and survival, host physiology, spatial and temporal distribution of hosts, resource availability and outcome of competitive interspecific interactions (Boddy *et al.,* 2014).

Mushrooms appear to be collected and consumed during almost the entire year, but most fungi are collected during the rainy season, suggesting the importance of

rainfall patterns in fungal phenology (Dijk *et al.,* 2003). Such is the case in tropical Africa, where many species are found in the rainy season, but there are a few species that are present throughout the year (Adekunle and Ajao, 2005; Gbolagade *et al.,* 2006). Straatsma *et al.* (2001) reported that the peak of mushroom fruiting was around late summer to autumn based on their long term survey in the fungal reserve La Chaneaz in western Switzerland and suggested temperature to be the potential triggering factor.

Tibuhwa (2011) studied the phenology of macrofungi community at the University of Dar es Salaam main campus, Tanzania and observed that the long rains of March- May in the year had the largest number of macrofungi species recorded. He found out a strong correlation between the numbers of fruit body and the amount of rainfall received prior to fructification. He proposed the March- May rains to be the best season for macrofungi surveys and harvesting in the study area and probably in other parts in the region with similar rainfall pattern. Polyporacea and Ganodermatacea were found capable to survive and overcome environmental changes including desiccation unlike other forms which produce simple short lived fruit bodies. Traditionally, surveys of wood-inhabiting fungi in Northern Europe have been conducted between August and October (Halme *et al.,* 2009; Jonsson *et al.,* 2008), which is regarded as 'the peak fruiting season' even though empirical data about the fruiting times of wood-inhabiting fungi does not exist.

The seasonal effect was strongest in agarics and to some extent the polypores. Annual polypores and corticioids seemed to be varying less and perennial polypores with no seasonality at all. For annual polypores, the relatively low seasonality is partly evident based on the fact that there are many species with relatively tough, sturdy fruit bodies or semi perennial species that have an annual fruit body which hibernates for one winter and is still visible and sporulating in next spring (Schigel *et al.,* 2006). So it is reasonable and expected that annual polypores are a species group with low variation in their occurrences. The absence of seasonality among the perennial polypores fortifies the statement of Halme *et al.* (2009) that perennial polypores could really be a useful indicator species group, even though there is no knowledge yet about

how well their occurrences predict the occurrences of other species groups than annual polypores.

2.8 SUBSTRATE CHARACTERISTICS AND POLYPORE DIVERSITY

Different polypore species have distinct functional characteristics defined by their differential decay capacity in different wood substrate conditions (e.g. living stem, standing or fallen dead stem, dead log, and branches of different diameters) with different physical and chemical properties (Rayner and Todd, 1979). The polypore species that decay the wood of living trees are usually called parasites, and those species that decay the wood of dead trees or dead parts of living trees are called saprobes (Oberwinkler, 1994). The substrate type, size of substrate and decay stage of substrate will influence the polypore diversity.

2.8.1 Substrate types and polypore diversity

Studies on the community structure of polypores in Andean alder wood in Argentina have shown a preferential occurrence of polypores on different wood conditions (Urcelay and Robledo, 2004). Species richness was lowest on living trunks and highest on dead branches. Out of 16 species of polypores encountered, 14 were found on dead branches followed by dead trunk (8), cut stump (6) and living trunk (4). They have observed that the *Trametes cubensis*, *Ganoderma aff. adspersum* and *Phellinus gilvus* were characterized by the capability to decay standing living trunks. *Bjerkandera adusta* and *Lenzites betulina* showed the highest frequency on dead logs mainly on cut stumps and dead branches.

Substrate specificity of macrofungi community at the University of Dar es Salaam main campus, Tanzania have shown that the distribution of macrofungi differed markedly based on substrate (Tibuhwa, 2011). The tree log substrate supported more macrofungi (28%) followed by soil (26%), wood substrate (22%) and decaying leaf litter (22%). The live tree substrate supported the least macrofungi (6%) followed by 7 per cent on wood debris.

In Finland, only 36 polypore species (16%) are known to utilize living trees, whereas 207 species (93%) grow on dead wood and 20 species can live on both living and dead trees (Niemela, 2005). Sippola and Renvall (1999) documented 32 species from logged areas and old-growth boreal forests in Northern Finland, among them 84 per cent occurred on logs followed by 25 per cent on snags, 9 per cent on both cut and natural stumps and 41 per cent on logging waste. In general, on downed trees (logs), the total number of species and occurrences and the number of red-listed species were reported to be high than on standing dead trees (Rydin *et al.,* 1997; Sippola and Renvall, 1999; Sippola *et al.,* 2001, 2005; Berg *et al.,* 2002; Tikkanen *et al.,* 2006). Moreover, the number of unique species is higher on logs than on standing dead trees, i.e. most of those species that can grow on standing trees can also live on logs but not the other way round (Lindhe *et al.,* 2004; Sippola and Renvall, 1999; Junninen and Komonen, 2011).

The studies on the wood-rotting fungi in East Khasi Hills of Meghalaya, northeast India have shown that the logs harboured the maximum number of wood-rotting fungi (59.7 %) followed by tree stumps and twigs (32.5 %). The living trees harboured the least with 7.8 per cent of macrofungi (Lyngdoh and Dkhar, 2014). This substrate preference is due to the different species adaptations to the defence mechanisms present in the living trees, and not in logs, tree stumps and twigs, as well as differences in the microclimate within each substrate (Boddy, 2001). Further the larger logs contain more core-wood which supports a specialized flora of polypores with conk-shaped fruit-bodies (Rayner and Todd, 1979).

2.8.2 Substrate diameter class and polypore diversity

Substrate diameter is an important factor that determines the occurrences of wood-inhabiting polypores. Studies have shown that these fungi have different preferences for substrate diameter. Generally the number of species per dead wood item increases with increasing diameter of the substrate (Junninen and Komonen, 2011). The study on diversity of polypores in northern boreal forests by Sippola *et al.*

(2004) have shown that the number of polypore species doubled more than from the diameter classes less than 20 cm to the diameter classes >20 cm (all tree species included). The studies on the community structure and dynamics of wood-rotting fungi on decomposing conifer trunks in northern Finland have also shown the similar trend (Renvall, 1995). However Siitonen *et al.* (2005) found that the number of occurrences of polypores on logs less than or equal to 30 cm in diameter was 2-48 times the number of occurrences on logs 10-19 cm in diameter, depending on the species.

Rostamian and Kavosi (2013) have studied the effect of tree diameter on establishment, diversity and richness of Bracket fungi in Golestan province forest, North of Iran. They have found that the fungi establishment increased by increasing the trees diameters, and the stand trees with more than 80 cm diameter and fallen trees with more than 40 cm diameter have more bracket fungi than other trees.

Studies on the community structure of polypores in Andean alder wood in Argentina have shown a preference of large diameter logs (25-50 cm) by *Trametes cubensis, Ganoderma aff. adspersum* and *Phellinus gilvus.* While *Bjerkandera adusta* and *Lenzites betulina* were characterized by having the highest frequency on dead logs of intermediate diameter (10-15 cm). Finally, *Schizopora radula, Datronia mollis, Hexagonia papyracea, Junghuhnia carneola, Polyporus tricholoma* and *Perenniporia* sp. formed a group that was always found on decayed wood, mainly on dead branches with small diameter (less than 10 cm) (Urcelay and Robledo, 2004).

Among the common species in Pasoh Forest Reserve, Malaysia, *Coriolopsis retropicta* and *Microporus xanthopus* were restricted to small substrata such as fallen branches and twigs while, *Erythromyces crocicreas* and *Ganoderma australe* were found mostly on large substrata. *Earliella scabrosa* and *Stereum ostrea* occurred on both large and small substrata (Hattori and Lee, 2003).

Spatial distribution of the basidiocarps of aphyllophoraceous fungi in a tropical rainforest on Borneo Island, Malaysia have shown that the *Phellinus lamaensis* and *Ganodema australe* appeared to colonize woody debris across the full diameter range.

While *Coriolopsis retropicta, Microporus xanthopus, M. affinis* and *Trametes cf. mimetes* appeared primarily from woody debris smaller than 20.0 cm in diameter (Yamashita *et al.*, 2009)

The threshold diameter critical for polypores species richness appears to be at 20-30 cm, at least on spruce logs (Bader *et al.*, 1995; Renvall, 1995; Siitonen *et al.*, 2005; Sippola *et al.*, 2004). At this diameter, species demanding large-diameter dead wood start to appear, while species that are able to utilize small-diameter debris can usually grow on large logs as well.

Furthermore, many common polypore species are more frequent on large logs than on small ones, which increases the average species number per log (Siitonen *et al.*, 2005). The importance of log diameter in promoting fungal species richness, however, is not straight forward. It has been shown that if equal volumes are compared, small-diameter dead wood can host more species than large-diameter wood (Kruys and Jonsson, 1999; Norden *et al.*, 2004). This has been explained by a larger surface area per volume of small-diameter dead wood, and a larger number of wood pieces per volume which, in turn, results in a larger variation in micro-environmental conditions (Kruys and Jonsson, 1999).

2.8.3 Substrate decay class and polypore diversity

During wood decay, moisture, temperature and gaseous conditions vary, and thereby also the prerequisites for fungal growth (Rayner and Boddy, 1988). These changes are to a major extent an effect of fungal decomposition itself and thus the activity of early species may facilitate the establishment of others (Rayner and Boddy, 1988). Among the variables related to the quality of dead wood, decay gradient has been identified as the strongest factor (Hoiland and Bendiksen, 1996; Lindblad, 1998; Renvall, 1995). Compared to the diameter of trees, the decay stage is a more subjective measure and decay stages measured in different studies are more difficult to compare. Nevertheless, the general hump-shaped trend is clear: more species at the mid-decay stages than at the early or the final stages (Bader *et al.*, 1995; Groven *et al.*, 2002;

Hoiland and Bendiksen, 1996; Junninen *et al.*, 2007; Jonsson *et al.*, 2008; Kruys *et al.*, 1999; Lindblad, 1998; Siitonen *et al.*, 2005; Sippola *et al.*, 2005; Stokland and Kauserud, 2004).

Studies on the polypores of the Norway spruce (*Picea abies*) forests in the boreal zone of Sweden have shown that the greatest numbers of species are found at intermediate stages of decay, i.e. decorticated logs where the wood has started to soften. During these stages logs may contain a mixture of early, intermediate and late successional species. In addition, if spore dispersal is limited, establishment poor, or the growth of mycelia slow, a highly decayed log may support a higher number of species, simply because of its age. (Bader *et al.*, 1995). Intermediate to late decay classes were preferred by red-listed and frequent species in managed Swedish boreal forests in northern Sweden (Kruys *et al.*, 1999).

Studies on the polypores on fallen logs of Norway spruce have shown that newly fallen and weakly decayed logs in a natural forest had a higher species richness, more red-listed species, as well as more indicator species compared to similar logs in a managed forest (Lindblad, 1998). Presence of logs in later stages of decomposition increased the total species number in a natural forest stand with 42 (63 %), compared to a survey of only newly fallen and weakly decayed logs. Presence of logs in later stages of decomposition also increased the diversity of the species pool colonizing newly fallen and weakly decayed logs. The highest number of fruiting species was found on intermediately decayed logs and on logs lying in contact with the ground (Lindblad, 1998).

Studies on the polypores of tropical rainforest on Borneo Island, Malaysia have shown that the dominant fungal species differed among the woody debris decay classes. More than 50 per cent of the basidiocarps of *Microporus affinis* and *Trametes cf. mimetes* were collected from fresh woody debris, whereas more than 50 per cent of *Phellinus lamaensis* was collected from old woody debris; *Amauroderma subrugosum, Ganoderma australe, Rigidoporus sp., Coriolopsis retropicta* and *Microporus*

xanthopus were predominantly collected from both fresh and medium debris (Yamashita *et al.*, 2009).

Hattori and Lee (2003) examined the effects of decomposition stage of substrata on species of wood-decaying basidiomycetes in Pasoh Forest Reserve, Malaysia. Some species such as *Cyclomyces tabacinus*, *Earliella scabrosa*, *Ganoderma australe*, *Microporus affinis* and *Rigidoporus microporus* were found mainly found on newly fallen trees while other species such as *Antrodiella* spp., *Nigroporus vinosus*, *Postia* spp. and *Tyromyces* spp. were found on well-decomposed trees. Species richness of wood-decaying basidiomycetes was higher in a primary forest plot than in a regenerating forest plot. They suggested that a low frequency of tree fall in the regenerating forest reduced the species richness of wood-decaying basidiomycetes.

In Norway spruce forests, Sweden the early colonizers were primarily affected by the stage of decomposition; secondary colonizers were affected by a variety of within patch and/or between patch variables, maintaining high species coexistence within intermediate stages of decay (Jonsson *et al.*, 2008). Recently, the studies on variety of woody debris as the factor influencing wood-inhabiting fungal richness and assemblages in northern Navarre, in the northern part of the Iberian Peninsula have shown that the Polyporaceae were adapted to coarse wood debris and they appeared mostly on recently fallen or first stage decaying logs (Abrego and Salcedo, 2013).

2.9 FOREST TYPE AND POLYPORE DIVERSITY

Forest vegetation type is one of the factors that are related with the occurrence of macrofungal communities in the forests (Bujakiewicz, 1992; Perini *et al.*, 1993). Distribution patterns of polypores is the reflection of distributions of forest vegetation types (Strid, 1975; Vaisuanen *et al.*, 1992).

Hattori (2005) examined species composition and diversity of wood-inhabiting polypores in beech, *Castanopsis*, secondary oak, secondary pine, Japanese cedar and Hinoki cypress forests situated in a temperate area of Japan. Cluster analysis of the

polypore communities revealed a correlation between forest vegetation types and the species composition of polypores occurring in the forests. He divided the polypores as vegetation type specific species, hardwood specific species and conifer specific species. Vegetation type specific species are defined as those recorded only in one forest vegetation type, which will include real specialists restricted to the forest type and infrequent species possibly occurring in other forest types. *Cystidiophorus castaneus*, *Cryptoporus volvatus*, *Diplomitoporus lenis* and *Trichaptum abietinum* were vegetation type specific species in pine forest. *Phellinus sanfordii, Antrodiella gypsea* and *Oxyporus cuneatus* were vegetation type specific in Japanese cedar plantations.

In mangrove forests the abundant polypores were distinct from those in freshwater swamp forests suggesting that a unique mycobiota exists in mangrove forests (Gilbert *et al.*, 2008). Hymenochaetaceae species, especially *Phellinus rimosus* and its allies, are important mangrove-inhabiting fungi in Central and South America and in Micronesia (Gilbert and Sousa, 2002; Baltazar *et al.*, 2009a; 2009b). In freshwater swamp forest in lowland Malaysia, *Earliella scabrosa*, *Microporus affinis* and *Rigidoprus microporus* showed preferences for freshwater swamps (Gilbert *et al.*, 2008). Similarly, out of 100 species of polypores recorded from montane forests of Malaysia, 26 species were montane species known only from the montane forest of Malaysia and 57 species were classified as lowland rainforest species that are more frequently collected in lowland areas of Malaysia. Most of the others are temperate species distributed mainly in temperate areas in East Asia (Hattori, 2005).

Zhou *et al.* (2011) investigated diversity and preferences for hosts and substrates for polypores from a boreal forest, a temperate and warm temperate forest zone, and a tropical and subtropical forest zone in China and found that the their ecological patterns are generally related to the type of forest ecosystem. The tropical and subtropical forest zone harbored the highest polypore diversity. The temperate and warm temperate forest zone showed a greater similarity of polypore diversity to the boreal forest zone than to the tropical or subtropical forest zone, although the representative areas of temperate and warm temperate forest and tropical and

subtropical forest zones are geographically closer. The species number and proportion of brown rot polypores decreased from the boreal forest to tropical and subtropical forest zone by 22 per cent and 21.8 per cent respectively. Fallen trunks were the most attractive substrate for polypores in all three zones, but the proportion of polypores on fallen trunks decreased from the boreal forest to tropical and subtropical forest zone by 20%. They have been explained that the distinctions could be due to the varied proportion of gymnosperm and angiosperm trees, as well as different substrate diversity in the three forest zones with different climatic conditions.

2.10 HOST PREFERENCE AND SPECIFICITY

A combination of the distributions of suitable hosts and environmental conditions determine the natural distribution of plant-associated fungi across broad geographic ranges (Brandle and Brandl, 2006; Gilbert *et al.*, 2007; Robertson *et al.*, 2006). Many fungi that depend on plants for nutrition are associated with a broad diversity of plant hosts and habitats (Gilbert *et al.*, 2008). Determination of selectivity is usually based on the presence of fruit bodies, but absence of fruit bodies does not necessarily indicate absence of mycelia. The causes of host selectivity of wood-decay species are complex and include wood chemistry, wood microclimate, gaseous regime and the way of fungal establishment (Boddy, 2001).

Globally generalist wood inhabiting polypores may be host specialists within given ecological contexts (Thompson, 1982; Gilbert *et al.*, 2008). More than half of the polypore fungi described as pine or spruce specialists in Scandinavia show broad host ranges in China (Dai and Penttila, 2006). Understanding local host selectivity is important since it affects patterns of spread, density-dependent population dynamics, and in turn the maintenance of biological diversity and aspects of ecosystem function (Gilbert *et al.*, 2008).

The host specificity of polypores and other wood-inhabiting basidiomycetes is widely considered to be low in tropical areas because the probability of successful colonization decreases, as host trees become rarer in these areas with high species

richness (Schmit, 2005). Nevertheless, the study by Gilbert and Sousa (2002) in low diversity neotropical Caribbean mangrove forest revealed that just three polypore species comprised 88 per cent of all collections and each of the five species encountered multiple times showed very strong host preferences. In Micronesian tropical flooded forests also polypores shows strong host preferences (Gilbert *et al.*, 2008).

Studies on the community structure of wood-decaying Basidiomycetes in Pasoh Forest Reserve, a lowland rainforest of Malaysia by Hattori and Lee (2003) recorded saprobic species of polypores and other aphyllophoraceous fungi on fallen logs of 33 tree families. Many of the frequently occurring polypores did not show a preference for any particular tree family: *Ganoderma australe*, one of the most common species in Pasoh, was recorded on 15 tree families, *Nigroporus vinosus* on 13 families and *Rigidoporus microporus* on 10 families. However, in Pasoh the some common polypores and aphyllophoraceous wood-inhabiting fungi occurred exclusively on Dipterocarpaceae.

Studies on the aphyllophoraceous fungi in a tropical rainforest on Borneo Island, Malaysia have shown that some fungal species are generalists that can survive on a range of plant species. For example, *Ganoderma australe* has been collected from species in the Leguminosae, Dipterocarpaceae and Euphorbiaceae, and *Phellinus lamaensis* has been collected from species in the Dipterocarpaceae and Meliaceae from the study site (Yamashita *et al.*, 2009). However, the study by Yamashita *et al.* (2010) in broadleaf forest in cool temperate area of Japan detected host specificity of fungal species at species and population level. The five of the dominant wood-inhabiting fungal species were recorded only on oak and chest nut trees. Among them *Hymenochaete rubiginosa*, *Piploporous soloniensis* and *Xylobolus frustulatus* were completely restricted to *Quercus* and *Castanea*. In Europe, nearly one-third of the polypores had preferences for certain tree genera and only a limited number of species occured on both coniferous and hardwood trees (Ryvarden and Gilbertson, 1993; 1994).

A study based on thorough world literature survey for the host range of *Phellinus* species have shown its infection on about 91 plant families. Amongst all the families, genera of Fabaceae were found to be most susceptible, followed by Rosaceae, Myrtaceae, Cupressaceae, Caesalpiniaceae, Ericaceae, Euphorbiaceae and Lauraceae. The families like Meliaceae, Pinaceae, Rubiaceae, Arecaceae, Fagaceae and Olecaceae were also reported as the most frequently infected families. *Quercus* was the most frequent host of Phellinus spp. (Ranadive *et al.*, 2012).

Vishal *et al.* 2012 studied the diversity and host specificity of wood rotting fungi in Western Ghats region of Maharashtra. Out of total rotting specimens collected, 94.45 per cent (102 specimens) were grown exclusively on dicotyledonous host whereas, only 5.55 per cent (6 specimens) were grown on monocotyledon family. They has been reported severe infection of *Polyporus xanthopus* on live trunk of *Terminalia bellerica, Fomes albomarginatus* and *F. fomentarius* with extensive colonization on *Terminalia arjuna* and *Delonix regia* respectively. The most frequently seen species of wood rotting fungi infecting to different host found in Western Ghats of Maharashtra were *Daedalia* (12 hosts), *Hexgonia* (14 hosts), *Lenzites* (7 hosts), *Polyporus* (19 hosts), *Schizophyllum* (7 hosts), *Trametes* (16 Hosts) and *Sparassis* (1 host).

The study on decay of standing trees in the semi evergreen, evergreen and wet evergreen forests of Kerala showed a wide host range of polypores. While a few species like *Fomitopsis palustris, Hexagonia sulcata* and *Rigidoporus lineatus,* etc. exhibited restricted distribution and very narrow host range. Among the *Fomitopsis dochmius* and *F. rhodophaeus* were the most widespread in occurrence as well as they exhibited a wide host range (Mohanan, 1994). The study of Imrose *et al.* (2005) on the decay characteristics of polypores on some selected tree species of local significance in Kerala showed signs of host preference. *Hexagonia tenuis* was found infecting the wood of all the five selected tree species. The *Phellinus gilvus* was found attacking only *Peltophorum ferrugineum* timber. The studies on the macrofungal flora of Peechi-Vazhani wildlife sanctuary have shown that most of the polypore have a wide host

range and *Terminalia paniculata, Tectona grandis, Xylia xylocarpa* were the most infected host trees (Florence and Yesodharan, 2000).

While reviewing the literature, it was noted that studies on the polypore phenology, host specificity and role of substrate features on the diversity of polypores in tropical forests were negligible compared to the temperate forests. Only few studies could be traced with respect to polypore phenology, seasonal variation and diameter class preference in tropical forests. Against this background, the present study was aimed to explore the above mentioned aspects which would be helpful in determining the ecological and functional role of polypores in tropical ecosystems.

MATERIALS AND METHODS

MATERIALS AND METHODS

3.1 STUDY AREA

3.1. 1 Name, location and extent

Silent Valley National Park (SVNP) lies within the geographical extremes of latitudes 11°, 2' N and 11°, 13' N and longitudes 76°, 24' E and 76°, 32' E (Fig. 1) in the southwest corner of Nilgiri hills of Southern Western Ghats. Silent Valley National Park constitutes part of the core area of India's first biosphere reserve, the Nilgiri Biosphere Reserve. Silent Valley Division, comprised of Silent Valley National Park as its core area (89.52 sq. km) was formed on 16th May 1986. In 2007 an area of 148 sq. km. was added to this division as buffer zone. The present study was carried out in the core area of the National Park.

3.1.2 Terrain

The terrain of the SVNP is generally undulating with steep escarpments and many hillocks. The elevation ranges from 900 M to 2,300 M above MSL with the highest peak at 2,383 M (Anginda peak).

3.1.3 Climate

There is considerable variation in climate due to change in elevation from plains to the Ghats where hills are drier and cooler; the plains are humid and hot. From March a light western sea breeze is experienced in the later part of the day, which gradually develops into a south west monsoon around the beginning of June. From November to March, there are strong dry east winds blowing during early hours of the day, till past noon. There are occasional thunder storms in April and May.

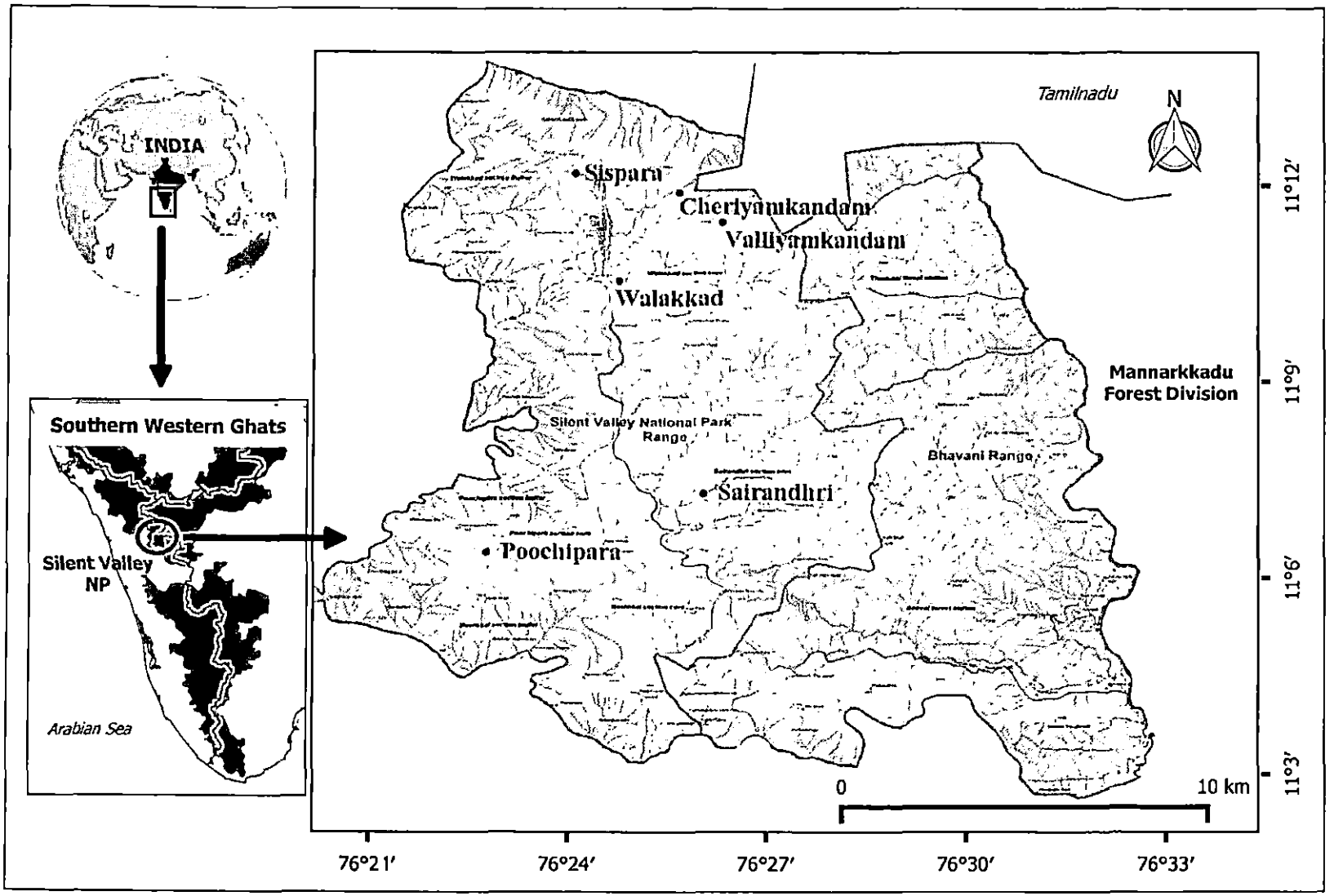


Fig. 1. Location map of the study area in Silent Valley National Park

3.1.3.1 Rainfall

Both the south west monsoon and the north eastern monsoon cause rains in this area. The major share, however, comes from the south west monsoon, which sets in during the first week of June. The heaviest rainfall is during the months of June, July, and August.

The variation in the intensity of rainfall is observed across the area. The elevated hills on the western side of Silent Valley receive an average of 5045 mm and near Walakkad, the rainfall even reaches up to 6500 mm.

3.1.3.2 Relative humidity

From June to December, relative humidity is consistently high often around 95 per cent. The highest minimum value of relative humidity during different months across the vegetation types shows that its upper limit is around 75 per cent in the case of grass lands and ecotone while it goes up to 90 per cent in the forests during some months. This is also reflected in the difference between monthly maximum and minimum; the lowest range of this difference was between 23 per cent and 27 per cent in grass land/ecotone while it was only 5 per cent in the case of forests.

3.1.3.3 Temperature

The temperature varies widely both in the plains as well as in the hills. The temperature variation in the plains is between 20° C to 40° C and in the hilly areas it ranges from 10 ° C to 30 ° C.

3.1.3.4 Wind

The prevailing winds are from the west and south west during the period April to September and from east during the period October to March. Wind velocity shows higher values during the monsoon months.

3.1.4 Geology, Rock and Soil

The whole Park is a roughly rectangular tableland closed on all sides. It has high and continuous ridges along its entire east, north and northeast borders and a somewhat lower ridge along the entire western and southern border. Along its entire length, the plateau slopes toward the bed of Kunthipuzha, which divides it to two halves. The rock formation is of Archaean age and consists predominantly of Nilgiri gneiss and its metamorphic variations. The gneiss is finely foliated and is composed of Quartz, Feldspar and Mica. The gneiss has undergone metamorphism during the course of time. Veins of quartz are not uncommon and some quartzite is also prevalent. Soils in general are loam in the surface as well as in deeper layers.

3.1.5 Vegetation

The forests exhibit considerable variation in floristic composition, physiognomy and life forms due to climatic, edaphic and altitudinal variations. About 75-80 per cent of the land in the Protected Area is covered with thick woody vegetation and about 20 per cent of the area is having grassland and little area is under rocky patches with little vegetation cover.

The Silent Valley in general embodies vast stretches of wet evergreen forest in the undulating hills and valleys between elevation of 900 m and 1500 m. The Evergreen forest of Silent Valley is the home par excellence of the broad leaved evergreen trees in multi-storeyed canopies often reaching up to 40 m or more. The dominant tree species in this type of forest are usually about 45 m in the height, and consists generally of *Cullenia exarillata, Machilus macrantha, Elaeocarpus munronii, Palaquim ellipticum, Mesua ferrea, Calophyllum inophyllum, Cinnamomum malabatrum, Canarium strictum, Syzygium cumini, Syzygium laetum, Dysoxylum malabaricum, Poeciloneuron indicum, Mangifera indica, Artocarpus integrifolia, Holigarna grahamii, Hopea glabra* and *Garcinia gummi-gutta.*

Wet evergreen forest at Poochippara

Shola forest at Sisppara

Plate 1. Study area habitats

The shola forests is seen in cliffs and sheltered folds above 1800 m where water is available in surplus. The Sispara area is enriched with typical shola forests. Because of wind and high altitude these forests are stunted, the trees seldom attaining a height above 15 m. Lauraceae and Myrtaceae members constitute the bulk of the flora. The dominant species found are *Rhododendron arboreum, Schefflera rostrata, Ternstroemia gymnanthera, Michelia nilgirica, Gordonia obtusa, Ilex wightiana, Meliosma pinnata, Cinnamomum sulphuratum, Cinnamomum wightii, Litsea floribunda, Litsea stocksii, Euonymaus crenulatus, Glochidion ellipticum* and *Symplocos racemosa.*

3.2 SAMPLING OF POLYPORE FUNGI

3.2.1 Sample plots

Six permanent sample plots of size 100 m × 100 m were established in evergreen and shola forests (3 in each ecosystem) as per the methodology followed earlier fungal studies (Yamashita *et al.*, 2010; Mohanan, 2011). In evergreen forests, the sample plots were taken in three different locations viz. Sairandhri, Poochipara and Walakkad sections. Three sample plots of shola forest were taken in different locations viz., Sispara, Cheriyamkandam and Valliyamkandam. Subplots of 10 m x 10 m were also fixed in each permanent plot for detailed diversity analysis. The sample plots were visited during pre-monsoon, monsoon and post monsoon periods for the documentation of polypores including collection of sporocarps, labelling, identification of rot character, taking photographs, recording macromorphological description and details of substratum in the illustrated data sheet. A total area of 60,000 m^2 was surveyed in each of the three climatic seasons. The species recorded from the sample plot only were considered for the diversity parameter analysis. Additional collection of polypores was also made from "off plots" in the study area. Thus, a combination of opportunistic and plot-based survey was carried out to maximize the documentation of polypore diversity and distribution. All the trunks and branches were enumerated using standard equipments. The decay stages of the logs were determined according to a 5-grade scale (based on decay classification system of Pyle and Brown, 1998).

3.2.2 Specimen collection and identification

The polypore specimens collected from the study area were kept in paper bags and brought to the lab. The specimens were properly air dried or oven dried at 70° C and stored in polythene zip-cover under less humid conditions. The specimens were identified based on their macro and micro morphological features. The colour names and colour codes of the specimens were given as per Kornerup and Wanscher (1967). The identification key provided by Bakshi (1971) and Leelavathy and Ganesh (2000) were used for the confirmation of polypore species. The micromorphological characteristics of the polypores were studied using Lieca DM 750 Microscope. Some of the specimens were compared with those in the Herbaria at Kerala Forest Research Institute, Peechi. The taxonomy and nomenclature are as per indexfungorum (http://www.indexfungorum.org/names/names.asp), and the authors of scientific names are according to the 'Authors of Fungal Names' (http://www.indexfungorum.org/authorsoffungalnames.htm). All the specimens collected during the study period were catalogued and kept under less humid conditions in the Department of Forest Management and Utilization, College of Forestry at Kerala Agricultural University (Appendix I).

3.2.3 Mycosociology

The polypore community has been quantitatively analyzed for their abundance, frequency, density and their relative values as similar to vegetation studies (Curtis and McIntosh, 1950). In order to determine the quantitative relationship between the polypore species, the following parameters were used. (Each basidiocarp is considered as an individual)

1. Density (D) $= \frac{\text{No. of individuals}}{\text{Hectare}}$

2. Relative density (R. D) $= \frac{\text{No. of individuals of the species} \times 100}{\text{No. of individuals of all species}}$

Sairandhri

Poochippara

Sisppara

Walakkad

Cheriyamkandam

Valliyamkandam

Plate 2. Fungal collection and dead wood examination in the study area

Plate 3. Micromorphological study of polypores using Leica DM750 image analyzer

3. Abundance (A) $= \frac{\text{Total No. of individuals of the species}}{\text{No .of quadrats of occurrence}}$

4. Frequency (F) $= \frac{\text{No .of quadrats of occurrence}}{\text{Total No. of quadrats studied}}$

5. Percentange Frequency (P. F) $= \frac{\text{No .of quadrats of occurrence x 100}}{\text{Total No.of quadrats studied}}$

6. Relative Frequency (R. F) $= \frac{\text{Percentage frequency of individual species x 100}}{\text{Sum percentage frequency of all species}}$

3.2.4 Polypore fungal diversity

In addition to the quantitative analysis, the diversity of polypores was calculated using Shannon-Weiner and Simpson Index of diversity as similar to plant species diversity measurements (Magurran, 1988). The following formulae have used for determine the diversity of polypores.

1 Simpson Index of diversity, $D = 1 - \sum (ni / N)^2$ (Simpson, 1949)

Where ni – Number of individuals of the species

N – Total number of individuals in the plot, D- Diversity

2. Shannon-Weiner's Index, $H = 3.3219 (\text{Log } N - 1/N \sum ni \text{ log } ni)$

(Shannon and Weiner, 1962)

Where,

ni – Number of individuals of the species

N – Total number of individuals

3. Pielou's Evenness Index (E) = (LnN-1/N $\sum$ ni ln ni)/Ln N

Where,

ni – Number of individuals of the species

N – Total number of individuals

4. Berger-Parker Dominance Index (D) = nmax/N (Berger and Parker, 1970)

Where,

nmax – Highest value of number of individuals of species

N – Total number of individuals

5. Margalef Richness Index (R) = (S-1)/N

Where,

S – Total number of species

N – Total number of individuals

3.2.5 Sorenson Similarity Index

Similarity of each polypore community was calculated by the following equation:

QS= 2c/ a+b

Where,a and b represent the species numbers occurring in two different plots, and c, the species occurring in both plots (Sorenson, 1948).

3.2.6 Decay class analysis

The decay stage of the substrate was determined according to a 5-grade scale based on decay classification system of Pyle and Brown (1998).

Table 1. Classification of logs according to decay stage as per Pyle and Brown (1998)

SI No.	Substrate characteristics	Decay classes				
		1	2	3	4	5
1	Bark firmly attached	+	-	-	-	-
2	Wood has `fresh' color (not stained by weathering)	+	-	-	-	-
3	Branches retain many small twigs	+	+/-	-	-	-
4	Bark present, but not firmly attached	+	+/-	-	-	-
5	Log is a solid piece (though decay may be present)	+	+	+/-	-	-
6	When log is thudded perpendicularly, wood surface may flake off (flakes on the order of 2 cm 7 cm or larger) or shreddy flakes may remain attached to log or wet surface may flatten then rise back	+	+	+	-	-
7	Log is a solid piece with decay easily seen	-	-	+/-	+/-	-
8	Log shape may be oval	-	-	-	+/-	+
9	Log is no longer a solid piece, but large (sometime quite hard) chunks of wood remain	-	-	-	+	-
10	Kicked log may cleave into large pieces (not flakes)	-	-	-	+	-
11	Log may crush when thudded with a foot	-	-	-	+	+/-
12	Log is predominately powdery wood (>85%, class V)	-	-	-	+/-	+
13	Log shape may be flattened	-	-	-	+/-	+

[+ present, – absent]

3.2.7 Statistical Analysis

Linear regression analysis was done in PAST 3.04 and Principal Component Analysis (PCA –Bi plot) was done in version 15/4/2015 of XLSTAT.

Decay class 1

Decay class 2

Decay class 3

Decay class 4

Decay class 5

Plate 4. Substrates under different decay stages

RESULTS

RESULTS

The study on diversity and distribution of polypores in the wet evergreen and shola forests of Silent Valley National Park, Kerala was carried out during the period of 2014-2015. The results obtained from the study are explained below.

4.1 SPECIES COMPOSITION OF POLYPORES IN THE WET EVERGREEN AND SHOLA FORESTS

A combination of opportunistic and plot based sampling was carried out in order to maximize the documentation of polypore distribution. The list of polypores identified from wet evergreen and shola forests is given in Table 2. Fifty seven polypore species in twenty nine genera belonging to seven families were documented. The distribution of polypores was analyzed based on habitat, family, rot and habit (Fig. 2). The wet evergreen forest was enriched with 52 species whereas the shola forest harboured 20 polypore species. Fifteen species were found in both ecosystems while 5 species were exclusively found in shola forest.

The Polyporaceae was the dominant family with 30 species followed by Hymenochaetaceae (16 sp.), Fomitopsidaceae and Meripilaceae with 3 species each. Ganodermataceae and Schizoporaceae made their presence with two species each while only one species was reported under family Meruliaceae. Among the polypores documented, 42 species were annuals and 15 were perennials. While analyzing the rot characteristics of the recorded polypores, it was found that the white rot polypores have notable dominance over brown rot polypores. Out of 57 species analysed, 52 polypores were white rotters and only five species were brown rotters.

Table 2. Species composition of polypores in the wet evergreen and shola forests of Silent Valley National Park

SI. No	Species	Family	Habit	Rot	Occurrence	
					Ever green	Shola
1	*Abortiporus biennis* (Bull.) Singer	Meruliaceae	A	W	✓	
2	*Cellulariella acuta* (Berk.) Zmitr. & V. Malysheva	Polyporaceae	A	W	✓	✓
3	*Coriolopsis telfairii* (Klotzsch) Ryvarden 1972	Polyporaceae	A	W	✓	
4	*Cyclomyces setiporus* (Berk.) Pat.	Hymenochaetaceae	A	W	✓	
5	*Daedalea dochmia* (Berk. & Broome) T. Hatt.	Fomitopsidaceae	P	B	✓	
6	*Earliella scabrosa* (Pers.) Gilb. & Ryvarden	Polyporaceae	A	W	✓	✓
7	*Favolus tenuiculus* P. Beauv.	Polyporaceae	A	W	✓	
8	*Fomes extensus* (Lev.) Cooke	Polyporaceae	P	W	✓	
9	*Fomes pseudosenex* (Murrill) Sacc. & Trotter	Polyporaceae	P	W	✓	
10	*Fomitopsis feei* (Fr.) Kreisel	Fomitopsidaceae		B	✓	
11	*Fomitopsis palustris* (Berk. & M.A. Curtis) Gilb. & Ryvarden	Fomitopsidaceae	A	B	✓	
12	*Fulvifomes cesatii* (Bres.) Y.C. Dai	Hymenochaetaceae	A	W		✓
13	*Funalia caperata* (Berk.) Zmitr. & V. Malysheva	Polyporaceae	A	W	✓	
14	*Fuscoporia contigua* (Pers.) G. Cunn.	Hymenochaetaceae	P	W	✓	
15	*Fuscoporia ferrea* (Pers.) G. Cunn.	Hymenochaetaceae	A	W	✓	
16	*Fuscoporia senex* (Nees & Mont.) Ghob.-Nejh.	Hymenochaetaceae	A	W	✓	
17	*Fuscoporia wahlbergii* (Fr.) T. Wagner & M. Fisch.	Hymenochaetaceae	P	W	✓	✓
18	*Ganoderma australe* (Fr.) Pat.	Ganodermataceae	P	W	✓	✓
19	*Ganoderma lucidum* (Curtis) P. Karst.	Ganodermataceae	A	W	✓	✓
20	*Hexagonia tenuis* (Hook.) Fr.	Polyporaceae	A	W	✓	
21	*Inonotus luteoumbrinus* (Romell) Ryvarden	Hymenochaetaceae	P	W	✓	
22	*Inonotus pachyphloeus* (Pat.) T. Wagner & M. Fisch.	Hymenochaetaceae	P	W	✓	
23	*Inonotus* sp. nov.	Hymenochaetaceae	P	W	✓	
24	*Inonotus tabacinus* (Mont.) G. Cunn.	Hymenochaetaceae	A	W	✓	
25	*Leucophellinus hobsonii* (Berk. ex Cooke) Ryvarden	Schizoporaceae	A	W	✓	✓
26	*Microporellus obovatus* (Jungh.) Ryvarden	Polyporaceae	A	W	✓	✓

[A-Annual, P-Perennial, W-White rot, B-Brown rot, * New report from Kerala, ** New to the Science]

Contd...

Sl. No	Species	Family	Habit	Rot	Occurrence	
					Evergreen	Shola
27	*Microporus affinis* (Blume & T. Nees) Kuntze	Polyporaceae	A	W	✓	✓
28	*Microporus* sp. nov.	Polyporaceae	A	W	✓	
29	*Microporus xanthopus* (Fr.) Kuntze	Polyporaceae	A	W	✓	✓
30	*Neofomitella rhodophaea* (Lev.) Y.C. Dai	Polyporaceae	A	B	✓	
31	*Nigroporus vinosus* (Berk.) Murrill	Polyporaceae	A	W	✓	
32	*Phellinus dependens* (Murrill) Ryvarden	Hymenochaetaceae	P	W	✓	
33	*Phellinus fastuosus* (Lev.) S. Ahmad	Hymenochaetaceae	P	W	✓	✓
34	*Phellinus gilvus* (Schwein.) Pat.	Hymenochaetaceae	A	W	✓	
35	*Phellinus nilgheriensis* (Mont.) G. Cunn.	Hymenochaetaceae	P	W	✓	✓
36	*Phellinus zealandicus* (Cooke) Teng	Hymenochaetaceae	A	W	✓	
37	*Phylloporia pectinata* (Klotzsch) Ryvarden	Hymenochaetaceae	P	W		✓
38	*Polyporus dictyopus* Mont.	Polyporaceae	A	W	✓	
39	*Polyporus grammocephalus* Berk.	Polyporaceae	A	W	✓	
40	*Polyporus leprieurii* Mont.	Polyporaceae	A	W	✓	
41	*Polyporus* sp. nov.	Polyporaceae	A	W	✓	
42	*Rigidoporus lineatus* (Pers.) Ryvarden	Meripilaceae	A	W	✓	✓
43	*Rigidoporus microporus* (Sw.) Overeem	Meripilaceae	A	W	✓	
44	*Rigidoporus ulmarius* (Sowerby) Imazeki	Meripilaceae	P	B	✓	
45	*Schizopora paradoxa* (Schrad.) Donk	Schizoporaceae	A	W	✓	✓
46	*Spongipellis unicolor* (Schwein.) Murrill	Polyporaceae	A	W	✓	
47	*Trametes cingulata* Berk.	Polyporaceae	A	W	✓	
48	*Trametes cotonea* (Pat.) Ryvarden	Polyporaceae	A	W	✓	
49	*Trametes hirsuta* (Wulfen) Pilat	Polyporaceae	A	W	✓	✓
50	*Trametes marianna* (Pers.) Ryvarden	Polyporaceae	A	W	✓	
51	*Trametes maxima* (Mont.) A. David & Rajchenb	Polyporaceae	A	W	✓	
52	*Trametes menziesii* (Berk.) Ryvarden	Polyporaceae	A	W	✓	✓
53	*Trametes ochracea* (Pers.) Gilb. & Ryvarden	Polyporaceae	A	W		✓
54	*Trametes pubescens* (Schumach.) Pilat	Polyporaceae	A	W		✓
55	*Trametes versicolor* (L.) Lloyd	Polyporaceae	A	W		✓
56	*Trichaptum biforme* (Fr.) Ryvarden	Polyporaceae	A	W	✓	
57	*Trichaptum byssogenum* (Jungh.) Ryvarden	Polyporaceae	A	W	✓	

[A-Annual, P-Perennial, W-White rot, B-Brown rot, * New report from Kerala, ** New to the Science]

Abortiporus biennis

Cellulariella acuta

Coriolopsis telfairii

Cyclomyces setiporus

Daedalea dochmia

Earliella scabrosa

Favolus tenuiculus

Fomes extensus

Plate 5a. Polypore species recorded from Silent Valley National Park

Fomes pseudosenex

Fomitopsis feei

Fomitopsis palustris

Fulvifomes cesatii

Funalia caperata

Fuscoporia contigua

Fuscoporia ferrea

Fuscoporia senex

Plate 5b. Polypore species recorded from Silent Valley National Park

Fuscoporia wahlbergii

Ganoderma australe

Ganoderma lucidum

Hexagonia tenuis

Inonotus luteoumbrinus

Inonotus pachyphloeus

Inonotus sp. nov.

Inonotus tabacinus

Plate 5c. Polypore species recorded from Silent Valley National Park

Leucophellinus hobsonii

Microporellus obovatus

Microporus affinis

Microporus sp. nov.

Microporus xanthopus

Neofomitella rhodophaea

Nigroporus vinosus

Phellinus dependens

Plate 5d. Polypore species recorded from Silent Valley National Park

Phellinus fastuosus

Phellinus gilvus

Phellinus nilgheriensis

Phellinus zealandicus

Phylloporia pectinata

Polyporus dictyopus

Polyporus grammocephalus

Polyporus leprieurii

Plate 5e. Polypore species recorded from Silent Valley National Park

Polyporus sp. nov.

