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Diversity and distribution of macrofungi in Khadimnagar National Park, Sylhet, Bangladesh

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The study was carried out to identify and quantify the diversity and distribution of macrofungi in Khadimnagar National Park, a protected area in the north-eastern region of Bangladesh. A total of 29 fungal species, belonging to 23 genera under 16 families, were recorded and identified. Polyporaceae was the most dominant family with 12 fungal species. *Lentinus tigrinus*, *Fomes lamaoensis* and *Phallus indusiatus* were the most abundant species,with an abundance of 5.00. *Microporus xanthopus* was the most frequent species,with frequency and relative frequency of 38% and 14.39%, respectively. The Simpson diversity index (0.95) and Shannon-Wiener index (3.18) indicated a high level of fungal diversity in the study area. Furthermore, the species richness index (5.06), species evenness index (0.94), and species diversity index (0.11)indicated that macro fungi were almost evenly distributed across the study area.The study under scores the need for further research on the diversity and distribution of these ecologically important components in other protected areas of Bangladesh, as they contribute substantially to maintaining the health and functionality of the forest ecosystem.

Keywords : Mycorrhiza, parasite, saprophyte, wood-decay fungi

INTRODUCTION

Macrofungiare among the primary agents of biological degradation inforest ecosystems and are divided into three classes: saprophytes, parasites, and symbionts.Most macrofungi are saprobes or mycorrhizal symbionts, while a few cause plant diseases.Saprobes or plant pathogens are generally found to develop on woody substrates (Kinge *et al*. 2017). Mycorrhizae, an important association of fungi with tree roots, help to take nutrients and water and protect tree roots against pathogenic fungi and nematodes (Ostry *et al*. 2011). Wood-decay fungi are among the most important decomposers in forests, producing spores, generally annual or perennial, that can be found on the stems of dead and living trees. They feed on suitable cell wall materials, such as cellulose and lignin, for their own growth, thereby degrading wood's mechanical properties and aesthetic value (Ador *et al*. 2024). Despite having a considerable ecological influence, only 6.7% of the 1.5 million macrofungi have been identified globally.

Although the tropical region harbours the greatest diversity of such fungi, it is rarely evaluated for its fungal diversity (Vabeikhokhei *et al*. 2019).In Bangladesh, a few studies have been conducted on macrofungal communities in different parks, forests, and protected areas (Ador *et al*. 2023; Das and Aminuzzaman, 2017; Marzana *et al*. 2018; Rashid *et al*. 2016; Rumainul and Aminuzzaman, 2016; Tanjim *et al*. 2019; Tanni *et al*. 2020).To the best of our knowledge, no studies have been conducted on such fungi in Khadimnagar National Park (KNP) of Bangladesh. Therefore, the present study was carried out to identify and determine the diversity and distribution of macrofungi in KNP, Sylhet, Bangladesh.

MATERIALS AND METHODS

Study area

The study was conducted in Khadimnagar National Park, located in Karimnagar Union of

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Sylhet Sadar Upazila (sub-district) and Fatehpur Union of Guainghat Upazila (sub-district) in Sylhet district, Bangladesh (Fig.1).

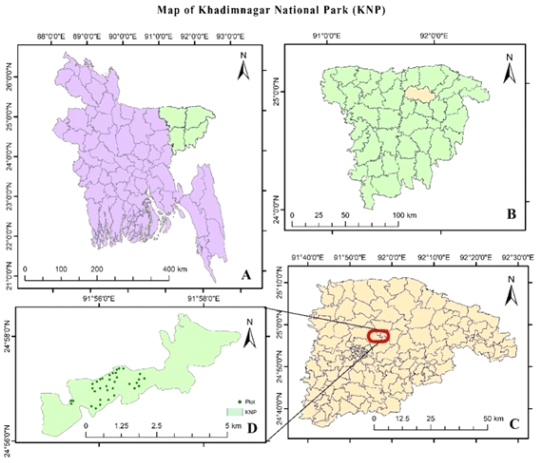

Fig 1: Map showing the locations of the study area: A. Bangladesh; B. Sylhet division; C. Sylhet district; D. Khadimnagar National Park

The study site covers approximately 678.80 hectares and is located between 24°56' and 24°58' N latitude and 91°55' and 91°59' E longitude.KNP is characterized by floristic diversity, with 74 plant and 83 animal species, and was declared areserve forest in 1957 and a national park in 2006. KNP experiences a tropical climate with distinct wet and dry seasons. The annual average temperature of KNP ranges between 18.9°C and 30.7°C, with an average annual rainfall of 3,400mm, which is very frequent between June and September. In general, the geography is undulating, with slopes and hillocks ranging from 10 to 50 meters (Redowan *et al*. 2014; Sobuj and Rahman, 2011).