Rigidoporus lineatus

Rigidoporus microporus

Rigidoporus ulmarius

Schizopora paradoxa

Spongipellis unicolor

Trametes cingulata

Trametes cotonea

Plate 5f. Polypore species recorded from Silent Valley National Park

Trametes hirsuta

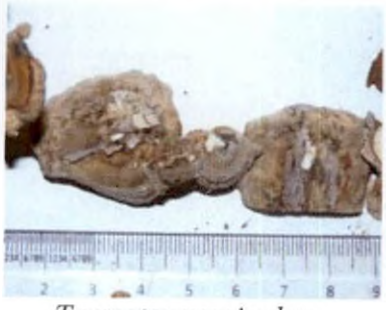
Trametes marianna

Trametes maxima

Trametes menziesii

Trametes ochracea

Trametes pubescens



Trametes versicolor

Trichaptum biforme

Trichaptum byssogenum

Plate 5g. Polypore species recorded from Silent Valley National Park

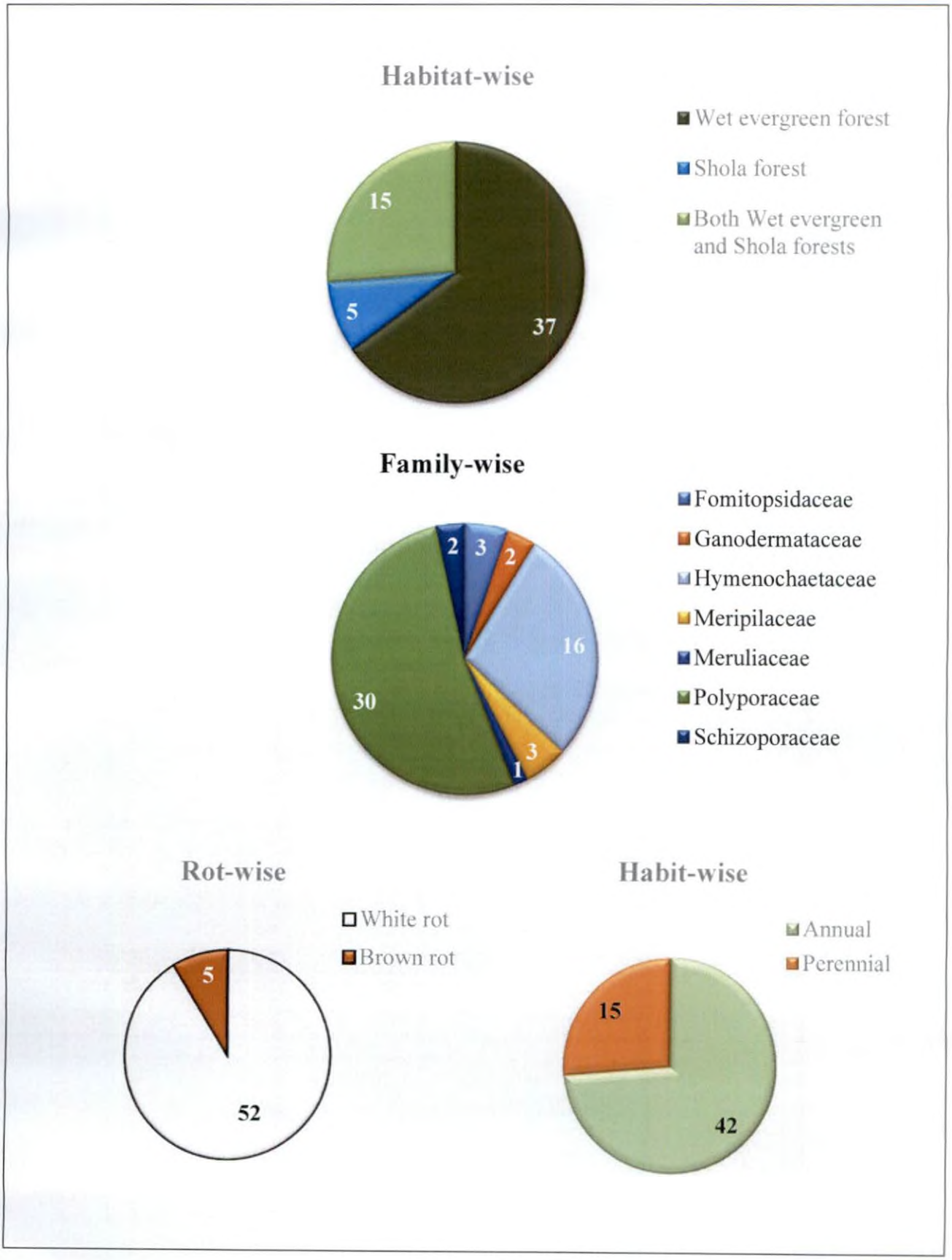


Fig. 2. Distribution of polypores in wet evergreen and shola forests

4.1.1 Key to the polypore species collected from Silent Valley National Park

An identification key was developed for the polypores documented from Silent Valley National Park based on the micro and macro morphological features as furnished below.

(I) KEY TO FAMILIES OF POLYPORES

1. Spore wall double, outer hyaline and thin,
   inner wall thick ornamental; spores truncate.....**GANODERMATACEAE**

1'. Spores smooth, inner wall if present thin,
   hyaline or coloured.....2

2. Context xanthochroic, Annual or perennial;
   generative hyphae if dimitic, simple septate,
   dark brown setae present or not, never trimitic.....**HYMENOCHAETACEAE**

2'. Context usually never xanthochroic,
   generative hyphae simple, septate
   or clamped, setae never present.....3

3. Hymenophore sporoid or irregularly laminate,
   sometimes shallow; context duplex.....**MERULIACEAE**
   (*Abortiporus biennis*)

3'. Context homogeneous, pores round to angular,
   if daedaloid never monmitic.....4

4. Individual pileate large,
   flabelliform with concentric zones, in large
   rosette-like cluster, clamps absent.....**MERUPILIACEAE**

4'. Pileate, solitary or imbricate or resupinate,
   never forming a rosette; clamps present or not,
   hyphal system dimitic or trimitc.....5

5. Consistency tough, tubes often irregular,
   cystidioles with capitate apex.....**SCHIZOPORACEAE**

5'. Consistency fleshy or spongy,
   tubes regular, context well developed,
   cystidioles usually absent.....6

6. Sporophore annual to perennial,
   stipitate or not, resupinate to solitary,
   pores angular to circular;
   soft to leathery, cystidia present.....**POLYPORACEAE**

6'. Sporophore perennial, tough, woody,
   Usually solitary, applanate, cystidia absent.....**FOMITOPSIDACEAE**

(II) KEY TO GENUS AND SPECIES OF POLYPORES

GANODERMATACEAE Donk,
Bull. bot. Gdns Buitenz. 17(4): 474 (1948)

1. Fruitbody leathery, (sub) stiptate;
pileus surface laccate, reddish brown or greyish.....*Ganoderma lucidum*

1'. Fruitbody sessile, surface never laccate,
brownish or darker.....*Ganoderma australe*

HYMENOCHAETACEAE Donk,
Bull. bot. Gdns Buitenz. 17(4): 474 (1948)

1. Sporophore annual or perennial; hyphal system dimitic,
generative hyphae hyaline, thin walled.....2

1'. Sporophore usually annual; hyphal system monomitic.....3

2. Context homogeneous; tubes stratified in perennials.....***Phellinus***

2'. Context duplex with spongy upper layer.....***Phylloporia***
(*P. pectinata*)

3. Sporophore annual, resupinate, setae absent.....***Fulvifomes***
(*F. cesatii*)

3'. Sporophore annual or perennial, never resupinate,
setae present or absent.....4

4. Hyphal system monomitic..... ***Inonotus***

4'. Hyphal system dimitic.....5

5. Sporophore annual, coriaceous, concentrically lamellate
to minutely poroid, spores hyaline.....***Cyclomyces***
(*C. setiporus*)

5'. Sporophore annual to perennial, hard woody,
strictly poroid, spores hyaline or greyish.....***Fuscoporia***

Phellinus Quel.,
Enchir. fung. (Paris): 172 (1886)

1. Setae present in trama or hymenium.....2

1'. Setae absent.....4

2. Sporophore annual, pileus surface hirsute to glabrous.....*Phellinus gilvus*

2'. Sporophore perennial, glabrous.....3

3. Setae up to 12-15 x 5-7 µm.....*Phellinus dependens*

3'. Setae up to 25-40 x 7-10 µm.....*Phellinus zeal*and*icus*

4. Fruitbody flabelliform to spathulate,
velutinate when young; spores subglobose.....*Phellinus fastuosus*

4'. Fruitbody applanate to ungulate,
glabrous, spores globose.....*Phellinus nilgheriensis*

Inonotus P. Karst.,
Meddn Soc. Fauna Flora fenn. 5: 39 (1879)

1. Hymenial and setal hyphae absent.....2

1'. Hymenial and setal hyphae present.....3

2. Pores 6-7 per mm; hyphal system monomitic;
spores globose.....*Inonotus* sp. nov.

2'. Pores 4-5 per mm; hyphalsystem dimitic;
spores 5-6 x 4.5-5 µm.....*Inonotus luteoumbrinus*
3. Setal hyphae abundant, 12-20 µm broad;
hyphal systemdimitic.....*Inonotus pachyphloeus*

3'. Setal hyphae 7.5- 10 µm broad;
hyphal system monomitic.....*Inonotus tabacinus*

Fuscoporia Murrill,
N. Amer. Fl. (New York) 9(1): 3 (1907)

1. Fruitbody pileate; pores 4-5 per mm.....2

1'. Fruitbody resupinate; pores 6-7 per mm.....3

2. Setae 15-25 µm long; decay: white stringy.....*Fuscoporia senex*

2'. Setae 30-40 µm long; decay: white rot.....*Fuscoporia wahlbergii*

3. Pores irregular, angular to daedaloid.....*Fuscoporia contigua*

3'. Pores smooth round.....*Fuscoporia ferrea*

POLYPORACEAE Fr. ex Corda [as 'Polyporei'], Icon. fung. (Prague) 3: 49 (1839)

1. Hymenophore angular, hexagonal or daedaloid.....2

1'. Hymenophore poroid.....3

2. Hymenophore hexagonal.....***Hexagonia*** (*H. tenuis*)

2'. Hymenophore daedaloid or lamellate.....***Cellulariella*** (*C. acuta*)

3. Context not xanthochroic, hyphal system dimitic or trimitic, clamps present or not.....4

3'. Context not xanthochroic, hyphal system dimitic or trimitic, clamps present or not.....6

4. Sporophore annual, leathery, pileus surface yellowish brown, hairs present.....5

4'. Sporophore perennial, heavy woody, glabrous .....***Fomes***

5. Pileal surface yellowish, hispid to scrupose, pores angular, up to 2 per mm; dissepiments often sharp or tricolor.....***Coriolopsis*** (*C. telfairii*)

5'. Sporophore brown, soft, tomentose, pores round, 3-5 per mm; dissepiments smooth.....***Funalia*** (*F. caperata*)

6. Sporophore stipitate, stipe central or lateral.....7

6'. Sporophore resupinate to pileate, never stipitate.....9

7. Stipe central, hyphal system dimitic.....***Polyporus***

7'. Stipe lateral, hyphal system trimitic.....8

8. Spore elliptical, coralloid elements present.....***Microporus***

8'. spores globose to subglobose; coralloid elements absent.....***Microporellus*** (*M. obovatus*)

9. Pileus surface vinaceus brown,
context reddish brown.....*Nigroporus*
(*N. vinosus*)

9'. Pileus surface yellowish, context lighter.....10

10. Pileus surface with prominent hairs, pore round to
daedaloid to irpicoid.....***Trichaptum***

10'.Pileus surface almost glabrous, pore mouth minute.....11

11. Pore tubes sunk into even depth
in forming a uniform stratum.....12

11'Pore tubes sunk into uneven stratum.....***Trametes***

12. Pore small, more than 6 per mm.....*Neofomitella*
(*N. rhodophaea*)

12'.Pores large, 1 per mm.....*Spongipellis*
(*S. unicolor*)

***Fomes* (Fr.) Fr.,**
Summa veg. Scand., Section Post. (Stockholm): 319 (adnot.), 321 (1849)

1. Fruitbody triquetrous, context with a black crusty line.....*Fomes extensus*

1'. Fruitybody conchate, irregular, context without
black crusty line.....*Fomes pseudosenex*

***Polyporus* P. Micheli ex Adans.,**
Fam. Pl. 2: 10 (1763)

1. Stipe central to eccentric.....*Polyporus leprieurii*

1'. Stipe lateral.....2

2. Pores more than 10 per mm;
dissepiments 20- 30 µm thick..... .....*Polyporus* sp. nov.

2'. Pore less than 8 per mm;
dissepiments more than 35 µm thick.....3

3. Pileus surface orange yellow to greyish,
radially straite;
pore surface brownish yellow to light orange.....*Polyporus grammocephalus*

3'. Pileus surface corn to hair brown;
pore surface yellowish white.....*Polyporus dictyopus*

Microporus P. Beauv., Fl. Oware 1: 12 (1805)

1. Stipe central, funnel shaped.....*Microporus xanthopus*

1'. Stipe lateral, flabelliform.....2

2. Pore mouth 50-70 µm wide; dissepiments 35-75 µm thick.....*Microporus affinis*

2'. Pore mouth 90-100 µm wide; dissepiments 50-60 µm thick.....*Microporus* sp. nov.

Trichaptum Murrill, Bull. Torrey Bot. Club 31(11): 608 (1904)

1. Pileus surface hispid, yellowish grey to violet, pores 1-2 per mm.....*Trichaptum byssogenum*

1'. Pore surface tomentose, yellowish white with greyish patch; Pores 3-5 per mm.....*Trichaptum biforme*

Trametes Fr., Fl. Scan.: 339 (1836)

1. Pileus surface hirsute, velutinate.....2

1'. Pileus surface glabrous.....6

2. Pileus surface azonate, white to cream coloured.....3

2'. Pileus surface yellowish to brownish coloured.....4

3. Pores 2-3 per mm, basidiospores cylindric to elliptic, 4-5 x 2.5-3 µm.....*Trametes cotonea*

3'. Pores 4-5 per mm, basidiospores oval, 6-7 x 2.5 µm.....*Trametes pubescens*

4. Pore surface white to cream.....*Trametes versicolor*

4'. Pore surface yellowish to yellowish grey.....5

5. Pileus surface velvety tomentose with glabrous bands.....*Trametes ochracea*

5'. Pileus surface with coarse hairs in bundles.....*Trametes hirsuta*

6. Pore surface irpicoid to dentate.....*Trametes maxima*

6'. Pore surface smooth.....7

7. Pileus surface yellowish; pores 6-8 per mm.....*Trametes marianna*

7'. Pileus surface with dark zonationsin bands,
Pores less than 5 per mm.....8

8. Laterally substipitate to very narrow attachment;
Pileus surface with narrow grey zonations.....*Trametes menziesii*

8'. Attachment with broad lateral base;
Pileus surface sooty brown broad strations.....*Trametes cingulate*

MERIPILACEAE Julich
Biblthca Mycol. 85: 378, 1981

1. Encrusted cystidia present.....*Rigidoporus lineatus*

1'. Cystidia usually absent, if present mucronate,
not encrusted.....2

2. Spores size : 4-5 µm or 4-5 x 3.5-4.5 µm;
decay causing white rot.....*Rigidoporus microporus*

2'. Spores size : 5-6 µm;
decay causing brown cuboidal rot.....*Rigidoporus ulmarius*

SCHIZOPORACEAE Julich,
Biblthca Mycol. 85: 389 (1982)

1. Sporophore resupinate; pores 4-6 per mm.....***Schizopora***
(*S. paradoxa*)

1'. Sporophore effused reflexed,
pileus surface hispid to strigose;
Pores 1 per mm.....***Leucophellinus***
(*L. hobsonii*)

FOMITOPSIDACEAE Julich,
Biblthca Mycol. 85: 367 (1982)

1. Sporophore annual, coriaceous.....***Fomitopsis***

1'. Sporophore perennial, hard, woody.....***Daedalea***
(*D. dochmia*)

***Fomitopsis* P. Karst.,**
Meddn Soc. Fauna Flora fenn. 6: 9 (1881)

1. Pileus surface rust brown to reddish blonde;
Spore cylindic to ellipsoid, 4-6 x 1.5-2.5 µm.....*Fomitopsis feei*

1'. Pileus surface white cream to pure yellow;
Spore cylindric to oblong ellipsoid.....*Fomitopsis palustris*

4.1.2 New records of polypores

During the present study, five species were found to be new records from Kerala and three species were found to be new to science (Table 3). These species have been described based on the macro-morphology and micro-morphology.

Table 3. New records of polypores from the wet evergreen and shola forests

SI. No.	Species	Family	Rot type	Collected from
1	*Inonotus pachyphloeus** (Pat.) T. Wagner & M. Fisch.	Hymenochaetaceae	White	Poochippara
2	*Inonotus* **sp. nov.	"	"	Poochippara
3	*Microporus*** sp. nov.	Polyporaceae	"	Walakkad
4	*Phylloporia pectinata** (Klotzsch) Ryvarden	Hymenochaetaceae	"	Sisppara
5	*Polyporus* **sp. nov.	Polyporaceae	"	Walakkad
6	*Trametes menziesii** (Berk.) Ryvarden	"	"	Sisppara
7	*Trametes ochracea** (Pers.) Gilb. & Ryvarden	"	"	Sisppara
8	*Trametes pubescens** (Schumach.) Pilat	"	"	Sisppara

[* New report from Kerala, ** New to Science]

4.1.2.4 Inonotus pachyphloeus (Pat.) T. Wagner & M. Fisch.

Cryptoderma pachyphloeum (Pat.) Imazeki, Bulletin of the Government Forest Experimental Station Meguro 57: 101 (1952)

Inonotus pachyphloeus (Pat.) T. Wagner & M. Fisch., Mycologia 94 (6): 1009 (2002)

Phellinus pachyphloeus (Pat.) Pat., Essai taxonomique sur les familles et les genres des Hymenomycètes: 97 (1900)

Polyporus pachyphloeus Pat., Journal de Botanique (Morot) 3: 257 (1889)

Scindalma pachyphloeum (Pat.) Kuntze, Revisio generum plantarum 3: 519 (1898)

Fruitbody perennial, solitary, pileate, attached with broad lateral base, semicircular to irregular, triquetrous or ungulate, tough and woody, light when dry,

size:12 x 13 x 14.5 cm. Pileus surface dark brown (6F7) or darker (5E8), glabrous when young and old, radially cracking with age, concentrically ridged, ridges smooth and rounded, crusty; margin wavy, rounded, smooth, projecting ahead of previous year's growth; Pore surface dark brown (7F4), uneven, dull; Pore tubes yellowish brown (5D8); pores minute not visible to naked eye, round, 8-9 per mm, pore mouth (75) 90-100 (110) μm wide, margin distinct, growth uniform; Dissepiments thin (30) 50- 80 (110) μm thick; Context brown (6E8).

Hyphal system trimitic. Generative hyphae hyaline, thin walled, branched simple septate, 2-3 μm in diam. Skeletal hyphae hyaline, slightly thick walled, lumen uniform, 2-4 μm in diam. Setal hyphae dark brown, thick walled, lumen absent, abundant in context, sharp pointed apices, 9-17 μm in diam. (Plate 6).

Decay: White rot

Specimens examined: on living trunk of *Elaeocarpus tuberculatus* Roxb. Poochippara, Silent Valley National Park, Herb. ACK 28/23-5-2014; ACK 34/30-1-2015

4.1.2.2 Inonotus sp. nov.

Fruitbody annual, solitary, imbricate, confluent, attached with tapering, but broad base, neagative in KOH, subflabelliform to irregular, corky while fresh, pliable when dry, 6-8 x 6-10 x 0.5- 2.5 cm. Pileus surface brown (6E7) to dark brown (6F8), highly uneven, powdery, tomentose, margin rounded, margin sometimes lobed; Pore surface brown (6E7), rough and uneven, growth not uniform, margin often entire or wavy, rounded, smooth, pores not not visible to naked eye, round to oval, 6-7 per mm, pore mouth 100-120 (155) μm wide; Pore tube of varying length, uniform, 0.1-0.3 cm long, brown (6E7); Dissepiments thin 50-60 (70) μm thick; Context of varying thickness, light brown (6D5), shining, homogeneous, 0.1 to 0.7 cm thick.

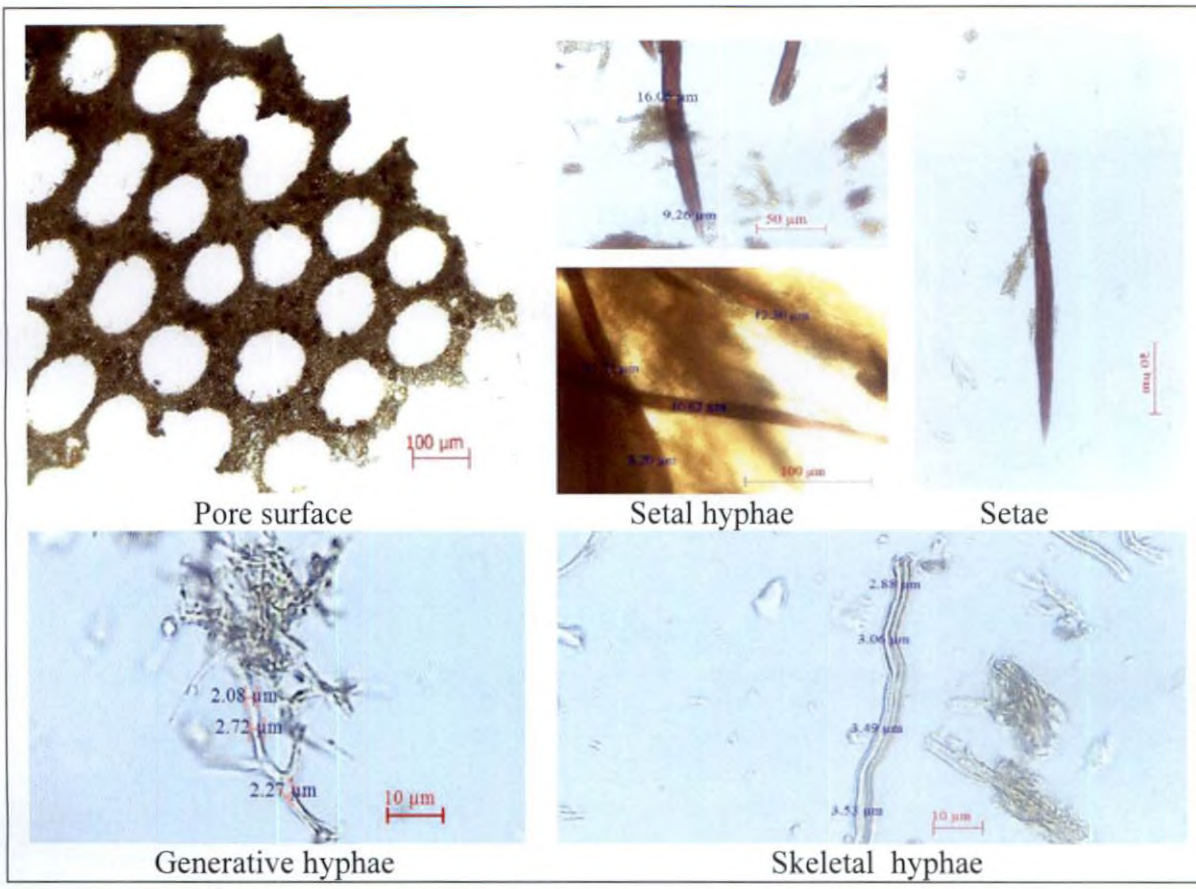


Plate 6. *Inonotus pachyphloeus* (Pat.) T. Wagner & M. Fisch

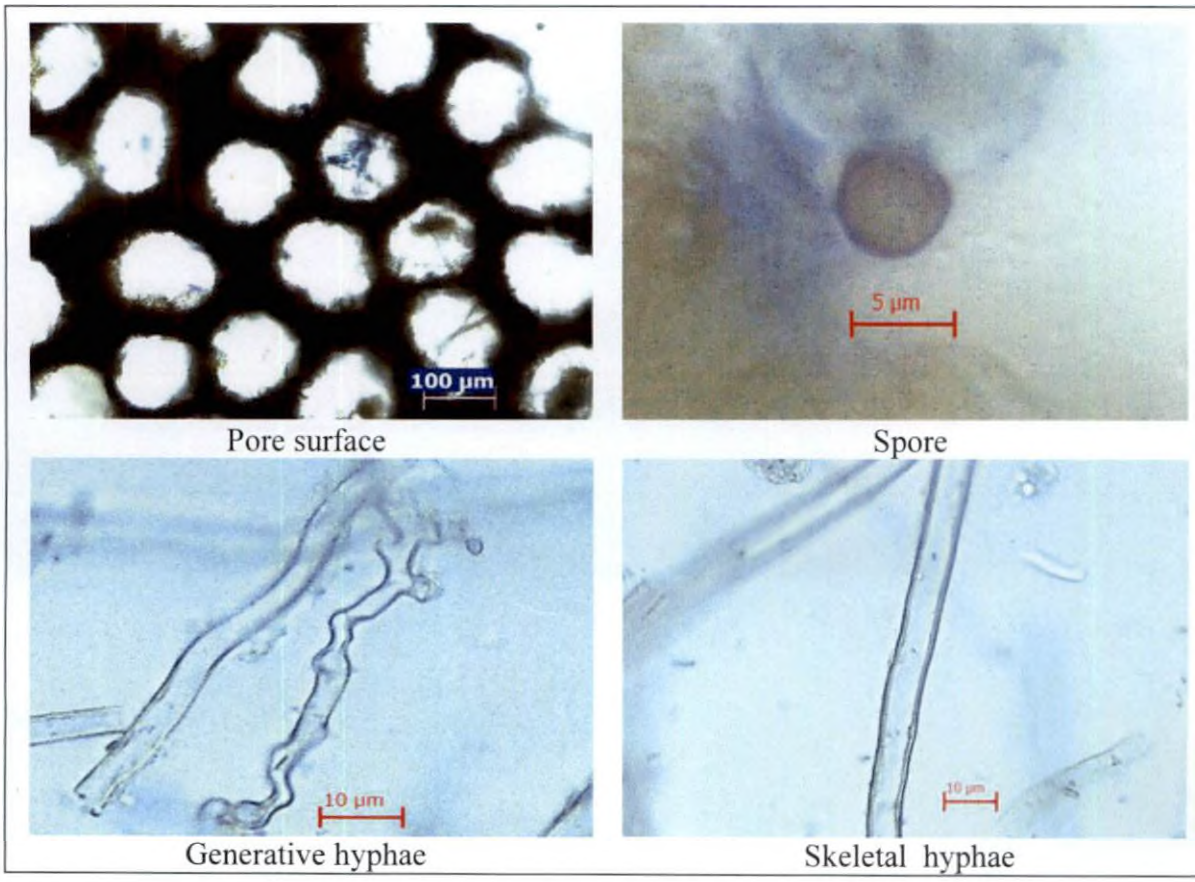


Plate 7. *Inonotus* sp. nov.

Hyphal system dimitic. Generative hyphae hyaline, thin walled, well branched, septate with clamps, 2-2.5 µm in diam. Binding hyphae hyaline, thick walled, nonseptate, lumen broad, slightly yellowish, 2.5-3.2 µm in diam. Skeletal hyphae thick walled with very broad lumen, mostly unbranched, 5-7 µm in diam. Basidia 4.5 x 9.5-10.5 µm, four spored. Setae absent. Basidiospore globose, thick walled, yellowish brown, epiculate (Plate 7).

Decay: White rot

Specimen observed: on decaying log of *Mesua ferrea,* Poochippara, Silent Valley National Park, Herb. ACK 47/28-2-2015

Remarks: Cunningham (1965) reported 10 *Inonotus* species from New Zealand and Ryvarden and Jonansen (1980) reported 3 *Inonotus* species from East Africa. The genus *Inonotus* is less described from India. However according to new nomenclature, several taxa both monomitic and dimitic, setae present or not, known under other genera are now included under *Inonotus.* Brownish flabelliform sporophore with regular surface of the present species differs from the resupinate to pileate forms of East Africa. The dimitic hypal system, globose basidiospores and absence of setae jointly occurred only in the present species.

4.1.2.3 Microporus sp. nov.

Fruitbody annual, pileate, attached with lateral stipe, flabelliform to aplanate, imbricate, 4.5 x 7-11 x 0.3 cm; Pileus surface dark brown to lighter (6D7, 6D8), smoothly velutinate with powdery deposit, dull, concentrically striate, uneven, partly lobed towards margin, coriaceous, slightly brittle when dry, margin thin, smooth, lighter straight, stipe rudimentary to 1 cm, 0.5 cm in dia., solid; Pore surface brownish orange (5B3) uneven, wavy, margin distinct; Pores round to angular, 7-9 per mm, pore mouth (80) 90-100(110) µm wide; Pore tubes greyish brown (5B3), uniform to 1 mm long; Dissepiments thin 50-60(80) µm thick; Context greyish brown (5B3), homogenous to 1 mm thick (Plate 8).

Hyphal system trimitic. Binding hyphae hyaline, thick walled, well branched, branches smaller in diameter, edges tapering, (1.5) 2-3 μm in diam. Skeletal hyphae hyaline, thick walled, lumen uniform in diam., usually unbranched but for extremities, (3.5) 4.5-6 (6.5).

Decay: White rot

Specimen examined: on decaying log of *Syzigium cumini*, Walakkad, Silent Valley National Park, Herb. ACK 46/28-2-2015

Remarks: Ryvarden and Jonansen (1980) have described 7 species of *Microporus*, of which none have concentrically striate, uneven upper surface with partly lobed margin. The present species shows trimitic hyphal system while all the former species are dimitic. The Large pore mouth (90-100 um) also differ from that of Ryvarden and Jonansen (1980).

4.1.2.4 Phylloporia pectinata (Klotzsch) Ryvarden

Boudiera pectinata (Klotzsch) Lazaro Ibiza, Revta R. Acad. Cienc. exact. fis. nat. Madr. 14: 837 (1916)

Cryptoderma substygium (Berk. & Broome ex Cooke) Imazeki, Bull. Tokyo Sci. Mus. 6: 107 (1943)

Fomes pectinatus (Klotzsch) Gillet, Grevillea 14 (no. 69): 20 (1885)

Fomes pectinatus var. congoanus Bres., Bull. Jard. bot. Etat Brux. 4: 19 (1913)

Fomes pectinatus (Klotzsch) Gillet, Grevillea 14 (no. 69): 20 (1885) var. pectinatus

Fomes subpectinatus (Murrill) Sacc. & Trotter, Syll. fung. (Abellini) 21: 290 (1912)

Fomes substygius (Berk. & Broome ex Cooke) Cooke, Grevillea 14(no. 69): 20 (1885)

Fulvifomes pectinatus (Klotzsch) Bondartseva & S. Herrera, Mikol. Fitopatol. 26 (1): 13 (1992)

Fulvifomes subpectinatus (Murrill) Murrill, Tropical Polypores: 84 (1915)

Inonotus substygius (Berk. & Broome ex Cooke) Teng, Chung-kuo Ti Chen-chun, [Fungi of China]: 761 (1963)

Microporus xerampelinus (Kalchbr.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 497 (1898)

Phaeoporus ferrugineus Romell, K. svenska Vetensk-Akad. Handl., ser. 3 26: 26 (1901)

Phellinus pectinatus (Klotzsch) Quel., Enchir. fung. (Paris): 173 (1886)

Phellinus pectinatus (Klotzsch) Quel., Enchir. fung. (Paris): 173 (1886) var. pectinatus

Polyporus bonianus Pat., J. Bot., Paris 5: 311 (1891)

Polyporus ferrugineus (Romell) Sacc. & P. Syd., Syll. fung. (Abellini) 16: 150 (1902)

Polyporus oroniger Lloyd, Mycol. Writ. 6 (Letter 65): 1044 (1920) [1921]

Polyporus pectinatus Klotzsch, Linnaea 8 (4): 485 (1833)

Polyporus substygius (Berk. & Broome ex Cooke) Lloyd, Mycol. Writ. 4 (Syn. Apus): 364 (1915)

Polyporus xerampelinus Kalchbr., Grevillea 4(no. 30): 72 (1875)

Polystictus substygius Berk. & Broome ex Cooke, Nuovo G. bot. ital. 10(1): 17 (1878)

Polystictus substygius f. minor Bres., Hedwigia 51: 315 (1912)

Polystictus substygius Berk. & Broome ex Cooke, Nuovo G. bot. ital. 10(1): 17 (1878) f. substygius

Polystictus tabacinus var. substygius (Berk. & Broome ex Cooke) P.W. Graff, Bull. Torrey bot. Club 65: 451 (1918)

Polystictus xerampelinus (Kalchbr.) Cooke, Grevillea 14 (no. 71): 86 (1886)

Porodaedalea pectinata (Klotzsch) Aoshima, Trans. Mycol. Soc. Japan 7: 89 (1966)

PyroPolyporus pectinatus (Klotzsch) Murrill, Bull. Torrey bot. Club 34: 479 (1907)

PyroPolyporus pectinatus (Klotzsch) Murrill, Bull. Torrey bot. Club 34: 479 (1907) var. pectinatus

PyroPolyporus subpectinatus Murrill, N. Amer. Fl. (New York) 9(2): 109 (1908)

Scindalma pectinatum (Klotzsch) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 519 (1898)

Scindalma substygium (Berk. & Broome ex Cooke) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 519 (1898)

Xanthochrous pectinatus (Klotzsch) Pat., Essai Tax. Hymenomyc. (Lons-le-Saunier): 101 (1900)

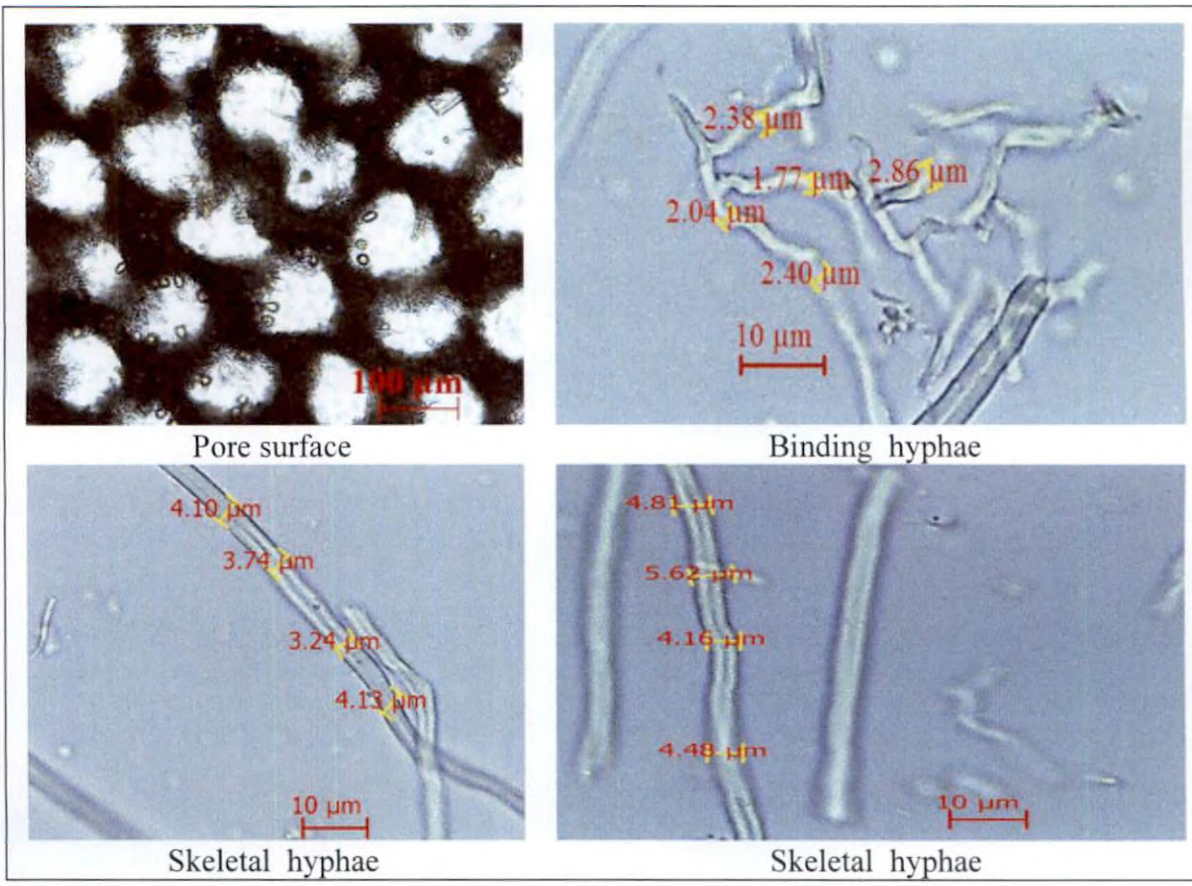


Plate 8. *Microporus* sp. nov.

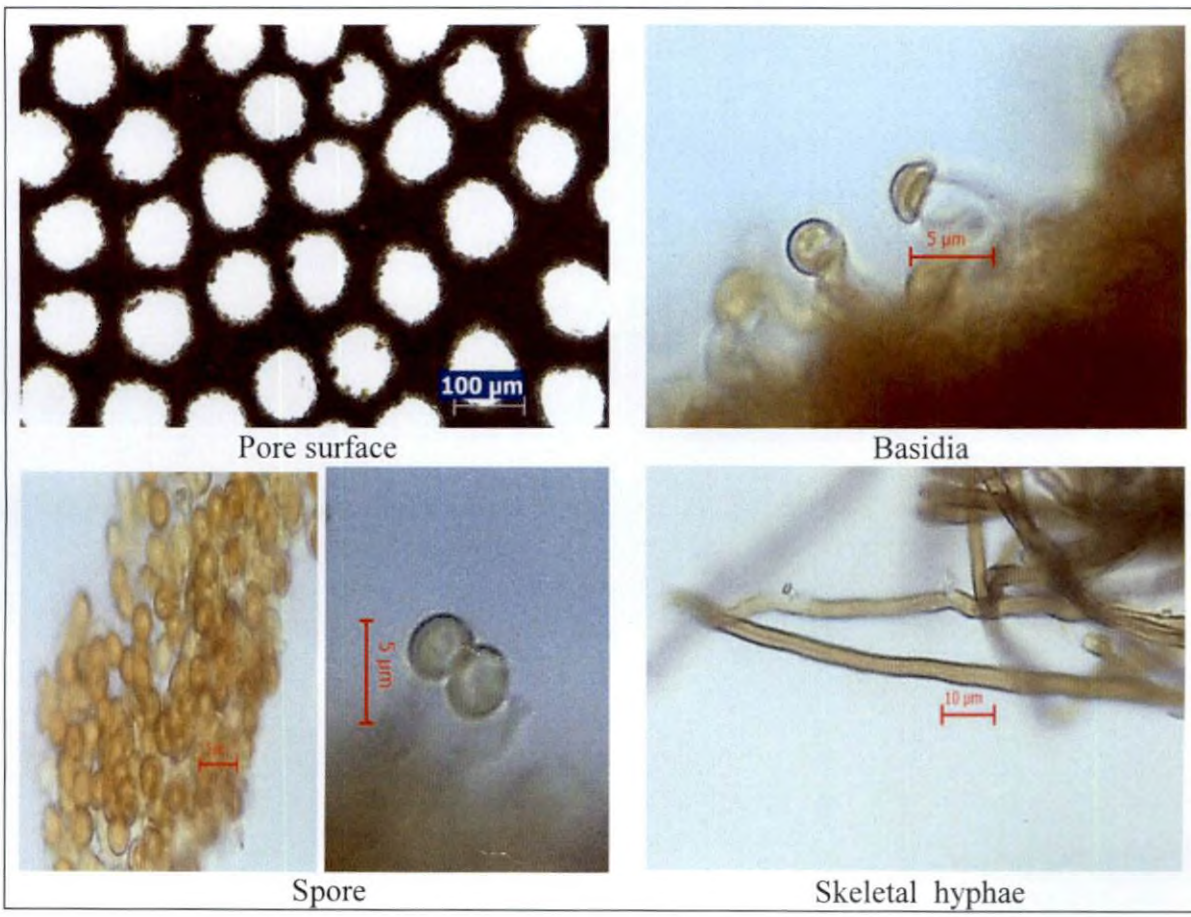


Plate 9. *Phylloporia pectinata* (Klotzsch) Ryvarden

Fritbody annual, solitary, imbricate, effused reflexed to pileate, attached with a broad base, 1-1.5 x 1,5-2.5 x 0.2-0.4 cm; Pileus surface concentrically grooved, highly velutinate, smooth glabrous, uneven, dark brown (6F8), margin smooth, entire, velutinate. Pore surface dark brown (6F8); Pores not visible to naked eye, 9-10 per mm, pore mouth 70 -100 μm wide, margin distinct; Pore tubes of varying length, 1-2 mm long, shining; Dissepiments thin (40) 50-70 (120) μm thick; Context uniform, shining, brownish orange (6E7), 0.8-1mm thick (Plate 9).

Hyphal system dimitic. Skeletal hyphae yellowish brown, thick walled, usually unbranched, but extremities sparsely branched, bent sometimes, lumen narrow, 2.5-3.5 μm in diam. Basidiospore yellowish, round to globose to slightly sub globose, slightly thick walled. Basidia long, clavate, sleritmata incipient, four spored, 7-8 x 2.5-3 μm.

Decay: White rot

Specimen examined: on decaying log of *Cinnamomum sulphuratum*, Cheriamkandam, Silent Valley National Park, Herb. ACK 45/23-5-2014; ACK 39/30-1-2015; ACK 20, 32/28-2-2015; ACK 22/30-3-2015

4.*1.2.5 Polyporus* sp. nov.

Sporophore annual, stipitate, solitary to imbricate, confluent, flabelliform to semicircular, coriaceous to flexible, 1-1.5 cm in dia. or 2- 4.5 x 2-5 x 0.1-0.2 cm; Pileus surface dark brown (6F7) or lighter (6F4), margin brownish yellow (5B7), warty towards the stipe, concentrically striate, uneven to wavy, glabrous shining thin but rigid margin, stipe short, 5mm long, brownish black, solid 4-6 mm in dia. pore surface rusty brown to coffee brown (6F7, 6F8), uneven margin, sterile; Pores brown, 10-11 per mm, pore mouth (90) 100 -120 (130) μm wide; Pore tubes, uniform, of equal length; Dissepiments thin (15) 20 -30 (45) μm thick; Context yellowish brown (5E5) uniform, becoming dark when in KOH. Hyphal system: monometric freely branched,

older hyphae brownish, simple septate, setae absent, basidia and basidiospore not observed (Plate 10).

Hyphal system dimitic. Generative hyphae hyaline, thick walled, well branched, profusely clamped, (2.5) 3-4 (5) µm in diam. Skeletal hyphae hyaline, thick walled, lumen uniform, 4.5-5.5 µm in diam.

Decay: White rot

Specimen examined: decaying log of *Melicope lunu-ankenda*, Sairandhri, Silent Valley National Park, Herb. ACK 51/30-3-2015

Remarks: The flabelliform to semi-circular dark brown nature of the present species differs from the sub-flabelliform to three cornered or clavate, sulphur colour of the fruit body of *Polyporus bamboosicola*, which was described from roots of bamboo from Saharanpur, India as insufficiently known by Bakshi (1970). The present species have concentrically striate, glabrous upper surface while *P. bamboosicola* have smooth to velvety surface. The number of pores (10-11 per mm) and thin dissepiments are other salient features of the present species.

4.1.2.6 Trametes menziesii (Berk.) Ryvarden

Boletus convolutus Zipp. ex Lev., Annls Sci. Nat., Bot., ser. 3 2: 186 (1844)
Coriolopsis luzonensis (Murrill) J.R. Sharma, Bull. bot. Surv. India 31(1-4): 96 (1992) *[1989]*
Coriolus blumei (Lev.) G. Cunn., Proc. Linn. Soc. N.S.W. 75(3-4): 219 (1950)
Coriolus gaudichaudii (Lev.) Pat., Essai Tax. Hymenomyc. (Lons-le-Saunier): 94 (1900)
Coriolus kurzianus (Cooke) Pat., Essai Tax. Hymenomyc. (Lons-le-Saunier): 94 (1900)
Coriolus meleagris (Berk.) Imazeki, Bull. Gov. Forest Exp. Stn Tokyo 57: 100 (1952)
Coriolus murinus (Lev.) Pat., Essai Tax. Hymenomyc. (Lons-le-Saunier): 94 (1900)

Favolus thwaitesii (Berk.) Syd., Syll. fung. (Abellini) 12: 246 (1897)

Fomes thwaitesii (Berk.) Cooke, Grevillea 14(no. 69): 20 (1885)

Fomes thwaitesii (Berk.) Cooke, Grevillea 14(no. 69): 20 (1885) var. thwaitesii

Fomes thwaitesii var. umbrinotinctus (Berk. & Broome) Sacc. [as 'umbrino-tinctus'], Syll. fung. (Abellini) 6: 199 (1888)

Leiotrametes menziesii (Berk.) Welti & Courtec., in Welti, Moreau, Favel, Courtecuisse, Haon, Navarro, Taussac & Lesage-Meessen, Fungal Diversity 55(1): 60 (2012)

Leucoporus dealbatus (Fr.) Pat., Essai Tax. Hymenomyc. (Lons-le-Saunier): 82 (1900)

Microporus arcuatus (Pat.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 495 (1898)

Microporus blumei (Lev.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 495 (1898)

Microporus convolutus (Zipp. ex Lev.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 495 (1898)

Microporus didrichsenii (Fr.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 496 (1898)

Microporus dilatatus (Lev.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 496 (1898)

Microporus gaudichaudii (Lev.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 496 (1898)

Microporus kurzianus (Cooke) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 496 (1898)

Microporus meleagris (Berk.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 496 (1898)

Microporus menziesii (Berk.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 496 (1898)

Microporus murinus (Lev.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 496 (1898)

Microporus nepalensis (Berk.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 496 (1898)

Microporus vittatus (Berk.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 497 (1898)

Polyporellus dilatatus (Lev.) P. Karst., Meddn Soc. Fauna Flora fenn. 5: 38 (1879)

Polyporus arcuatus Pat., J. Bot., Paris 3: 256 (1889)

Polyporus blumei Lev., Annls Sci. Nat., Bot., ser. 3 2: 185 (1844)

Polyporus convolutus Zipp. ex Lev., Annls Sci. Nat., Bot., ser. 3 2: 186 (1844)

Polyporus corium Berk., Hooker's J. Bot. Kew Gard. Misc. 6: 163 (1854)

Polyporus dilatatus Lev., Annls Sci. Nat., Bot., ser. 3 2: 184 (1844)

Polyporus gaudichaudii Lev., Annls Sci. Nat., Bot., ser. 3 2: 185 (1844)

Polyporus luzonensis (Murrill) Sacc. & Trotter, Bull. Torrey bot. Club 34: 476 (1907)

Polyporus meleagris Berk., J. Linn. Soc., Bot. 16(no. 89): 42 (1878) [1877]

Polyporus menziesii Berk., Ann. Mag. nat. Hist., Ser. 1 10: 378 (1843) [1842]

Polyporus murinus Lev., Annls Sci. Nat., Bot. , ser. 3 2: 185 (1844)

Polyporus nepalensis Berk., Hooker's J. Bot. Kew Gard. Misc. 6: 162 (1854)

Polyporus subzonalis Cooke, Grevillea 19(no. 90): 44 (1890)

Polyporus thwaitesii Berk., Hooker's J. Bot. Kew Gard. Misc. 6: 229 (1854)

Polyporus thwaitesii Berk., Hooker's J. Bot. Kew Gard. Misc. 6: 229 (1854) var. thwaitesii

Polyporus thwaitesii var. umbrinotinctus Berk. & Broome, J. Linn. Soc., Bot. 14(no. 73): 52 (1873) [1875]

Polyporus vittatus Berk. London J. Bot. 6: 505 (1847)

Polystictus arcuatus (Pat.) Sacc. Syll. fung. (Abellini) 9: 182 (1891)

Polystictus blumei (Lev.) Cooke, Grevillea 14(no. 71): 79 (1886)

Polystictus convolutus (Zipp. ex Lev.) Cooke, Grevillea 14(no. 71): 84 (1886)

Polystictus didrichsenii Fr., Nova Acta R. Soc. Scient. Upsal., Ser. 3 1(1): 76 (1851) [1855]

Polystictus didrichsenii Fr., Nova Acta R. Soc. Scient. Upsal., Ser. 3 1(1): 76 (1851) [1855] var. didrichsenii

Polystictus didrichsenii var. meiopora Sacc., Syll. fung. (Abellini) 6: 233 (1888)

Polystictus didrichsenii var. mejopora Berk.

Polystictus dilatatus (Lev.) Cooke, Grevillea 14(no. 71): 78 (1886)

Polystictus gaudichaudii (Lev.) Fr., Nova Acta R. Soc. Scient. Upsal., Ser. 3 1(1): 77 (1851) [1855]

Polystictus kurzianus Cooke, Grevillea 15(no. 73): 22 (1886)

Polystictus meleagris (Berk.) Cooke, Grevillea 14(no. 71): 79 (1886)

Polystictus menziesii (Berk.) Fr., Nova Acta R. Soc. Scient. Upsal., Ser. 3 1(1): 74 (1851) [1855]

Polystictus murinus (Lev.) Cooke, Grevillea 14(no. 71): 79 (1886)

Polystictus nepalensis (Berk.) Cooke, Grevillea 14(no. 71): 79 (1886)

Polystictus thwaitesii (Berk.) Lloyd, Mycol. Writ. 5(Letter 65): 16 (1917)

Polystictus vittatus (Berk.) Cooke, Grevillea 14(no. 71): 84 (1886)

Scindalma thwaitesii (Berk.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 519 (1898)

Spongipellis luzonensis Murrill, Bull. Torrey bot. Club 34: 473 (1907)

Trametes blumei (Lev.) G. Cunn., Bull. N.Z. Dept. Sci. Industr. Res., Pl. Dis. Div. 164: 161 (1965)

Trametes grisea Pat., J. Bot., Paris 11: 341 (1897)

Trametes meleagris (Berk.) Imazeki, Bull. Tokyo Sci. Mus. 6: 73 (1943)

Trametes murina (Lev.) Ryvarden, Norw. JI Bot. 19: 236 (1972)

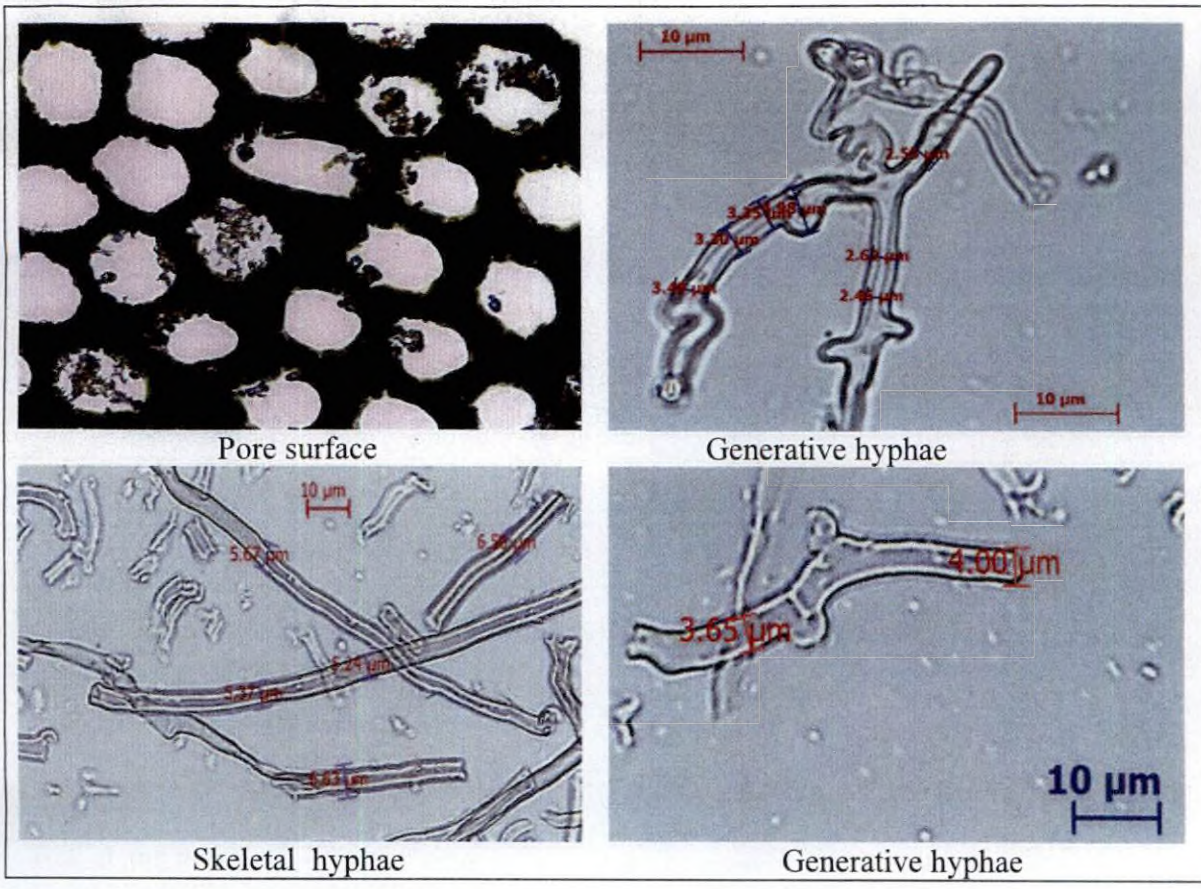
Trametes vittata (Berk.) Bres., Annls mycol. 12(6): 542 (1914)

Fruitbody annual, solitary, imbicate, confluent, laterally stipitate, flabelliform to spathulate, lobed towards margin, stipe prominent when young, 1.5-4-5 x 1-4 x 0.15cm. Pileus surface uneven, orange white (5A2), radially folded, concentrically zonate, warty towards base, finely velutinate towards margin, shining, margin very thin, stipe rudimentary to 5 mm, spreading at base, greyish orange (5B4), tough, soft hyphae, angulate, to give a warty appearance; Pore surface brown (6E7) to greyish brown (5B3); Pores almost visible to naked eye, 5-6 per mm, pore mouth (50) 70-90 (110) µm wide, uneven stipe, margin distinct, shining, young and smaller towards margin, older region yellowish brown, margin lighter; Dissepiments thin (30) 50-70 (100) µm thick; Pore tubes pale orange (5B3), uniform, 1.5 mm long; Context less than 1mm, homogenous towards margin, pores angular, round when young (Plate 11).

Hyphal system trimitic. Generative hyphae hyaline, thin slightly thick walled, septate with clamp connections, branched, (3) 3.5-4.5 (5) µm in diam. Skeletal hyphae hyaline, thin to slightly thick walled, 4-5 in diam.

Decay: White rot

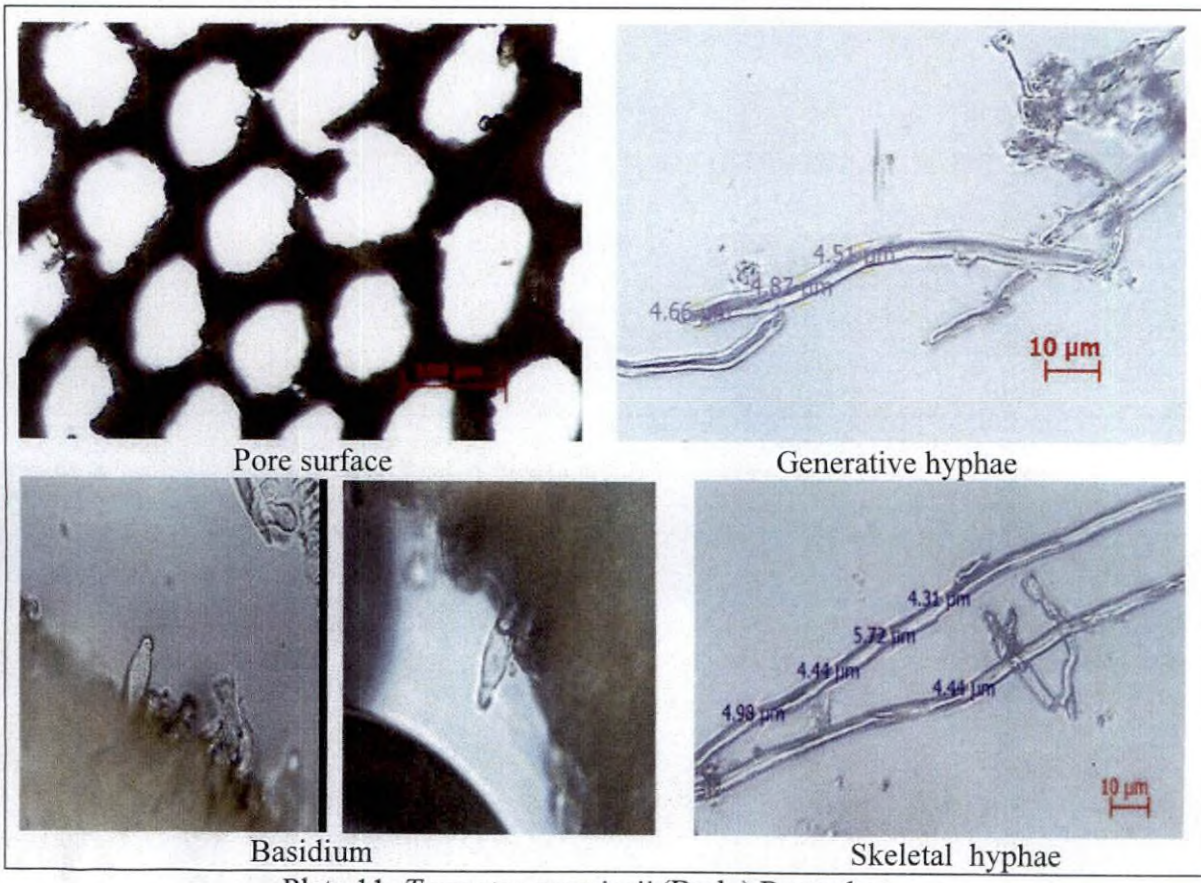
Specimen observed: on decaying log of *Cullenia exarillata,* Sairandhri, Silent Valley National Park, Herb. ACK 13/29-7-2014; ACK 43/28-8-2014; ACK 58/19-10-2014, ACK 9/9-12-2014; ACK 21/30-1-2015; 35, 38, 41/28-2-2015; ACK 41/30-3-2015



Pore surface | Generative hyphae

Skeletal hyphae | Generative hyphae

Plate 10. *Polyporus* sp. nov.



Pore surface | Generative hyphae

Basidium | Skeletal hyphae

Plate 11. *Trametes menziesii* (Berk.) Ryvarden

4.1.2.7 Trametes ochracea (Pers.) Gilb. & Ryvarden

Agaricus multicolor (Schaeff.) E.H.L. Krause, Basidiomycetum Rostochiensium, Suppl. 4: 142 (1932)

Bjerkandera zonata (Nees) P. Karst., Acta Soc. Fauna Flora fenn. 2(no. 1): 30 (1881) [1881-1885]

Boletus multicolor Schaeff., Fung. bavar. palat. nasc. (Ratisbonae) 4: 91 (1774)

Boletus ochraceus Pers., Ann. Bot. (Usteri) 11: 29 (1794)

Boletus zonatus Nees, Syst. Pilze (Wurzburg): 221 (1816) [1816-17]

Bulliardia rufescens Lazaro Ibiza, Revta R. Acad. Cienc. exact. fis. nat. Madr. 14: 844 (1916)

Coriolus concentricus Murrill, N. Amer. Fl. (New York) 9(1): 23 (1907)

Coriolus hirsutus var. ochraceus (Pers.) Maire, Act. Inst. bot. Univ. Athen. 1: 78 (1940)

Coriolus lloydii Murrill, N. Amer. Fl. (New York) 9(1): 23 (1907)

Coriolus ochraceus (Pers.) Prance, (1984)

Coriolus zonatus (Nees) Quel., Enchir. fung. (Paris): 175 (1886)

Daedalea rufescens (Lazaro Ibiza) Sacc. & Trotter, Syll. fung. (Abellini) 23: 450 (1925)

Hansenia zonata (Nees) P. Karst., Meddn Soc. Fauna Flora fenn. 5: 40 (1879)

Microporus multicolor (Schaeff.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 495 (1898)

Polyporus aculeatus Velen., Ceske Houby 4-5: 646 (1922)

Polyporus lloydii (Murrill) Overh., Annual Report of the Missouri Botanical Garden, St. Louis 1: 95 (1914)

Polyporus ochraceus (Pers.) Sommerf., Suppl. Fl. lapp. (Oslo): 276 (1826)

Polyporus versicolor var. ochraceus (Pers.) Pers., Mycol. eur. (Erlanga) 2: 72 (1825)

Polyporus versicolor var. zonatus (Nees) Jørst., Kgl. norske vidensk. Selsk. Skr. 10: 44 (1937)

Polyporus zonatus Nees, Syst. Pilze (Wurzburg) 1: 368 (1816) [1816-17]

Polyporus zonatus var. imperfectus Peck, Ann. Rep. Reg. N.Y. St. Mus. 49: 31 (1897) [1896]

Polyporus zonatus var. ochraceus Fr.

Polyporus zonatus Nees, Syst. Pilze (Wurzburg) 1: 368 (1816) [1816-17] var. zonatus

Polystictus concentricus (Murrill) Sacc. & Trotter, Syll. fung. (Abellini) 21: 313 (1912)

Polystictus imperfectus (Peck) Sacc., Syll. fung. (Abellini) 14(1): 186 (1899)

Polystictus lloydii (Murrill) Sacc. & Trotter, Syll. fung. (Abellini) 21: 316 (1912)

Polystictus ochraceus (Pers.) Lloyd, Mycol. Writ. 5: 651 (1917)

Polystictus zonatus (Nees) Fr., Nova Acta R. Soc. Scient. Upsal., Ser. 3 1(1): 86 (1851) [1855]

Polystictus zonatus var. imperfectus Peck, Ann. Rep. Reg. N.Y. St. Mus. 49: 31 (1897) [1896]

Polystictus zonatus (Nees) Fr., Nova Acta R. Soc. Scient. Upsal., Ser. 3 1(1): 86 (1851) [1855] var. zonatus

Trametes multicolor (Schaeff.) Julich, Persoonia 11(4): 427 (1982)

Trametes zonata (Nees) Pilat, in Kavina & Pilat, Atlas Champ. l' Europe, Ill, Polyporaceae (Praha) 1: 263 (1939)

Trametes zonatella Ryvarden, Polyp. N. Eur. (Oslo) 2: 436 (1978)

Fruitbody annual, solitary, imbricate, confluent, attached with broad base, often centrally stipitate but growth not uniform, coriaceous while flesh, hard and pliable when dry, almost round to applanate, flabelliform while young, 0.8-2 x 1-3 x 0.1-0.2 cm. Pileus surface concentrically zonate, light brown (7D1,) to dark brown (8F7) to reddish brown (8D8, 9E6) to grey (9D1), finely velutinate to glabrous, shining, margin uneven, smooth, incurved, thin when dry, stipe rudimentary, dark brown (8F8), warty, velutinate; Pore surface even shining, brownish orange (5C4); Pores not visible to naked eye, margin very thin but distinct, 6-7 per mm, pore mouth (100) 120-140 (155) µm wide; Pore tube uniform, 0.1 to0.15 cm long, pale yellow (4A3); Dissepiments thin (40) 50-60 µm thick; Context yellowish white (4E2), concolorous, with poretubes, very thin, less than 1 mm, homogenous (Plate 12).

Hyphal system trimitic. Generative hyphae hyaline, thin walled, closely branched, zig zag, septate with clamps, 2-3 µm in diam. Binding hyphae hyaline, sparsely branched, thick walled withnarrow lumen, nonseptate, 2-3.5 µm in diam.

Skeletal hyphae hyaline to slightly brownish, long and branched, thick walled, nonseptate, lumen narrow, sometimes obliterated, 4-5 (7) μm in diam. Basidia broadly clavate, four spored, 3.5-4.5 x 6-7 μm. Cystidia none. Basidiospore not observed.

Decay: White rot

Specimen observed: on decaying log of *Cinnamomum sulphuratum*, sisppara, Silent Valley National Park, Herb. ACK 1, 13/28-2-2015; ACK 20, 40/30-3-2015

4.1.2.8 Trametes pubescens (Schumach.) Pilat

*Bjerk*and*era pubescens* (Schumach.) P. Karst., Bidr. Kann. Finl. Nat. Folk 37: 41 (1882)

*Bjerk*and*era velutinus* (Pers.) P. Karst., Acta Soc. Fauna Flora fenn. 2 (no.1): 30 (1881) [1881-1885]

Boletus pubescens Schumach., Enum. pl. (Kjbenhavn) 2: 384 (1803)

Boletus velutinus Pers., Ann. Bot. (Usteri) 11: 29 (1794)

Boletus velutinus var. albus Alb. & Schwein., Consp. fung. (Leipzig): 253 (1805)

Boletus velutinus var. lutescens Alb. & Schwein., Consp. fung. (Leipzig): 253 (1805)

Boletus velutinus Pers., Ann. Bot. (Usteri) 11: 29 (1794) var. velutinus

Coriolus applanatus P. Karst., Finl. Basidsvamp. 46(no. 11): 3 (1904)

Coriolus pubescens (Schumach.) Quel., Fl. mycol. France (Paris): 391 (1888)

Coriolus pubescens f. amurensis Pilat, Bull. trimest. Soc. mycol. Fr. 48(1): 13 (1932)

Coriolus pubescens f. myriadopora Bourdot & Galzin, Bull. trimest. Soc. mycol. Fr. 41(1): 140 (1925)

Coriolus pubescens (Schumach.) Quel., Fl. mycol. France (Paris): 391 (1888) f. pubescens

Coriolus pubescens f. resupinatus Pilat, Bull. trimest. Soc. mycol. Fr. 51(3-4): 364 (1936) [1935]

Coriolus pubescens f. tenuis Bondartsev, Trut. Grib Evrop. Chasti SSSR Kavkaza [Bracket Fungi Europ. U.S.S.R. Caucasus] (Moscow-Leningrad): 484 (1953)

Coriolus pubescens f. velutinus (Pers.) Pilat, Bull. trimest. Soc. mycol. Fr. 51(3-4): 364 (1936) [1935]

Coriolus pubescens var. grayi (Cooke & Ellis) Bondartsev, Bot. Mater. Otd. Sporov. Rast. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 16: 120 (1963)

Coriolus pubescens (Schumach.) Quel., Fl. mycol. France (Paris): 391 (1888) var. pubescens

Coriolus sullivantii (Mont.) Murrill, Bull. Torrey bot. Club 32(12): 650 (1905)

Coriolus velutinus (Pers.) Pat., Essai Tax. Hymenomyc. (Lons-le-Saunier): 94 (1900)

Hansenia imitata P. Karst., Meddn Soc. Fauna Flora fenn. 13: 161 (1886)

Hansenia pubescens (Schumach.) P. Karst., Bidr. Kann. Finl. Nat. Folk 48: 304 (1889)

Hansenia velutina (Pers.) P. Karst., Meddn Soc. Fauna Flora fenn. 5: 40 (1879)

Leptoporus pubescens (Schumach.) Pat., Essai Tax. Hymenomyc. (Lons-le-Saunier): 84 (1900)

Microporus imitatus (P. Karst.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 496 (1898)

Microporus molliusculus (Berk.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 496 (1898)

Microporus sullivantii (Mont.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 497 (1898)

Microporus velutinus (Pers.) Kuntze, Revis. gen. pl. (Leipzig) 3(2): 497 (1898)

Polyporus molliusculus Berk., London J. Bot. 6: 320 (1847)

Polyporus pubescens (Schumach.) Fr., Observ. mycol. (Havniae) 1: 124 (1815)

Polyporus pubescens var. grayi Cooke & Ellis, in Ellis, N. Amer. Fung., Ser. 2: no. 1933 (1888)

Polyporus pubescens (Schumach.) Fr., Observ. mycol. (Havniae) 1: 124 (1815) var. pubescens

Polyporus sullivantii Mont., Annls Sci. Nat., Bot., ser. 2 18: 243 (1842)

Polyporus velutinus Pers., Ann. Bot. (Usteri) 11: 29 (1794)

Polyporus velutinus var. stratosus Jungh., Praem. Fl. Crypt. Javae (Batavia): 59 (1838)

Polyporus velutinus Pers., Ann. Bot. (Usteri) 11: 29 (1794) var. velutinus

Polystictus applanatus (P. Karst.) Sacc. & D. Sacc., Syll. fung. (Abellini) 17: 129 (1905)

Polystictus imitatus (P. Karst.) Sacc., Syll. fung. (Abellini) 6: 259 (1888)

Polystictus molliusculus (Berk.) Fr., Nova Acta R. Soc. Scient. Upsal., Ser. 3 1(1): 84 (1851) [1855]

Polystictus pubescens (Schumach.) Gillot & Lucand, Cat. Champ. sup. Saone-et-Loire: 351 (1890)

Polystictus sullivantii (Mont.) Cooke, Grevillea 14 (no. 71): 81 (1886)

Polystictus velutinus (Pers.) Sacc., Syll. fung. (Abellini) 6: 258 (1888)

Polystictus velutinus var. stratosus (Jungh.) Sacc., Syll. fung. (Abellini) 6: 258 (1888)

Trametes pubescens var. anthopora Zmitr., N. Bukharova & V. Malysheva, Mikol. Fitopatol. 47(6): 377 (2013)

Trametes velutina (Pers.) G. Cunn., Bull. N.Z. Dept. Sci. Industr. Res., Pl. Dis. Div. 164: 173 (1965)

Tyromyces pubescens (Schumach.) Imazeki, Bull. Tokyo Sci. Mus. 6: 84 (1943)

Fruitbody annual, resupinate becoming pileate, broadily attached, imbricate, pileus surface glabrous, shining concentrically striate, thin, coriaceous, margin incurved slightly when dry, uneven and wavy, 1-1.5 x 1.5-3 x 0.2 cm. Pileus surface greyish orange (5B6), striations black, yellowish brown (5E4) towards base; Pore surface orange white (5A2), smooth, even not visible to naked eye, margin free, oval to round not uniform, 6 to 7per mm, pore mouth (110) 120 -140 (150) µm wide; Pore tube whitish (5A1), uniform to 1mm long; Dissepiments thin (50) 70-90 (120) µm thick; Context thin, whitish (5A1), homogenous to 0.5 mm thick (Plate 13).

Hyphal system dimitic. Generative hyphae hyaline, thin walled, well branched, nonseptate with clamps, 2-4.5 µm in diam. Skeletal hyphae hyaline, thick walled, lumen uniform, unbranched, non-septate, 3.5-5) µm in diam.

Decay: White spongy with mycelial strands in wood crevices.

Specimens examined: on decaying log of *Elaeocarpus tuberculatus* Roxb. Walakkad, Silent Valley National Park, Herb. ACK 20/19-10-2015, 3/28-2-2015.

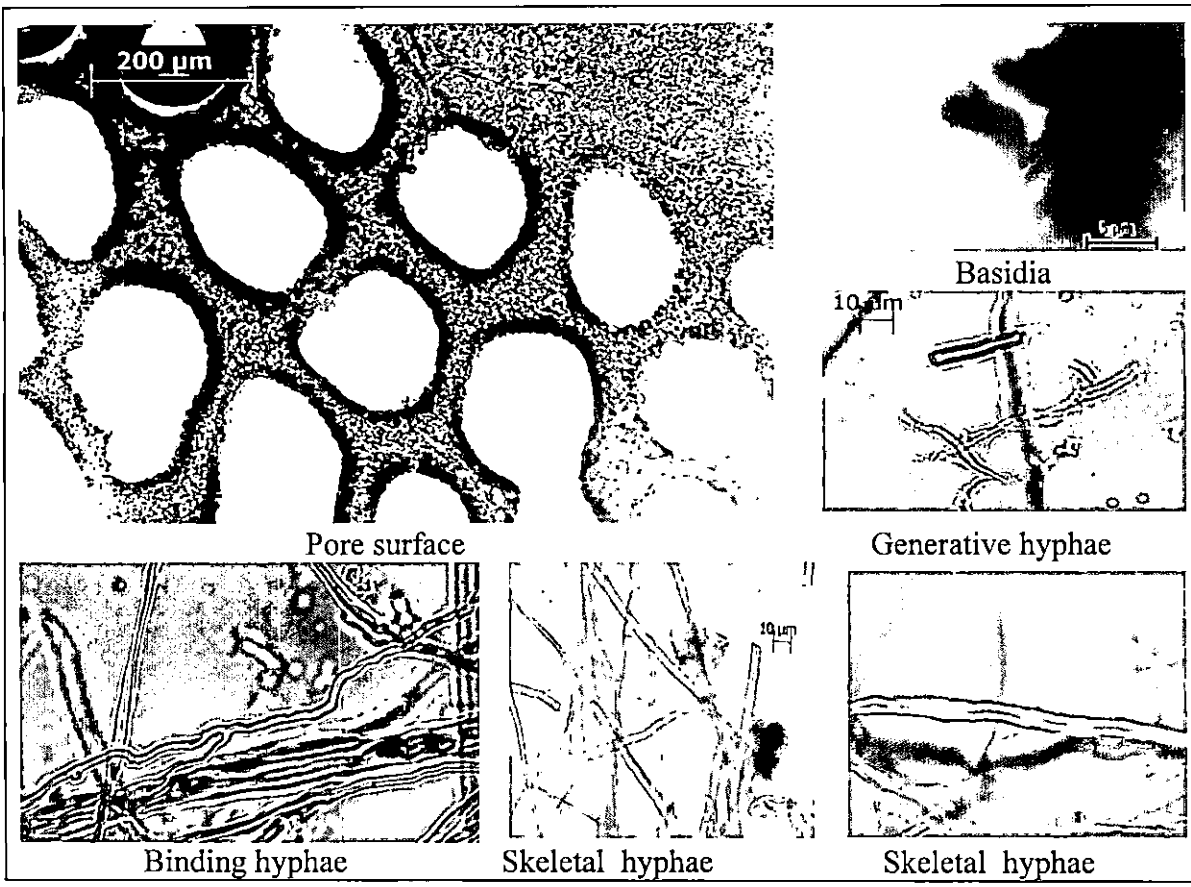


Plate 12. *Trametes ochracea* (Pers.) Gilb. & Ryvarden

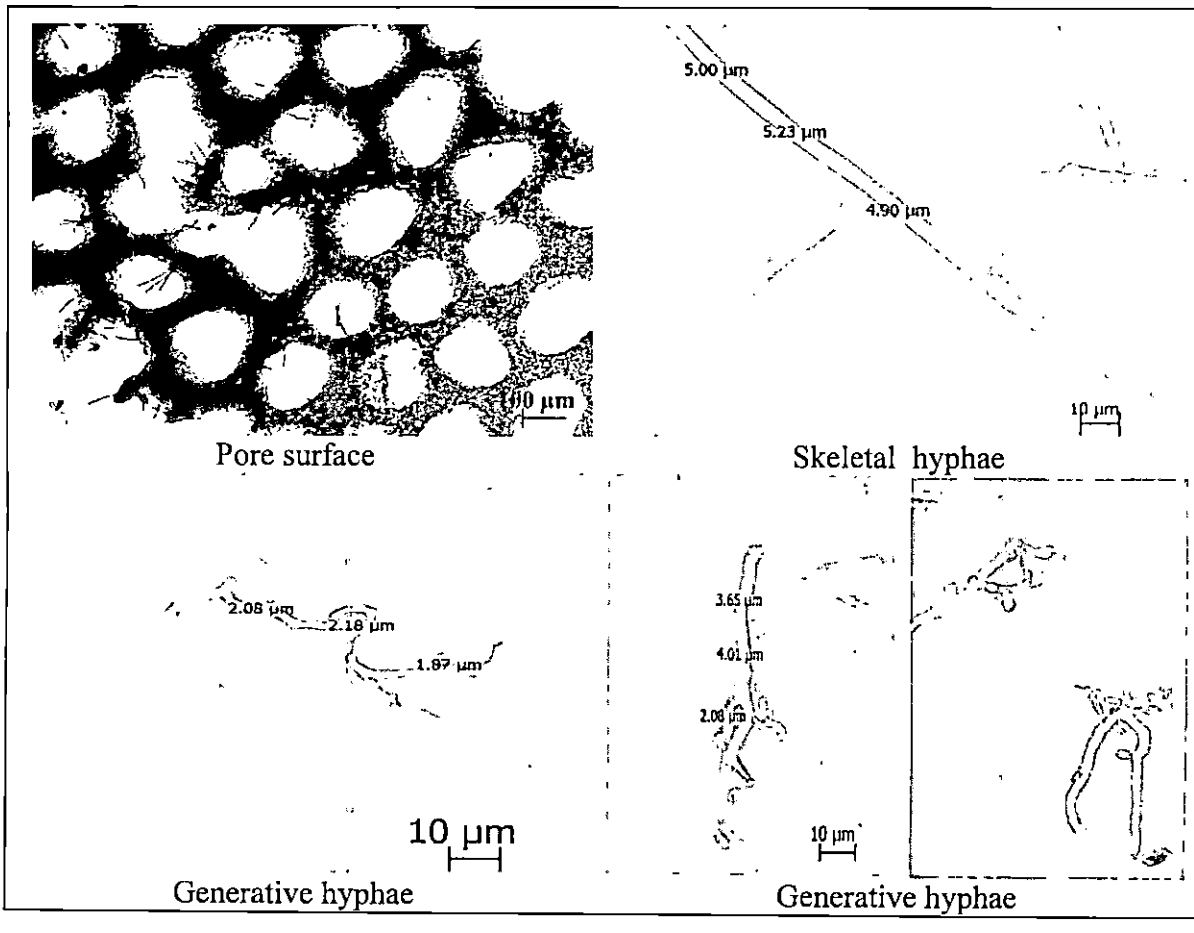


Plate 13. *Trametes pubescens* (Schumach.) Pilat

4.1.3 Diversity of polypores in wet evergreen and shola forests

In order to understand the diversity attributes of the polypores in wet evergreen and shola forests, the diversity, richness, dominance and evenness were analyzed using Simpson diversity index, Shanon-wiener index, Pielou's evenness index, Berger-Parker dominance Index and Margalef richness Index (Table 4).

Table 4. Diversity Indices of polypores of wet evergreen and shola forests

Forest type	Simpson diversity Index	Shanon-wiener Index	Margalef richness Index	Pielou's evenness Index	Berger-Parker dominance Index
Wet evergreen forest	0.92	2.83	3.15	0.84	0.12
Shola forest	0.78	2.02	1.74	0.77	0.42

In wet evergreen forest, Simpson's Index of diversity was observed to be 0.92 i.e, if 100 pairs of polypores were taken at random, 92 will comprise of different species while in shola it was only 0.78. The wet evergreen forest showed higher Shanon-wiener Index value (2.83) than that in shola forest (2.02). The Margalef Richness Index was also found to be relatively high in wet evergreen forest (3.15) while it was 1.74 in shola forest. The evenness in distribution of polypores was observed to be comparatively high in wet evergreen forest with Pielou's Evenness Index 0.84 than in shola forest (0.77). The shola forest showed more Berger-Parker Dominance Index value (0.42) in the polypore distributon while it was only 0.12 in evergreen forest (fig. 3).

4.1.4 Sorenson's Similarity Index

Sorenson's Similarity Index was worked out to find the similarity of polypore community in the wet evergreen forest and shola forest during different seasons. In all the seasons similarity between polypore community in the two ecosystems was found to be low. In pre monsoon season, it was 0.53 and reduced to 0.44 and 0.42 during monsoon and post monsoon period respectively (Fig. 4).

4.2. COMMUNITY STRUCTURE OF POLYPORES

Seasonal community structure of polypores were analized based on their abundance, density and frequency both in wet evergreen and shola forests.

4.2.1 Community structure of polypores in wet evergreen forest

4.2.1.1 Seasonal changes in Abundance, Density and *Relative density of polypores in wet evergreen forest during different seasons*

4.2.1.1.1 Pre monsoon period

During this period, a total of 334 individuals of polypores per hectare belonging to 21 different species were recorded over the sampling area of 30,000 m^2 (Table 5). The structural analysis of polypore community revealed that *Daedalea dochmia* had maximum relative density (26.35 %) followed by *Microporus xanthopus* with 11.07 per cent and *Hexagonia tenuis* with 10.17 per cent. The lowest value was recorded for *Inonotus pachyphloeus* and *Phellinus fastuosus* (0.60 %). Out of 21 species the highest abundance was recorded for *Microporus xanthopus* (31.50) followed by *Daedalea dochmia* (24.00) and *Neofomitella rhodophaea* (19.00). The lowest abundance was recorded for *Inonotus pachyphloeus* and *Phellinus senex* (3.00).

4.2.1.1.3 Monsoon period

A total of 1178 individuals of polypores per hectare belonging to 29 species were recorded during monsoon period (Table 6). Structural analysis of these polypores showed that *Trametes menziesii* had with highest relative density (12.22 %) followed by *Phellinus gilvus* (11.37 %). The lowest relative density was recorded for *Polyporus* sp. nov. (0.08 %). Highest abundance during this period was recorded for *Phellinus gilvus* (50.25) followed by *Neofomitella rhodophaea* (43.67) and *Inonotus pachyphloeus* was found to be the least abundant species (2.14).

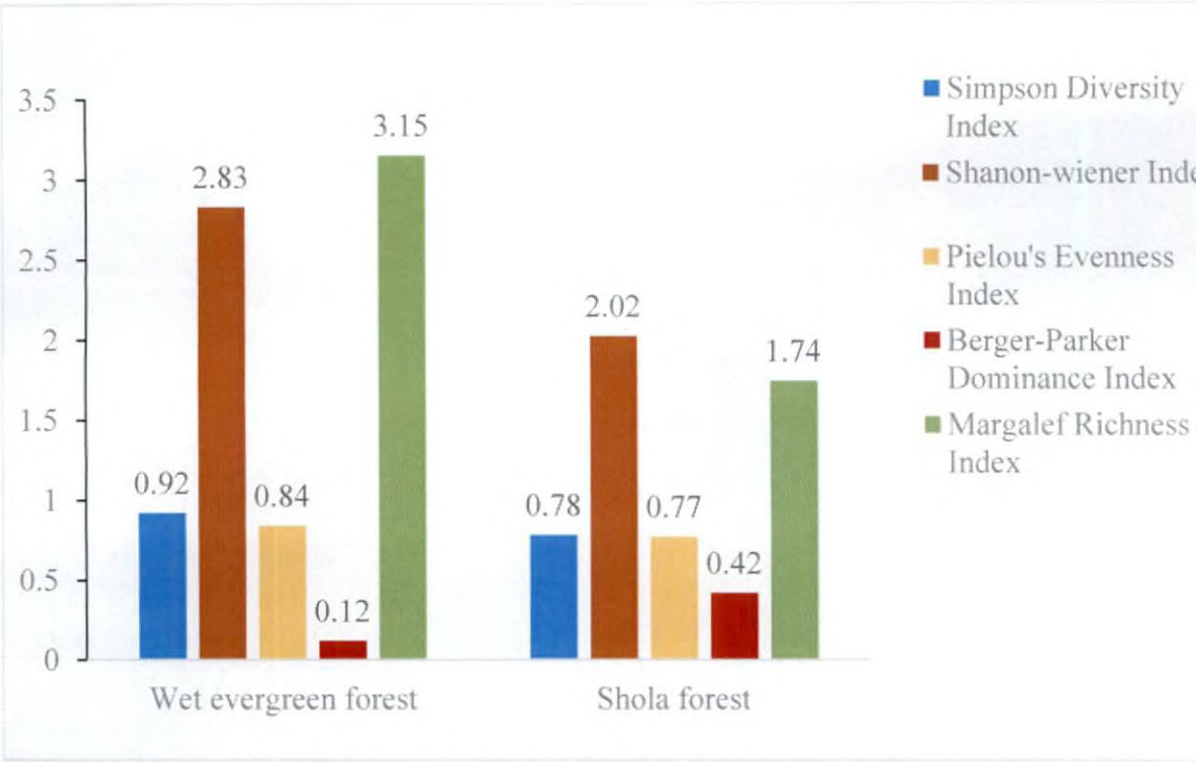


Fig. 3. Diversity Indices of polypore fungi in wet evergreen and shola forests

Fig. 4. Seasonal variation in Sorenson's Similarity Index of polypore communities in two forest ecosystems

4.2. COMMUNITY STRUCTURE OF POLYPORES

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Table 5. Abundance, Density and Relative density of polypores in wet evergreen forest during pre monsoon period

Sl.No.	Fungal species	Abundance (Nos.)	Density (No. of friutbodies /ha)	Relative Density (%)
1	*Cellulariella acuta**	5.25	14.00	4.19
2	*Daedalea dochmia***	24.00	88.00	26.35
3	*Fomitopsis feei**	10.50	14.00	4.19
4	*Funalia caperata**	4.50	3.00	0.90
5	*Fuscoporia contigua***	6.00	4.00	1.20
6	*Fuscoporia ferrea**	9.00	3.00	0.90
7	*Fuscoporia senex***	3.00	2.00	0.60
8	*Fuscoporia wahlbergii***	9.00	3.00	0.90
9	*Ganoderma australe***	12.75	17.00	5.08
10	*Hexagonia tenuis **	11.33	34.00	10.17
11	*Inonotus pachyphloeus***	3.00	2.00	0.60
12	*Microporus affinis**	18.00	12.00	3.59
13	*Microporus xanthopus**	11.10	37.00	11.07
14	*Neofomitella rhodophaea**	19.00	19.00	5.69
15	*Phellinus dependens***	4.50	3.00	0.90
16	*Phellinus fastuosus***	6.00	2.00	0.60
17	*Phellinus gilvus**	31.50	21.00	6.29
18	*Phellinus nilgheriensis***	6.86	16.00	4.79
19	*Schizopora paradoxa**	4.50	3.00	0.90
20	*Trametes marianna**	8.14	19.00	5.69
21	*Trametes menziesii**	9.00	18.00	5.39
	Total	**216.93**	**334.00**	**100.00**

[*Annual, ** Perennial]

Table 6. Abundance, Density and Relative density of polypores in wet evergreen forest during monsoon period

Sl.No.	Fungal species	Abundance (Nos.)	Density (No. of friutbodies /ha)	Relative Density (%)
1	*Cellulariella acuta**	5.40	36.00	3.06
2	*Daedalea dochmia***	26.45	97.00	8.23
3	*Earliella scabrosa* *	8.14	19.00	1.61
4	*Favolus tenuiculus**	15.42	36.00	3.06
5	*Fomitopsis feei* *	7.61	33.00	2.80
6	*Funalia caperata**	17.57	41.00	3.48
7	*Fuscoporia contigua***	8.00	8.00	0.68
8	*Fuscoporia ferrea**	2.40	4.00	0.34
9	*Fuscoporia senex***	5.00	5.00	0.42
10	*Fuscoporia wahlbergii***	8.00	8.00	0.68
11	*Ganoderma australe***	10.63	39.00	3.31
12	*Ganoderma lucidum**	8.25	22.00	1.88
13	*Hexagonia tenuis**	10.69	57.00	4.84
14	*Inonotus pachyphloeus***	2.14	5.00	0.42
15	*Microporellus obovatus**	6.00	14.00	1.19
16	*Microporus affinis**	11.33	34.00	2.88
17	*Microporus xanthopus**	13.56	104.00	8.83
18	*Neofomitella rhodophaea**	43.67	131.00	11.12
19	*Phellinus dependens***	4.50	6.00	0.51
20	*Phellinus fastuosus***	6.00	2.00	0.17
21	*Phellinus gilvus**	50.25	134.00	11.37
22	*Phellinus nilgheriensis***	11.00	33.00	2.8
23	*Polyporus grammocephalus**	9.00	9.00	0.76
24	*Polyporus leprieurii**	6.00	14.00	1.19
25	*Polyporus* sp. nov.*	3.00	1.00	0.08
26	*Schizopora paradoxa**	6.60	11.00	0.93
27	*Spongipellis unicolor**	9.00	3.00	0.25
28	*Trametes marianna**	29.54	128.00	10.86
29	*Trametes menziesii**	25.41	144.00	12.22
	Total	**370.59**	**1178.00**	**100.00**

[*Annual, ** Perennial]

4.2.1.1.3 Post monsoon period

During post monsoon, a total of 873 individuals of polypores per hectare representing 27 species were recorded (Table 7). Structural analysis indicated that *Neofomitella rhodophaea* (12.14 %) recorded the highest relative density followed by

Daedalea dochmia (11.34 %) and *Phellinus gilvus* (11.22 %). The lowest value was recorded for *Fuscoporia ferrea* and *Phellinus fastuosus* (0.34 %). The highest abundance was recorded for *Phellinus gilvus* (42.00) followed by *Neofomitella rhodophaea* (39.75). *Fuscoporia ferrea* (2.25) was found to be the least abundant species during this period.

Table 7. Abundance, Density and Relative density of polypores in wet evergreen forest during post monsoon period

Sl.No.	Fungal species	Abundance (Nos.)	Density (No. of friutbodies /ha)	Relative Density (%)
1	*Cellulariella acuta**	9.00	21.00	2.40
2	*Daedalea dochmia***	22.84	99.00	11.34
3	*Earliella scabrosa**	13.50	9.00	1.03
4	*Favolus tenuiculus**	9.00	6.00	0.69
5	*Fomitopsis feei**	9.37	25.00	2.86
6	*Funalia caperata**	6.75	9.00	1.03
7	*Fuscoporia contigua***	6.60	11.00	1.26
8	*Fuscoporia ferrea**	2.25	3.00	0.34
9	*Fuscoporia senex***	5.25	7.00	0.80
10	*Fuscoporia wahlbergii***	15.00	10.00	1.14
11	*Ganoderma australe***	9.92	43.00	4.92
12	*Ganoderma lucidum**	8.50	17.00	1.95
13	*Hexagonia tenuis**	9.46	41.00	4.70
14	*Inonotus pachyphloeus***	3.60	6.00	0.69
15	*Microporellus* obovatus**	7.20	12.00	1.37
16	*Microporus affinis**	11.57	27.00	3.09
17	*Microporus xanthopus**	14.47	82.00	9.39
18	*Neofomitella rhodophaea**	39.75	106.00	12.14
19	*Phellinus dependens***	4.80	8.00	0.91
20	*Phellinus fastuosus***	4.50	3.00	0.34
21	*Phellinus gilvus**	42.00	98.00	11.22
22	*Phellinus nilgheriensis***	9.46	41.00	4.70
23	*Polyporus grammocephalus**	6.00	8.00	0.92
24	*Polyporus leprieurii**	6.00	12.00	1.37
25	*Schizopora paradoxa**	6.75	9.00	1.03
26	*Trametes marianna**	20.70	69.00	7.90
27	*Trametes menziesii**	18.20	91.00	10.42
	Total	**322.45**	**873.00**	**100.00**

[*Annual, ** Perennial]

4.2.1.2 Seasonal changes in Percentage frequency and *Relative frequency of polypores in wet evergreen forest*

4.2.1.2.1 Pre monsoon period

During pre monsoon period, *Daedalea dochmia* (12.50 %) possessed the maximum relative frequency followed by *Microporus xanthopus* (11.36), *Hexagonia tenuis* (10.22 %) and *Cellulariella acuta* (9.09 %). The lowest relative frequency (1.13 %) was recorded for *Phellinus fastuosus, Fuscoporia wahlbergii* and *Fuscoporia ferrea* (Table 8). *Daedalea dochmia* accounted for the highest percentage frequency (3.67 %) followed by *Microporus xanthopus* (3.33 %) and *Hexagonia tenuis* (3 %). The lowest value was recorded for three species namely *Phellinus fastuosus, Fuscoporia ferrea* and *Fuscoporia wahlbergii* with 0.33 per cent.

Table 8. Percentage frequency and Relative frequency of polypores in wet evergreen forest during pre monsoon period

Sl.No.	Fungal species	Percentage Frequency (%)	Relative Frequency (%)
1.	*Cellulariella acuta**	2.67	9.09
2.	*Daedalea dochmia***	3.67	12.5
3.	*Fomitopsis feei**	1.33	4.54
4.	*Funalia caperata**	0.67	2.27
5.	*Fuscoporia contigua***	0.67	2.27
6.	*Fuscoporia ferrea**	0.33	1.13
7.	*Fuscoporia senex***	0.67	2.27
8.	*Fuscoporia wahlbergii***	0.33	1.13
9.	*Ganoderma australe***	1.33	4.54
10.	*Hexagonia tenuis **	3.00	10.22
11.	*Inonotus pachyphloeus***	0.67	2.27
12.	*Microporus affinis**	0.67	2.27
13.	*Microporus xanthopus**	3.33	11.36
14.	*Neofomitella rhodophaea**	1.00	3.40
15.	*Phellinus dependens***	0.67	2.27
16.	*Phellinus fastuosus***	0.33	1.13
17.	*Phellinus gilvus**	0.67	2.27
18.	*Phellinus nilgheriensis***	2.33	7.95
19.	*Schizopora paradoxa**	0.67	2.27
20.	*Trametes marianna**	2.33	7.95
21.	*Trametes menziesii**	2.00	6.81
	Total	**29.33**	**100.00**

[*Annual, ** Perennial]

4.2.1.2.2 Monsoon period

During this period the highest relative frequency was observed for *Microporus xanthopus* (9.66 %) followed by *Cellulariella acuta* (8.40 %) and *Trametes menziesii* (7.14 %). The lowest value of 0.42 per cent was recorded for *Phellinus fastuosus* and *Polyporus* sp. nov. (Table 9). In terms of percentage frequency, *Microporus xanthopus, Cellulariella acuta* and *Trametes menziesii* topped the figures with values 7.67 per cent, 6.67 per cent and 5.67 per cent respectively. The lowest value was observed with *Phellinus fastuosus* and *Polyporus* sp. nov. (0.33 %).

Table 9. Percentage frequency and Relative frequency of polypores in wet evergreen forest during monsoon period

Sl.No.	Fungal species	Percentage Frequency (%)	Relative Frequency (%)
1.	*Cellulariella acuta**	6.67	8.40
2.	*Daedalea dochmia***	3.67	4.62
3.	*Earliella scabrosa* *	2.33	2.94
4.	*Favolus tenuiculus**	2.33	2.94
5.	*Fomitopsis feei* *	4.33	5.46
6.	*Funalia caperata**	2.33	2.94
7.	*Fuscoporia contigua***	1.00	1.26
8.	*Fuscoporia ferrea**	1.67	2.10
9.	*Fuscoporia senex***	1.00	1.26
10.	*Fuscoporia wahlbergii***	1.00	1.26
11.	*Ganoderma australe***	3.67	4.62
12.	*Ganoderma lucidum**	2.67	3.36
13.	*Hexagonia tenuis**	5.33	6.72
14.	*Inonotus pachyphloeus***	2.33	2.94
15.	*Microporellus obovatus**	2.33	2.94
16.	*Microporus affinis**	3.00	3.78
17.	*Microporus xanthopus**	7.67	9.66
18.	*Neofomitella rhodophaea**	3.00	3.78
19.	*Phellinus dependens***	1.33	1.68
20.	*Phellinus fastuosus***	0.33	0.42
21.	*Phellinus gilvus**	2.67	3.36
22.	*Phellinus nilgheriensis***	3.00	3.78
23.	*Polyporus grammocephalus**	1.00	1.26
24.	*Polyporus leprieurii**	2.33	2.94
25.	*Polyporus* sp. nov.*	0.33	0.42
26.	*Schizopora paradoxa**	1.67	2.10
27.	*Spongipellis unicolor**	0.33	0.42
28.	*Trametes marianna**	4.33	5.46
29.	*Trametes menziesii**	5.67	7.14
	Total	**79.33**	**100.00**

[*Annual, ** Perennial]

4.2.1.2.2 Post monsoon period

During the post monsoon period, *Microporus xanthopus* was recorded with highest relative frequency (9.09 %) followed by *Trametes menziesii* (8.02 %), *Daedalea dochmia, Phellinus nilgheriensis, Hexagonia tenuis* and *Ganoderma australe* with 6.95 per cent each (Table 10). The lowest relative frequency was observed with *Earliella scabrosa, Favolus tenuiculus, Fuscoporia wahlbergii* and *Phellinus fastuosus* (1.07 %). *Microporus xanthopus* acconted for the highest percentage frequency (5.67 %) followed by *Trametes menziesii* (5.00 %), *Cellulariella acuta* and *Hexagonia tenuis* (4.33 %) The least percentage frequency was recorded for *Earliella scabrosa, Favolus tenuiculus, Fuscoporia wahlbergii* and *Phellinus fastuosus* (0.67 %).