Sampling design, sample collection and preservation

Adaptive plot-based sampling following the methodology of Prayudi *et al*. (2019) was carried out, and fungal samples were collected between September and December 2021 from 50 circular plots of ~5m radius, including a couple of 2m transects each.Fungal fruiting bodies were collected from dead logs, living trees, and soil using a sharp knife, placed in air-tight polyethylene bags, and brought to the laboratory. Photographs of each fungal specimen were taken using a digital camera. The collected samples were properly labelled, air-dried and preserved under low humidity for further examination. Specimens were deposited atthe Mycology and Forest Pathology laboratory of Shahjalal University of Science and Technology, Sylhet, Bangladesh.

Identification of macrofungi

Morphological features of collected fungal samples were examined under a light microscope. Fungal samples were identified by examining their macroscopic features, including fruiting bodies, cap size and shape, cap colour and margin, and gills, pores, and features of stipes. Identification of the specimens were performed by comparing them with literature data using MycoBank and Index Fungorum.Scientific journals, books and field guides (Ador *et al*. 2023; Cabral *et al*. 2019; Das *et al*. 2017; Ginns, 2017; Kakde and Gaikwad, 2014; Ostry *et al*. 2011; Prasad, 2016; Rashid *et al*. 2016; Tanjim *et al*. 2019; Tanni *et al*.2020; Vabeikhokhei *et al*. 2019; Villegas *et al*. 2016), online resources (https://www.mushroo-mexpert.com/;https://firstnature.com/; https://www.indiabiodiversity.org/), and expert opinions were used for the identification of fungi.

Diversity study of Macrofungi

Frequency (F) was determined through the percentage of sample plots in whicha species was found, and the total number of sample plots. Relative Frequency (RF) was calculated through the percentage proportion of the frequency of a given species,and the total frequencies of all species. Density (D) was determined as the percentage of the total number of individuals of a given species relative to the total number of sample plots studied. Relative Density (RD) was calculated through the percentage proportion of the total number of individuals of a given species, and the total number of individuals of all species. Abundance was determined through the proportion of the total number of individuals of a given species and the total number of sample plots in which the species occurred.

A diversity index is a quantitative metric that computes the distributional equality and variance of species within a particular system. The

Shannon-Wiener Index (H) (Eq. 1), Simpson Diversity Index (D) (Eq. 2), Species Diversity Index (SDI) (Eq. 3), Species Richness Index (R) (Eq. 4) and Species Evenness Index (E) (Eq. 5) were calculated following the methodology as described by Ador *et al*. (2023).

The following are the formulas for the indices stated above :

$$H = \sum_{i=1}^{S} \text{pi} \ln pi \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$D = 1 - \sum_{i=1}^{S} pi^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$SDI = \frac{S}{N} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$R = \frac{S-1}{lnN} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$E = \frac{H}{lnS} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Here, *S* is the total number of species; *N* is the total number of individuals of all species; *I* is the number of individuals of each species; and *pi* is the number of individuals of each species divided by the total number of individuals of all species.

RESULTS

Identification of fungi

A total of 29 macrofungi (Fig.2) belonging to 23 genera and distributed across 16 families have been identified (Table 1). A detailed enumeration and description of macrofungiare provided in Table 1.

The genera identified were *Amanita*, *Antrodia*, *Auricularia*, *Boletus*, *Calocera*,*Clavariadelphus*, *Coprinus*, *Coprinopsis*, *Daldinia*, *Fomes*, *Ganoderma*, *Lentinus*, *Lenzites*, *Marasmius*, *Microporus*, *Phallus*, *Polyporus*, *Polystictus*, *Schizophyllum*, *Spongipellis*, *Tubaria*, *Trametes*, and *Volvariella* (Table 1). Among the genera, *Trametes* was the most abundant with 3 species. *Polyporus*, *Fomes*, *Ganoderma*, and *Marasmius*each included 2 species, while other genera contained only 1 species.The identified fungi belonged to 16 families, including Agaricaceae, Amanitaceae, Auriculariaceae, Boletaceae, Clavariadelphaceae, Dacrymycetaceae, Ganodermataceae, Hypoxylaceae, Marasmiaceae, Meripilaceae, Phallaceae, Pluteaceae, Polyporaceae, Psathyrellaceae, Schizophyllaceae, and Tubariaceae (Table 1).

Polyporaceae was the most abundant family with 12 species,whereas Ganoder mataceae and Marasmiaceae had 2 species each;the remaining families had only one species each.Among the macrofungi, 13 species originated from soil, litter, and woody debris lying on the ground, seven species on dead branches, and the woody debris of Muli Bamboo (*Melocanna baccifera*) (Table 1). Mahogany (*Swietenia mahagoni*) hosted about three fungal species. Garjan (*Dipterocarpus turbinatus*), Akashmoni (*Acacia auriculiformis*), and Chickrashi (*Chukrasia tabularis*) each hosted approximately 2 fungal species, while Jarul (*Lagerstroemia speciosa*), Teak (*Tectona grandis*), Koroi (*Albizia procera*), and Debdaru (*Polyalthia longifolia*) hosted one species each (Table1).