Table 10. Percentage frequency and Relative frequency of polypores in wet evergreen forest during post monsoon period

Sl.No.	Fungal species	Percentage Frequency (%)	Relative Frequency (%)
1.	*Cellulariella acuta**	2.33	3.74
2.	*Daedalea dochmia***	4.33	6.95
3.	*Earliella scabrosa**	0.67	1.07
4.	*Favolus tenuiculus**	0.67	1.07
5.	*Fomitopsis feei**	2.67	4.28
6.	*Funalia caperata**	1.33	2.14
7.	*Fuscoporia contigua***	1.67	2.67
8.	*Fuscoporia ferrea**	1.33	2.14
9.	*Fuscoporia senex***	1.33	2.14
10.	*Fuscoporia wahlbergii***	0.67	1.07
11.	*Ganoderma australe***	4.33	6.95
12.	*Ganoderma lucidum**	2,00	3.20
13.	*Hexagonia tenuis**	4.33	6.95
14.	*Inonotus pachyphloeus***	1.67	2.67
15.	*Microporellus* obovatus**	1.67	2.67
16.	*Microporus affinis**	2.33	3.74
17.	*Microporus xanthopus**	5.67	9.09
18.	*Neofomitella rhodophaea**	1.33	2.14
19.	*Phellinus dependens***	1.67	2.67
20.	*Phellinus fastuosus***	0.67	1.07
21.	*Phellinus gilvus**	2.33	3.74
22.	*Phellinus nilgheriensis***	4.33	6.95
23.	*Polyporus grammocephalus**	1.33	2.14
24.	*Polyporus leprieurii**	2.00	3.20
25.	*Schizopora paradoxa**	1.33	2.13
26.	*Trametes marianna**	3.33	5.34
27.	*Trametes menziesii**	5.00	8.02
	Total	**62.33**	**100.00**

[*Annual, ** Perennial]

4.2.2 Community structure of polypores in shola forest

4.2.2.1 Seasonal changes in Abundance, Density and *Relative density of polypores in shola forest*

4.2.2.1.1 Pre monsoon period

During the pre monsoon period, a total of 82 individuals of polypores per hectare belonging to 9 different species were recorded over the sampling area of 30,000 m^2 (Table 11). The structural analysis of polypore community indicated that *Trametes ochracea* had maximum relative density (45.12 %) followed by *Trametes menziesii* (19.51) and *Phylloporia pectinata* (9.76 %). The lowest value was recorded for *Fuscoporia wahlbergii* (1.21 %). High abundance was recorded for *Trametes ochracea* (22.20) followed by *Phylloporia pectinata* (12) and *Trametes menziesii* (5.33). The lowest abundance was recorded by *Fuscoporia wahlbergii* (1).

Table 11. Abundance, Density and Relative density of polypores in shola forest during pre monsoon period

Sl.No.	Fungal species	Abundance (Nos.)	Density (No. of friutbodies /ha)	Relative Density (%)
1	*Fulvifomes cesatii**	1.90	7.00	8.53
2	*Fuscoporia wahlbergii***	1.00	1.00	1.21
3	*Ganoderma australe***	4.00	4.00	4.88
4	*Microporus xanthopus**	2.14	5.00	6.09
5	*Phellinus nilgheriensis***	2.00	2.00	2.44
6	*Phylloporia pectinata***	12.00	8.00	9.76
7	*Schizopora paradoxa**	3.00	2.00	2.43
8	*Trametes menziesii**	5.33	16.00	19.51
9	*Trametes ochracea**	22.2	37.00	45.12
	Total	**53.58**	**82.00**	**100.00**

[*Annual, ** Perennial]

4.2.2.1.3 Monsoon period

A total of 290 individuals of polypores per hectare belonging to 14 species were recorded during this period, (Table 12). Structural analysis showed that *Trametes ochracea*, possessed the highest relative density (42.76 %) followed by *Trametes menziesii* (11.72 %) and *Trametes pubescens* (10.69 %). *Fuscoporia wahlbergii* was recorded with lowest relative density (1.03 %). Highest abundance during this period

was recorded for *Trametes ochracea* (37.20) followed by *Trametes pubescens* (13.28) and *Trametes menziesii* (9.27). *Ganoderma lucidum* (1.71) was the least abundant species during post monsoon period.

Table 12. Abundance, Density and Relative density of polypores in shola forest during monsoon period

Sl.No.	Fungal species	Abundance (Nos.)	Density (No. of friutbodies /ha)	Relative Density (%)
1	*Earliella scabrosa**	8.00	8.00	2.76
2	*Fulvifomes cesatii***	3.69	16.00	5.52
3	*Fuscoporia wahlbergii***	3.00	3.00	1.03
4	*Ganoderma australe***	3.00	8.00	2.76
5	*Ganoderma lucidum**	1.71	4.00	1.38
6	*Leucophellinus hobsonii**	8.00	8.00	2.76
7	*Microporellus obovatus**	4.20	7.00	2.41
8	*Microporus xanthopus**	4.75	19.00	6.55
9	*Phellinus nilgheriensis***	4.00	4.00	1.38
10	*Phylloporia pectinata***	6.37	17.00	5.86
11	*Schizopora paradoxa**	7.00	7.00	2.41
12	*Trametes menziesii**	9.27	34.00	11.72
13	*Trametes ochracea**	37.20	124.00	42.76
14	*Trametes pubescens**	13.28	31.00	10.69
	Total	**113.49**	**290.00**	**100.00**

[*Annual, ** Perennial]

4.2.2.1.2 Post monsoon period

During this period a total of 204 individuals of polypores per hectare representing 14 species were documented (Table 13). Structural analysis showed that *Trametes ochracea* (40.28 %) recorded the highest relative density followed by *Trametes pubescens* (10.18 %) and *Trametes menziesii* (9.72 %). The lowest value (1.39 %) was recorded for *Ganoderma lucidum.* The highest abundance was recorded for *Trametes ochracea* (32.62) followed by *Trametes pubescens* (13.20) and *Leucophellinus hobsonii* (10.50). The lowest abunadnce was recorded for *Ganoderma lucidum* (1.80).

Table 13. Abundance, Density and Relative density of polypores in shola forest during post monsoon period

Sl.No.	Fungal species	Abundance (Nos.)	Density (No. of friutbodies /ha)	Relative Density (%)
1	*Earliella scabrosa**	3.75	5.00	2.31
2	*Fulvifomes cesatii***	3.25	13.00	6.01
3	*Fuscoporia wahlbergii***	3.75	5.00	2.31
4	*Ganoderma australe***	7.50	10.00	4.62
5	*Ganoderma lucidum**	1.80	3.00	1.39
6	*Leucophellinus hobsonii**	10.50	7.00	3.24
7	*Microporellus obovatus**	4.00	4.00	1.85
8	*Microporus xanthopus**	4.71	11.00	5.09
9	*Phellinus nilgheriensis***	3.60	6.00	2.78
10	*Phylloporia pectinata***	5.40	18.00	8.33
11	*Schizopora paradoxa**	6.00	4.00	1.85
12	*Trametes menziesii**	7.00	21.00	9.72
13	*Trametes ochracea**	32.62	87.00	40.28
14	*Trametes pubescens**	13.20	22.00	10.18
	Total	**107.08**	**216.00**	**100.00**

[*Annual, ** Perennial]

4.2.2.2 Seasonal changes in Percentage frequency and *Relative frequency of polypores in shola forest*

4.2.2.2.1 Pre monsoon period

During the pre monsoon period *Fulvifomes cesatii* was recorded with highest relative frequency (24.44 %) followed by *Trametes menziesii* (20 %) and *Microporus xanthopus* (15.55 %). *Phylloporia pectinata* and *Schizopora paradoxa* possessed the lowest relative frequency (4.44 %). In terms of percentage frequencies *Fulvifomes cesatii* (3.67 %) was recorded the highest value. The lowest Percentage frequency was recorded for two species namely *Phylloporia pectinata* and *Schizopora paradoxa* with one per cent (Table 14).

Table 14. Percentage frequency and Relative frequency of polypores in shola forest during pre monsoon period

Sl.No.	Fungal species	Percentage Frequency (%)	Relative Frequency (%)
1	*Fulvifomes cesatii**	3.67	24.44
2	*Fuscoporia wahlbergii***	1.00	6.67
3	*Ganoderma australe***	1.00	6.67
4	*Microporus xanthopus**	2.33	15.55
5	*Phellinus nilgheriensis***	1.00	6.67
6	*Phylloporia pectinata***	0.67	4.44
7	*Schizopora paradoxa**	0.67	4.44
8	*Trametes menziesii**	3.00	20.00
9	*Trametes ochracea**	1.67	11.11
	Total	**15.00**	**100.00**

[*Annual, ** Perennial]

4.2.2.2.2 Monsoon period

During the monsoon period the maximum relative frequency value (13.54%) was recorded with *Fulvifomes cesatii* (Table 15) followedby *Microporus xanthopus* (12.50 %), *Schizopora paradoxa* (11.46 %) and *Trametes menziesii* (10.42 %). The lowest relative frequency (3.12 %) was recorded for four species viz. *Earliella scabrosa, Fuscoporia wahlbergii, Leucophellinus hobsonii* and *Schizopora paradoxa.* In terms of percentage frequency, *Fulvifomes cesatii* dominated the others with 4.33 per cent followed by *Microporus xanthopus* with 4 per cent and *Trametes menziesii* with 3.67 per cent. The lowest percentage frequency (1 %) was recorded with 3 species viz. *Earliella scabrosa, Fuscoporia wahlbergii, Leucophellinus hobsonii* and *Schizopora paradoxa.*

4.2.2.2.3 Post monsoon period

During the post monsoon period the maximum relative frequency value (15 %) was recorded with *Fulvifomes cesatii* followed by *Phylloporia pectinata* (12.50 %) and *Trametes menziesii* (11.25 %) (Table 16). The lowest relative frequency (2.50 %) was recorded for *Leucophellinus hobsonii.* In terms of percentage frequency, *Fulvifomes cesatii* dominated the others with 4 per cent followed by *Phylloporia pectinata* with 3.33 per cent and *Trametes menziesii* with 3 per cent. The lowest

percentage frequency (0.67 %) was recorded with. *Leucophellinus hobsonii* and *Schizopora paradoxa.*

Table 15. Percentage frequency and Relative frequency of polypores in shola forest during monsoon period

Sl.No.	Fungal species	Percentage Frequency (%)	Relative Frequency (%)
1	*Earliella scabrosa**	1.00	3.12
2	*Fulvifomes cesatii***	4.33	13.54
3	*Fuscoporia wahlbergii***	1.00	3.12
4	*Ganoderma australe***	2.67	8.33
5	*Ganoderma lucidum**	2.33	7.29
6	*Leucophellinus hobsonii**	1.00	3.12
7	*Microporellus obovatus**	1.67	5.21
8	*Microporus xanthopus**	4.00	12.50
9	*Phellinus nilgheriensis***	1.00	3.12
10	*Phylloporia pectinata***	2.67	8.33
11	*Schizopora paradoxa**	1.00	3.12
12	*Trametes menziesii**	3.67	11.46
13	*Trametes ochracea**	3.33	10.42
14	*Trametes pubescens**	2.33	7.29
	Total	**32.00**	**100.00**

[*Annual, ** Perennial]

Table 16. Percentage frequency and Relative frequency of polypores in shola forest during post monsoon period

Sl.No.	Fungal species	Percentage Frequency (%)	Relative Frequency (%)
1	*Earliella scabrosa**	1.33	5.00
2	*Fulvifomes cesatii***	4.00	15.00
3	*Fuscoporia wahlbergii***	1.33	5.00
4	*Ganoderma australe***	1.33	5.00
5	*Ganoderma lucidum**	1.67	6.30
6	*Leucophellinus hobsonii**	0.67	2.50
7	*Microporellus obovatus**	1.00	3.75
8	*Microporus xanthopus**	2.33	8.75
9	*Phellinus nilgheriensis***	1.67	6.25
10	*Phylloporia pectinata***	3.33	12.50
11	*Schizopora paradoxa**	0.67	2.50
12	*Trametes menziesii**	3.00	11.25
13	*Trametes ochracea**	2.67	10.00
14	*Trametes pubescens**	1.67	6.25
	Total	**26.67**	**100.00**

[*Annual, ** Perennial]

4.2.3 Structural analysis of polypores

The structural analysis of polypores have been carried out in wet evergreen and shola forests by pooling the observation in three different seasons. The findings are funished below.

4.2.3.1 Structural analysis of polypores in wet evergreen forest

The distribution of polypores in the entire wet evergreen forests irrespective season has been pooled. A total of 2385 fruitbodies of polypores per hectare belonging to 29 different species were recorded over a sampling area of 30,000 m^2 (Table 17). Of which *Neofomitella rhodophaea* recorded the highest abundance (48.00) followed by *Phellinus gilvus* (44.65) and *Daedalea dochmia* (24.34). *Inonotus pachyphloeus* (2.78) was the least abundant species in the wet evergreen forest. *Daedalea dochmia* (11.90 %) was recorded with highest relative density followed by *Fomitella rhodophaea* (10.73 %) and *Phellinus gilvus* (10.60 %). *Polyporus* sp. nov. possessed the lowest relative density (0.04 %). *Spongipellis unicolor* and *Phellinus fastuosus* were also recorded with lower relative density 0.12 per cent and 0.29 per cent respectively. In terms of percentage frequency, *Microporus xanthopus* was recorded with highest value (16.67 %) followed by *Hexagonia tenuis* (12.67 %), *Trametes menziesii* (12.67 %) and *Daedalea dochmia* (11.67 %). The lowest percentage frequency (0.33 %) was possessed by two species namely *Polyporus* sp. nov. and *Spongipellis unicolor.*

Table 17. Structural analysis of polypores in wet evergreen forest

Sl. No.	*Fungal species*	A	D	RD	PF	RF
1	*Cellulariella acuta**	6.08	71.00	2.98	11.67	6.82
2	*Daedalea dochmia***	24.34	284.00	11.90	11.67	6.82
3	*Earliella scabrosa* *	9.33	28.00	1.17	3.00	1.75
4	*Favolus tenuiculus**	14.00	42.00	1.76	3.00	1.75
5	*Fomitopsis feei* *	8.64	72.00	3.01	8.33	4.87
6	*Funalia caperata**	12.23	53.00	2.22	4.33	2.53
7	*Fuscoporia contigua***	6.90	23.00	0.96	3.33	1.95
8	*Fuscoporia ferrea**	3.00	10.00	0.41	3.33	1.95
9	*Fuscoporia senex***	4.67	14.00	0.59	3.00	1.75

Contd...

Sl. No.	Fungal species	A	D	RD	PF	RF
10	*Fuscoporia wahlbergii***	10.5	21.00	0.88	2.00	1.17
11	*Ganoderma australe***	10.6	99.00	4.15	9.33	5.46
12	*Ganoderma lucidum**	8.36	39.00	1.63	4.67	2.73
13	*Hexagonia tenuis**	10.42	132.00	5.53	12.67	7.40
14	*Inonotus pachyphloeus***	2.78	13.00	0.54	4.67	2.73
15	*Microporellus obovatus**	6.50	26.00	1.09	4.00	2.34
16	*Microporus affinis**	12.17	73.00	3.06	6.00	3.50
17	*Microporus xanthopus**	13.38	223.00	9.35	16.67	9.75
18	*Neofomitella rhodophaea**	48.00	256.00	10.73	5.33	3.11
19	*Phellinus dependens***	4.64	17.00	0.71	3.67	2.14
20	*Phellinus fastuosus***	5.25	7.00	0.29	1.33	0.78
21	*Phellinus gilvus**	44.65	253.00	10.61	5.67	3.31
22	*Phellinus nilgheriensis***	9.31	90.00	3.77	9.67	5.65
23	*Polyporus grammocephalus**	7.286	17.00	0.71	2.33	1.36
24	*Polyporus leprieurii**	6.00	26.0	1.09	4.33	2.53
25	*Polyporus* sp. nov.*	3.00	1.00	0.04	0.33	0.19
26	*Schizopora paradoxa**	6.27	23.0	0.96	3.67	2.14
27	*Spongipellis unicolor**	9.00	3.00	0.12	0.33	0.19
28	*Trametes marianna**	21.6	216.00	9.05	10.00	5.85
29	*Trametes menziesii**	19.97	253.00	10.61	12.67	7.40
	Total	**348.89**	**2385.00**	**100.00**	**171.00**	**100.00**

[*Annual, ** Perennial, Abundance (A), Relative density (RD), Percentage Frequency (PF) and Relative Frequency (RF)]

4.2.3.2 Structural analysis of polypores in shola forest

The distribution of polypores in the entire shola forest has been pooled irrespective of season. A total of 588 fruitbodies of polypores per hectare belonging to 14 different species were recorded over a sampling area of 30,000 m^2 (Table 18). Out of 14 species *Trametes ochracea* recorded the highest abundance (37.20) followed by *Phylloporia pectinata* (16.12) and *Trametes pubescens* (11.36). *Fuscoporia wahlbergii* (2.70) was the least abundant species in the shola forest. *Trametes ochracea* had the highest relative density (42.18 %) followed by *Trametes menziesii* (12.07 %) and *Trametes pubescens* (9.01 %). Lowest values was recorded for *Ganoderma lucidum* (1.19 %). Distribution of polypores in the shola forest revealed that the *Fulvifomes cesatii* had the highest relative frequency (18.22 %) followed by *Trametes menziesii* (15.10 %) and *Microporus xanthopus* (13.54 %).

The lowest relative frequency (2.60 %) was recorded for three species namely *Earliella scabrosa, Leucophellinus hobsonii* and *Microporellus obovatus*. In terms of percentage frequency *Fulvifomes cesatii* dominated the others with 11.67 per cent followed by *Trametes menziesii* (9.67 %) and *Microporus xanthopus* (8.87 %). The lowest relative frequency (1.67 %) was recorded for three species namely *Earliella scabrosa, Leucophellinus hobsonii* and *Microporellus obovatus.*

Table 18. Structural analysis of polypores in shola forest

Sl. No.	Fungal species	A	D	RD	PF	RF
1	*Earliella scabrosa**	7.80	13.00	2.21	1.67	2.60
2	*Fulvifomes cesatii***	3.08	36.00	6.12	11.67	18.22
3	*Fuscoporia wahlbergii***	2.70	9.00	1.53	3.33	5.20
4	*Ganoderma australe***	6.00	22.00	3.74	3.67	5.73
5	*Ganoderma lucidum**	3.00	7.00	1.19	2.33	3.64
6	*Leucophellinus hobsonii**	9.00	15.00	2.55	1.67	2.60
7	*Microporellus obovatus**	6.60	11.00	1.87	1.67	2.60
8	*Microporus xanthopus**	4.03	35.00	5.95	8.67	13.54
9	*Phellinus nilgheriensis***	3.60	12.00	2.04	3.33	5.20
10	*Phylloporia pectinata***	16.12	43.00	7.31	2.67	4.17
11	*Schizopora paradoxa**	5.57	13.00	2.21	2.33	3.64
12	*Trametes menziesii**	7.34	71.00	12.07	9.67	15.10
13	*Trametes ochracea**	37.20	248.00	42.18	6.67	10.41
14	*Trametes pubescens**	11.36	53.00	9.01	4.67	7.29
	Total	**123.42**	**588.00**	**100.00**	**64.00**	**100.00**

[*Annual, ** Perennial, Abundance (A), Relative density (RD), Percentage Frequency (PF) and Relative Frequency (RF)]

4.2.4 Seasonal influence on polypore association

4.2.4.1 Seasonal influence on polypore association in wet evergreen forest

A Principal component analysis was done to find the association among polypores during pre-monsoon, monsoon and post monsoon season based on their composition and density (Fig. 5). From the PCA, it was understood that species like *Trametes menziesii, Phellinus gilvus, Neofomitella rhodophaea* and *Trametes marianna* were intensively linked with monsoon and post monsoon periods. Whereas the distribution of *Daedalea dochmia* is found to be more linked with pre monsoon period and not very much affected by the monsoon and post monsoon periods.

Similarly the distribution of species like *Hexagonia tenuis, Ganoderma australe, Fomitopsis feei, Cellulariella acuta* and *Microporus affinis* were not that much affected by the rainy seasons. Additionally the distribution of perennial species like *Fuscoporia contigua, Phellinus dependens, Phellinus fastuosus, Fuscoporia ferrea, Fuscoporia senex, Fuscoporia wahlbergii* and *Phellinus cesatii were* also not much affected by the rainy season as compared to other polypores. The distribution of annual polypores with fleshy friutbodires like *Microporellus obovatus, Favolus tenuiculus, Polyporus grammocephalus, Polyporus leprieurii, Earliella scabrosa, Funalia caperata* and *Ganoderma lucidum* is found to be highly influenced by the monsoon period.

4.2.4.2 Seasonal influence on polypore association in shola forest

The principal component analysis showed that the distribution of polypores like *Phellinus nilgheriensis, Ganoderma australe, Microporus xanthopus, Fulvifomes cesatii, Phylloporia pectinata, Fuscoporia wahlbergii, Schizopora paradoxa* and *Trametes menziesii* is not much associated with the monsoon and post monsoon periods (Fig. 6). Whereas the species like, *Trametes ochracea* and *Trametes pubescens* is more associated with the monsoon and post monsoon periods. Simlarly the species like *Earliella scabrosa, Ganoderma lucidum, Leucophellinus hobsonii* and *Microporellus obovatus* is more influenced by the rainy season.

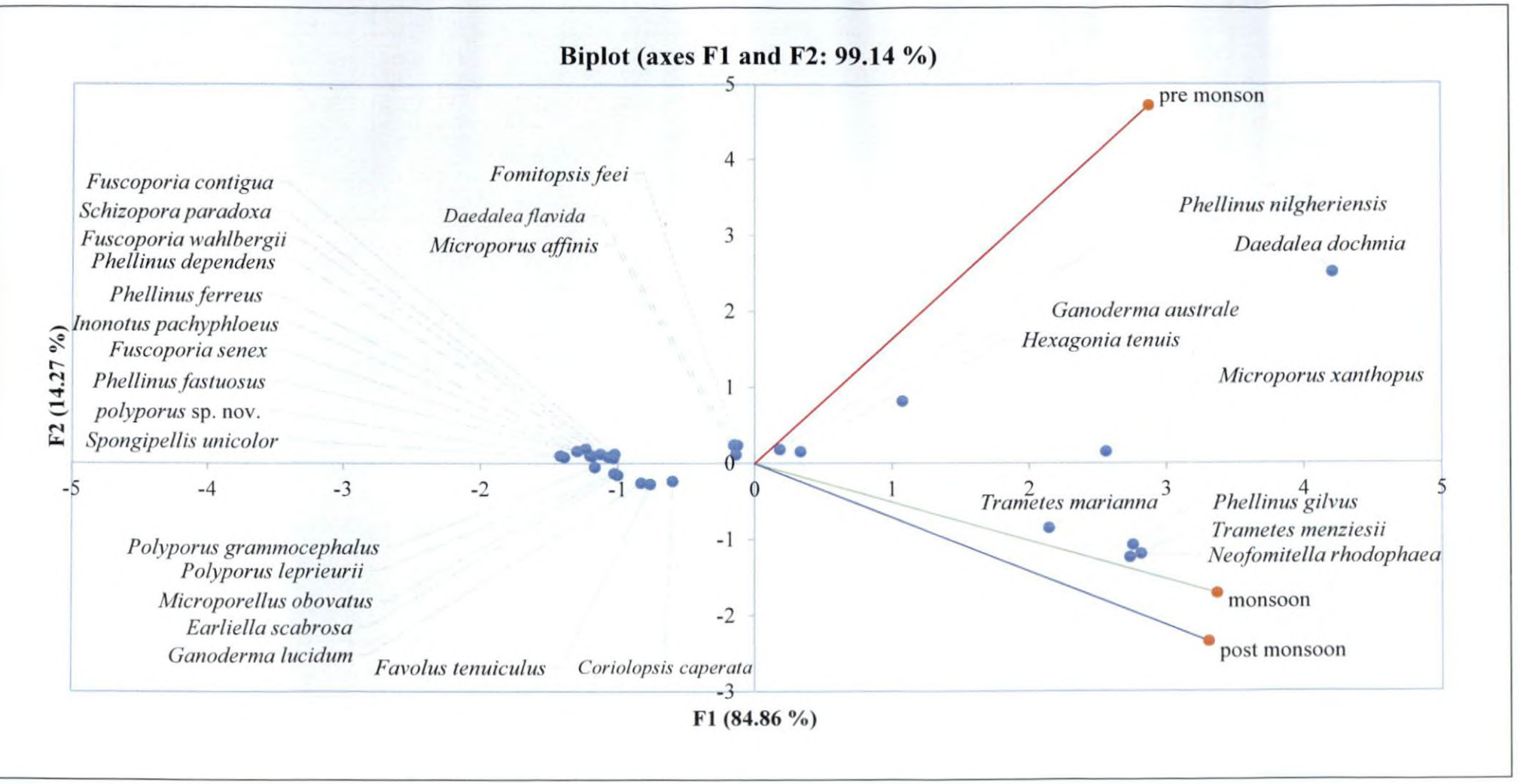


Fig. 5. PCA bi-plot of polypores in wet evergreen forest during different seasons

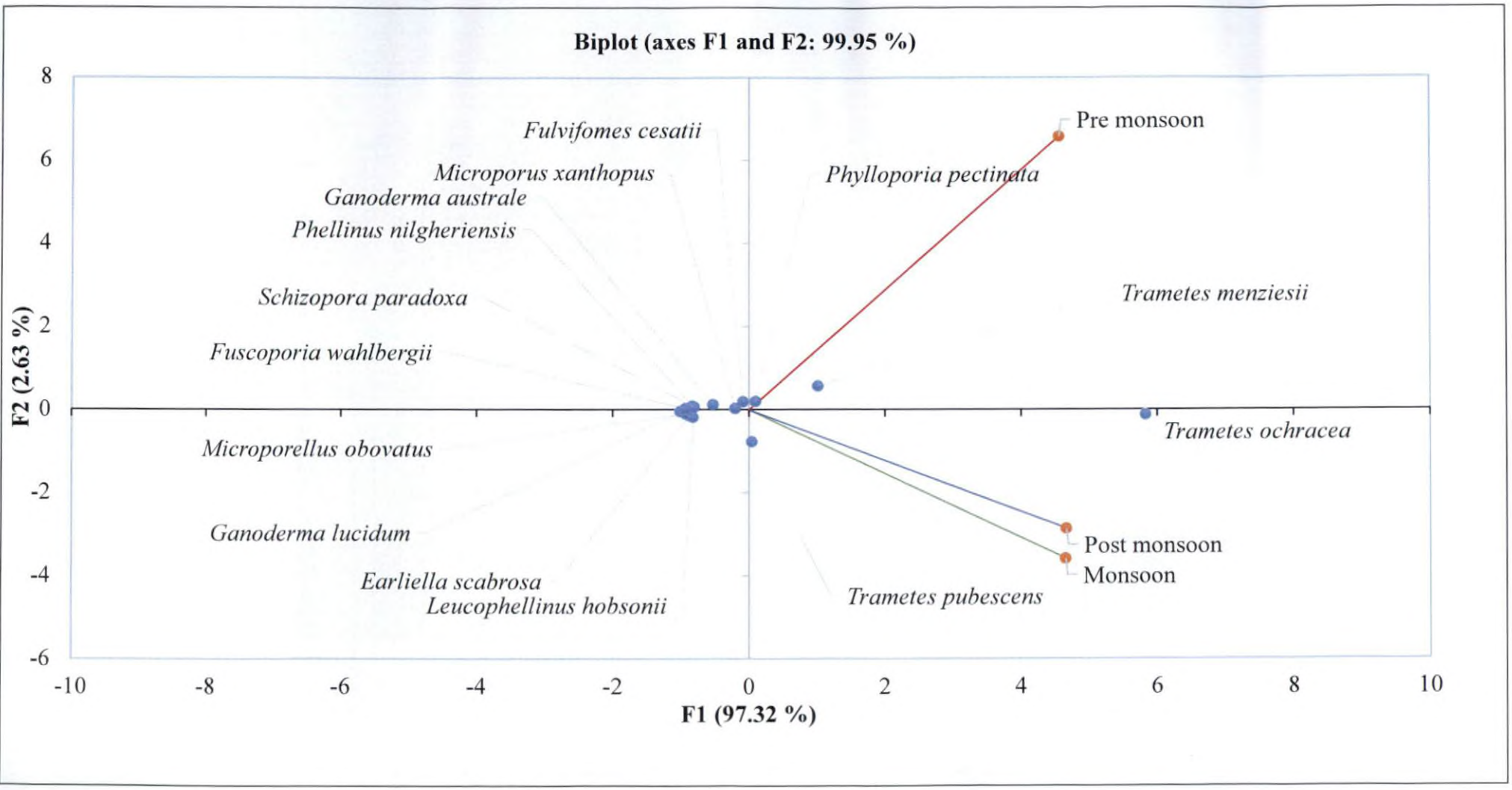
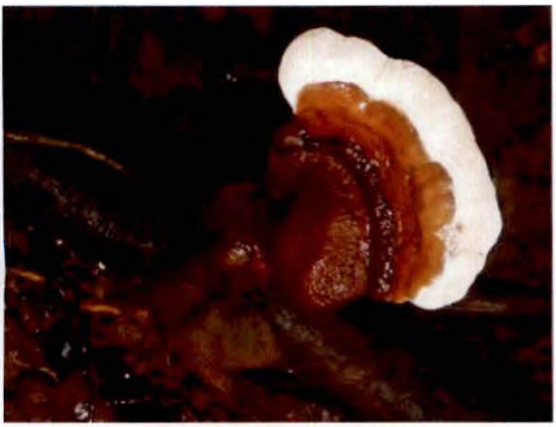


Fig. 6. PCA bi-plot of polypores in shola forest during different seasons



Ganoderma lucidum

Nigroporus vinosus

Polyporus grammocephalus

Rigidoporus lineatus

Hexagonia tenuis

Spongipellis unicolor

Microporellus obovatus

Neofomitella rhodophaea

Plate 14. Newly germinated polypore during monsoon

4.3. POLYPORE DISTRIBUTION ALONG THE ALTITUDINAL GRADIENT IN SILENT VALLEY NATIONAL PARK

The influence of altitudinal variation in the distribution pattern of polypores in the forests of Silent Valley National Park were analyzed based on their occurrence along different altitudinal gradient. The density of polypores during different seasons was combined together in locations wise (Table 19). The Diversity Indices like Shannon-wiener Index, Margalef Richness Index, Pielou's Evenness Index and Berger-Parker Dominance Index were calculated for detailed analysis (Table 20).

Most of the species showed a drastic reduction in density as the altitude increases (Table 19). The density is recorded highest (2613) in wet evergreen forest at Sairandhri (1000-1050 m) followed by Poochippara (1150-1200 m) with density 2415 and Walakkad (1300-1350m) with density 2129. A remarkable reduction in the density was observed in high altitude shola forest at Sispara (1950-2000 m) as it is reduced to 732 fruitbodies. The shola forest at highest altitudes at Cheriyamkandam (2100-2150 m) and Valliyamkandam (2200-2250 m) harboured only 597 and 435 fruitbodies of plypores respectively. It was also observed that the species richness is reduced from 29 at Sairandhri (1000-1050 m) to 5 at Valliyamkandam (2200-2250 m) along the altitudinal gradient.

Interestingly, five species (*Phylloporia pectinata, Fulvifomes cesatii, Leucophellinus hobsonii, Trametes ochracea* and *Trametes pubescens*) were recorded only from high altitude shola forest. Whereas most of the species were found to be confined only in evergreen forest (Table 20). Nevertheless the species like *Earliella scabrosa, Phellinus nilgheriensis, Ganoderma lucidum, Microporellus obovatus* and *Fuscoporia wahlbergii* made their presence upto 2000 m altitude (Sisppara). Similarly, the species like *Ganoderma australe, Microporus xanthopus, Fuscoporia wahlbergii, Schizopora paradoxa* and *Trametes menziesii* were found to be distributed upto 2150 m altitude (Cheriyamkandam). The species that were found above 2200 m altitude were *Phylloporia pectinata, Schizopora paradoxa, Trametes menziesii, Trametes ochracea* and *Trametes pubescens* and they were

found to be less evenly distributed. Among them, Trametes *ochracea* was recoreded with highest number of individuals (231).

The Sairandhri, the lowest altitude (1000-1150 m) area of study showed the highest Shannon-wiener Index (2.9) and Margalef Richness Index (3.558) followed by Poochippara (1150-1200 m) with Diversity Index 2.8 and Richness Index 3.338. In wet evergreen forest Walakkad (1300-1350 m) showed the lower diversity and species richness with Shannon-wiener Index (2.68) and Margalef Richness Index (3.131). In shola forest, the Sispara (1950-2000 m) showed higher Richness Index (1.516) and reduced to 1.115 and 0.658 in Cheriyamkandam (2100-2150 m) and Valliyamkandam (2200-2250 m), respectively. The Diversity Index was also found to be relatively high (2.043) in Sispara (1950-2000 m) and reduced to 1.8 and 1.218 in Cheriyamkandam (2100-2150 m) and Valliyamkandam (2200-2250 m), respectively.

The Pielou's Evenness Index is found to be decreased from Sairandhri (0.861) to Valliyamkandam (0.756) along the altitudinal gradient. It was understood that the lower altitude area shows more evenness in polypore distribution. Interestingly, the dominance is observed to be high in high altitude shola forest of Valliyamkandam with Berger-Parker Dominance Index 0.531 while, it was very low in Sairandhri (0.112). A gradual increase in dominance is observed along the altitudinal gradient (Fig. 7 & 8).

Table 19. Density of polypores in Silent Valley National Park at different altitudes

Sl. No	*Fungal species*	Distribution of polypores in different locations (No. of fruitbodies)					
		Wet evergreen forest			Shola forest		
		Sairandhri (1000-1050 m)	Poochippara (1150-1200 m)	Walakkad (1300-1350 m)	Sispara (1950-2000 m)	Cheriyamkandam (2100-2150 m)	Valliyamkandam (2200-2250 m)
1	*Funalia caperata**	76	45	38	-	-	-
2	*Cellulariella acuta**	88	69	56	-	-	-
3	*Earliella scabrosa* *	24	32	28	39	-	-
4	*Favolus tenuiculus* *	57	48	21	-	-	-
5	*Inonotus pachyphloeus***	23	16	-	-	-	-
6	*Neofomitella rhodophaea***	265	257	246	-	-	-
7	*Daedalea dochmia***	294	287	271	-	-	-
8	*Fomitopsis feei**	87	76	53	-	-	-
9	*Phellinus nilgheriensis***	106	96	68	36	-	-
10	*Phellinus gilvus**	211	224	324	-	-	-
11	*Ganoderma australe***	108	94	95	-	66	-
12	*Ganoderma lucidum**	48	38	31	21	-	-
13	*Hexagonia tenuis**	158	129	109	-	-	-
14	*Leucophellinus hobsonii**	-	-	-	45	-	-
15	*Microporellus obovatus**	34	16	28	33	-	-
16	*Microporus affinis**	49	122	48	-	-	-
17	*Microporus xanthopus**	226	229	214	50	55	-
18	*Fulvifomes cesatii**	-		-	108	-	-
19	*Fuscoporia contigua***	36	18	15	-	-	-
20	*Phellinus dependens***	16	17	18	-	-	-
21	*Phellinus fastuosus***	11	4	6	-	-	-
22	*Fuscoporia ferrea**	12	11	7	-	-	-
23	*Phylloporia pectinata***	-	-	-	-	63	66
24	*Fuscoporia senex***	21	14	7	-	-	-

Contd...

Sl. No	*Fungal species*	Distribution of polypores in different locations (No. of fruitbodies)					
		Wet evergreen forest			Shola forest		
		Sairandhri (1000-1050 m)	Poochippara (1150-1200 m)	Walakkad (1300-1350 m)	Sispara (1950-2000 m)	Cheriyamkandam (2100-2150 m)	Valliyamkandam (2200-2250 m)
25	*Fuscoporia wahlbergii***	43	20		26	1	-
26	*Polyporus grammocephalus**	21	17	13	-	-	-
27	*Polyporus leprieurii**	37	20	21	-	-	-
28	*Polyporus* sp. nov.*	3	-	-	-	-	-
29	*Schizopora paradoxa**	21	25	23	-	38	1
30	*Spongipellis unicolor**	9	-	-	-	-	-
31	*Trametes marianna**	263	249	136	-	-	-
32	*Trametes menziesii**	267	241	253	77	69	67
33	*Trametes ochracea**	-	-	-	265	248	231
34	*Trametes pubescens**	-	-	-	32	57	70
	Total individuals	**2613**	**2415**	**2129**	**732**	**597**	**435**
	Total species	**29**	**27**	**25**	**11**	**8**	**5**

[*Annual, ** Perennial]

Table 20. The Diversity Indices of different sites with altitudinal gradient at Silent Valley National Park

Sl.No	Study locations	Margalef Richness Index	Shannon-wiener Index	Pielou's Evenness Index	Berger-Parker Dominance Index
1	Sairandhri (1000-1150 m)	3.558	2.900	0.861	0.112
2	Poochippara (1150-1200 m)	3.338	2.812	0.853	0.119
3	Walakkad (1300-1350 m)	3.131	2.680	0.833	0.152
4	Sispara (1950-2000 m)	1.516	2.043	0.852	0.362
5	Cheriyamkandam (2100-2150 m)	1.115	1.800	0.749	0.466
6	Valliyamkandam (2200-2250 m)	0.658	1.218	0.756	0.531

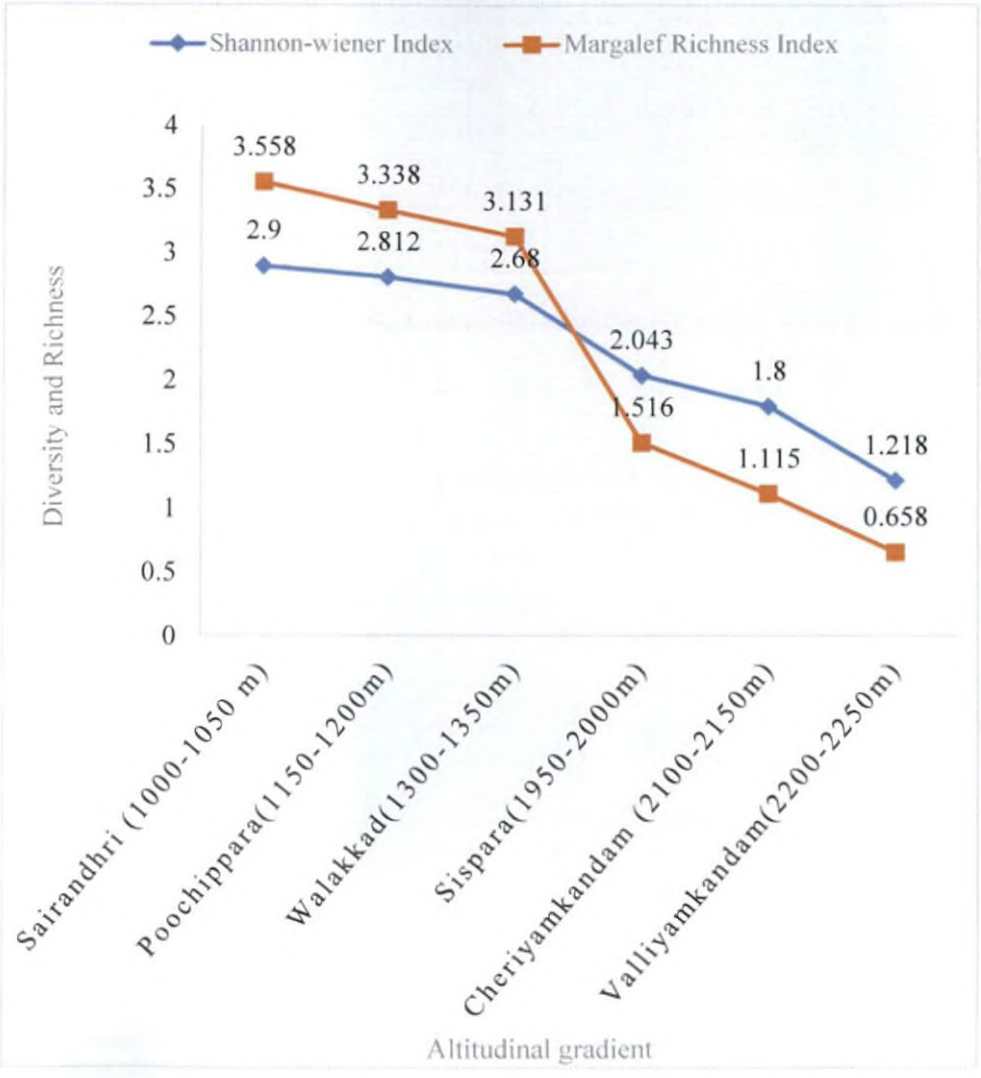


Fig. 7. Diversity and richness along the altitudinal gradient

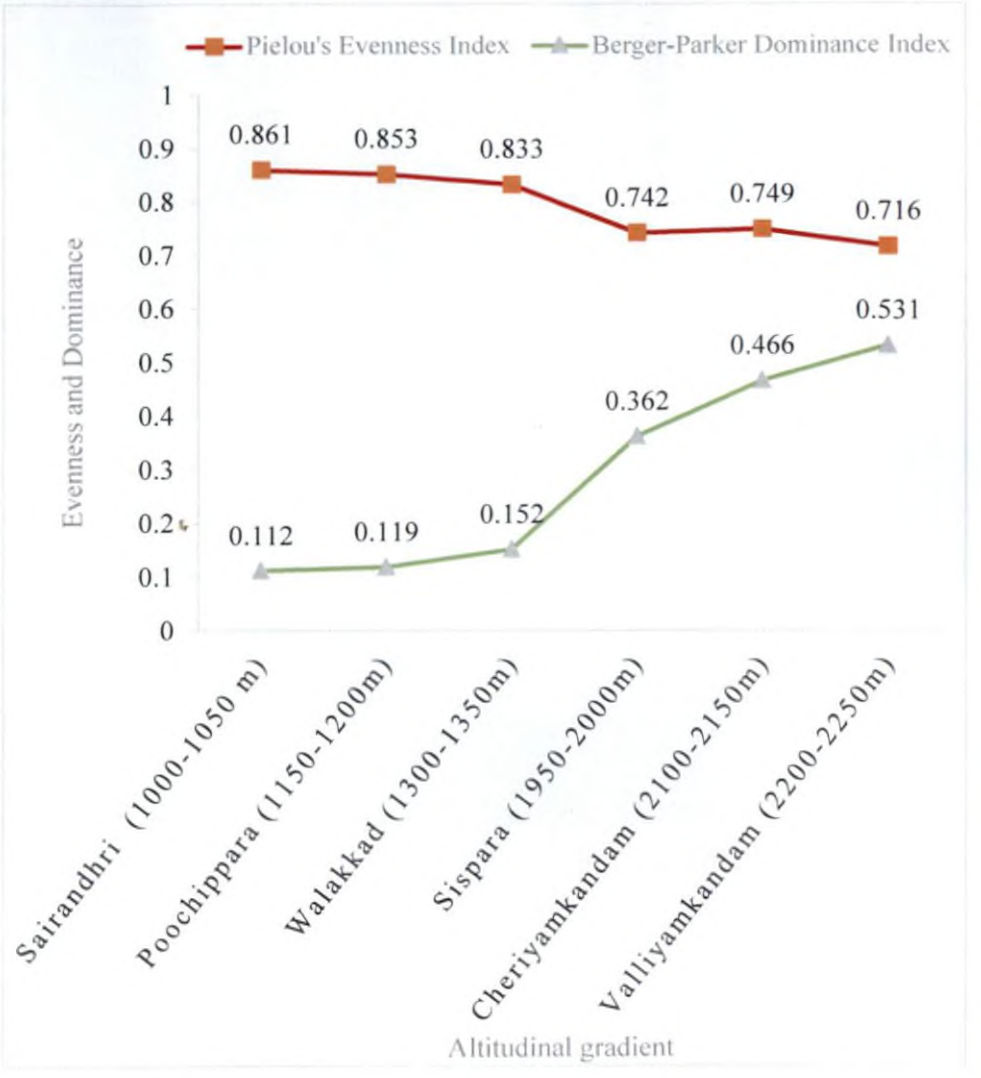


Fig. 8. Dominance and evenness along the altitudinal gradient

4.4 HOST ASSOCIATION OF POLYPORES

4.4.1 Distribution of host species in wet evergreen and shola forests

The distribution of different tree host species of polypores was studied in wet evergreen and shola forests. The tree species present in the study area was identified and divided into host and non-host tree species based on the presence and absence of polypores during the entire study period (Table 21). A total of 91 tree species belonging to 32 families were identified and out of this, 29 species under 16 families were host species (Fig. 9). Lauraceae and Myrtaceae contributed 5 and 3 species respectively and they represented the major host families (Fig.10).

Table 21. List of host and non-host tree species with respect to polypores in wet evergreen and shola forests

Sl. No	Species	Family	Status & Occurrence	
			Evergreen	Shola
1	*Acronychia pedunculata*	Rutaceae	H	A
2	*Actinodaphne bourdillonii*	Lauraceae	NH	A
3	*Agrostistachys borneensis*	Euphorbiaceae	H	A
4	*Aphanamixis polystachya*	Meliaceae	A	NH
5	*Apodytes dimidiata*	Icacinaceae	NH	A
6	*Apollonias arnottii*	Lauraceae	A	NH
7	*Artocarpus heterophyllus*	Moraceae	NH	A
8	*Beilschmiedia wightii*	Lauraceae	A	NH
9	*Bischofia javanica*	Euphorbiaceae	H	A
10	*Callicarpa tomentosa*	Verbenaceae	H	A
11	*Calophyllum inophyllum*	Clusiaceae	H	A
12	*Calophyllum polyanthum*	Clusiaceae	NH	A
13	*Canarium strictum*	Burseraceae	NH	A
14	*Cinnamomum malabatrum*	Lauraceae	H	A
15	*Cinnamomum sulphuratum*	Lauraceae	A	H
16	*Clerodendrum infortunatum*	Verbenaceae	H	A
17	*Cryptocarya wightiana*	Lauraceae	NH	A
18	*Cullenia exarillata*	Bombacaceae	H	A
19	*Daphniphyllum neilgherrense*	Euphorbiaceae	A	NH
20	*Dimocarpus longan*	Sapindaceae	NH	A
21	*Dysoxylum malabaricum*	Meliaceae	NH	A
22	*Elaeocarpus glandulosus*	Elaeocarpaceae	NH	A
23	*Elaeocarpus munronii*	Elaeocarpaceae	H	H
24	*Elaeocarpus recurvatus*	Elaeocarpaceae	NH	NH

(A -Absent, H-Host, NH-Non Host)

Contd...

Sl. No	Species	Family	Status & Occurrence	
			Evergreen	Shola
26	*Eurya nitida*	Symplocaceae	A	H
27	*Excoecaria oppositifolia*	Euphorbiaceae	A	NH
28	*Ficus amplissima*	Moraceae	NH	A
29	*Ficus exasperata*	Moraceae	NH	A
30	*Ficus nervosa*	Moraceae	NH	A
31	*Garcinia gummi-gutta*	Clusiaceae	NH	A
32	*Garcinia morella*	Clusiaceae	NH	A
33	*Garcinia xanthochymus*	Clusiaceae	NH	A
34	*Glochidion ellipticum*	Euphorbiaceae	A	NH
35	*Gnidia glauca*	Theaceae	A	NH
36	*Gomphandra coriacea*	Icacinaceae	NH	A
37	*Gordonia obtusa*	Theaceae	NH	A
38	*Holigarna nigra*	Anacardiaceae	NH	A
39	*Holigarna beddomei*	Anacardiaceae	NH	A
40	*Hopea glabra*	Dipterocarpaceae	H	A
41	*Hopea racophloea*	Dipterocarpaceae	NH	A
42	*Hydnocarpus alpina*	Flacourtiaceae	NH	A
43	*Ilex gardneriana*	Aquifoliaceae	A	NH
44	*Ilex wightiana*	Aquifoliaceae	A	H
45	*Lepisanthes tetraphylla*	Sapindaceae	NH	NH
46	*Litsea floribunda*	Lauraceae	H	H
47	*Litsea stocksii*	Lauraceae	H	A
48	*Lophopetalum wightianum*	Celastraceae	NH	A
49	*Macaranga indica*	Euphorbiaceae	NH	A
50	*Mallotus tetracoccus*	Euphorbiaceae	NH	A
51	*Mangifera indica*	Anacardiaceae	NH	A
52	*Mastixia arborea*	Cornaceae	NH	A
53	*Melicope lunu-ankenda*	Rutaceae	H	A
54	*Meliosma pinnata*	Sabiaceae	A	NH
55	*Meliosma simplicifolia*	Sabiaceae	NH	NH
56	*Mesua ferrea*	Calophyllaceae	H	A
57	*Michelia nilagirica*	Magnoliaceae	A	NH
58	*Microtropis ramiflora*	Celastraceae	A	NH
59	*Myristica beddomei*	Myristicaceae	H	A
60	*Myristica malabarica*	Myristicaceae	H	A
61	*Myrsine wightiana*	Meliaceae	A	NH
62	*Neolitsea scrobiculata*	Lauraceae	A	NH
63	*Nothapodytes nimmoniana*	Icacinaceae	A	NH
64	*Nothopegia racemosa*	Anacardiaceae	NH	A
65	*Olea dioica*	Oleaceae	H	A
66	*Olea paniculata*	Oleaceae	NH	A
67	*Palaquium ellipticum*	Sapotaceae	H	A

(A -Absent, H-Host, NH-Non Host)

Contd...

Sl. No	Species	Family	Status & Occurrence	
			Evergreen	Shola
68	*Phoebe wightii*	Lauraceae	H	A
69	*Pittosporum neelgherrense*	Pittosporaceae	A	NH
70	*Poeciloneuron indicum*	Clusiaceae	A	NH
71	*Polyalthia coffeoides*	Annonaceae	A	NH
72	*Rhododendron arboreum*	Ericaceae	A	H
73	*Schleichera oleosa*	Sapindaceae	NH	A
74	*Schefflera rostrata*	Sapindaceae	A	NH
75	*Symplocos cochinchinensis*	Staphyleaceae	A	NH
76	*Symplocos obtusa*	Symplocaceae	A	NH
77	*Symplocos racemosa*	Symplocaceae	A	H
78	*Syzygium calophyllifolium*	Myrtaceae	H	H
79	*Syzygium cumini*	Myrtaceae	H	A
80	*Syzygium densiflorum*	Myrtaceae	A	NH
81	*Syzygium hemisphericum*	Myrtaceae	NH	A
82	*Syzygium laetum*	Myrtaceae	H	A
83	*Syzygium lanceolatum*	Myrtaceae	NH	A
84	*Syzygium munronii*	Myrtaceae	NH	A
85	*Ternstroemia gymnanthera*	Theaceae	NH	A
86	*Toona ciliata*	Meliaceae	NH	A
87	*Trichilia connaroides*	Meliaceae	NH	A
88	*Turpinia cochinchinensis*	Staphyleaceae	A	NH
89	*Turpinia malabarica*	Staphyleaceae	A	NH
90	*Vaccinium* leschenaultii	Thymeleaceae	A	NH
91	*Viburnum coriaceum*	Caprifoliaceae	A	NH

(A -Absent, H-Host, NH-Non Host)

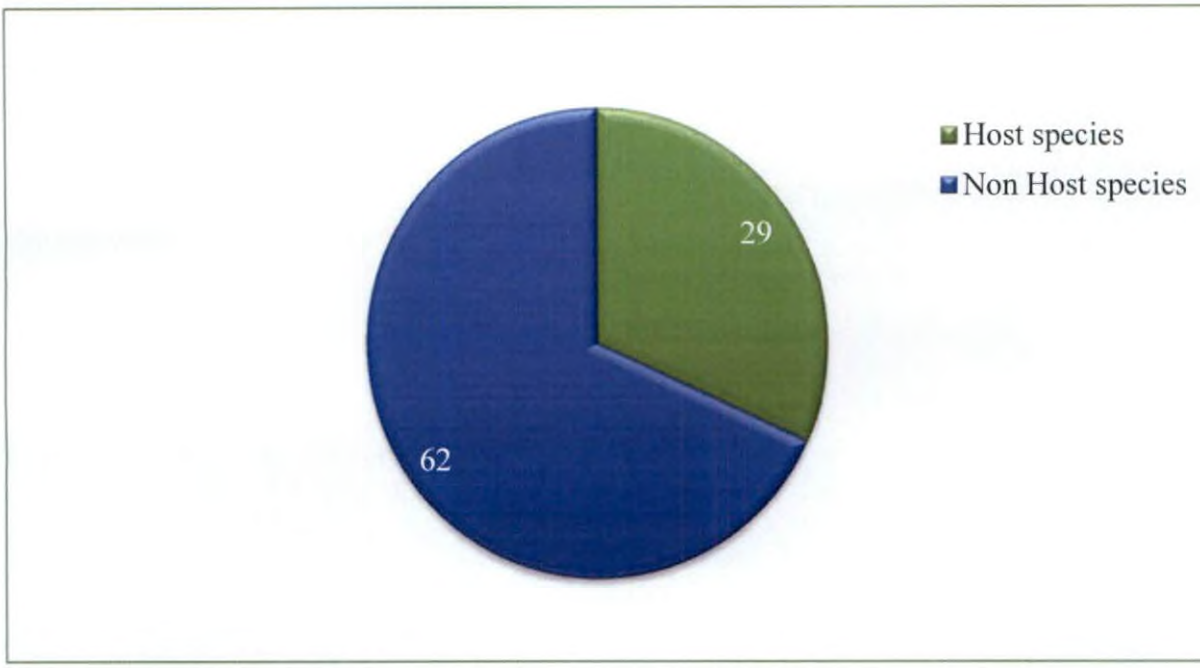


Fig. 9. Distribution of host and non-host tree species of polypores in Silent Valley National Park

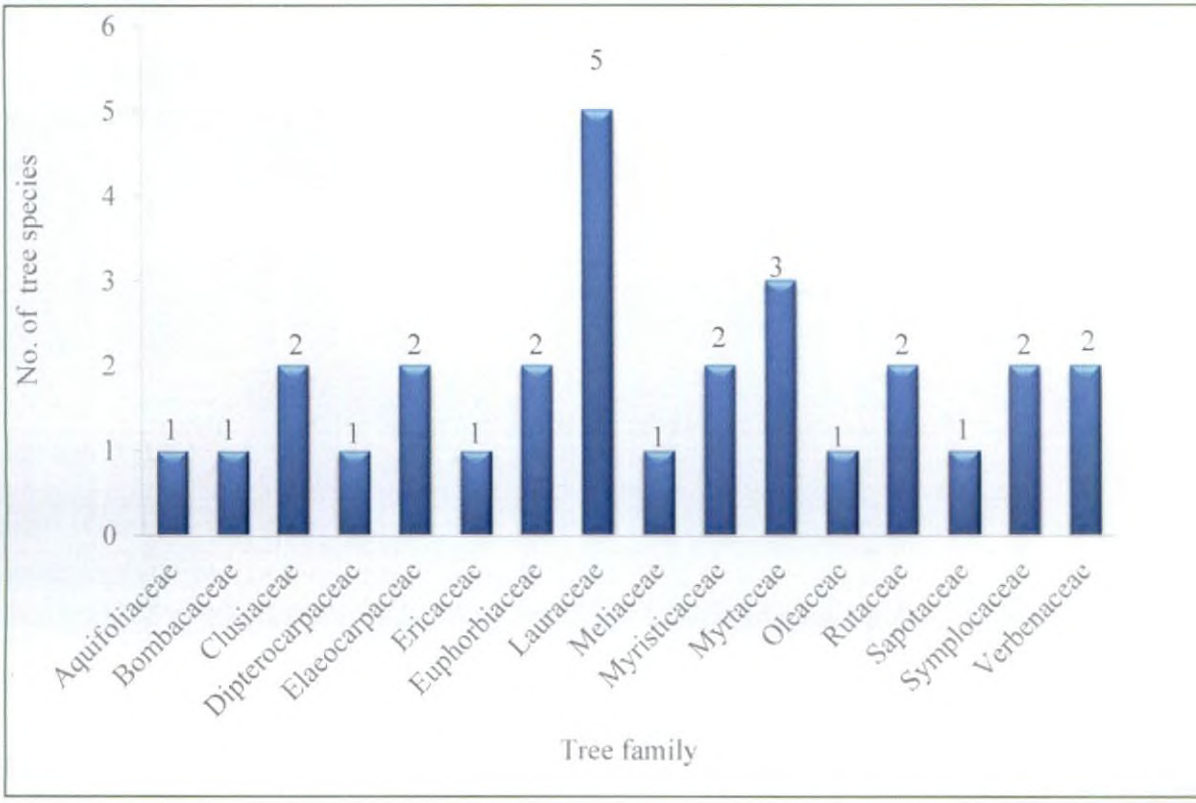


Fig. 10. Distribution of tree host species of polypores on different families

4.4.2 Density and occurrence of polypores on host trees

The density and occurrence of polypores on different host tree species in the study area has been quantified (Table 22). *Mesua ferrea* harboured 1289 individuals belonging 13 species followed by *Elaeocarpus tuberculatus* (1028) with 12 species and *Cullenia exarillata* (749) with 8 species. Host trees species like *Bischofia javanica, Rhododendron arboretum, Myristica malabarica, Eurya nitida* and *Olea dioica* showed very less polypore density (Fig. 11a & Fig. 11b). The highest number of occurrence was observed in *Mesua ferrea* (95) followed by *Elaeocarpus tuberculatus* (68), *Melicope lunu-ankenda* (43) and *Dysoxylum malabaricum* (39). Lowest occurrence of polypores was recorded for species like *Bischofia javanica, Acronychia pedunculata, Litsea stocksii, Myristica malabarica* and *Rhododendron arboretum* (Fig. 12a & 12b).

Density and occurrence of polypores on different host families was also analyzed (Fig. 13 & Fig. 14). Highest number of polypore individuals was recorded on Clusiaceae (1629) followed by Elaeocarpaceae (1405), Lauraceae (1252) and Bombacaceae (749). Lowest density (45) was observed for Ericaceae. In case of occurrence, polypores occurred highest in Clusiaceae (128) followed by Elaeocarpaceae (93) and Lauraceae (91). The lowest polypore occurrence (8) was observed in Ericaceae.

Table 22. Density and occurrence of polypores on different host tree species in wet evergreen and shola forests

Sl. No.	*Host tree species*	Family	No. of polypores species	No. of occurrence	No. of individuals
1	*Acronychia pedunculata*	Rutaceae	3	6	84
2	*Agrostistachys borneensis*	Euphorbiaceae	6	16	245
3	*Bischofia javanica*	Euphorbiaceae	3	5	49
4	*Callicarpa tomentosa*	Verbenaceae	4	19	210
5	*Calophyllum inophyllum*	Clusiaceae	8	31	340
6	*Cinnamomum malabatrum*	Lauraceae	6	29	298
7	*Cinnamomum sulphuratum*	Lauraceae	5	35	509
8	*Clerodendrum infortunatum*	Verbenaceae	5	29	296
9	*Cullenia exarillata*	Bombacaceae	8	29	749
10	*Dysoxylum malabaricum*	Meliaceae	5	39	345
11	*Elaeocarpus munronii*	Elaeocarpaceae	7	25	377
12	*Elaeocarpus tuberculatus*	Elaeocarpaceae	12	68	1028
13	*Eurya nitida*	Symplocaceae	2	16	90
14	*Hopea glabra*	Dipterocarpaceae	3	10	209
15	*Ilex wightiana*	Aquifoliaceae	4	18	291
16	*Litsea floribunda*	Lauraceae	3	9	136
17	*Litsea stocksii*	Lauraceae	4	8	215
18	*Melicope lunu-ankenda*	Rutaceae	7	43	398
19	*Mesua ferrea*	Clusiaceae	13	95	1289
20	*Myristica beddomei*	Myristicaceae	8	39	434
21	*Myristica malabarica*	Myristicaceae	1	8	78
22	*Olea dioica*	Oleaceae	1	9	97
23	*Palaquium ellipticum*	Sapotaceae	7	26	284
24	*Phoebe wightii*	Lauraceae	2	10	94
25	*Rhododendron arboreum*	Ericaceae	2	8	45
26	*Symplocos racemosa*	Symplocaceae	3	16	116
27	*Syzygium calophyllifolium*	Myrtaceae	2	8	38
28	*Syzygium cumini*	Myrtaceae	9	31	308
29	*Syzygium laetum*	Myrtaceae	7	20	267
Total				**705**	**8919**

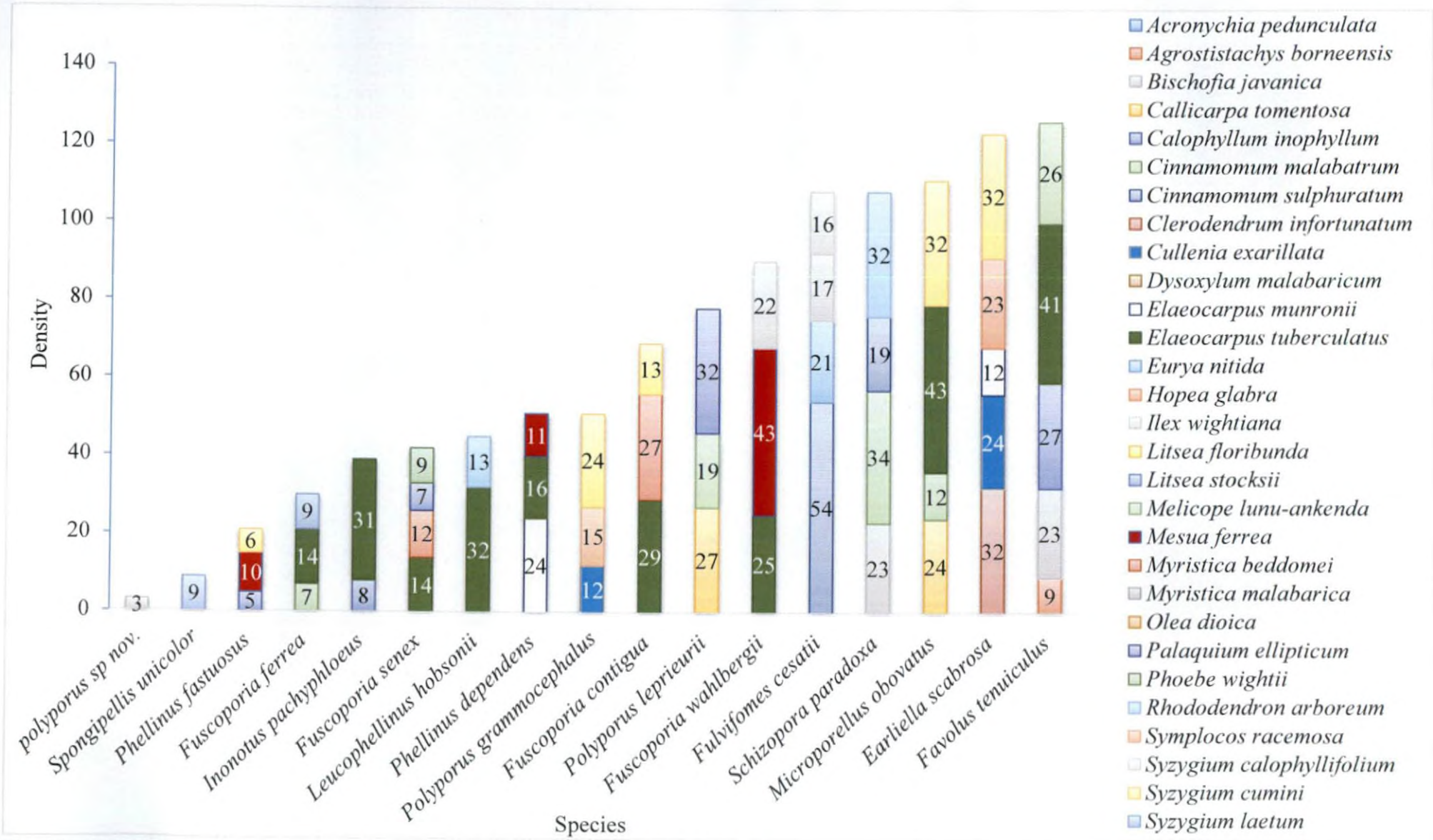


Fig. 11a. Density of polypores on tree host species in Silent Valley National Park

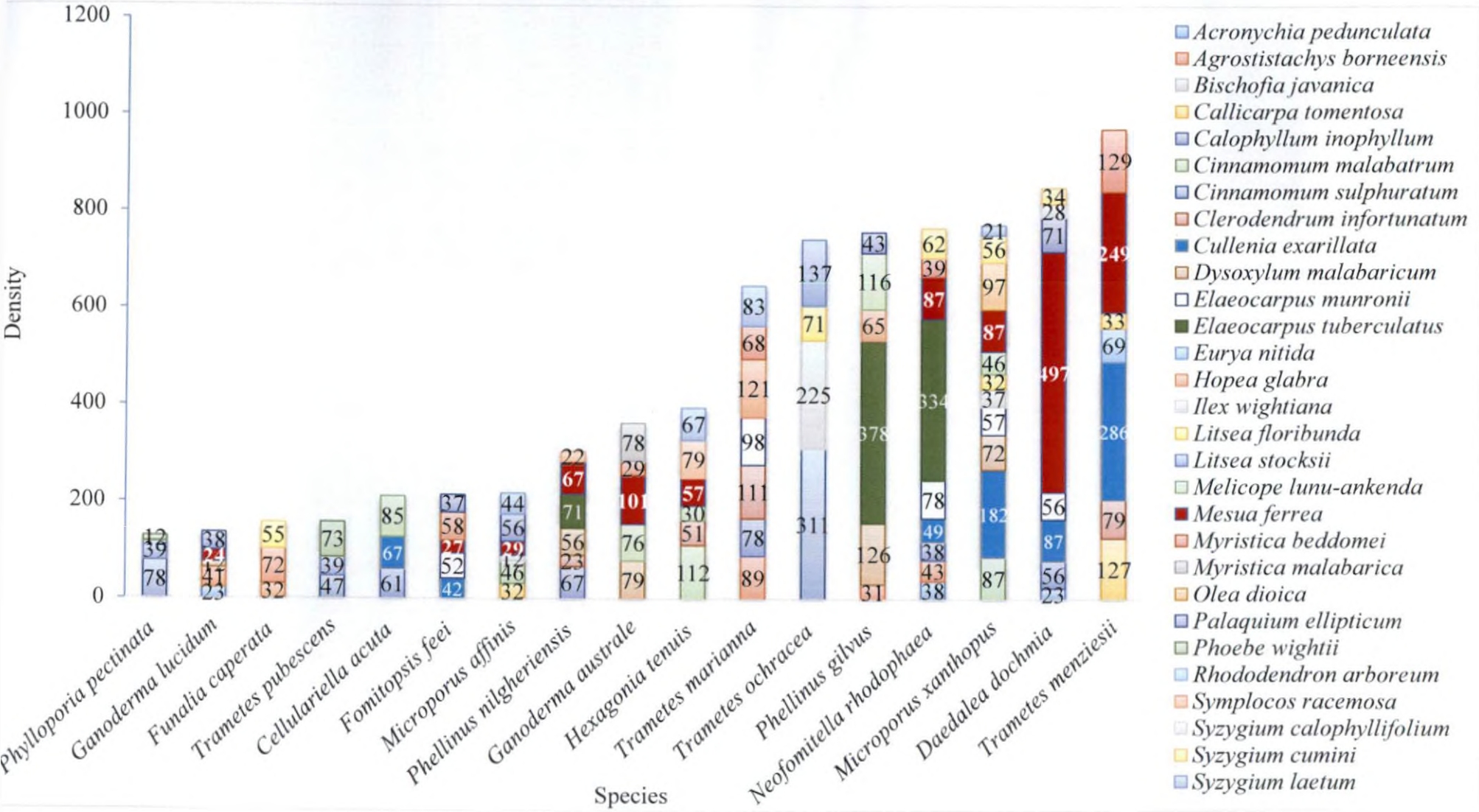


Fig. 11b. Density of polypores on tree host species in Silent Valley National Park

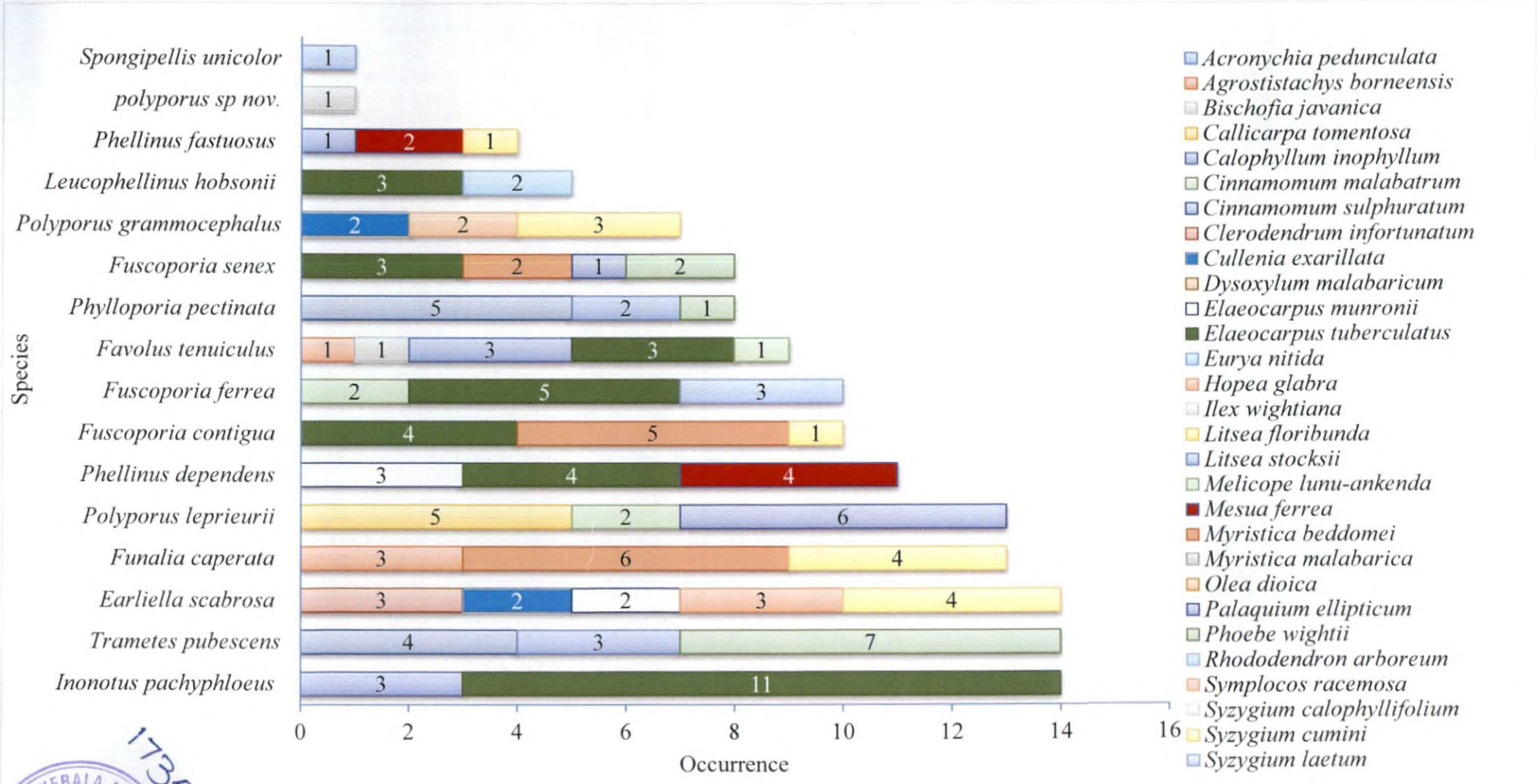


Fig. 12a. Occurrence of polypores on tree host species in Silent Valley National Park

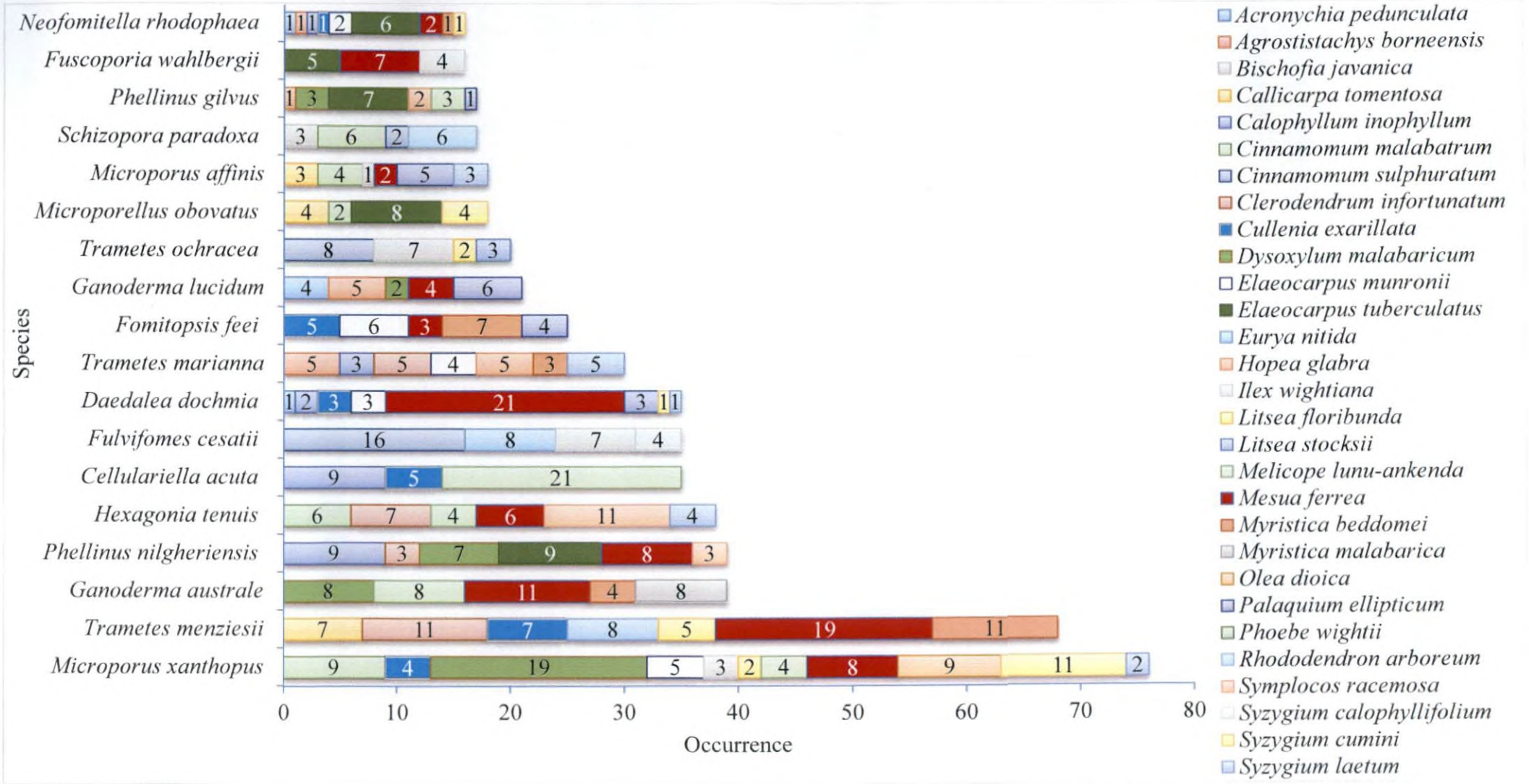


Fig. 12b. Occurrence of polypores on tree host species in Silent Valley National Park

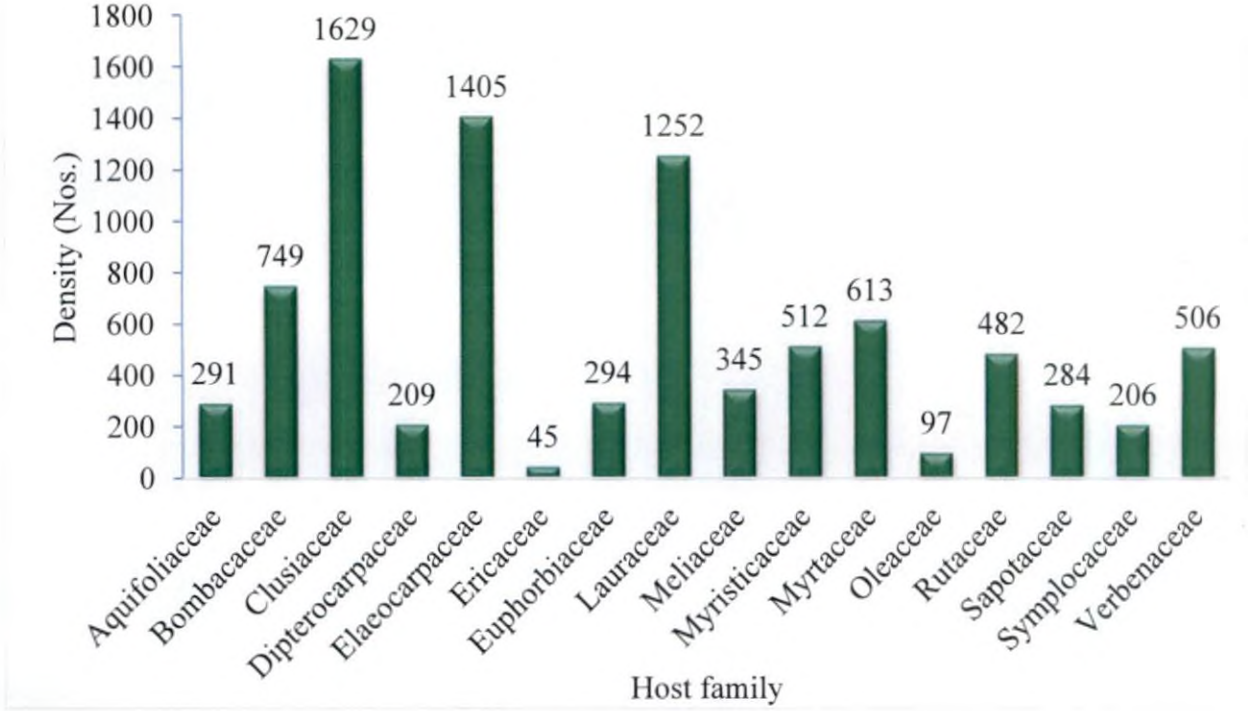


Fig. 13. Density of polypores on different host families

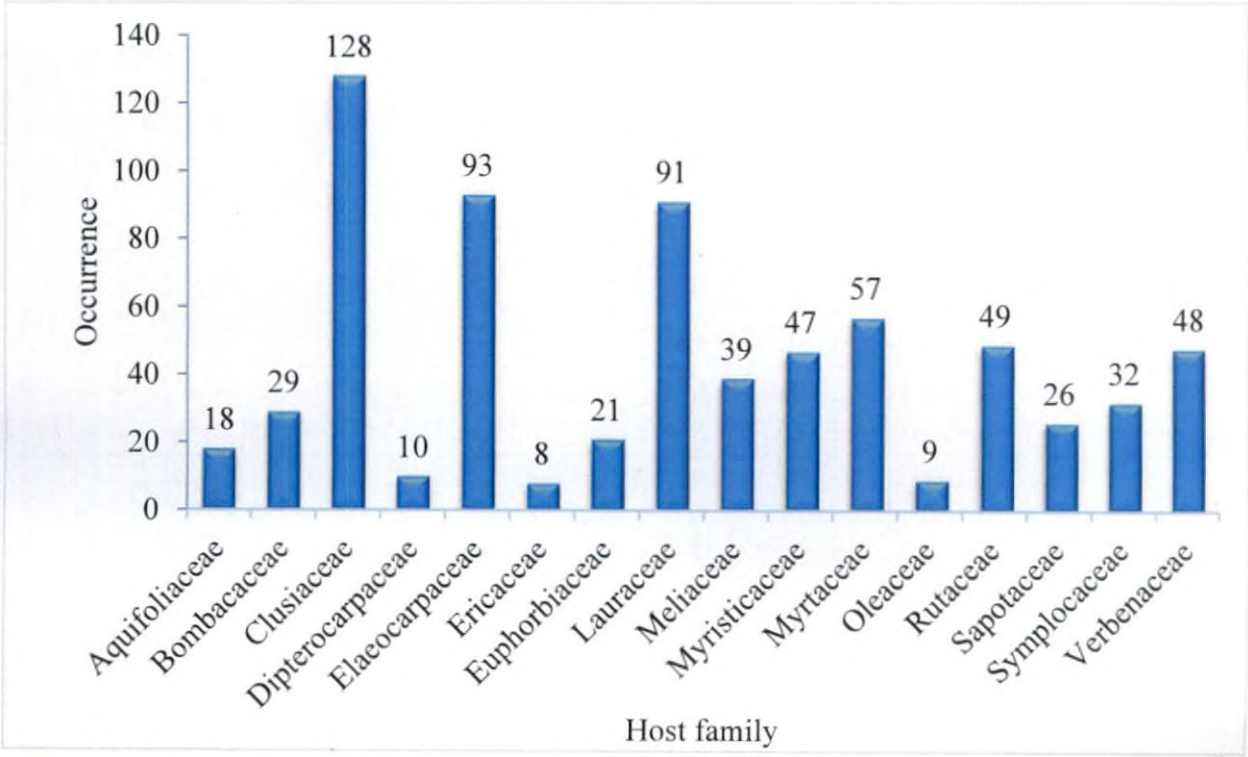


Fig. 14. Occurrence of polypores on different host families

4.4.3 Host density and polypore species richness

The relationship between density of tree host species and polypore fungal diversity was analyzed by recording the number of logs belonging to each species and number of fungal species on the logs (Table 23). Altogether 434 logs of different size belonging to 29 host species were recorded. The highest number of logs were contributed by *Mesua ferrea* (52) followed by *Elaeocarpus tuberculatus* (34) and *Cullenia exarillata* (23). Only two logs were recorded for *Myristica malabarica* while, *Olea dioica* contributed only one log.

In order to understand the relationship between the diversity of polypores and the number of logs, a regression has been plotted. A significant positive relationship between the polypore fungal diversity and density of logs was observed (Fig. 15). It was understood that the diversity of polypores has increased linearly with the number of logs.

Table 23. Association of polypores with host trees and their logs

Sl. No.	Host tree species	No. of polypores species	No. of logs
1	*Acronychia pedunculata*	3	10
2	*Agrostistachys borneensis*	6	17
3	*Bischofia javanica*	3	8
4	*Callicarpa tomentosa*	4	13
5	*Calophyllum inophyllum*	8	21
6	*Cinnamomum malabatrum*	6	18
7	*Cinnamomum sulphuratum*	5	14
8	*Clerodendrum infortunatum*	5	16
9	*Cullenia exarillata*	8	23
10	*Dysoxylum malabaricum*	5	14
11	*Elaeocarpus munronii*	7	20
12	*Elaeocarpus tuberculatus*	12	34
13	*Eurya nitida*	2	5
14	*Hopea glabra*	3	8
15	*Ilex wightiana*	4	11
16	*Litsea floribunda*	3	8
17	*Litsea stocksii*	4	12
18	*Melicope lunu-ankenda*	7	20
19	*Mesua ferrea*	13	52
20	*Myristica beddomei*	8	21

Contd...

Sl. No.	Host tree species	No. of polypores species	No. of logs
21	*Myristica malabarica*	1	2
22	*Olea dioica*	1	1
23	*Palaquium ellipticum*	7	19
24	*Phoebe wightii*	2	8
25	*Rhododendron arboreum*	2	6
26	*Symplocos racemosa*	3	9
27	*Syzygium calophyllifolium*	2	5
28	*Syzygium cumini*	9	23
29	*Syzygium laetum*	7	16
	Total		**434**

4.4.4 Host preference and specificity of polypores

Based on the presence or absence of polypore species on each log, the host preference of polypores has been analysed in the wet evergreen and shola forests. All fruiting bodies of the same species on a log were treated as one occurrence, irrespective of the number of fruiting bodies. The clustered occurrence of polypores was also considered as single occurrence. The polypore species, which have more than 50 per cent occurrence on a particular host has also been considered for detailed analysis.

Most of the species were host generalist and more or less evenly distributed among the host tree species. Only five species showed a possible preference for a tree host (Table 24). *Elaeocarpus tuberculatus* was preferred by *Inonotus pachyphloeus, Phellinus gilvus* and *Leucophellinus hobsonii*. *Mesua ferrea* was stongly preferred by *Daedalea dochmia* with 21 occurrence out of 45. *Phylloporia pectinata,* which was recorded only from shola forest have showed preference towards *Cinnamomum sulphuratum*.

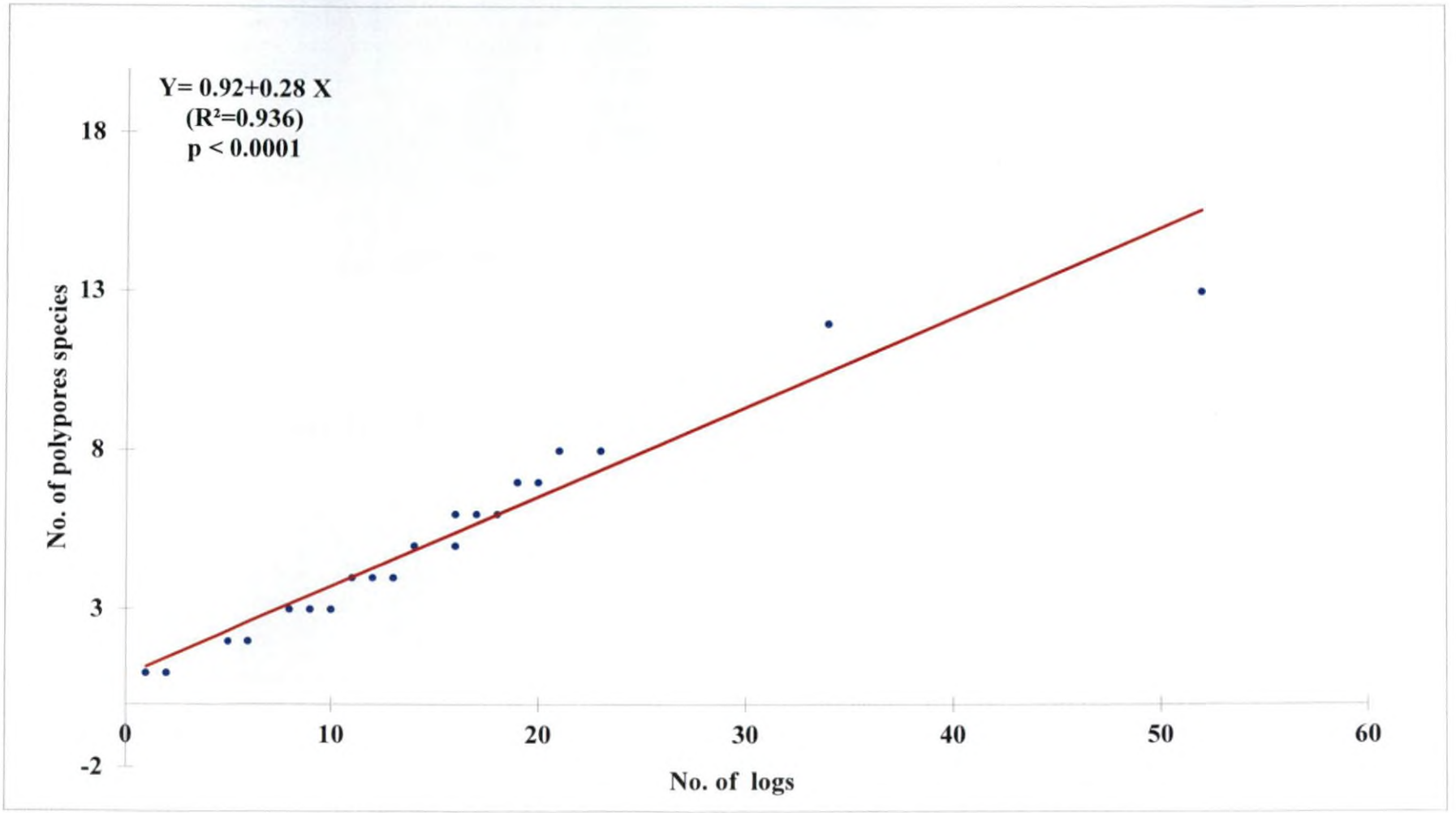


Fig. 15. Relationship between species richness and number of logs

Table 24. Polypore fungal species and their preference on different tree host species

Sl. No.	Host tree species	No. of polypores species	Preference
1	*Acronychia pedunculata*	3	0
2	*Agrostistachys borneensis*	6	0
3	*Bischofia javanica*	3	0
4	*Callicarpa tomentosa*	4	0
5	*Calophyllum inophyllum*	8	0
6	*Cinnamomum malabatrum*	6	0
7	*Cinnamomum sulphuratum*	5	1
8	*Clerodendrum infortunatum*	5	0
9	*Cullenia exarillata*	8	0
10	*Dysoxylum malabaricum*	5	0
11	*Elaeocarpus munronii*	7	0
12	*Elaeocarpus tuberculatus*	12	1
13	*Eurya nitida*	2	0
14	*Hopea glabra*	3	0
15	*Ilex wightiana*	4	0
16	*Litsea floribunda*	3	0
17	*Litsea stocksii*	4	0
18	*Melicope lunu-ankenda*	7	0
19	*Mesua ferrea*	13	1
20	*Myristica beddomei*	8	0
21	*Myristica malabarica*	1	0
22	*Olea dioica*	1	0
23	*Palaquium ellipticum*	7	0
24	*Phoebe wightii*	2	0
25	*Rhododendron arboreum*	2	0
26	*Symplocos racemosa*	3	0
27	*Syzygium calophyllifolium*	2	0
28	*Syzygium cumini*	9	0
29	*Syzygium laetum*	7	0

The number of host tree species and the number occurrences of each polypores species were listed (Table 25). A linear regression has been plotted by natural logarithm of number of host tree species against natural logarithm of number of occurrence of polypores in order to understand the relationship between the host tree density and polypore distribution (Fig. 16). Among the 29 species, *Polyporus* sp. nov. and *Spongipellis unicolor* were not considered because of their single occurrence. It was understood that the number of occurrence of polypores increased with the overall number of host tree species. The number of occurrence of polypores and the number of host trees were transformed into natural logarithm to make their distributions close

to normal and to avoid disproportionate influence of a few abundant species in the analysis. The relationship was significant ($R = 0.918695$, $P < 0.0001$).

Table 25. Relationship between number of host trees and polypores

Sl. No.	Fungal species	No. of host tree species	No. of occurrence of polypores
1	*Cellulariella acuta*	3	12
2	*Daedalea dochmia*	8	17
3	*Earliella scabrosa*	5	14
4	*Favolus tenuiculus*	5	9
5	*Fomitopsis feei*	5	31
6	*Fulvifomes cesatii*	4	13
7	*Funalia caperata*	3	13
8	*Fuscoporia contigua*	3	10
9	*Fuscoporia ferrea*	3	10
10	*Fuscoporia senex*	4	12
11	*Fuscoporia wahlbergii*	3	13
12	*Ganoderma australe*	5	16
13	*Ganoderma lucidum*	5	14
14	*Hexagonia tenuis*	6	18
15	*Inonotus pachyphloeus*	2	7
16	*Leucophellinus hobsonii*	2	5
17	*Microporellus obovatus*	4	12
18	*Microporus affinis*	6	18
19	*Microporus xanthopus*	11	35
20	*Neofomitella rhodophaea*	9	20
21	*Phellinus dependens*	3	11
22	*Phellinus fastuosus*	3	9
23	*Phellinus gilvus*	6	17
24	*Phellinus nilgheriensis*	6	19
25	*Phylloporia pectinata*	3	8
26	*Polyporus grammocephalus*	3	9
27	*Polyporus leprieurii*	3	9
28	*Polyporus* sp nov.	1	1
29	*Schizopora paradoxa*	4	17
30	*Spongipellis unicolor*	1	1
31	*Trametes marianna*	7	22
32	*Trametes menziesii*	7	23
33	*Trametes ochracea*	4	13
34	*Trametes pubescens*	3	8

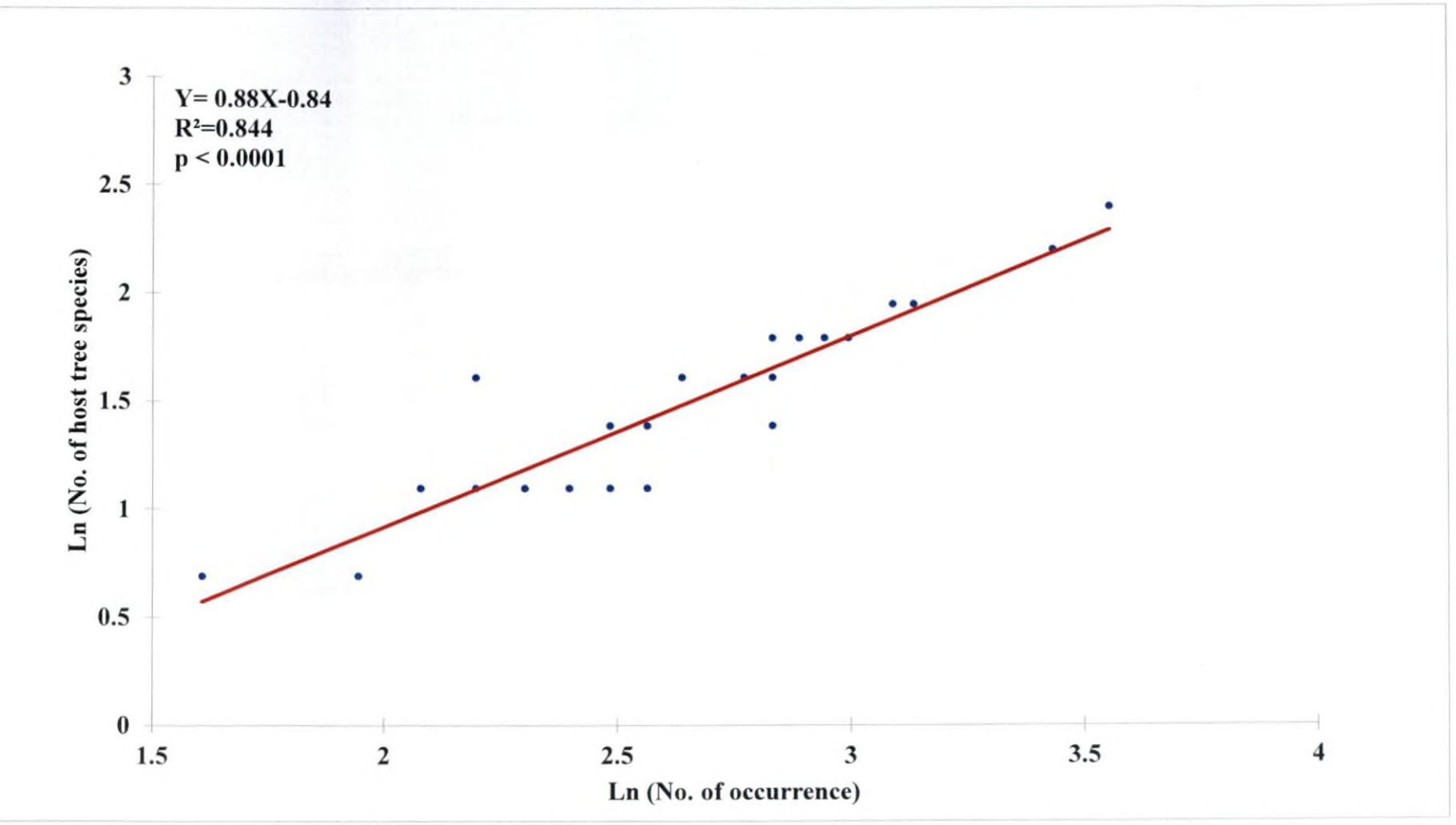


Fig.16. Relationship between number of host trees and occurrence of polypores

4.5 SUBSTRATE FEATURES AND POLYPORE ASSEMBLAGE

The influence of various substrate features like substrate type, size and decay stages on the distribution of polypores were studied. The number of occurrence and number of fruitbodies recorded on each categories were compared.

4.5.1 Substrate type and distribution of polypores

Distribution of polypores on different substrate types from whole study area (6 ha) were documented (Table 26). Based on their nature of material the substrates were categorized in to Snag (dead standing tree), living tree, log and twig/branch. The substrates having minimum 10 cm diameter and length 1.5 m were considered as the log. The substrates having diameter less than 5 cm were considered as twig. The substrates having diameter 5-10 cm were recorded as branches.

Among the substrate types, log (4292) harbored the maximum number of fruitbodies followed by twig/branch (2280) and snag (2081). Only 266 fruitbodies were recorded from the living trees. *Daedalea dochmia, Fuscoporia senex, Ganoderma lucidum, Inonotus pachyphloeus, Microporus affinis, Phellinus dependens, Phellinus fastuosus* and *Phellinus nilgheriensis* are the polypores which were found to be infected on living trees.

A box plot analysis was also done for the association of polypores with substrate types (Fig.17). The box plot revealed that the distribution of polypores in different substrate types. In case of snag, the polypore density varied with a minimum of 4 individuals to the maximum of 512 fruitbodies with mean value 61.20, while in case of living trees, the density varied with a minimum of 4 fruitbodies to the maximum of 105 fruitbodies with mean value 7.82. In case of log, the density of polypores varied by 6 to 612 fruitbodies with mean value 126.23 and in case of twig/branch the density ranged with a minimum of 3 to the maximum of 568 fruitbodies with mean value 67.05.

Table 26. Number of fruitbodies of polypores on different substrate types

Sl. No.	Fungal species	Substrate types			
		Snag	Log	Twig/ Branch	Living tree
1	*Cellulariella acuta*	4	178	31	-
2	*Daedalea dochmia*	397	349	-	106
3	*Earliella scabrosa*	-	123	-	-
4	*Favolus tenuiculus*	-	119	7	-
5	*Fomitopsis feei*	89	127	-	-
6	*Fulvifomes cesatii*	-	11	97	-
7	*Funalia caperata*	-	159	-	-
8	*Fuscoporia contigua*	24	45	-	-
9	*Fuscoporia ferrea*	9	21	-	-
10	*Fuscoporia senex*	28	6	-	8
11	*Fuscoporia wahlbergii*	19	71	-	-
12	*Ganoderma australe*	232	124	7	-
13	*Ganoderma lucidum*	35	67	14	22
14	*Hexagonia tenuis*	-	-	396	-
15	*Inonotus pachyphloeus*	11	24	-	4
16	*Leucophellinus hobsonii*	-	-	45	-
17	*Microporellus obovatus*	20	84	7	-
18	*Microporus affinis*	-	32	181	6
19	*Microporus xanthopus*	-	206	568	-
20	*Neofomitella rhodophaea*	512	256	-	-
21	*Phellinus dependens*	23	12	-	16
22	*Phellinus fastuosus*	8	11	-	2
23	*Phellinus gilvus*	291	367	101	-
24	*Phellinus nilgheriensis*	78	126	-	102
25	*Phylloporia pectinata*	32	97	-	-
26	*Polyporus grammocephalus*	-	37	14	-
27	*Polyporus leprieurii*	-	57	21	-
28	*Polyporus* sp. nov.	-	-	3	-
29	*Schizopora paradoxa*	-	29	79	-
30	*Spongipellis unicolor*	-	9	-	-
31	*Trametes marianna*	124	398	126	-
32	*Trametes menziesii*	12	612	348	-
33	*Trametes ochracea*	114	403	227	-
34	*Trametes pubescens*	19	132	8	-
	Total	**2081**	**4292**	**2280**	**266**

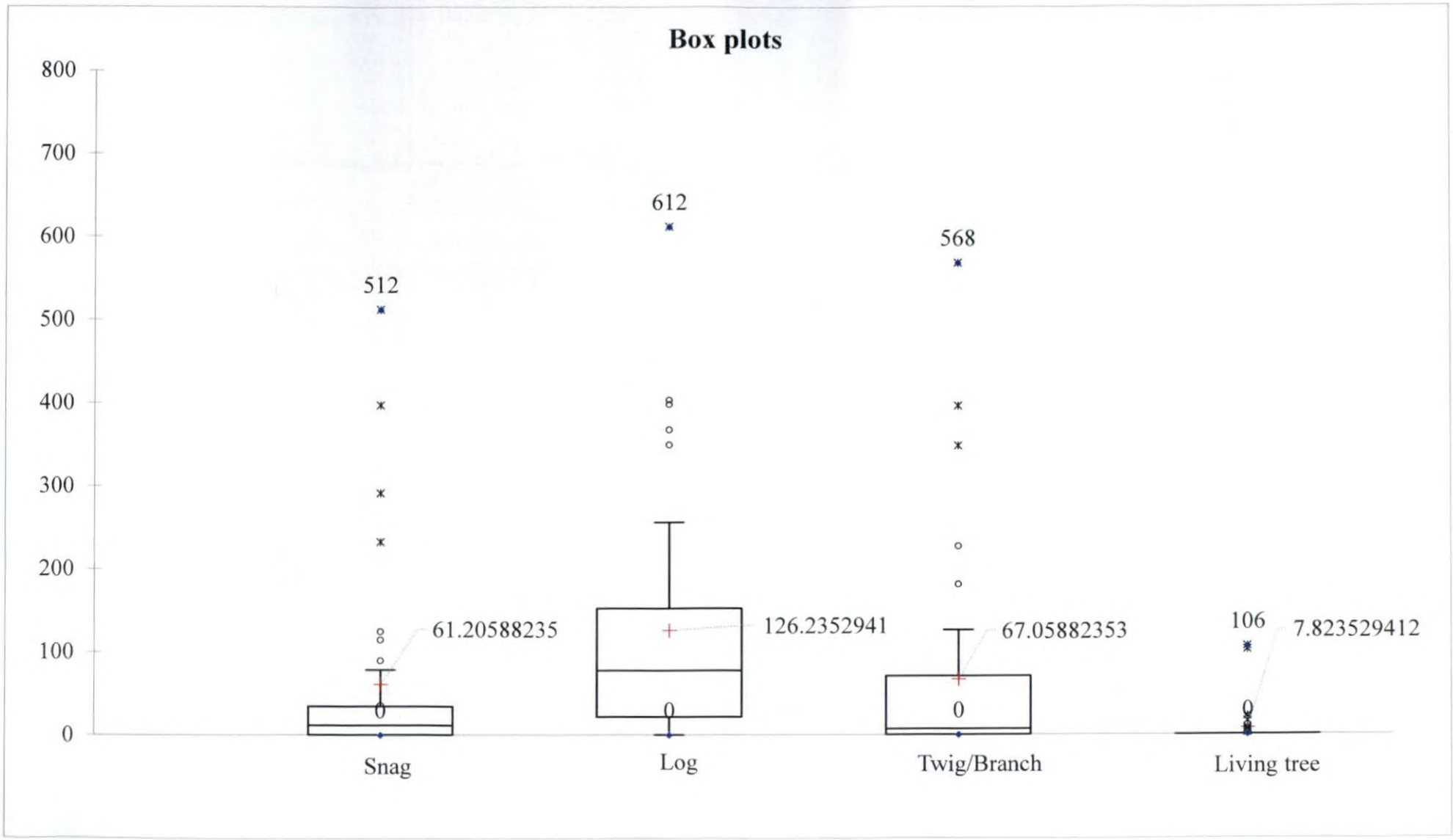


Fig. 17 Distribution of polypores species on different substrate type

Neofomitella rhodophaea on *Mesua ferrea* snag

Daedalea dochmia on *Mesua ferrea* snag

Trametes menziesii on *Cinnamomum sulphuratum* snag

Neofomitella rhodophaea on *Cullenia exarillata* snag

Ganoderma lucidum and *Microporus affinis* on *Palaquium ellipticum* snag

Earliella scabrosa on *Syzygium cumini* snag

Plate 15. Polypores on snags

Daedalea dochmia on *Mesua ferrea* logs

Trametes marianna on *Dysoxylum malabaricum* log

Trametes menziesii on *Cinnamomum sulphuratum* log

Earliella scabrosa on *Elaeocarpus tuberculatus* log

Plate 16. Polypores on logs

Daedalea dochmia on
Mesua ferrea

Fuscoporia senex on
Elaeocarpus munronii

Ganoderma lucidum on
Myristica beddomei

Inonotus pachyphloeus on
Elaeocarpus tuberculatus

Phellinus dependens on
Elaeocarpus tuberculatus

Phellinus fastuosus on
Mesua ferrea

Phellinus nilgheriensis on
Syzygium cumini

Microporus affinis on
Cullenia exarillata

Plate 17. Polypores on living trees

4.5.2 Substrate diameter and polypores distribution

To study the distribution of polypores on different diameter class of host trees, the polypores documented from sample plots in wet evergreen forest and shola forests are combined together. All the available substrates were divided into seven different diameter class viz. 0- < 10 cm, 11- < 20 cm, 21- < 30 cm, 31- < 40 cm, 41- < 50 cm, 51- < 60 cm and 61cm & above. The density of polypores on different diameter classes have been studied from whole study area (6 ha) (Table 27). The maximum species density has been recorded to 31- < 40 cm diameter class (2471 fruitbodies) followed by 21- < 30 cm cm diameter class (2328 fruitbodies) and 11- < 20 cm diameter class (1707 fruitbodies). The low diameter class 0- < 10 cm harboured 1126 fruitbodies while the 61cm & above diameter class were recorded with 132 fruitbodies. Lowest species density was observed in 51- < 60 cm diameter class with 107 fruitbodies. Species like *Neofomitella rhodophaea, Daedalea dochmia, Phellinus gilvus, Trametes marianna, Trametes menziesii* and *Trametes ochracea* contributed maximum number of individuals in 31- < 40 cm and 21- < 30 cm diameter class. Characteristic difference was observed on the distribution pattern of polypores on different diameter classes. Species like *Cellulariella acuta, Neofomitella rhodophaea, Phellinus gilvus* and *Ganoderma australe* were observed with wide range of diameter class, while species, *Hexagonia tenuis, Microporus xanthopus* and *Fulvifomes cesatii* associated with only a narrow range of diameter classes (Fig. 18).

4.5.2.1 Occurrence and diameter class preference of polypores

Diameter class preference of polypores was analyzed based on the frequency of occurrence of polypores in whole study area (6 ha) (Table 28). Polypores with more than ten total occurrences on different diameter classes only were considered. Among these, *Polyporus* sp. nov. and *Spongipellis unicolor* were not considered for the diameter class range because they were found only once. Out of this, more than 50 per cent occurrence on a particular diameter class was treated as preference for that diameter class.

A total of ten polypore species have shown preference for a particular diameter class (Fig. 19). *Daedalea dochmia, Phellinus nilgheriensis* showed preference for 41-<50 cm diameter class while *Hexagonia tenuis, Microporus xanthopus, Microporus affinis* and *Fulvifomes cesatii* showed preference for 0- < 10 cm diameter class. The diameter class 31-<40 cm was preferred by *Phellinus gilvus, Phellinus dependens* and *Fuscoporia wahlbergii* while, *Schizopora paradoxa* showed preference towards the 11-<20 cm diameter class. It was observed that the higher diameter classes like 51- 60 cm and above were not preferred by any polypores.

Table 27. Number of fruitbodies of polypores on substrates under different diameter classes

Sl. No.	Fungal species	Substrate diameter class						
		0- <10 cm	11-<20 cm	21-<30 cm	31-<40 cm	41-<50 cm	51-<60 cm	61 cm & Above
1.	*Cellulariella acuta*	22	34	98	50	9	-	-
2.	*Daedalea dochmia*	-	-	122	235	463	32	-
3.	*Earliella scabrosa*	-	53	48	22		-	-
4.	*Favolus tenuiculus*	-	52	60	14		-	-
5.	*Fomitopsis feei*	-	6	102	92	16	-	-
6.	*Fulvifomes cesatii*	86	22	-	-	-	-	-
7.	*Funalia caperata*	-	27	70	62	-	-	-
8.	*Fuscoporia contigua*	-	21	10	38	-	-	-
9.	*Fuscoporia ferrea*	-	-	12	13	5	-	-
10.	*Fuscoporia senex*	-	-	-	34	6	2	-
11.	*Fuscoporia wahlbergii*	-	-	12	66	10	2	-
12.	*Ganoderma australe*	6	27	121	193	16	-	-
13.	*Ganoderma lucidum*	-	6	83	22	27	-	-
14.	*Hexagonia tenuis*	226	170	-	-	-	-	-
15.	*Inonotus pachyphloeus*	-	-	-	13	9	7	10
16.	*Leucophellinus hobsonii*	12	33	-	-	-	-	-
17.	*Microporellus obovatus*	3	22	55	31	-	-	-
18.	*Microporus affinis*	180	21	4	14	-	-	-
19.	*Microporus xanthopus*	531	243	-	-	-	-	-
20.	*Neofomitella rhodophaea*	-	165	279	224	58	42	-
21.	*Phellinus dependens*	-	-	19	28	3	-	1
22.	*Phellinus fastuosus*	-	-	2	13	4	-	2
23.	*Phellinus gilvus*	9	86	207	225	119	-	113
24.	*Phellinus nilgheriensis*	-	-	-	80	198	22	6
25.	*Phylloporia pectinata*	-	11	81	37	-	-	-
26.	*Polyporus grammocephalus*	-	32	15	4	-	-	-
27.	*Polyporus leprieurii*	-	19	29	21	9	-	-
28.	*Polyporus* sp nov.	3	-	-	-	-	-	-
29.	*Schizopora paradoxa*	30	55	23	-	-	-	-
30.	*Spongipellis unicolor*	-	-	-	9	-	-	-
31.	*Trametes marianna*	-	144	152	256	96	-	-
32.	*Trametes menziesii*	18	165	360	429	-	-	-
33.	*Trametes ochracea*	-	226	295	223	-	-	-
34.	*Trametes pubescens*	-	67	69	23	-	-	-
	Total	**1126**	**1707**	**2328**	**2471**	**1048**	**107**	**132**

Table 28. Occurrence of polypores on substrates under different diameter classes and its preference

Sl. No.	Fungal species	Total occurrence (Nos.)	Substrate diameter class						
			0-<10 cm	11-<20 cm	21-<30 cm	31-<40 cm	41-<50 cm	51-<60 cm	61 cm & Above
1	*Cellulariella acuta*	35	2	6	13	14	-	-	-
2	*Daedalea dochmia*	35	-	-	4	10	19	2	-
3	*Earliella scabrosa*	14	-	6	5	3	-	-	-
4	*Favolus tenuiculus*	9	-	3	5	1	-	-	-
5	*Fomitopsis feei*	25	-	1	6	7	11	-	-
6	*Fulvifomes cesatii*	35	23	12	-	-	-	-	-
7	*Funalia caperata*	13	-	3	6	4	-	-	-
8	*Fuscoporia contigua*	10	-	4	4	2	-	-	-
9	*Fuscoporia ferrea*	10	-	-	4	2	4	-	-
10	*Fuscoporia senex*	9	-	-	-	6	1	2	-
11	*Fuscoporia wahlbergii*	16	-	-	2	11	2	1	-
12	*Ganoderma australe*	39	1	3	11	14	10	-	-
13	*Ganoderma lucidum*	21	-	2	3	7	9	-	-
14	*Hexagonia tenuis*	38	22	16	-	-	-	-	-
15	*Inonotus pachyphloeus*	14	-	-	-	6	3	4	1
16	*Leucophellinus hobsonii*	5	3	2	-	-	-	-	-
17	*Microporellus obovatus*	17	1	3	8	5	-	-	-
18	*Microporus affinis*	18	12	3	1	2	-	-	-
19	*Microporus xanthopus*	76	45	31	-	-	-	-	-
20	*Neofomitella rhodophaea*	16	-	4	5	4	2	1	-
21	*Phellinus dependens*	11	-	-	3	6	1	-	1
22	*Phellinus fastuosus*	4	-	-	1	1	1	-	1
23	*Phellinus gilvus*	17	1	2	2	9	2	-	1
24	*Phellinus nilgheriensis*	39	-	-	-	11	21	1	6
25	*Phylloporia pectinata*	8	-	1	3	4	-	-	-
26	*Polyporus grammocephalus*	7	-	2	3	2	-	-	-
27	*Polyporus leprieurii*	13	-	3	6	3	1	-	-
28	*Polyporus* sp nov.	1	1	-	-	-	-	-	-
29	*Schizopora paradoxa*	18	5	10	3	-	-	-	-
30	*Spongipellis unicolor*	1	-	-	-	1	-	-	-
31	*Trametes marianna*	30		6	15	7	2	-	-
32	*Trametes menziesii*	67	3	12	21	31	-	-	-
33	*Trametes ochracea*	20	-	5	8	7	-	-	-
34	*Trametes pubescens*	14	-	5	6	3	-	-	-
	Total	**705**	**119**	**145**	**148**	**183**	**89**	**11**	**10**

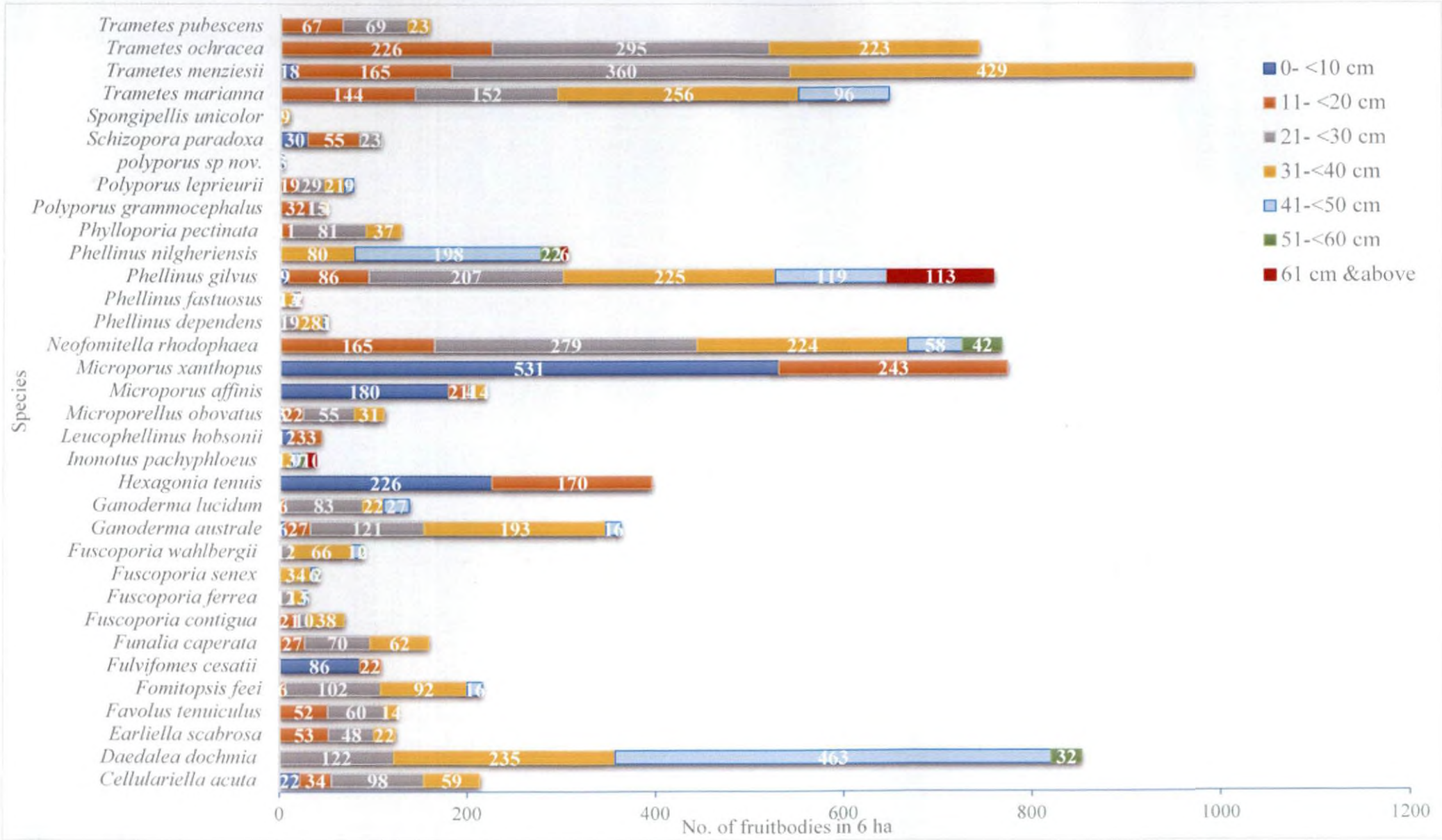


Fig. 18. Density of polypores on substrates under different diameter classes in Silent Valley National Park

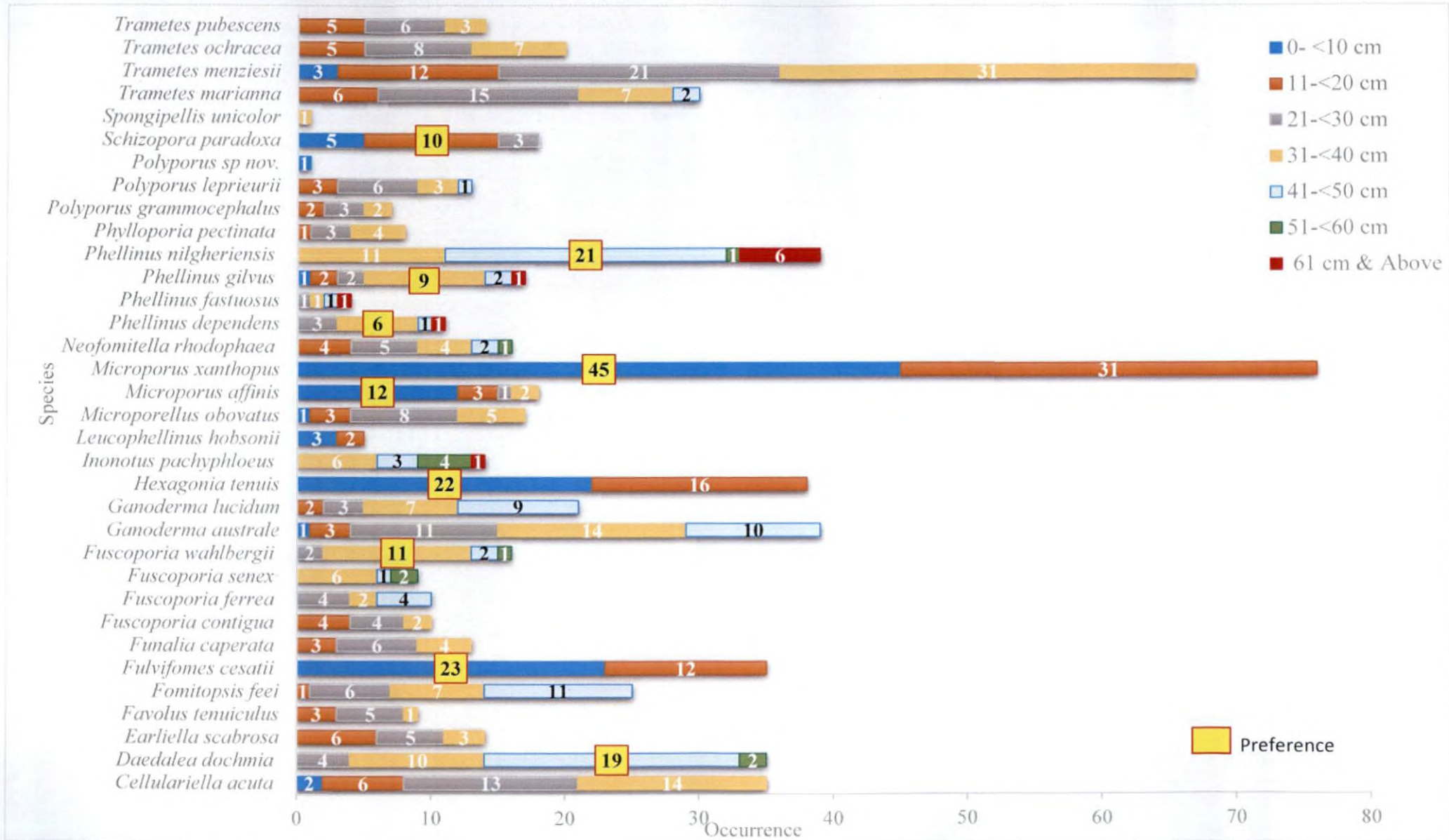


Fig. 19. Occurrence of polypores on substrates under different diameter classes and its preference in Silent Valley National Park

Microporus affinis on
Callicarpa tomentosa

Microporus affinis on
Cinnamomum malabatrum

Hexagonia tenuis on
Syzygium laetum

Hexagonia tenuis on
Mesua ferrea

Microporus xanthopus on
Mesua ferrea

Microporus xanthopus on
Syzygium cumini

Phellinus cesatii on
Cinnamomum sulphuratum

Phellinus cesatii on
Eurya nitida

Plate 18. Polypores on small twigs and branches

4.5.3 Substrate decay class and distribution of polypores

To study the distribution of polypores on decay class of host trees, the polypores documented from wet evergreen and shola forests were combined together. The substrates were classified in to 5 decay classes (Pyle and Brown, 1998). Density of polypores on different decay classes was studied in whole study area (Table 29 & Fig. 20). The substrates under decay class 3 harboured the maximum of 3194 fruitbodies followed by decay class 4 with 2085, decay class 2 with 1798, decay class 1 with 1172 and decay class 5 with 670 fruitbodies.

A box plot analysis was done for the association of polypores with substrate decay classes (Fig. 21). The box plot revealed that the distribution of polypores in different substrate decay classes. In case of substrate under decay class 1, the polypore density varied with a minimum of 4 fruitbodies to the maximum of 154 fruitbodies. The substrates under decay class 2 density varied with a minimum of 16 to maximum of 277 while in case of decay class 3, it varied with a minimum of 9 fruitbodies to the maximum of 397 fruitbodies. In case of decay class 4 substrates, the density of polypores varied by 3 to 273 while, it varied by 1 to 241 in decay class 5.

Decay class preference of polypores was analyzed based on the frequency of occurrence in whole study area (Table 30). Polypores with more than ten total occurrences on different diameter classes only were considered. Out of this, more than 50 per cent occurrence on a particular diameter class was treated as preference for that decay class. A total of 24 polypore species have shown preference for a particular decay class. Out of 24 species 7 species showed preference towards decay class 1 and two species showed affinity towards decay class 2. Eleven species showed preference towards substrate under decay class 3 while decay class 4 was preferred by only 4 species. No preference was observed towards decay class 5 (Fig. 22). The species like *Earliella scabrosa, Fuscoporia wahlbergii, Inonotus pachyphloeus, Microporellus obovatus, Microporus affinis, Phellinus dependens* and *Phellinus nilgheriensis* showed preference for substrate under decay class 1. The polypores which showed preference for substrate under decay class 2 were *Funalia caperata* and *Microporus xanthopus.* The substrates under decay class 3 were preferred by *Daedalea dochmia, Fomitopsis feei, Fulvifomes cesatii, Fuscoporia contigua, Ganoderma lucidum,*

Hexagonia tenuis, Neofomitella rhodophaea, Polyporus grammocephalus, Schizopora paradoxa, Trametes menziesii and *Trametes pubescens.* The decay class 4 substrates were preferred *Fuscoporia ferrea, Polyporus leprieurii, Trametes Marianna* and *Trametes ochracea.*

Table 29. Number of fruitbodies of polypores on substrates under different decay classes

Sl. No	Fungal species	Substrate decay class				
		Decay class 1	Decay class 2	Decay class 3	Decay class 4	Decay class 5
1	*Cellulariella acuta*	34	30	89	34	26
2	*Daedalea dochmia*	141	201	397	113	-
3	*Earliella scabrosa*	96	27	-	-	-
4	*Favolus tenuiculus*	-	-	86	22	18
5	*Fomitopsis feei*	-	32	121	40	23
6	*Fulvifomes cesatii*	-	-	45	37	26
7	*Funalia caperata*	45	64	31	19	-
8	*Fuscoporia contigua*	-	-	47	22	-
9	*Fuscoporia ferrea*	-	-	9	21	-
10	*Fuscoporia senex*	29	-	13	-.	-
11	*Fuscoporia wahlbergii*	50	20	-	20	-
12	*Ganoderma australe*	154	61	49	70	29
13	*Ganoderma lucidum*	27	32	69	10	-
14	*Hexagonia tenuis*	61	67	132	116	20
15	*Inonotus pachyphloeus*	23	-	16	-	-
16	*Leucophellinus hobsonii*	-	-	24	21	-
17	*Microporellus obovatus*	56	19	36	-	-
18	*Microporus affinis*	109	69	22	19	-
19	*Microporus xanthopus*	112	277	247	120	18
20	*Neofomitella rhodophaea*	-	140	377	194	57
21	*Phellinus dependens*	39	-	12	-	-
22	*Phellinus fastuosus*	18	-	-	3	-
23	*Phellinus gilvus*	16	173	257	242	71
24	*Phellinus nilgheriensis*	107	99	49	50	1
25	*Phylloporia pectinata*	51	40	38	-	-
26	*Polyporus grammocephalus*	4	-	30	17	-
27	*Polyporus leprieurii*	-	16	14	38	10
28	*Polyporus* sp nov.	-	-	-	3	-
29	*Schizopora paradoxa*	-	32	55	21	-
30	*Spongipellis unicolor*	-	-	-	9	-
31	*Trametes marianna*	-	108	267	273	-
32	*Trametes menziesii*	-	132	332	267	241
33	*Trametes ochracea*	-	159	208	247	130
34	*Trametes pubescens*	-	-	122	37	-
	Total	**1172**	**1798**	**3194**	**2085**	**670**

Table 30. Occurrence of polypores on substrates under different decay classes

Sl. No	Fungal species	Substrate decay class				
		Decay class 1	Decay class 2	Decay class 3	Decay class 4	Decay class 5
1	*Cellulariella acuta*	5	7	14	7	2
2	*Daedalea dochmia*	4	6	19	6	
3	*Earliella scabrosa*	8	6	-	-	-
4	*Favolus tenuiculus*	-	-	5	3	1
5	*Fomitopsis feei*	-	5	14	4	2
6	*Fulvifomes cesatii*	-	-	18	13	4
7	*Funalia caperata*	2	7	3	1	-
8	*Fuscoporia contigua*	-	-	6	4	-
9	*Fuscoporia ferrea*	-	-	4	6	-
10	*Fuscoporia senex*	4	-	5	-	-
11	*Fuscoporia wahlbergii*	9	5	-	2	-
12	*Ganoderma australe*	21	6	6	5	1
13	*Ganoderma lucidum*	3	5	11	2	-
14	*Hexagonia tenuis*	5	4	21	7	1
15	*Inonotus pachyphloeus*	8	-	6	-	-
16	*Leucophellinus hobsonii*	-	-	3	2	-
17	*Microporellus obovatus*	9	6	2	-	-
18	*Microporus affinis*	10	5	2	1	-
19	*Microporus xanthopus*	17	39	11	7	2
20	*Neofomitella rhodophaea*	-	3	9	3	1
21	*Phellinus dependens*	6	-	5	-	-
22	*Phellinus fastuosus*	2	-	-	2	-
23	*Phellinus gilvus*	3	2	6	5	1
24	*Phellinus nilgheriensis*	20	4	8	6	1
25	*Phylloporia pectinata*	5	1	2	-	-
26	*Polyporus grammocephalus*	1	-	4	2	-
27	*Polyporus leprieurii*	-	1	4	7	1
28	*Polyporus* sp. nov.	-	-	-	1	-
29	*Schizopora paradoxa*	-	3	10	5	-
30	*Spongipellis unicolor*	-	-	-	1	-
31	*Trametes marianna*	-	5	9	16	-
32	*Trametes menziesii*	-	12	35	17	3
33	*Trametes ochracea*	-	2	6	11	1
34	*Trametes pubescens*	-	-	9	5	-
	Total	**142**	**134**	**257**	**151**	**21**

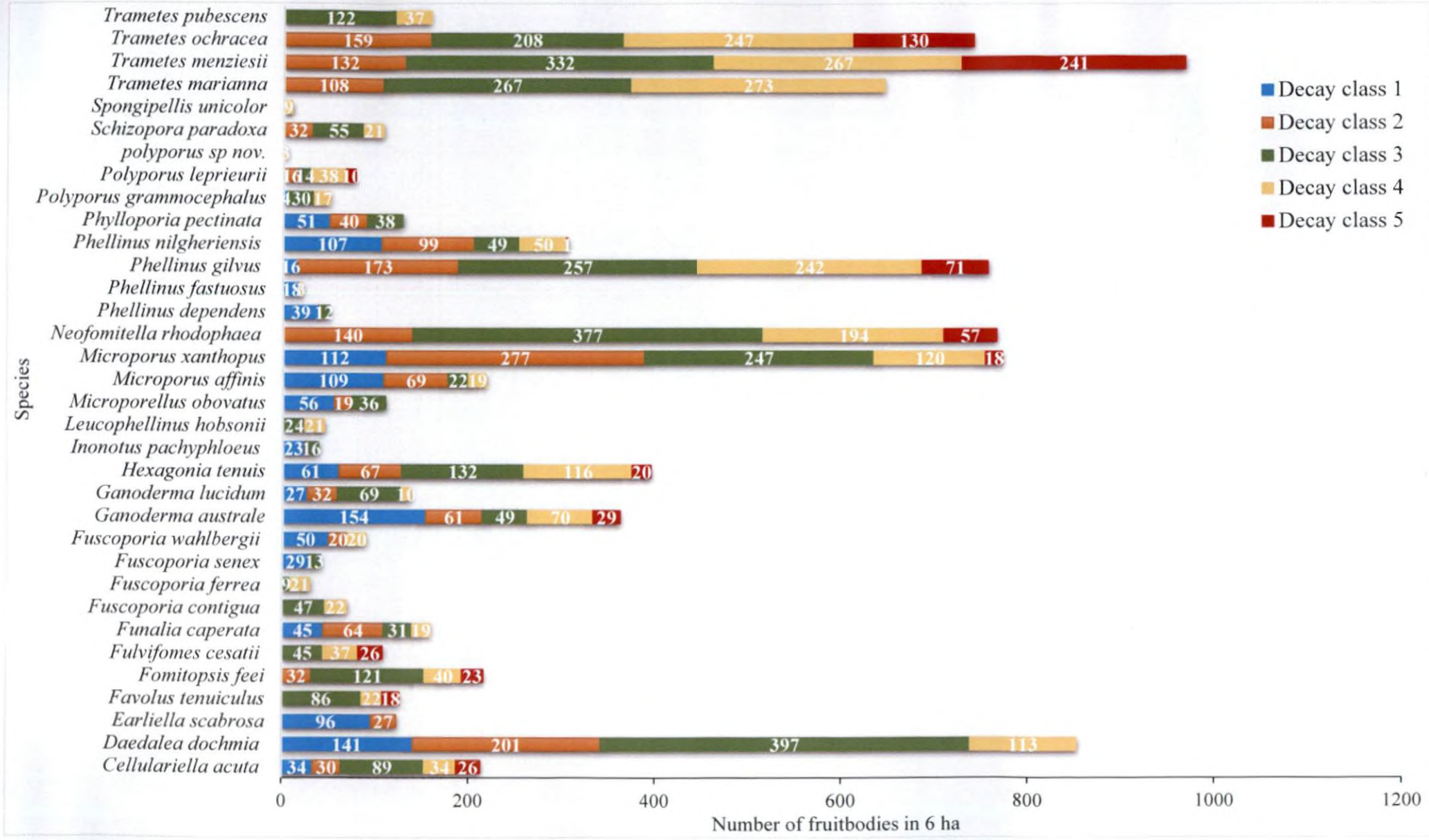


Fig. 20. Density of polypores on substrate decay classes in in Silent Valley National Park

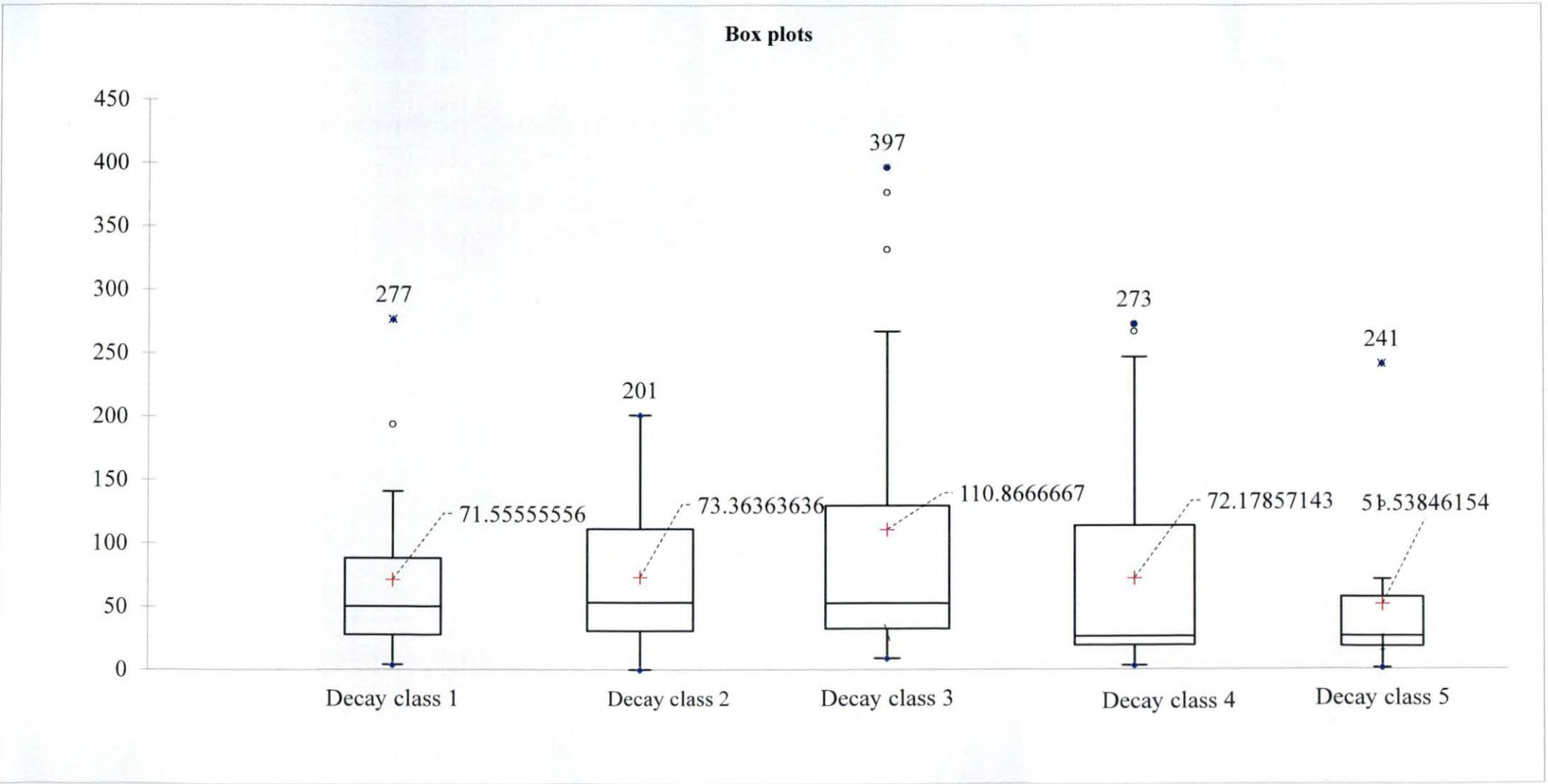


Fig. 21. Distribution of polypores species on different substrate decay classes

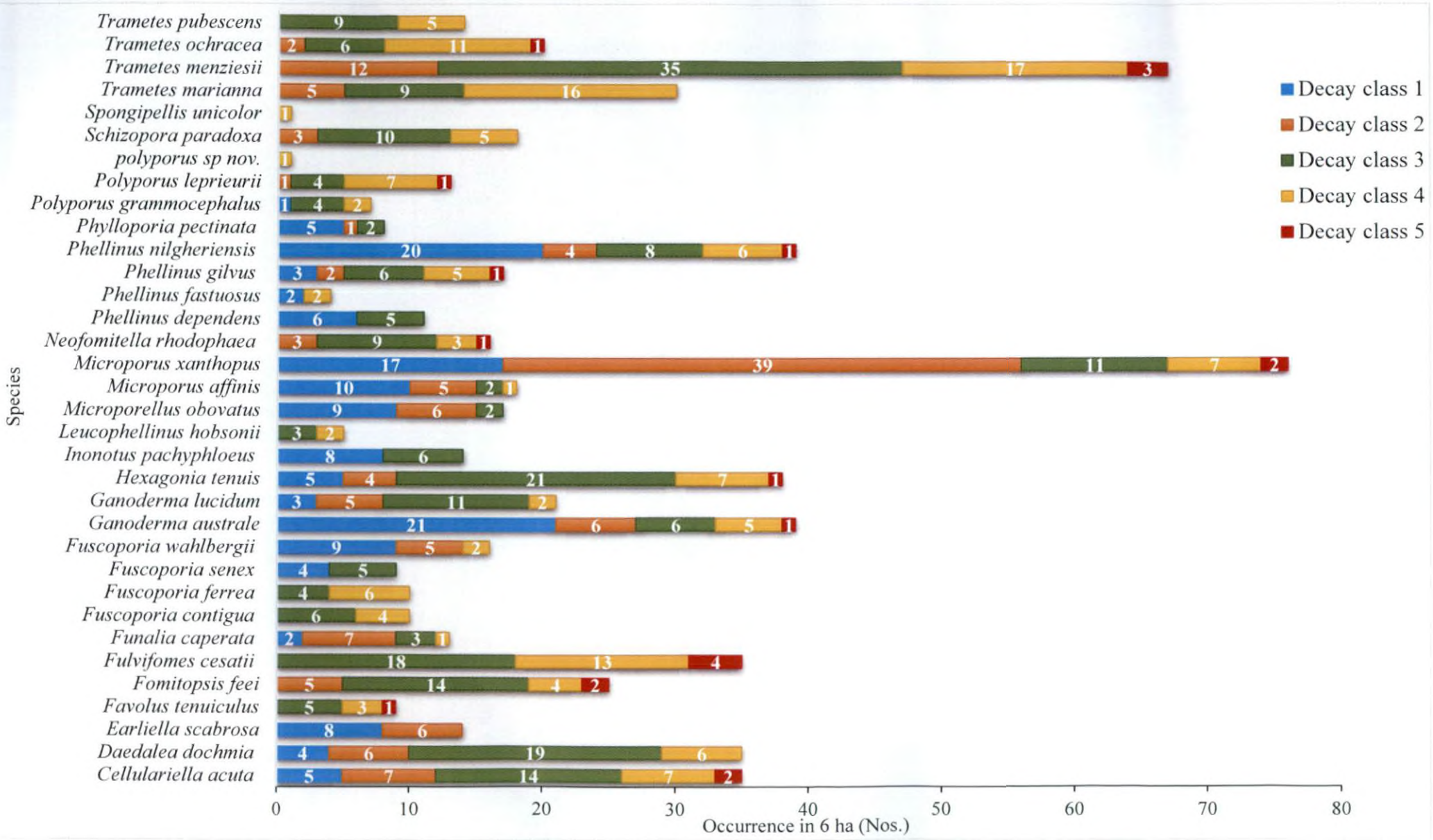


Fig. 22. Occurrence of polypores on different substrate decay classes and its preference in Silent Valley National Park

4.6 ECOLOGICAL STRATEGIES OF POLYPORES

In order to reveal the natural distribution of polypores in wet evergreen and shola forests, the primary ecological strategies were analysed based on the ecological determinants (Table 31). Based on host association, and substrate features like diameter of substrate, substrate type and substrate decay class, the observed polypores were found to belong to any of the three categories listed below (Fig. 23).

4.6.1 R-selected polypores

The polypores with fleshy fruitbodies like *Funalia caperata, Earliella scabrosa, Favolus tenuiculus, Microporellus obovatus, Polyporus leprieurii, Spongipellis unicolor* and *Polyporus grammocephalus* were short-lived and didn't show any preference or specificity for host trees. Their phenology was mostly associated with monsoon and post monsoon periods and mostly found in small diameter class substrates. Most of them showed preference towards substrates in intermediate to late decay stages.

4.6.2 S-selected polypores

Polypores like *Cellulariella acuta, Ganoderma lucidum, Hexagonia tenuis, Leucophellinus hobsonii, Microporus affinis, Microporus xanthopus, Phellinus gilvus, Polyporus* sp. nov., *Schizopora paradoxa, Trametes menziesii, Trametes marianna, Trametes ochracea* and *Trametes pubescens* were the species with persistent and moderately hard fruitbodies, made presence in all climatic seasons, showed moderate level of growth and germination during the entire life cycle. *Ganoderma lucidum, Microporus affinis, Microporus xanthopus, Schizopora paradoxa* and *Trametes menziesii* were found in both wet evergreen and shola forest. *Cellulariella acuta, Microporus xanthopus* and *Phellinus gilvus* were found in substrates under all stages of decay. *Microporus xanthopus, Microporus affinis* and *Hexagonia tenuis* showed preference towards small diameter class substrates.

4.6.3 C-selected polypores

Perennial species like *Daedalea dochmia, Fomitopsis feei, Fulvifomes cesatii, Fuscoporia contigua, Fuscoporia ferrea, Fuscoporia senex, Fuscoporia wahlbergii, Ganoderma australe, Inonotus pachyphloeus, Neofomitella rhodophaea, Phellinus dependens, Phellinus fastuosus, Phellinus nilgheriensis* and *Phylloporia pectinata* were with long-lived, woody and corky fruitbodies. These polypores were found abundant in early decay stages and some species like *Inonotus pachyphloeus, Daedalea dochmia, Phellinus nilgheriensis, Leucophellinus hobsonii* and *Phylloporia pectinata* showed preference for host tree species. Most of them showed wide range occurrence in different substrate diameter classes.

Table 31. Primary ecological strategies of polypores in wet evergreen and shola forests

Sl. No	Species	Behavioural attributes											
		Characters of fruit body					Host association	Substrate diameter			Substrate decay class		
		Long lived	Short lived	Persistent & Moderately hard	Woody & corky	Fleshy	Host specific	Small	Intermediate	Large	Early decay	Intermediate decay	Late decay
1	*Cellulariella acuta*	✓		✓				✓	✓	✓		✓	✓
2	*Daedalea dochmia*	✓		✓	✓		✓		✓	✓	✓	✓	
3	*Earliella scabrosa*		✓			✓		✓	✓			✓	
4	*Favolus tenuiculus*	✓							✓	✓		✓	
5	*Fomitopsis feei*	✓		✓	✓				✓	✓	✓	✓	
6	*Fulvifomes cesatii*	✓		✓	✓			✓	✓	✓	✓	✓	✓
7	*Funalia caperata*		✓			✓			✓			✓	
8	*Fuscoporia contigua*	✓		✓	✓				✓	✓	✓	✓	
9	*Fuscoporia ferrea*	✓		✓	✓				✓	✓	✓	✓	
10	*Fuscoporia senex*	✓		✓	✓				✓	✓	✓	✓	
11	*Fuscoporia wahlbergii*	✓		✓	✓				✓			✓	
12	*Ganoderma australe*	✓		✓	✓			✓	✓	✓	✓	✓	
13	*Ganoderma lucidum*	✓		✓	✓			✓	✓		✓	✓	✓
14	*Hexagonia tenuis*	✓		✓					✓			✓	
15	*Inonotus pachyphloeus*	✓			✓		✓		✓	✓	✓	✓	
16	*Leucophellinus hobsonii*	✓		✓			✓	✓	✓	✓		✓	
17	*Microporellus obovatus*		✓			✓		✓	✓		✓	✓	✓
18	*Microporus affinis*	✓		✓				✓	✓			✓	
19	*Microporus xanthopus*	✓		✓				✓	✓	✓		✓	

Contd...

Sl. No	Species	Behavioural attributes											
		Characters of fruit body					Host association	Substrate diameter			Substrate decay class		
		Long lived	Short lived	Persistent & Moderately hard	Woody & corky	Fleshy	Host specific	Small	Interm ediate	Large	Early decay	Interm ediate decay	Late decay
20	*Neofomitella rhodophaea*	✓		✓	✓				✓	✓	✓	✓	
21	*Phellinus dependens*	✓		✓	✓				✓	✓	✓	✓	
22	*Phellinus fastuosus*	✓		✓	✓				✓	✓	✓	✓	
23	*Phellinus gilvus*	✓		✓	✓				✓	✓	✓	✓	✓
24	*Phellinus nilgheriensis*	✓		✓	✓		✓	✓	✓	✓	✓	✓	
25	*Phylloporia pectinata*	✓		✓	✓		✓		✓	✓	✓	✓	
26	*Polyporus grammocephalus*		✓		✓			✓	✓			✓	
27	*Polyporus leprieurii*		✓			✓			✓			✓	
28	*Polyporus* sp. nov.	✓		✓					✓			✓	
29	*Schizopora paradoxa*	✓		✓					✓			✓	✓
30	*Spongipellis unicolor*		✓			✓			✓	✓		✓	
31	*Trametes marianna*	✓		✓				✓	✓	✓	✓	✓	✓
32	*Trametes menziesii*	✓	✓	✓		✓			✓			✓	✓
33	*Trametes ochracea*	✓		✓					✓			✓	✓
34	Trametes pubescens	✓		✓					✓			✓	✓

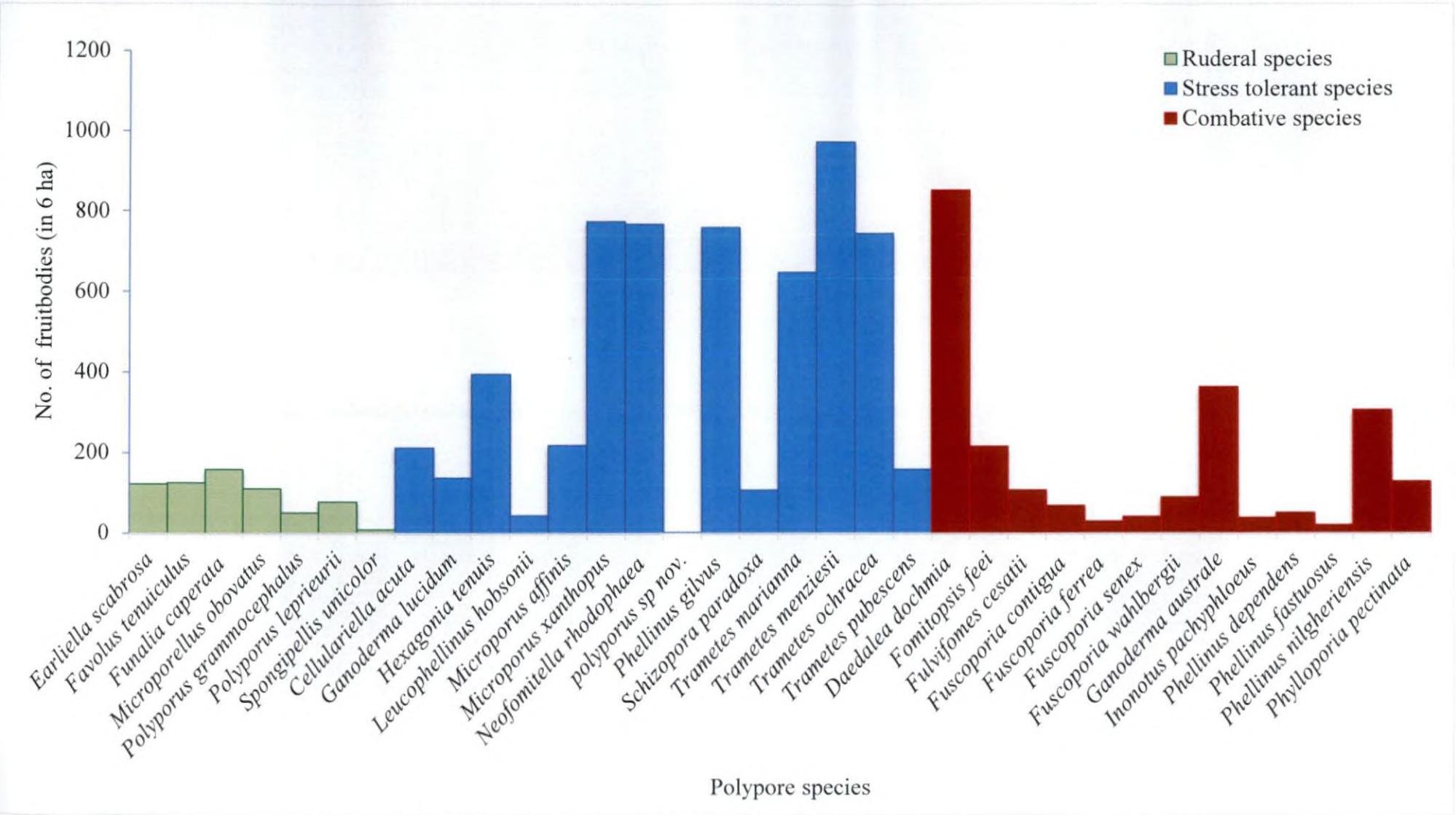


Fig. 23. Primary ecological strategies of polypores and their density in wet evergreen and shola forests

DISCUSSION

DISCUSSION

5.1 SPECIES COMPOSITION

The present study on the diversity and distribution of polypores in wet evergreen and shola forest of Silent Valley National Park reported 57 species altogether. The species composition analysis of polypores in the wet evergreen and shola forests highlighted the dominance of family polyporaceae over others in all seasons. Of the 57 species identified, 52.63 per cent belonged to Polyporaceae and 28.07 per cent belonged to Hymenochaetaceae followed by Fomitopsidaceae and Meripilaceae with 5.26 per cent each. The families Ganodermataceae and Schizoporaceae constituted 3.50 per cent each. Meruliaceae (1.75 %) was with least number of species. The rot character analysis proved the dominancy of white rot polypores over brown rotter with 91.22 per cent of the total species. The density of brown rot polypores was also low in Silent Valley (Table 2, 17 & 18).

In Changbaishan Nature Reserve, Northeastern China, 216 polypores were reported, among them 158 were white rot polypores (Dai *et al.*, 2014). Similarly, Zhou and Dai (2012) reported 248 polypore species from Fenglin Nature Reserve, Northeast China and among them 71.8 per cent (178 species) were white rotters. Recently, Lyngdoh and Dkhar (2014) reported 78 species of wood-rotting fungi from East Khasi Hills of Meghalaya, Northeast India. Among them, majority of the wood-rotting fungi (89.61 %) was white-rot fungi and only few were brown rotters.

Leelavathy and Ganesh (2000) reported 78 species of polypores belonging to 26 genera from both the forest and non-forest areas of Kerala and in that study Polyporaceae was identified as the major family represented in the surveyed areas. Among the 78 species, 6 were brown rot polypores. Similarly, studies on the diversity of plypores in the Peechi-Vazhani Wildlife Sanctuary by Florence and Yesodharan (2000) recorded 31 species of polypores with Polyporaceae as the dominant family. Among them, only 29 species were white rotters and only two species were brown rotters. The study by Mohanan (2008) on the prevalence of decay fungi in natural

forests of Kerala reported altogether 44 polypores, among them only 20 per cent polypores caused brown-rot, while all the rest were associated with white rot. In another study, Mohanan (2011) reported 89 polypore species with Polyporaceae as the major family and 90 per cent of them were identified as white rotters. More recently, Iqbal (2015) reported 36 polypore species from Peechi-Vazhani wildlife sanctuary and among them 90 per cent were white rotters.

It was suggested that brown-rot has been repeatedly derived from white-rot (Gilbertson, 1980). In contrast, it was also suggested that brown-rot fungi forms the plesiomorphic form in the homobasidiomycetes, and that white-rot has been repeatedly derived by elaborated wood decay mechanisms (i.e., gaining the ability to degrade lignin) (Nobles, 1965; 1971). However, recent authors have supported Gilbertson's view that the brown-rot fungi were derived from white-rot fungi (Ryvarden, 1991; Worrall *et al.*, 1997).

White-rot fungi occur frequently on hardwoods, while brown-rot fungi have an obvious preference for coniferous substrates (Tuor *et al.*, 1995; Schmidt, 2006; Karami *et al.*, 2014). Hardwood lignin is composed mainly of gluaiacyl and syringyl units. Lignin distribution, content and composition have a significant influence on decay resistance (Frankenstein and Schmitt, 2006). White-rot fungi achieve wood degradation with several different combinations of peroxidases and oxidases like ligninase, Manganese peroxidase (Mnp), Lignin peroxidase (Lip) and lactase and able to utilize wide variety of substrates (Tuor *et al.*, 1995). On the other hand, the white rot fungi are have a geographic distribution not corresponding to their most suitable hosts (Gilbertson, 1980). These views support the high proportion of white rot polypores in the study area.

The present study analyzed the diversity of polypores in Silent Valley National Park in detail. Leelavathy and Ganesh (2000) have reported 19 species of polypore from the National Park area. Of this, fifteen species were observed during the present study. Species like *Hexagonia sulcata, Pycnoporus sanguineus, Trametes modesta* and *Coriolopsis sanguinaria* were not observed during the present study.

Polypore diversity exploration in the present study added 5 new reports to polypores of Kerala and 3 species is found to be new to science (Table 4). The identity of the species were confirmed by comparing the characters described for the specimens collected by Bakshi (1971), Ryvarden and Jonansen (1980) and Leelavathy and Ganesh (2000). An identification key has also been prepared for the polypores recorded from the study area (Chapter 4.1.1).

Inonotus sp. nov. is proposed new since it differs from a variety of characters from the other described species. The genus *Inonotus* is less described from India. However, according to new nomenclature several taxa known under other genera are now included under *Inonotus*. Brownish flabelliform sporophore with regular surface of the present species differs from the resupinate to pileate forms of East Africa. The dimitic hypal system, globose basidiospores and absence of setae jointly occurred only in the present species. *Microporus* sp. nov. differs from a variety of characters from the described species. None of the *Microporus* species described by Ryvarden and Jonansen (1980) have concentrically striate, uneven upper surface with partly lobed margin. The present species shows trimitic hyphal system while, all the former species are dimitic. The Large pore mouth (90-100 um) is another salient feature of this species. *Polyporus* sp. nov. differs from the closely related other *Polyporus* species. The flabelliform to semi-circular dark brown nature of the present species differs from the sub-flabelliform to three cornered or clavate, sulphur colour of the fruit body of *Polyporus bamboosicola*, which was described from roots of bamboo from Saharanpur, India as insufficiently known by Bakshi (1970). The present species have concentrically striate, glabrous upper surface while *P. bamboosicola* have smooth to velvety surface. The number of pores (10-11 per mm) and thin dissepiments are other salient features of the present species.

5.1.1 Diversity of polypores in wet evergreen and shola forests

The wet evergreen forest showed relatively high polypore diversity and evenness than that of shola forest (Fig. 3). Also, wet evergreen forest showed relatively high species richness (29 species) than that of shola forest (14 species). In wet

evergreen forest, Simpson's Index of diversity was observed to be 0.92 i.e., if 100 pairs of polypores were taken at random, 92 will comprise of different species while in shola it was only 0.78. The Margalef Richness Index was also found to be relatively high in wet evergreen forest (3.15) while, it was 1.74 in shola forest. The less polypore diversity and richness in the shola forest can be explained on the basis of the theory of ecological niches and strategies of saprophytic fungi by Cooke and Rayner (1984). The availability of suitable substrate is an important determinant of the polypore diversity. Two characteristics of substrates influence patterns of fungal development are; the ease with which they can be assimilated and their spatial and temporal distribution (Cooke and Rayner, 1984). In shola forest, only 7 tree species were recorded as host out of total of 36 tree species identified, while in evergreen forest 23 tree species served as host out of the 61 identified tree species (Table 22).

The arborescent floras of the two forest type also contained many disjunctively distributed species. Only 6 species were found to be common to both ecosystems (Fig. 24 based on Table 21). Tree species of shola forest is characterized by much stunted habit (seldom attaining a height above 15 m) with spreading, umbrella shaped canopy, crooked and twiggy branches and branchlets (Nair and Menon, 2000). The trees are very often covered with several epiphytic lichens, mosses, ferns and orchids. Even though they are mostly associated with living trees, they will remain on the logs of early stages of decay. The number of logs was also noticed to be comparatively less in shola forest. It has been pointed out that a broad diversity of host tree species, of various volumes, diameters and degree of decomposition seems to be major factors contributing to the diversity of the wood-rotting fungi (Kuffer and Senn-Irlet, 2005). Thus the less availability of suitable substrate is a major factor for the low diversity and richness of polypores in shola forest.

The ecological strategies of polypores is strongly influenced by three factors; competition, stress and disturbance (Cooke and Rayner, 1984). The competition involves the struggle for capture and defense of resources between neighbours. In shola forest, the tree branches are often covered with several epiphytic lichens, mosses, ferns and orchids which could be a barrier for the germination and establishment of

polypores. Similarly, the under growth of shrubs like *Strobilanthus* sp. was found to prevent the light on the fallen logs. The shady environment around the logs is not favorable for the polypore establishment. Light has a wide range of effects on basidiomycete fruiting such as production, development and abundance (Moore *et al.*, 2008). Additionally, the under growth of *Strobilanthus* sp. may also prevent the spore dispersal of the polypores in shola forests.

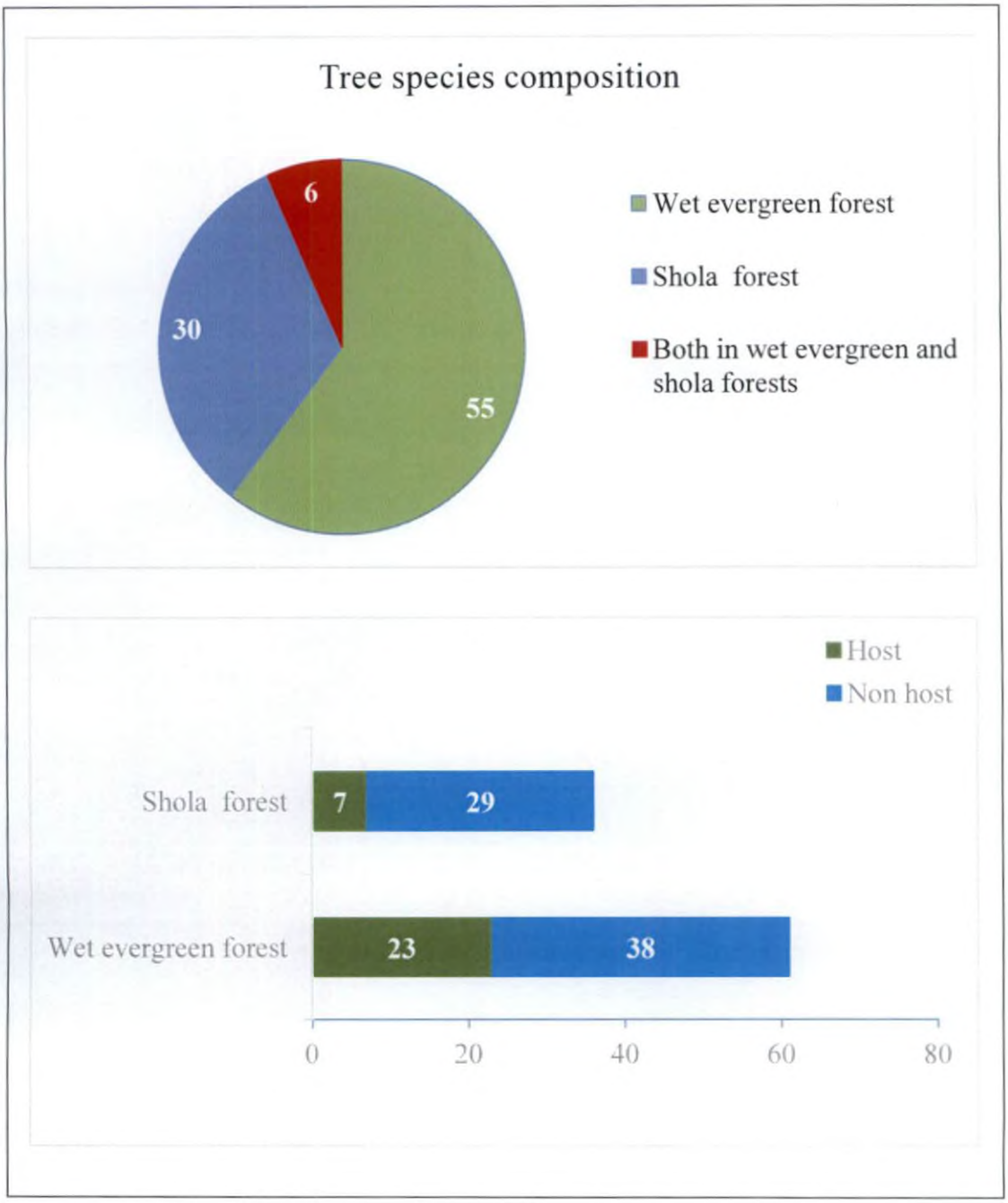


Fig. 24. Arborescent floral similarity between wet evergreen and shola forests

Further, the stress may be any form of continuously imposed environmental extreme which tends to restrict fruitbody production of polypores (Cooke and Rayner, 1984). The low temperature of the shola forest could also be a limiting factor for the polypore diversity. Extension rate of mycelial cord-forming basidiomycetes generally increase as temperature does, up to optima of about 20°C- 25 °C (A'Bear *et al.*, 2014). Low temperature of the shola forest also cause physiological dryness to the plants growing there, restricting their moisture absorption capability from the topsoil which is often frozen (Nair and Menon, 2000). The lower temperature is therefore an important determinant of polypore diversity in shola forests. Finally, the disturbance describe a state in which the whole or part of the total fungal biomass is destroyed or subjected to new selection pressures by a drastic change in environmental conditions (Cooke and Rayner, 1984). The severe low temperature in the shola forest could be acting as a disturbance for most of the polypores.

The evenness in distribution of polypores was found to be comparatively high in wet evergreen forest with Pielou's Evenness Index 0.84 than in shola forest (0.77). On other hand, shola forest showed more Berger-Parker Dominance Index value (0.42) in polypore distribution which was low (0.12) in evergreen forest. This could be due to polypores which can tolerate the prevailing environmental severity and dominate over the rest. Species like *Phylloporia pectinata, Fulvifomes cesatii, Leucophellinus hobsonii, Trametes ochracea* and *Trametes pubescens* were recorded only from high altitude shola forest, indicating their environmental tolerance and adaptation to disturbances. Similar pattern of increasing dominance of some macrofungi which are able to tolerate the prevailing environmental severity has been recorded in Laojun Mountain region in China (Zhang *et al.*, 2010).

The similarity of polypore community between wet evergreen forest and shola forest is found to be less during different seasons with Similarity Indices 0.53, 0.44 and 0.42 during pre-monsoon, monsoon and post monsoon period, respectively. The little overlap in arborescent floras among these two ecosystem and the difference in the prevailing environmental conditions could be the reason for the low similarity among the polypore communities in these ecosystems.

5.2 COMMUNITY STRUCTURE OF POLYPORES

The community structure analysis of polypores in both wet evergreen and shola forests revealed that the number of species was changing significantly during pre-monsoon, monsoon and post monsoon periods (Table 5-16). In wet evergreen forest during pre-monsoon period, 21 species were recorded while, during monsoon and post monsoon period, the number of species was 29 and 27, respectively. A total of 21 species were common to all the three seasons. Similarly, in shola forest during pre-monsoon period 9 species were documented and it increased to 14 in monsoon. The species richness did not change during post monsoon period. The shola forest had 9 species in common to all the three seasons. In wet evergreen forest during the pre-monsoon period, polypore density was 334 individuals ha^{-1} but during the monsoon period the number of individuals has been increased tremendously to 1178 individuals ha^{-1} and it decreased to 873 individuals ha^{-1} during post monsoon. Similarly, in shola forest, the density was observed to be changing from 82 during pre-monsoon to 290 and 216 during monsoon and post monsoon, respectively.

In the Mount Cameroon region, the diversity and distribution of macrofungi had shown the similar pattern of species distribution, where the rainy seasons possessed the higher species richness (134 species) than in the early dry seasons (89 species). Eighty eight species were recorded only in the rainy seasons, 43 species in the early dry seasons and 46 species were common to both seasons (Andrew *et al.*, 2013). It was shown that most of the fleshy macrofungi was recorded in the rainy seasons as this period is favourable for their fruitbody production, since there is adequate moisture, favourable temperature, relative humidity and sunshine, which also aids the macrofungi in the decomposition of dead organic matter. In addition, Karim *et al.* (2013) reported the same pattern of polypore distribution in deciduous forest of Iran where the maximum numbers of macrofungal species were found in wet season and which was ascribed to seasonal changes in rainfall, temperature and moisture which are essential factors in distribution of macrofungi. Sharma (2006) reported that the temperature and precipitation during growing season explained 24-90 per cent of variation in the occurrence of wood rotting fungi in various forests of India.

The proportion of densities of annual and perennial polypores were changed notably during the seasons (Fig. 25 & 26 based on Table 5-7 & 11-13). In wet evergreen forest, during pre-monsoon period, of the 1002 individuals recorded, 591 were annuals and 411 were perennials (Table 5). During monsoon, the density of annuals and perennials increased to 2925 and 609, respectively (Table 6). It could be ascertained that during monsoon the density of annuals got increased 4 times (394 %) more than that of pre-monsoon period while that of perennials increased only by 48 %. In the post monsoon period, the density of perennials increased to 684 (12 %) but the density of annuals got decreased to 1935 (33 %) (Table 7). Similar pattern is also observed in shola forest (Fig. 26). The density of annual polypores were found to drastically change during different seasons. However, the perennials maintained a population that did not vary much across the seasons. Similar to this observations, from the southern to northern boreal vegetation zones of Finland, the perennial polypores were reported to be detectable throughout the year with the same frequency and same perceptivity. The occurrence of these was not substantially influenced by the weather or other conditions that may vary within a year or between the years (Halme *et al.*, 2009). Additionally, the perennial polypores had showed no seasonality at all in boreal vegetation zones of Muurame in Central Finland (Halme and Kotiaho, 2012).

The perennial fruiting bodies of large polypores may be able to cope with higher radiation levels and temperature fluctuations (Bassler *et al.*, 2010), so the population of these polypores was maintained without much variation. The annual species were subjected to yearly fluctuations in fruit body production and showed seasonality than perennials (Junninen and Komonen, 2011). In the present study, the soft bodied annuals were found to be attacked severely by the insects, especially beetles in monsoon season. Most of the annuals were found to provide both the feeding and breeding ground for many coleopterans. The perennials with woody and corky fruit bodies found during dry seasons have unique adaptations for survival for several years producing new layers of spore producing surfaces. It might also be probable that these species are not readily eaten by insects and other animals, thus the increase in their abundance (Andrew *et al.*, 2013).

The percentage frequency of occurrence of polypores over three different seasons revealed a remarkable variation in the community structure. The percentage frequency was 29.33 during pre-monsoon which increased during monsoon and decreased during post monsoon with 79.33 per cent and 62 per cent, respectively in wet evergreen forest. Similarly in shola forest, the percentage frequencies were observed to be 15, 32 and 26.67 during pre-monsoon, monsoon and post monsoon, respectively. The rapid increase in the number of individuals and percentage frequency over the season signifies that certain conditions especially the spore release, dispersal and germination are influenced by climatic variations (Cooke and Rayner, 1984). Falling water drops and relative humidity of the atmosphere play an important part in liberation of basidiospores and dispersal (Ingold, 1965). Sporocarps of some higher fungi including many woody and leathery bracket fungi are formed only on a damp substratum but can survive considerable periods of desiccation and will commence to shed spores again under moist conditions (Hawker, 1965).

The Principal component analysis revealed a significant positive correlation in species composition of polypores during monsoon and post monsoon season in both the ecosystems and this can be attributed to the presence of annual species (Fig. 5 & 6). The PCA also highlighted the association of annual flesh bodied polypores with the monsoon period. In wet evergreen forest, the population of *Microporellus obovatus, Favolus tenuiculus, Polyporus grammocephalus, Polyporus leprieurii, Earliella scabrosa, Funalia caperata* and *Ganoderma lucidum* was found to be influenced by rainy season. Similarly, a stable population of perennial polypores was also noticed from the PCA biplot. The distribution of perennial species like *Fuscoporia contigua, Phellinus dependens, Phellinus fastuosus Fuscoporia ferrea, Fuscoporia senex* and *Fuscoporia wahlbergii* were not much affected by rainy season as compared to other polypores. Species like *Trametes menziesii, Phellinus gilvus, Neofomitella rhodophaea* and *Trametes marianna* were very much linked with monsoon and post monsoon periods. Whereas, the distribution of *Daedalea dochmia* was found less affected by seasons and maintained more or less a stable population. Similarly in shola forest, species like *Earliella scabrosa, Ganoderma lucidum, Leucophellinus hobsonii* and *Microporellus obovatus* were more influenced by the rainy season while, the

perennials like *Phellinus nilgheriensis, Ganoderma australe, Phylloporia pectinata* and *Fuscoporia wahlbergii* were not much influenced by the rainy season (Fig. 4). Environmental conditions, particularly seasonal fluctuations act distinctly on different fungi to operate in the selection of species available for community development and also to act differently upon different phases in the life history of a single species (Park, 1968).

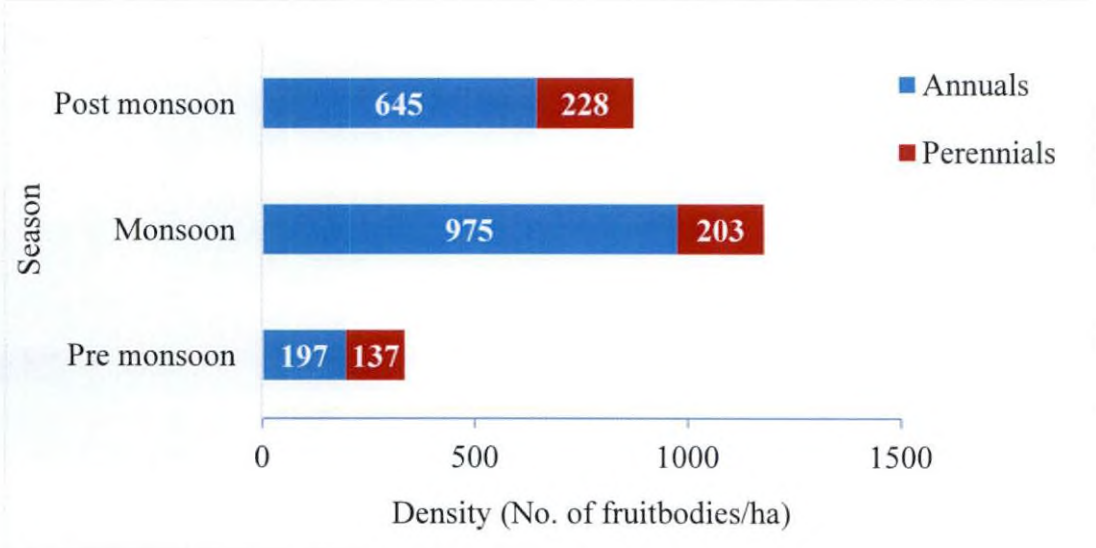


Fig. 25. Density of annual and perennial polypores in wet evergreen forest during different seasons

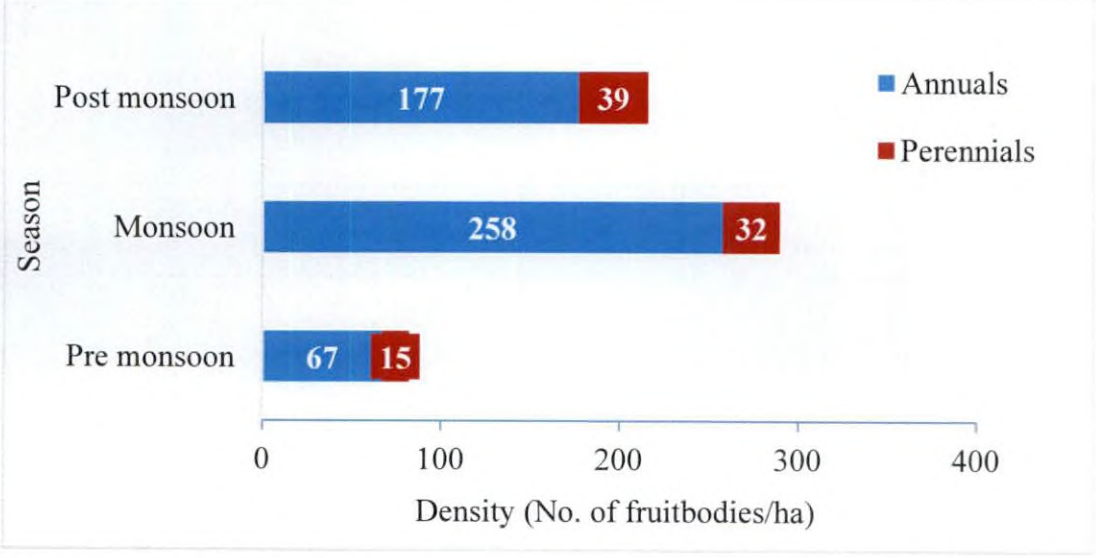


Fig. 26. Density of annual and perennial polypores in shola forest during different seasons

5.3. POLYPORE DISTRIBUTION ALONG WITH ALTITUDINAL GRADIENT

The distribution pattern of polypores in Silent Valley National Park along different altitudinal gradient was analyzed (Table 19). Most of the species showed a drastic reduction in density as the altitude increases. The lower altitude wet evergreen forest at Sairandhri (1000-1050 m) possessed high species richness (29 species) which gradually decreased as the altitude increased. The species richness decreased to 27 species (7 % reduction) at Poochipara (1150-1200 m) and in Walakkad (1300-1350 m), it was reduced to 25 (14 % reduction). Interestingly it was reduced to 11 species in Sispara (1950-2000 m) with 63 % reduction as compared to that of the lower altitude. At Cheriyamkandam (2100-2150 m) and Valliyamkandam (2200-2250 m), the species richness was found to be 8 and 5 with 72 per cent and 83 per cent reduction respectively, as comparing to that of Sairandhri. This monotonic decrease in species richness is also reflected in the polypore density. The density was found to be decreased from 2613 at Sairandhri (1000-1050 m) to 435 in high altitude shola forest at Valliyamkandam (2200-2250 m).

The studies on the polypore diversity along the elevation gradient in Changbaishan Nature Reserve, Northeastern China also showed a monotonic decrease pattern in species richness (Dai *et al.*, 2014).The polypore richness had decreased from 153 to 8 species with increasing elevation from 800 m to 1800 m, showing typical monotonic decrease pattern. They have discussed that the prevailing forest type shift and the abiotic factors were responsible for the decreasing pattern of species richness along the elevation gradient. In the present study also the forest type shift from the wet evergreen forest to the high altitude shola forest may have influenced species richness. Similarly the diversity of macrofungi in the Mount Cameroon Region was also found to decrease with the altitude (Andrew *et al.*, 2013).

At different positions along the altitude gradient, a positive correlations existed with respect to the relationship between species richness and diversity. Sairandhri was at the lowest altitude (1000-1150 m) and showed the highest Shannon-wiener Index (2.9) and Margalef Richness Index (3.6). Diversity and richness decreased to 1.2 and

0.66 respectively in Valliyamkandam (2200-2250 m). A gradual reduction was observed in both the diversity and richness with increasing altitude (Fig. 7). Similarly, studies on diversity and ecological distribution of macrofungi in the Laojun Mountain region, China also showed that the diversity and richness were in positive correlation and both were decreased with the elevation (Zhang *et al.*, 2010). The present study demonstrated that elevation was a factor in determining distribution of polypore species. Schmit *et al.* (2005) reported that there was a trend of decreasing macrofungal richness at higher latitudes. The macrofungal growth and distribution are affected by a multitude of factors. A number of environmental factors are associated with differences in elevation and the more important of these are temperature and precipitation; duration and intensity of illumination; physical and chemical characteristics of the soil; topographic position and tree density (Zhang *et al.*, 2010). These factors could potentially explain some of the variation in species richness of macrofungi (Straatsma *et al.* 2001; Mulder and Zwart, 2003; Rolstad *et al.* 2004; Gilbert *et al.* 2008). Both wet evergreen and shola forests in this study varied significantly in various ecological and environmental features. The tree composition also showed a significant difference in both the habitats (Table 21)

The study of variation that exists for dominance and evenness showed that the degree of dominance increased and the degree of evenness decreased along the altitude gradient (Fig. 8). Similar pattern of increasing dominance of some macrofungi species which are able to tolerate the prevailing environmental severity were recorded in Laojun Mountain region in China (Zhang *et al.*, 2010). In this study, species like *Phylloporia pectinata, Fulvifomes cesatii, Leucophellinus hobsonii, Trametes ochracea* and *Trametes pubescens* were recorded only from high altitude shola forest, indicating its environmental tolerance and habitat preference. *Trametes ochracea* showed high density in shola forest while, *Trametes menziesii* and *Microporus xanthopus,* the dominant species in wet evergreen forest, were recorded with low density (Table 19).

The phenomenon that many sporocarps of certain polypore species become smaller with increasing elevation was noted during the field work (Plate 19). The

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ACK 16/29-7-2014

ACK 40/28-8-2014

Specimens of *Microporus xanthopus* recorded from shola forest

ACK 48/28-8-2014

ACK 15/19-10-2014

Specimens of *Microporus xanthopus* recorded from wet evergreen forest

Plate 19. Variation in size of sporocarps of *Microporus xanthopus* with respect to elevation

studies on macrofungi of East Himalaya and their adaptive characteristics by Mao (1985) also reached a similar conclusion that fruiting bodies become smaller with increasing elevation. The smaller sporocarps also seem better adapted for the more extreme environmental conditions that exist at higher elevations (Zhang *et al.*, 2010). The lower temperatures, more abundant precipitation, greater humidity and stronger radiation in shola forest could be the reason for the production of smaller sporocarps.

5.4 HOST ASSOCIATION OF POLYPORES

5.4.1 Host association of polypores in wet evergreen and shola forests

The natural distribution of plant-associated fungi across broad geographic ranges is determined by a combination of suitable host plant distributions and environmental conditions (Brandle and Brandl, 2006; Gilbert *et al.* 2007; Gilbert *et al.*, 2008; Robertson *et al.* 2006). Understanding local host selectivity is important because it affects patterns of spread, density-dependent population dynamics, and in turn the maintenance of biological diversity and aspects of ecosystem function (Gilbert, 2002; 2005). In addition, fungi that appear to be specific to habitats with particular environmental conditions (e.g. moisture, irradiation, temperature and salinity), may actually be responding to environmentally determined distributions of susceptible host species (Gilbert *et al.*, 2008). The host and fungus interaction is governed by various factors like inoculum potential of the fungus, susceptibility of the host tissue to fungi and the environmental conditions of the habitat. Since fungi are obligate aerobes, oxygen is critical to fungal growth and wood moisture content of at least 28-30 per cent (based on dry wt.) equal to the fibre saturation point is required by wood decay fungi. Furthermore, the amount and type of lignin and the presence of accessory compounds are also known to influence fungal activity (Rayner and Boddy, 1988).

During the present study, of the 87 tree species under 31 families (both alive and dead) recorded in the study area, 29 tree species (33.33 %) belonging 16 families were documented under host species category (Fig. 9). Lauraceae and Myrtaceae

contributed 5 and 3 species respectively and they represented the major host families. The density and occurrence of polypores on different host species have been quantified. *Mesua ferrea* harboured 1289 fruitbodies belonging 13 species followed by *Elaeocarpus tuberculatus* (1028) with 12 species and *Cullenia exarillata* (749) with 8 species (Fig. 11 & 12). These three species together provided substrate for 34.37 per cent of the total individuals of polypores recorded from Silent Valley National Park. In case of the host families the highest number of polypore fruitbodies was recorded on Clusiaceae (1629) followed by Elaeocarpaceae (1405), Lauraceae (1252) and Bombacaceae (749). These four families together contributed substrates for 56.45 per cent of total polypore density in the National Park. The reason could be that the coarse woody debris of trees belonging these families were noticed to be abundant in the National Park (Table 23).

In Peechi Wildlife Sanctuary, logs of *Xylia xylocarpa, Tectona grandis* and *Terminalia paniculata* together provided substrate for the polypores like *Microporus affinis* and *Microporus xanthopus* having wide distribution throughout the state (Florence and Yesodharhan, 2000). However during the present study, *Microporus affinis* and *Microporus xanthopus* were reported from entirely different hosts and found to utilize 6 and 13 hosts, respectively (Fig. 11 & 12). Hence it can be ascertained that the utilization of available woody substrates by the polypores in a particular ecosystem is typically based on the local host density. Similarly, Gilbert and Sousa (2002) had reported that the degree of host specificity is a function of local host density in tropical forests. Notably, similar patterns of variation in host-use specialization as a function of local host plant diversity and density have been observed in the largest group of angiosperm shoot parasites, Loranthaceous mistletoes. These parasites showed low host specificity in diverse tropical rain forests but high host specificity in low-diversity temperate forests, open and arid tropical woodlands and mangrove forests (Barlow 1992; Norton and Carpenter, 1998; Gilbert and Sousa, 2002).

In Silent Valley National Park, host density was found to be an important factor in the diversity of polypores. A significant positive relationship between the polypore fungal diversity and density of host tree species has been observed (Fig. 16). *Mesua*

ferrea supported highest number of polypores species with more number of logs. Similarly, the number of polypores on other hosts also increase linearly with increase in number of logs (Fig. 15). Notably, the studies on diversity of polypore fungal communities in tropical forests of Panama had revealed that the host species with higher density supported greater fungal diversity (Gilbert *et al.*, 2002).

5.4.2 Host preference and specificity of polypores

Host specificity is a relationship in which a particular fungus is restricted to a single host or a group of related species but does not occur in association with other unrelated plants in the same habitat (Holliday, 1998). The causes of host selectivity of wood-decay species are complex and include wood chemistry, wood microclimate, gaseous regime and the ways in which fungi become established (Boddy, 2001). The host specificity of polypores and other wood-inhabiting basidiomycetes is widely considered to be low in tropical areas because of high host plant species richness (Schmit, 2005)

During the present study, most of the species were found to be host generalist while five species showed a possible preference for a host tree as defined by having more than 50 per cent of their occurrence on a single tree species (Fig. 12a &12b). *Elaeocarpus tuberculatus* was preferred by *Inonotus pachyphloeus, Phellinus gilvus* and *Leucophellinus hobsonii* while, *Mesua ferrea* was preferred by *Daedalea dochmia.* Similarly *Phylloporia pectinata* have showed preference towards *Cinnamomum sulphuratum. Elaeocarpus tuberculatus, Mesua ferrea* were most common tree species in the wet evergreen forest and plenty of logs of *Cinnamomum sulphuratum* were observed in shola forests.

Notably, *Microporus xanthopus* were recorded from 11 host trees followed by *Neofomitella rhodophaea* from 9 host trees, *Daedalea dochmia* from 8 host trees and *Trametes marianna* and *Trametes menziesii* from 7 host trees each indicating their host generalist life history characteristics. Remarkably studies on decay of standing trees in natural forests of Kerala by Mohanan (1994) had reported the wide host range of *Neofomitella rhodophaea* and *Daedalea dochmia.*

A strong pattern of host preference was not seen in the Silent Valley National Park and it could be due to the high diversity of host tree species that too in plenty in the study area. Notably, in low diversity neotropical Caribbean mangrove forest most of the polypores were reported to be host specialist (Gilbert and Sousa, 2002). Globally generalist wood inhabiting polypores may be host specialists within given ecological contexts (Thompson, 1982; Gilbert *et al.*, 2008). More than half of the polypore fungi described as pine or spruce specialists in Scandinavia showed broad host ranges in China (Dai and Penttila, 2006). Understanding local host selectivity is important since it affects patterns of spread, density-dependent population dynamics, and in turn the maintenance of biological diversity and aspects of ecosystem function (Gilbert *et al.*, 2008). Similarly, the present study also agrees with the importance of host preference within local ecological contexts which drive apparent preferences for different habitats.

5.5 SUBSTRATE FEATURES AND POLYPORE ASSEMBLAGE

5.5.1 Substrate type and distribution of polypores

The distribution of polypores on different substrate type revealed that 48.12 per cent of the total fruitbodies were found on trunk (4292 fruitbodies) followed by 25.56 per cent on branch/twig (2280 fruitbodies) and 23.33 per cent on snag (2081 fruitbodies). The living trees were found to be infested by only 2.98 per cent of total individuals (266 fruitbodies).

Logs, especially the larger ones, are more prone to harbour high species richness which is partially due to greater surface area and volume (Bader *et al.* 1995; Kruys *et al.* 1999). In addition, increasing micro and mesofauna activity will be prominent in logs and tend to increase the number of niches as decay proceeds (Heilmann-Clausen and Christensen, 2003). Additionally, the decay rate varies even on the same log, resulting in heterogeneous microhabitats (Crites and Dale 1998). The microclimatic regime is crucial for fungal community development in decaying wood (Rayner and Boddy, 1988). Logs with a high degree of soil contact are likely to be

buffered against fluctuations in temperature and especially water content compared to logs with little soil contact (Heilmann-Clausen and Christensen, 2003). All these factors are responsible for the high species richness and occurrence of polypores on logs observed during the present study.

Among the substrata, living tree harboured the least number of polypores. This may be due to the different species adaptations to the defence mechanisms present in the living trees. Furthermore, variations in the microclimate within the wood, particularly moisture but also aeration and temperature influence the development of decay (Boddy and Rayner, 1983; Boddy, 2001). In living trees, moisture content is highest where there are living cells and actively conducting tissues (sapwood). High moisture content imposes poor aeration, inhibiting aerobic processes and therefore providing a difficult environment for fungal growth (Rayner and Boddy, 1988). This could be a possible reason for the low diversity of polypores on living trees, although perennial species like *Phellinus nilgheriensis, Daedalea dochmia, Phellinus dependens, Phellinus fastuosus, Fuscoporia senex* and *Phellinus nilgheriensis* was observed in the living trees. Mohanan (1994) reported that species like *Fuscoporia ferrea, Phellinus gilvus, Phellinus nilgheriensis, Daedalea dochmia* and *Phellinus fastuosus* were the most common polypores associated with decay in trees in natural forests of Kerala. During the present study, these species were found many times on the living trunk of *Elaeocarpus tuberculatus* and *Mesua ferrea. Ganoderma lucidum* is also observed to be infecting the living trunk of *Mesua ferrea.* It is a familiar polypore which is known to cause diseases in plantations especially oil palm and coconut plantations (Vijayan and Natarajan, 1972; Treu, 1998). The species like *Neofomitella rhodophaea* and *Daedalea dochmia* showed high preference for snag (dead standing trees). This could be due to the availability of more or less uniform surface texture and microclimate in snags favorable for these particular polypore species.

Moreover, white rot fungi with annual habit like *Cellulariella acuta, Trametes cotonea, Trametes marianna, Trametes menziesii, Trametes ochracea, Phellinus gilvus, Microporellus obovatus, Microporus affinis, Microporus xanthopus, polyporus*

grammocephalus and *Hexagonia tenuis* have wide spread occurrence on fallen logs and branches/twigs. Mohanan (1994) reported that only a few polypores were found associated with heart rot of standing trees, while many of them caused decay of small branches and twigs and *Microporus affinis, Microporus xanthopus* were common in evergreen forests which caused mainly white rot of branches and twigs.

Similarly, in the boreal forest, the total number of species, occurrences and the number of red-listed species on downed trees (logs) were reported to be much higher than on standing dead trees (snags), the number of species being 2–6 fold more abundant (Berg *et al.*, 2002; Rydin *et al.*, 1997; Sippola *et al.*, 2001, 2005; Sippola and Renvall, 1999; Tikkanen *et al.*, 2006). Moreover, the number of unique species is higher on logs than on standing dead trees, i.e., most of those species that can grow on standing trees can also live on logs but not the other way around (Lindhe *et al.*, 2004; Sippola and Renvall, 1999). The importance of logs in forest ecosystem as substrate has also been documented by Bader *et al.* (1995). The abundance of logs is important for the total number of polypore species. It seems reasonable to expect that more woody debris would allow more species to colonise a site and possibly also to reduce the risk of extinction by chance (Bader *et al.*, 1995).

5.5.2 Substrate diameter and its influence on polypores distribution

Coarse Woody Debris (CWD) is a crucial component for many species in forest ecosystems as it provide a structurally and temporally variable habitat for a wide array of organisms, including fungi, bryophytes, lichens, insects, arthropods, nematodes and birds (Samuelsson *et al.*, 1994). A broad diversity of host tree species, of various volumes and diameters, i.e., logs, snags, branches or twigs, and its decay stages seems to be the major factors contributing to the diversity of the wood-rotting polypores in forest ecosystem (Kuffer and Senn-Irlet, 2005). During the present study, the relationship between the diameter of logs and the distribution of polypores were studied based on both the density and occurrence (Table 27 & 28).

In Silent Valley National Park, the maximum species density has been recorded on logs of diameter class 31- < 40 cm (2471 fruitbodies) followed by 21- < 30 cm (2328 fruitbodies) and 11- < 20 cm (1707 fruitbodies). The low diameter class (0- < 10 cm) harboured 1126 fruitbodies while, those with a diameter 61cm and above harboured 132 fruitbodies. Lowest species density was observed in 51- < 60 cm diameter class with 107 fruitbodies. A gradual increase was observed in the density of polypores in the diameter classes from the small class (0- < 10 cm) to large diameter class (31- < 40 cm). Substrates up to this diameter was more or less equally abundant in the study area and the substrates beyond this diameter was comparatively less.

The substrate size was found to be influencing the hymenial surface area per log as well as the density of polypores. A large log can support a greater mycelial biomass simply because of the larger volume, corresponding to a greater amount of resources (Bader *et al.*, 1995). However, many wood-inhabiting fungi need a good moist microclimate (Bondartsev, 1953) and optimal mycelial growth is achieved at an intermediate moisture content (Rayner and Boddy, 1988). A large log could be colonized by both stress-tolerant and drought- sensitive species because of its higher water holding capacity compared with a small log (Bader *et al.*, 1995). During the present study, both the fleshy annuals (*Polyporus grammocephalus, Polyporus leprieurii* and *Spongipellis unicolor*) and most of the perennials were found to utilize the larger diameter substrates (Table 29). Furthermore, larger logs are able to collect more number of spores and to function as a substratum for fruitbodies over a longer period of time than a small log (Soderstrom, 1988). Similarly, the large diameter trunk maintain more stable micro climate inside the trunks than do small substrates (Boddy, 1993) and a large volume also slows down the decomposition which seems to be crucial for many polypore species (Renvall, 1995). In shola forest, the small logs were found to be rapidly overgrown by large feather mosses and it could be a possible reason for the relatively low polypore density in small diameter substrates. Similar pattern of increasing species richness with increasing substrate diameter was reported in the boreal forest in Finland (Sippola *et al.*, 2004). In addition, Bader *et al* (1995) also reported the positive correlation between the percentage of logs with fruit bodies and the diameter of logs in the boreal spruce forest in northern Sweden.

Species like *Cellulariella acuta, Neofomitella rhodophaea, Phellinus gilvus,* and *Ganoderma australe* had a wide range of diameter class while, species like *Phellinus nilgheriensis, Hexagonia tenuis, Microporus xanthopus* and *Fulvifomes cesatii* were associated with only a narrow range of diameter classes (Fig. 19). Similarly, wide range diameter class and preference for a particular diameter class was observed for wood-inhabiting Aphyllophorales fungi in a cool temperate area of Japan (Yamashita *et al.*, 2010).

A total of ten polypore species have shown preference for a particular diameter class. The diameter class 31-<40 cm was preferred by the perennials like *Phellinus dependens* and *Fuscoporia wahlbergii.* Similarly, two more perennials, *Daedalea dochmia* and *Phellinus nilgheriensis* showed preference for 41-<50 cm diameter class. Notably, the association of perennials with large diameter substrates was also observed in tropical rainforest of Malaysia (Yamashita *et al.*, 2009). This could be due to fact that the large diameter substrate can function as a substratum for fruitbodies over a longer period of time than a small log and contain more amount of resources as suggested by Soderstrom (1988).

The species like *Hexagonia tenuis*, *Microporus xanthopus*, *Microporus affinis* and *Fulvifomes cesatii* showed preference for 0- < 10 cm diameter class. Similarly, Hattori and Lee (2003) reported the association of *Microporus xanthopus* with small diameter branches and twigs in Pasoh forest reserve, Malaysia. In addition, Yamashita *et al.* (2009) also reported that the *Microporus xanthopus* were mostly restricted to <10 cm diameter class in a tropical rainforest on Borneo Island, Malaysia. In the present study, the preference shown by these species highlight their ability to establish and utilize the less energy available substrates like twigs and branches.

5.5.3 Substrate decay class and distribution of polypores

The ecological roles played by a piece of CWD depend in part upon the state of decay of the material and the piece size (Maser *et al.*, 1979; Harmon and Sexton, 1996). Log decay characteristics and surface textures affect the ability of polypore to lodge on a woody substrate. The degree of decay and the related capacity to store moisture influences the use of CWD by biota (Graham, 1925; Savely, 1939; Fager, 1968; Crawford *et al.*, 1990). Higher rates of nitrogen fixation have been found in logs of higher levels of decay and moisture content (Larsen *et al.*, 1978). Moisture retention capacity increases as a CWD piece progresses along a chronological sequence of decay until a highly decayed state is reached when the larger void spaces preclude the retention of water against the force of gravity (Griffith and Boddy, 1991).

During the present study, analysis of both the density and occurrence of polypores on substrates under different decay classes, showed that the intermediate decay stages were harboured by majority of the polypores (Fig. 27 based on Table 29 & 30).

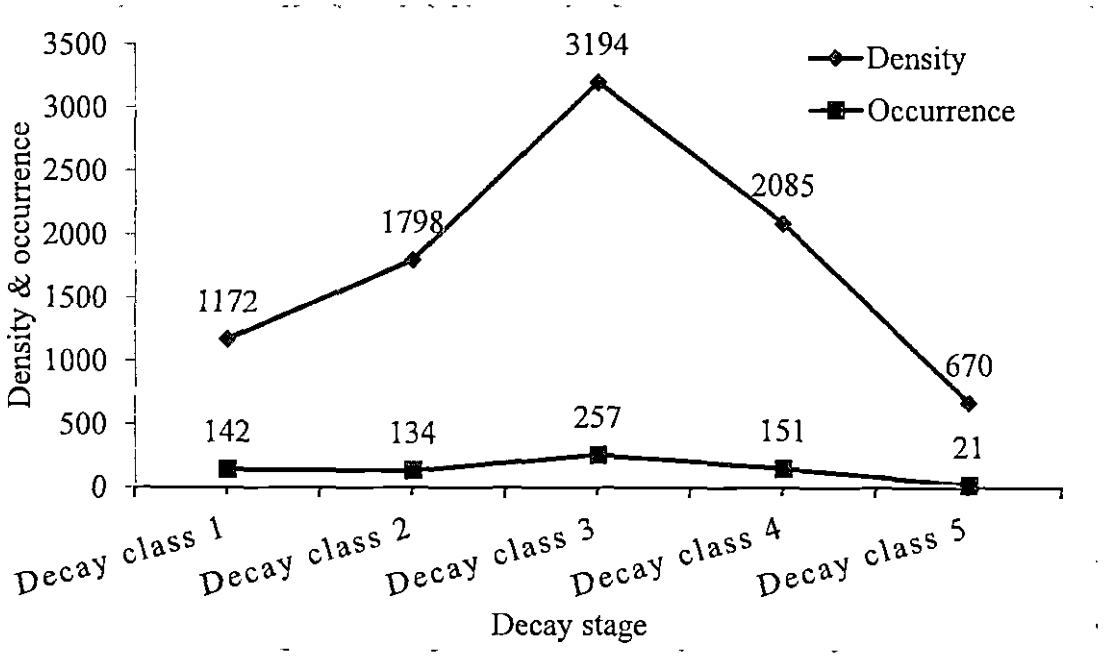


Fig. 27. The high density and occurrence of polypores on substrates under intermediate decay classes in Silent Valley National Park

The studies on the diversity of macrofungi on decaying beech logs in Eastern Denmark also showed that the logs in intermediate stages of decay are most species rich and support the highest number of red-listed species (Heilmann-Clausen and Christensen, 2003). Lange (1992), Renvall (1995) and Hoiland and Bendiksen (1996) also investigated the changes occurring in fungal community structure during log decay. All these authors found that the logs in intermediate stages of decay were the most species rich.

During the decay process some parts of a log may decay rapidly, other parts may remain relatively little decayed, allowing the co-occurrence of both early and late stage decay fungi in intermediately decayed logs (Pyle and Brown, 1999). In the present study, the homogeneity of within-log decay class varied by overall log decay class designation. On an average, the group of logs identified as class 3 contained the greatest proportion of other decay classes and had the greatest variability among logs within a decay class group. This may be why logs in intermediate stage of decay supported more number of polypores.

In addition, higher micro and mesofauna activity will tend to increase the number of niches as decay proceeds. The microclimatic conditions are likely to have a very pronounced effect on species richness at log level (Rayner and Boddy, 1988; Boddy, 2001). Moisture retention capacity increases as a log progresses along a chronological sequence of decay until a highly decayed state is reached when the larger void spaces preclude the retention of water against the force of gravity (Griffith and Boddy, 1991). An optimum level of moisture content is present in substrates under intermediate decay class and support co-occurrence of more number of macrofungi (Heilmann-Clausen and Christensen, 2003). The substrates under decay class 5 is being highly decayed logs that have lost their cylindrical shape and are composed primarily of powdery wood, which support only few polypores in a community (Pyle and Brown, 1999). In the present study also the substrates under decay class 5 supported only few species as compared to others (Table 29).

Twenty four polypore species have shown preference for a particular decay class (Fig. 22). Out of 24 species, 7 species showed preference for decay class 1 and two species showed affinity for decay class 2. Eleven species showed preference for substrate under decay class 3 while decay class 4 was preferred by only 4 species. No preference was observed for decay class 5. It is evident from several studies that the turnover in fungal community structure during log decay is considerable, with many species being more or less confined to certain decay stages (e.g. Chapela *et al.* 1988; Renvall, 1995; Hoiland and Bendiksen, 1996; Heilmann-Clausen, 2001).

The perennial species like *Fuscoporia wahlbergii, Inonotus pachyphloeus, Phellinus dependens* and *Phellinus nilgheriensis* were found predominantly on the substrates under decay class 1, which would typically hold more available energy. These results support the idea of an energy driven control of fruit body production for some species (Schmit, 2005). The annuals like *Earliella scabrosa, Microporellus obovatus* and *Microporus affinis* also showed preference for substrate under decay class 1. Similarly, Hattori and Lee (2003) observed that species such as *Earliella scabrosa* and *Microporus affinis* were found mainly on newly fallen trees in Pasoh Forest Reserve, Malaysia. Noteworthy, more than 50 % of the basidiocarps of *Microporus affinis* was collected from fresh woody debris in Borneo Island, Malaysia (Yamashita *et al.*, 2009).

The substrates under decay class 3 were preferred by 11 polypore species belonging to both annuals and perennials (Fig 22). This can be explained based on ability to provide varying microclimatic situation for both early and late stage decay fungi (Heilmann-Clausen and Christensen, 2003). However, species like *Cellulariella acuta, Hexagonia tenuis, Phellinus nilgheriensis, Phellinus gilvus* and *Microporus xanthopus* were found in substrates under all decay classes, which support the view that once a primary species is established in a fallen log, it may persist in the community for a long time (Vetrovsky *et al.*, 2011).

5.6 ECOLOGICAL STRATEGIES OF POLYPORES

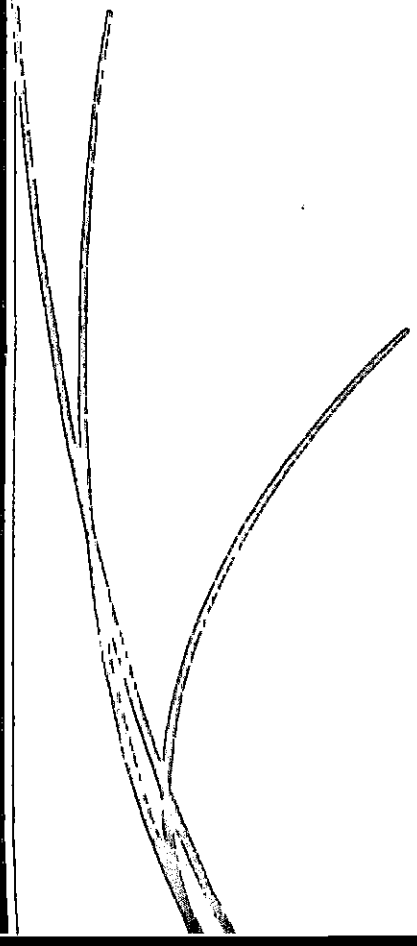
In order to understand the functional role of polypores in an ecosystem, its ecology and life history should be known. Cooke and Rayner (1984) proposed three primary ecological strategies of wood decaying fungi based on the behavioral attributes: a) Ruderal strategies (R-selected fungi) b) Stress-tolerant strategies (S-selected fungi) c) Combative strategies (C-selected fungi). The species with ruderal strategies are active only in habitats characterized by low degree of combative competition and stress and they are short-lived, capable only of utilizing easily assimilable resources, characterized by an abbreviated growth phase with high reproductive potential. Stress-tolerant species occupy a wide range of habitats from which most species are excluded by various degree of stress and subject to replacement if stress condition is alleviated. They are not generally of rapid growth, spore germination or reproduction rates and possess good enzymatic competence. The species with combative strategies are persistent, long lived, capable of defending captured resources, with or without rapid growth and spore germination, slow or intermittent reproduction and good enzymatic competence.

During the present study, the fleshy and short lived species like *Funalia caperata, Earliella scabrosa, Favolus tenuiculus, Microporellus obovatus, Polyporus leprieurii, Spongipellis unicolor* and *Polyporus grammocephalus* followed the ruderal strategies. They showed fast reproduction and rapid growth during the onset of monsoon and were observed only during the monsoon and post monsoon. The first species to colonise a new resource are termed primary colonisers, and typically exhibit R-selected characteristics (Boddy, 2001). Their efficient dispersal, rapid spore germination and fast growth will enable them to utilize compounds in previously uncolonized resources (Rayner and Boddy, 1988). Their competitive ability and survivability is thus principally concerned with the initial capture of available resources and this is probably determined by the quick mobilization of mycelial resources via rapid spore germination, mycelial extension and branch formation (Cooke and Rayner, 1984).

Species with persistent and moderately hard fruit bodies like *Cellulariella acuta, Ganoderma lucidum, Hexagonia tenuis, Leucophellinus hobsonii, Microporus affinis, Microporus xanthopus, Phellinus gilvus, polyporus* sp. nov., *Schizopora paradoxa, Trametes menziesii, Trametes marianna, Trametes ochracea* and *Trametes pubescens* may passes stress-tolerant strategies proposed by the Cooke and Rayner (1984) and observed during all seasons. S-selected characters are not associated with a particular stage of decomposition but enable individuals to function or survive under stressful conditions that inhibit growth of most organisms (Boddy and Heilmann-Clausen, 2008). They are able to survive in the low water potential and maintained their population more steadily in all seasons. *Ganoderma lucidum, Microporus affinis, Microporus xanthopus* and *Schizopora paradoxa* were found in both wet evergreen and shola forests, which means these species are able to adapt with the wide habitat variations. The polypore communities that grow in Very Fine Wood Debris (VFWD) may be specialized to unstable climatic conditions, high decomposition rates, and high surface area and wood volume ratio i.e. less wood volume per surface area unit (Abrego and Salcedo, 2011). The species like *Microporus xanthopus, Microporus affinis* and *Hexagonia tenuis* found to utilize the low nutrient available small diameter substrates like branches and twigs, highlighting their high stress tolerance capacity. *Cellulariella acuta, Microporus xanthopus* and *Phellinus gilvus* were found in substrates under all stages of decay which indicates their remarkable stress tolerance ability.

The perennial species like *Daedalea dochmia, Fomitopsis feei, Fulvifomes cesatii, Fuscoporia contigua, Fuscoporia ferrea, Fuscoporia senex, Fuscoporia wahlbergii, Ganoderma australe, Inonotus pachyphloeus, Neofomitella rhodophaea, Phellinus dependens, Phellinus fastuosus, Phellinus nilgheriensis* and *Phylloporia pectinata* followed the combative strategies. These species were found mostly in the substrates under decay class 1 and 2. The polypores arriving at previously colonized resources are termed secondary colonisers, and generally exhibit the C-selected characteristics necessary at this stage (Boddy and Heilmann-Clausen, 2008). These species had persistent and long lived fruitbodies and maintained their population more steadily in all seasons with slight increase during the seasons, which indicate their intermittent reproduction and good enzymatic competence (Fig. 25 & 26 based on Table 5-7 & 11-13).

SUMMARY



SUMMARY

The objective of the study was to understand the diversity and distribution of polypores in the wet evergreen and shola forests of Silent Valley National Park in three different seasons. Three permanent sample plots of 100m×100m were established in evergreen forests and three in shola forests as per standard methodology and the details like species composition, host, substrate features like diameter, type and decay class were collected during all the three seasons. The results obtained from the study are summarized below:

1. Fifty seven polypore species belonging to twenty nine genera and seven families were documented from the wet evergreen and shola forests of Silent Valley National Park during this study. Among these, five species (*Inonotus pachyphloeus*, *Phylloporia pectinata*, *Trametes menziesii*, *Trametes ochracea*, *Trametes pubescens*) were new records from Kerala and three species (*Inonotus* sp. nov., *Microporus* sp. nov. and *Polyporus* sp. nov.) were new to science. These species have been described based on the macro and micro morphology. A dichotomous identification key of polypores was also developed.

2. Of the 57 species identified, 52.63 per cent belonged to Polyporaceae and 28.07 per cent belonged to Hymenochaetaceae followed by Fomitopsidaceae and Meripilaceae with 5.26 per cent each. Species belonging to Ganodermataceae and Schizoporaceae contributed to 3.50 per cent each. Species richness of Meruliaceae (1.75 %) was recorded to be the least.

3. Among the polypores documented, 42 species were annuals and the rest were perennials.

4. The rot character analysis proved the dominancy of white rot polypores (91.22 % of the total species) over brown rotter.

5. The wet evergreen forest showed relatively high polypore diversity and richness than that of shola forest with higher Simpson's Index of diversity (0.92) and Margalef Richness Index (3.15). Similarity between polypore communities in the two ecosystems was found to be low during all the seasons.

6. The percentage frequency of occurrence of polypores over three different seasons revealed a remarkable variation in the community structure in both wet evergreen and shola forests. In both the ecosystem, monsoon season showed the highest percentage frequency of polypores.

7. The community structure of polypores during pre monsoon was significantly different from monsoon and post monsoon seasons. This variation was probably due to the fluctuations in the climatic factors such as rainfall, temperature and relative humidity.

8. In wet evergreen forest, *Microporellus obovatus, Favolus tenuiculus, Polyporus grammocephalus, Polyporus leprieurii, Earliella scabrosa, Funalia caperata* and *Ganoderma lucidum* were found to be influenced by rainy season. Whereas species like *Trametes menziesii, Phellinus gilvus*, *Neofomitella rhodophaea Trametes marianna* were intensively linked with monsoon and post monsoon periods.

9. In wet evergreen forest, the distribution of *Daedalea dochmia* was found less affected by seasons and maintained a more or less stable population.

10. In shola forests, species like *Earliella scabrosa, Ganoderma lucidum, Leucophellinus hobsonii* and *Microporellus obovatus* were more influenced by the rainy season while, the perennials like *Phellinus nilgheriensis, Ganoderma australe, Phylloporia pectinata* and *Fuscoporia wahlbergii* were not much influenced by the rainy season.

11. Most of the species showed a drastic reduction in density with increasing altitude. In lower altitude, wet evergreen forest at Sairandhri (1000-1050 m) possessed high species richness (29 species) and it gradually decreased as the altitude increased. The high altitude shola forest at Valliyamkandam (2200-2250 m) showed the lowest species richness (5 species). The degree of dominance and evenness was found to be increased and decreased respectively, along the altitudinal gradient.

12. Species like *Phylloporia pectinata, Fulvifomes cesatii, Leucophellinus hobsonii, Trametes ochracea* and *Trametes pubescens* were recorded only from high altitude shola forest, indicating its environmental tolerance and adaptation to the disturbances.

13. Polypore-host association revealed that, of the 91 tree species under 32 families (both live and dead) 29 tree species (31.87 %) belonging to 16 families were recorded as host for polypores.

14. The highest number of polypore fruitbodies was recorded from Clusiaceae (1629) followed by Elaeocarpaceae (1405), Lauraceae (1252) and Bombacaceae (749).

15. *Mesua ferrea* harboured 1289 fruitbodies which belonged to 13 species followed by *Elaeocarpus tuberculatus* (1028) with 12 species and *Cullenia exarillata* (749) with 8 species.

16. A total number of 434 logs of different sizes belonging to 29 host species were recorded. The highest number of logs were contributed by *Mesua ferrea* (51) followed by *Elaeocarpus tuberculatus* (34) and *Cullenia exarillata* (23). The number of polypores on host trees increased linearly with increase in number of logs.

17. Most of the species were found to be host generalists while, five species showed a possible host preference. *Elaeocarpus tuberculatus* was preferred by polypores like *Inonotus pachyphloeus, Phellinus gilvus* and *Leucophellinus hobsonii* while, *Mesua ferrea* was preferred by *Daedalea dochmia*. Similarly *Phylloporia pectinata* showed preference towards *Cinnamomum sulphuratum*.

18. The distribution of polypores on different substrate type revealed that 48.12 per cent of the total individuals were found on logs followed by 25.56 per cent in branch/twig and 23.33 per cent in snag. The living trees were found to be infested by only 2.98 per cent of total individuals.

19. The maximum species density was recorded on substrates under 31- < 40 cm followed by 21- < 30 cm and 11- < 20 cm while, the substrates under 51- < 60 cm and those above showed the lower polypore densities.

20. Species like *Neofomitella rhodophaea, Phellinus gilvus, Ganoderma australe* were associated with a wide range of diameter class while, species like *Phellinus nilgheriensis, Hexagonia tenuis, Microporus xanthopus* and *Fulvifomes cesatii* were found only on logs with a narrow range of diameter class.

21. Species like *Hexagonia tenuis*, *Microporus xanthopus*, *Microporus affinis* and *Fulvifomes cesatii* showed preference for 0- < 10 cm diameter class. *Schizopora paradoxa* showed preference for the 11-<20 cm diameter class. The diameter class 31-<40 cm was preferred by perennials like *Phellinus gilvus, Phellinus dependens* and *Fuscoporia wahlbergii.* Similarly, two more perennials, *Daedalea dochmia* and *Phellinus nilgheriensis* showed preference for 41-<50 cm diameter class.

22. Decay class association of polypores showed that the intermediate decay stages harboured the maximum both in terms of density and occurrence.

23. During the present study the fleshy and short lived species *Funalia caperata, Earliella scabrosa, Favolus tenuiculus, Microporellus obovatus, Polyporus leprieurii, Spongipellis unicolor* and *Polyporus grammocephalus* followed the ruderal strategies.

24. Polypores like *Cellulariella acuta, Ganoderma lucidum, Hexagonia tenuis, Leucophellinus hobsonii, Microporus affinis, Microporus xanthopus, Phellinus gilvus, Polyporus* sp. nov., *Schizopora paradoxa, Trametes menziesii, Trametes marianna, Trametes ochracea* and *Trametes pubescens* were found to agree with the stress-tolerant strategies.

25. Species like *Daedalea dochmia, Fomitopsis feei, Fulvifomes cesatii, Fuscoporia contigua, Fuscoporia ferrea, Fuscoporia senex, Fuscoporia wahlbergii, Ganoderma australe, Inonotus pachyphloeus, Neofomitella rhodophaea, Phellinus dependens, Phellinus fastuosus, Phellinus nilgheriensis* and *Phylloporia pectinata* were followed the Combative strategies.

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DIVERSITY AND DISTRIBUTION OF POLYPORES IN THE WET EVERGREEN AND SHOLA FORESTS OF SILENT VALLEY NATIONAL PARK, KERALA

By

ADARSH, C. K.

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ABSTRACT

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COLLEGE OF FORESTRY

KERALA AGRICULTURAL UNIVERSITY

VELLANIKKARA, THRISSUR -680 656

KERALA, INDIA

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ABSTRACT

The study was carried out with the objectives to assess the diversity and distribution of polypores in the wet evergreen and shola forests in Silent Valley National Park during three different seasons during 2014-15. An attempt has also been made to find out the effect of substrate features like diameter, type and decay class on the diversity and abundance of polypores. Three fixed size permanent sample plots of 100 m×100 m with subplots of 10 x 10 m were established in three different locations in each ecosystem and these sample plots were enumerated during three different seasons to collect information on influence of seasonal fluctuation in fruitbody production and details on substrate characteristics. Apart from the plot based sampling, opportunistic sampling method was also adopted to maximize the documentation of polypore fungal diversity and distribution.

A total of fifty seven species were recorded from the National Park and among this *Inonotus pachyphloeus*, *Phylloporia pectinata*, *Trametes menziesii*, *Trametes ochracea* and *Trametes pubescens* were the first report from Kerala. Three species (*Inonotus* sp. nov., *Microporus* sp. nov. and *Polypores* sp. nov.) were found to be new to science and these species have been described based on the macro and micro-morphology.

The wet evergreen forest showed relatively high polypore diversity and richness than that of shola forest with higher Simpson's index of diversity (0.92) and Margalef richness index (3.15). Similarity between polypore communities in two ecosystems was found to be low during all the seasons. The peak fruitbody production of the polypores was observed during the monsoon. The altitudinal variation analysis of polypores revealed a monotonic decrease pattern in species richness from lower altitude wet evergreen forests to higher altitude shola forests. The density of many of the polypore species was also found decrease drastically along the altitudinal gradient. The degree of dominance and evenness also showed a trend of increase and decrease respectively, along the altitudinal gradient.

Polypore-host association revealed that, of the 91 tree species under 32 families, 29 tree species (31.87 %) belonging 16 families were hosts to polypores. Among them, *Mesua ferrea* harboured maximum polypores belonging 13 species followed by *Elaeocarpus tuberculatus* with

12 species and *Cullenia exarillata* with 8 species. Most of the polypore were found to be host generalist and only five species showed possible preference for a particular tree species.

Among the substrate types, maximum polypore occurrence was observed on logs followed by branch/twig and snag while, living trees supported only very few polypores. The maximum species richness, density and occurrence has been recorded on substrates under 31- < 40 cm diameter class followed by 21- < 30 cm and 11- < 20 cm. Decay class association of polypores showed that the intermediate decay stages harboured the maximum both in terms of number of species, density and frequency of occurrence. The conceptual framework on primary ecological strategy revealed that polypores exhibits ruderal, combative and stress tolerant behaviours. The present study concluded that the diversity and distribution of polypores are determined by seasonal fluctuations, arborescent floral diversity and substrate features.

APPENDICES

APPENDIX I

Catalogue number of polypore specimens collected from Silent Valley National Park

SI. No.	Species	Catalogue No.
1	*Abortiporus biennis*	ACK 20,44/29-7-2014; ACK 7,12/28-8-2014; ACK 3/9-12-2014; ACK 23/30 -3-2015
2	*Cellulariella acuta*	ACK 2,3/23-5-2014; ACK 53/29-7-2014; ACK 27,49/28-8-2014; ACK 44/19-10-2014; ACK 13,34/9-12-2014; ACK 26/28-2-2015; ACK 30/30-3-2015
3	*Coriolopsis telfairii*	ACK 21/29-7-2014; ACK 1,42/19-10-2014; ACK 1,50/30-3-2015
4	*Cyclomyces setiporus*	ACK 32/23-5-2014; ACK 27/29-7-2014; ACK 20,38/28-8-2014; ACK 2/9-12-2014; ACK 5,14/28-2-2015
5	*Daedalea dochmia*	ACK 1,4,7/23-5-2014; ACK 54/29-7-2014; ACK 29/19-10-2014; ACK 5,25,35/9-12-2014; ACK 1,15/30-1-2015; ACK 16/28-2-2015; ACK 5,13/30-3-2015
6	*Earliella scabrosa*	ACK 1,5/29-7-2014; ACK 13,47/28-8-2014; ACK 6/19-10-2014
7	*Favolus tenuiculus*	ACK 3,7/29-7-2014;ACK 15/28-8-2014;ACK 14/9-12-2014
8	*Fomes extensus*	ACK 34,51/23-5-2014; ACK 40/19-10-2014; ACK 33/9-12-2014; ACK 3/30-1-2015; ACK 27/28-2-2015; ACK 29/30-3-2015
9	*Fomes pseudosenex*	ACK 5,6/23-5-2014; ACK 39,52/28-8-2014; ACK 60/19-10-2014; 26/9-12-2014; ACK 2,24/30-1-2015; ACK 6/30-3-2015
10	*Fomitopsis feei*	ACK 31,33/23-5-2014; ACK 22,45/29-7-2014; ACK 43/19-10-2014; ACK 1,12/9-12-2014; ACK 45/30-1-2015; ACK 15/28-2-2015; ACK 28/30-3-2015
11	*Fomitopsis palustris*	ACK 8/28-8-2014; ACK 24/9-12-2014; ACK 14/30-3-2015

12	*Fulvifomes cesatii*	ACK 39/19-10-2014; ACK 43/30-1-2015; ACK 27/30-3-2015
13	*Funalia caperata*	ACK 29,50/23-5-2014; ACK 50/28-8-2014; ACK 41/19-10-2014; ACK 15/9-12-2014; ACK 2/30-3-2015
14	*Fuscoporia contigua*	ACK 29,41/29-7-2014; ACK 21/28-8-2014; ACK 63/19-10-2014; ACK 17/28-2-2015; ACK 32/30-3-2015
15	*Fuscoporia ferrea*	ACK 30/23-5-2014; ACK 26/29-7-2014; ACK 64/19-10-2014; ACK 44/30-1-2015; ACK 31/30-3-2015
16	*Fuscoporia senex*	ACK 43/29-7-2014; ACK 28/28-8-2014; ACK 61/19-10-2014; ACK 4,19,25/30-1-2015
17	*Fuscoporia wahlbergii*	ACK 46/9-12-2014; ACK 28/30-1-2015; ACK 45/28-2-2015
18	*Ganoderma australe*	ACK 18,20,23/23-5-2014; ACK 53/28-8-2014; ACK 62/ 19-10-2014; ACK 6,23/9-12-2014; ACK 27/30-1-2015; ACK.28/28-2-2015; ACK 7,15,33,49/30-3-2015
19	*Ganoderma lucidum*	ACK 2,6,56/29-7-2014; ACK 1,14/28-8-2014; ACK 5,13,28/19-10-2014
20	*Hexagonia tenuis*	ACK 24,27/23-5-2014; ACK 35,9/28-8-2014; ACK 27,32/9-12-2014; ACK 5,16/30-1-2015; ACK 36,44/28-2-2015; ACK 34,48/30-3-2015
21	*Inonotus luteoumbrinus*	ACK 55/29-7-2014; ACK 45,59/19-10-2014; ACK 26/30-1-2015; ACK 8,18/28-2-2015; ACK 26/30-3-2015
22	*Inonotus pachyphloeus*	ACK 28/23-5-2014; ACK 34/30-1-2015
23	*Inonotus* sp. nov.	ACK 47/28-2-2015
24	*Inonotus tabacinus*	ACK 25/29-7-2014; ACK 29,22/28-8-2014; ACK 14,38/19-10-2014; ACK 22/9-12-2014; ACK 46/30-1-2015
25	*Leucophellinus hobsonii*	ACK 24,33,46/29-7-2014; ACK 46/19-10-2014

26	*Microporellus obovatus*	ACK 4,17/29-7-2014; ACK 2,16,46/28-8-2014; ACK 4,12/19-10-2014; ACK 28/9-12-2014
27	*Microporus affinis*	ACK 16,19,21/23-5-2014; ACK 28,30, 15/29-7-2014; ACK 23/28-8-2014; ACK 54,17, 48,57/19-10-2014; ACK 38,40/9-12-2014; ACK 17,35/30-1-2015; ACK 6,29,39/28-2-2015; ACK 8,25,35/30-3-2015
28	*Microporus* sp. nov.	ACK 46/28-2-2015
29	*Microporus xanthopus*	ACK 17,22,25/23-5-2014; ACK 13,16, 49/29-7-2014; ACK 40,48/28-8-2014; ACK 15,53/19-10-2014; ACK 4,16,36/9-12-2014; ACK 18,36/30-1-2015; ACK 30/28-2-2015; ACK 24,36/30-3-2015
30	*Neofomitella rhodophaea*	ACK 11,12,15/23-5-2014; ACK 14,18/29-7-2014; ACK 22,30/19-10-2014; ACK 37,44, 39,41/9-12-2014; ACK 14/30-1-2015; ACK 21,40/28-2-2015; ACK 9,47/30-3-2015
31	*Nigroporus vinosus*	ACK 39,41/23-5-2014; ACK 31,34/29-7-2014; ACK 16,27/19-10-2014
32	*Phellinus dependens*	ACK 10/28-8-2014; ACK 31/19-10-2014; ACK 29/9-12-2014; ACK 37/30-1-2015; ACK 7/28-2-2015; ACK 23/30-3-2015
33	*Phellinus fastuosus*	ACK 19,35,47/29-7-2014; ACK 19/19-10-2014; ACK 29/30-1-2015; ACK 46/30-3-2015
34	*Phellinus gilvus*	ACK 13/23-5-2014; ACK 31/28-8-2014; ACK 21,32/19-10-2014; ACK 7, 8,21/9-12-2014; ACK 38/30-1-2015; ACK 19,31/28-2-2015; ACK 10,37/30-3-2015
35	*Phellinus nilgheriensis*	ACK 40,42,44/23-5-2014; ACK 52/19-10-2014; ACK 17, 20,31/9-12-2014; ACK 13/30-1-2015; ACK 22,43/28-2-2015; ACK 45/30-3-2015
36	*Phellinus zealandicus*	ACK 14/23-5-2014; ACK 23/29-7-2014; ACK 30,51/28-8-2014; ACK 11,33/19-10-2014; ACK 38/30-3-2015

37	*Phylloporia pectinata*	ACK 45/23-5-2014; ACK 39/30-1-2015; ACK 20,32/28-2-2015; ACK 22/30-3-2015
38	*Polyporus dictyopus*	ACK 43/23-5-2014; ACK 18,26/19-10-2014; ACK 30/30-1-2015
39	*Polyporus grammocephalus*	ACK 8,9/29-7-2014; ACK 3,17, 34/28-8-2014; ACK 7,51/19-10-2014
40	*Polyporus leprieurii*	ACK 10,32/29-7-2014; ACK 5,41/28-8-2014; ACK 3,24/19-10-2014
41	*Polyporus* sp. nov.	ACK 51/30-3-2015
42	*Rigidoporus lineatus*	10,49/ 23-5-2014; ACK 26,36, 19, /28-8-2014; ACK 49,55/19-10-2014; ACK 30/9-12-2014; ACK 10,37/28-2-2015; ACK 21,44/30-3-2015
43	*Rigidoporus microporus*	ACK 36/23-5-2014; ACK 52/29-7-2014; ACK 44/28-8-2014; ACK 12,42/30-1-2015; ACK 42, 34/28-2-2015
44	*Rigidoporus ulmarius*	ACK 42/28-8-2014; ACK 10/9-12-2014; ACK 11/30-1-2015; ACK 43/30-3-2015
45	*Schizopora paradoxa*	ACK 46,49/23-5-2014; ACK 18/9-12-2014; ACK 41/30-1-2015; ACK 24/28-2-2015; ACK 18/30-3-2015
46	*Spongipellis unicolor*	ACK 36,48/29-7-2014; ACK 4,18/28-8-2014; ACK 2,8/19-10-2014
47	*Trametes cingulata*	ACK 42/9-12-2014; ACK 31,40/30-1-2015; ACK 23,33/28-2-2015
48	*Trametes cotonea*	ACK 35/23-5-2014; ACK 38/29-7-2014; ACK 36/19-10-2014; ACK 19/9-12-2014; ACK 7,9/30-1-2015; ACK 4,9/28-2-2015; ACK 3/30-3-2015
49	*Trametes hirsuta*	ACK 24,45/28-8-2014; ACK 56/19-10-2014; ACK 43,45/9-12-2014; ACK 8/30-1-2015; ACK 11/28-2-2015; ACK 19,42/30-3-2015

50	*Trametes Marianna*	ACK 47,48/23-5-2014; ACK 39/29-7-2014; ACK 25/28-8-2014; ACK 23,37, 25/19-10-2014; ACK 10,22,32/30-1-2015; ACK 11,17/30-3-2015
51	*Trametes maxima*	ACK 37,38/23-5-2014; ACK 40/29-7-2014; ACK 32/28-8-2014; ACK 10,35/19-10-2014
52	*Trametes menziesii*	ACK 13/29-7-2014; ACK 43/28-8-2014; ACK 58/19-10-2014 ACK 9/9-12-2014; ACK 21/30-1-2015; 35,38,41/28-2-2015; ACK 41/30-3-2015
53	*Trametes ochracea*	ACK 1,13/28-2-2015; ACK 20,40/30-3-2015
54	*Trametes pubescens*	ACK 20/19-10-2014; ACK 3/28-2-2015
55	*Trametes versicolor*	ACK 51/29-7-2014; ACK 33,37/28-8-2014; ACK 47/19-10-2014; ACK 33/30-1-2015; ACK 2,12/28-2-2015; ACK 12,16,39/30-3-2015
56	*Trichaptum biforme*	ACK 8/23-5-2014; ACK 12,50/29-7-2014; ACK 50/19-10-2014; ACK 11/9-12-2014; ACK 6,20/30-1-2015; ACK 4/30-3-2015
57	*Trichaptum byssogenum*	ACK 9/23-5-2014; ACK 11,37/29-7-2014; ACK 6,11/28-8-2014; ACK 9,34/19-10-2014; ACK 25/28-2-2015

APPENDIX II

List of polypore identified from Silent Valley National park and their Synonym as per older reports

Sl. No.	Family /Species with current accepted name	Synonym as per older reports	Reference	Status
I	**FOMITOPSIDACEAE**			
1	*Daedalea dochmia* (Berk. & Broome) T. Hatt.	*Fomitopsis dochmius* (Berk. & Br.) Ryv.	Leelavathy and Ganesh (2000)	Known from Kerala
2	*Fomitopsis feei* (Fr.) Kreisel	*Fomitopsis feei* (Fr.) Kreisel	Leelavathy and Ganesh (2000)	"
3	*Fomitopsis palustris* (Berk. & M.A. Curtis) Gilb. & Ryvarden	*Fomitopsis palustris* (Berk. & M.A. Curtis) Gilb. & Ryvarden	Leelavathy and Ganesh (2000)	"
II	**GANODERMATACEAE**			"
4	*Ganoderma australe* (Fr.) Pat.	*Ganoderma australe* (Fr.) Pat.	Leelavathy and Ganesh (2000)	"
5	*Ganoderma lucidum* (Curtis) P. Karst.	*Ganoderma lucidum* (Curtis) P. Karst.	Leelavathy and Ganesh (2000)	"
III	**HYMENOCHAETACEAE**			"
6	*Cyclomyces setiporus* (Berk.) Pat.	*Cyclomyces setiporus* (Berk.) Pat.	Leelavathy and Ganesh (2000)	"
7	*Fulvifomes cesatii* (Bres.) Y.C. Dai,	*Fulvifomes cesatii* (Bres.) Y.C. Dai,	Leelavathy and Ganesh (2000)	"
8	*Fuscoporia contigua* (Pers.) G. Cunn.	*Phellinus contiguous* (Pers. Ex. Fr.) Pat.	Leelavathy and Ganesh (2000)	"
9	*Fuscoporia ferrea* (Pers.) G. Cunn.	*Phellinus ferreus* (Pers.) Bourd. & Galzin	Leelavathy and Ganesh (2000)	"
10	*Fuscoporia senex* (Nees & Mont.) Ghob.-Nejh.	*Phellinus senex* (Nees & Mont.) Imaz.	Leelavathy and Ganesh (2000)	"
11	*Fuscoporia wahlbergii (Fr.) T. Wagner & M. Fisch.*	*Phellinus wahlbergii* (Fr.) Reid.	Leelavathy and Ganesh (2000)	
12	*Inonotus luteoumbrinus* (Romell) Ryvarden	*Phellinus sublinteus* (Murr.) Ryv.	Leelavathy and Ganesh (2000)	"

13	*Inonotus pachyphloeus* (Pat.) T. Wagner & M. Fisch.	*Fomes pachyphloeus* (Pat.) Bres.	Bakshi (1971)	New from Kerala
14	*Inonotus* sp. nov.			New species
15	*Inonotus tabacinus* (Mont.) G. Cunn.	*Cyclomyces tabacinus* (Mont.) Pat.	Leelavathy and Ganesh (2000)	"
16	*Phellinus dependens* (Murrill) Ryvarden	*Phellinus dependens* (Murrill) Ryvarden	Leelavathy and Ganesh (2000)	"
17	*Phellinus fastuosus* (Lév.) S. Ahmad	*Phellinus fastuosus* (Lév.) S. Ahmad	Leelavathy and Ganesh (2000)	"
18	*Phellinus gilvus* (Schwein.) Pat.	*Phellinus gilvus* (Schwein.) Pat.	Leelavathy and Ganesh (2000)	"
19	*Phellinus nilgheriensis* (Mont.) G. Cunn.	*Phellinus nilgheriensis* (Mont.) G. Cunn.	Leelavathy and Ganesh (2000)	"
20	*Phellinus zealandicus* (Cooke) Teng	*Fomes zealandicus* (Cooke) Cooke	Bakshi (1971)	"
21	*Phylloporia pectinata* (Klotzsch) Ryvarden	*Fomes pectinatus* (Klotzsch) Gill.	Bakshi (1971)	New from Kerala
IV	**MERIPILACEAE**			"
22	*Rigidoporus lineatus* (Pers.) Ryvarden	*Polyporus zonalis* Berk.	Bakshi (1971)	"
23	*Rigidoporus microporus* (Sw.) Overeem	*Rigidoporus microporus* (Sw.) Overeem	Leelavathy and Ganesh (2000)	"
24	*Rigidoporus ulmarius* (Sowerby) Imazeki	*Rigidoporus ulmarius* (Sowerby) Imazeki	Leelavathy and Ganesh (2000)	"
V	**MERULIACEAE**			
25	*Abortiporus biennis* (Bull.) Singer	*Abortiporus biennis* (Bull.) Singer	Leelavathy and Ganesh (2000)	
VI	**POLYPORACEAE**			"
26	*Cellulariella acuta* (Berk.) Zmitr. & V. Malysheva	*Lenzites acuta* Berk.	Leelavathy and Ganesh (2000)	"
27	*Coriolopsis telfairii* (Klotzsch) Ryvarden 1972	*Coriolopsis telfairii* (Klotzsch) Ryvarden 1972	Leelavathy and Ganesh (2000)	"
28	*Earliella scabrosa* (Pers.) Gilb. & Ryvarden	*Trametes scabrosa* (Pers.) G.H. Gunn.	Leelavathy and Ganesh (2000)	"
29	*Favolus tenuiculus* P. Beauv.	*Favolus brasiliensis* (Fr.) Fr.	Leelavathy and Ganesh (2000)	"

30	*Fomes extensus* (Lév.) Cooke	*Phellinus troyanus* (Murr.) Bondartseva & S. Herrera	Leelavathy and Ganesh (2000)	
31	*Fomes pseudosenex* (Murrill) Sacc. & Trotter	*Phellinus pseudosenex* (Murr.) Bond. & Herr.	Leelavathy and Ganesh (2000)	"
32	*Funalia caperata* (Berk.) Zmitr. & V. Malysheva	*Coriolopsis caperata* (Berk.) Murrill	Leelavathy and Ganesh (2000)	"
33	*Hexagonia tenuis* (Hook.) Fr.	*Hexagonia tenuis* (Hook.) Fr.	Leelavathy and Ganesh (2000)	"
34	*Microporellus* obovatus (Jungh.) Ryvarden	*Microporellus* obovatus (Jungh.) Ryvarden	Leelavathy and Ganesh (2000)	"
35	*Microporus* affinis (Blume & T. Nees) Kuntze	*Microporus* affinis (Blume & T. Nees) Kuntze	Leelavathy and Ganesh (2000)	"
36	*Microporus* sp. nov.			New species
37	*Microporus xanthopus* (Fr.) Kuntze	*Microporus xanthopus* (Fr.) Kuntze	Leelavathy and Ganesh (2000)	Known from Kerala
38	*Neofomitella rhodophaea* (Lév.) Y.C. Dai	*Fomitopsis rhodophaea* (Lev.) Imaz.	Leelavathy and Ganesh (2000)	"
39	*Nigroporus vinosus* (Berk.) Murrill	*Nigroporus vinosus* (Berk.) Murrill	Leelavathy and Ganesh (2000)	"
40	*Polyporus dictyopus* Mont.	*Polyporus dictyopus* Mont.	Leelavathy and Ganesh (2000)	"
41	*Polyporus grammocephalus* Berk.	*Polyporus grammocephalus* Berk.	Leelavathy and Ganesh (2000)	"
42	*Polyporus leprieurii* Mont.	*Polyporus leprieurii* Mont.	Ryvarden and Gilbertson (1993)	"
43	*Polyporus* sp. nov.			New species
44	*Spongipellis unicolor* (Fr.) Murrill	*Polyporus obtusus* Berk.	Bakshi (1971)	
45	*Trametes cingulata* Berk.	*Trametes cingulata* Berk.	Leelavathy and Ganesh (2000)	Known from Kerala
46	*Trametes cotonea* (Pat. & Har.) Ryvarden	*Trametes cotonea* (Pat. & Har.) Ryvarden	Leelavathy and Ganesh (2000)	"
47	*Trametes hirsuta* (Wulfen) Lloyd	*Trametes hirsuta* (Wulfen) Lloyd	Leelavathy and Ganesh (2000)	"
48	*Trametes marianna* (Pers.) Ryvarden	*Trametes marianna* (Pers.) Ryvarden	Leelavathy and Ganesh (2000)	"
49	*Trametes maxima* (Mont.) A. David & Rajchenb.	*Irpex maximus* (Mont.)	Bakshi (1971)	"
50	*Trametes menziesii* (Berk.) Ryvarden	*Polyporus thwaitesii* Berk. And Br.	Bakshi (1971)	New from Kerala

51	*Trametes ochracea* (Pers.) Gilb. & Ryvarden	*Polyporus zonatus* (Nees) Fries	Bakshi (1971)	New from Kerala
52	*Trametes pubescens* (Schumach.) Pilát	*Polyporus velutinus* Fries	Bakshi (1971)	New from Kerala
53	*Trametes versicolor* (L.) Lloyd	*Trametes versicolor* (L.) Lloyd	Ryvarden and Gilbertson (1993) , Mohanan (2011)	Known from Kerala
54	*Trichaptum biforme* (Fr.) Ryvarden	*Trichaptum biforme* (Fr.) Ryvarden	Leelavathy and Ganesh (2000)	"
55	*Trichaptum byssogenum* (Jungh.) Ryvarden	*Trichaptum byssogenum* (Jungh.) Ryvarden	Bakshi (1971)	"
VI	**SCHIZOPORACEAE**			
56	*Leucophellinus hobsonii* (Berk. ex Cooke) Ryvarden	*Oxyporus mollissimus* (Pat.) Ried.	Leelavathy and Ganesh (2000)	"
57	*Schizopora paradoxa* (Schrad.) Donk	*Poria versipora* (Pers.) Rom.	Bakshi (1971)	"