Diversity and distribution of macrofungi

Quantitative Status

Lentinus tigrinus, Fomes lamensis,and *Phallus indusiatus* were the most abundant species, with an abundance of 5.00. *F. pachyphlocus, Ganoderma lucidum, Daldiniaconcentrica, Tubariafurfuracea,* and *Spongipellis delectans* exhibited an abundance of 4.00. In contrast,*Microporus xanthopus, Polyporus tulipiferae, Antrodia albida*, and *Coprinopsis lagopus* had the lowest abundance of 1.32, 1.42, 1.44, and 1.44, respectively. The highest frequency (38.00%) and relative frequency (14.39%) were observed for *M. xanthopus,* followed by *L. betulina* and *Polyporus tulipiferae* (Table 2). *L. tigrinus, F. lamensis, F. pachyphlocus, G. lucidum, D. concentrica, P. indusiatus, T. furfuracea*, and *S.delectans* were recorded with the lowest frequency (2.00%) and relative frequency (0.76%). *M. xanthopus* had the highest density (50.00%) and relative density (9.84%). On the contrary,*Schizophyllum commune, Trametes pubescens, S. delectans, Marasmius capillaris,T. furfuracea*, and *P. indusiatus* showed the lowest density (8.00%) and relative density (1.57%) each (Table 2).

Fig. 2: Macrofungi species recorded from the different locations of the study area:(a) *Microporus xanthopus,* (b) *Polystictus sanguineus,* (c) *Amanita vaginata,* (d) *Auricularia cornea,* (e) *Coprinopsis lagopus,* (f) *Lentinus tigrinus,* (g) *Polyporus alveolaris,* (h) *Fomes lamaoensis,* (i) *Fomes pachyphloeus,* (j) *Ganoderma applanatum,* (k) *Ganoderma lucidum,* (l) *Trametes lactinea,* (m) *Lenzites betulina,* (n) *Daldinia concentrica,* (o) *Calocera cornea,* (p) *Volvariella hypopithys,* (q) *Clavariadelphus occidentalis,* (r) *Trametes versicolor,* (s) *Coprinus* sp., (t) *Boletus* sp., (u) *Polyporus tulipiferae,* (v) *Marasmius siccus,* (w) *Antrodia albida,* (x) *Phallus indusiatus,* (y) *Tubaria furfuracea,* (z) *Marasmius capillaris,* (i) *Spongipellis delectans,* (ii) *Trametes pubescens,* and (iii) *Schizophyllum commune.*

Table 1. Morphological features of the macrofungi collected from Khadimnagar National Park (KNP), Sylhet, Bangladesh, including their common names, scientific names, family names and hosts

Common name	Scientific name	Family name	Host	Morphological features
Yellow-footed polypore	*Microporus xanthopus* (Fr.) Kuntze (Fig. 2a)	Polyporaceae	Dead woody debries	It is a saprophytic fungus that grows on decaying logs, dead wood, and stumps. The thin (0.1 cm to 0.3 cm thick) funnel-shaped caps of mature fruiting bodies were concentrically zoned in various colours of brown, generally with a light, wavy edge. The caps were up to 15 cm wide.
Blood red bracket	*Polystictus sanguineus* f. *lactescens* Henn. (Fig. 2b)	Polyporaceae	Dead Muli Bamboo (*Melocanna baccifera*)	It is a wood-rotting fungus commonly grows on dead or decaying wood. The fruiting body was 4 cm × 2 cm. It had a thin, dry conk with a lateral connection to the substrate, was vibrant orange on all sides with concentric zonation, and had minute pores on the underside.
Grisette	*Amanita vaginata* (Bull.) Lam. (Fig. 2c)	Amanitaceae	Soil	It is an edible mushroom fungus and ectomycorrhizal species. It was convex, with a central ridge, and greyish brown, with a heavily lined margin. The gills were short, close or crowded; the gills were white. The fruiting body was 10 cm × 15 cm.
Wood ear	*Auricularia cornea* Ehrenb.(Fig. 2d)	Auriculariaceae	Woody debris of Akashmoni (*Acacia auriculiformis*)	It is an edible jelly fungus and is primarily a saprophyte. The fungus species is also a weak parasite. The exterior was thickly coated with small hairs, while the inside was brown with a whitish-grey bloom. The fruiting body was 10 cm × 4 cm and was squeezed into a small stalk.
Hare's foot Inkcap	*Coprinopsis lagopus* (Fr.) Redhead, Vilgalys & Moncalvo (Fig. 2e)	Psathyrellaceae	Soil, leaf litter, woodchip mulch	It is a mushroom like fungus that grows in groups on soil, wood chips, compost and a saprophytic species. The cap was egg-shaped and was coated in transitory fuzzy white scales. The fruiting body was 3 cm × 7 cm and greyish-white in colour. They had no ring and were white with transitory white scales.
Tiger sawgill fungi	*Lentinus tigrinus* (Bull.) Fr. (Fig. 2f)	Polyporaceae	Dead branches and soil	It is a wood-decaying mushroom species. The fruiting body was 5 cm × 2 cm. The cap was white with brown spots on the upper side. They were found in a cluster.
Hexagonal-pored polypore	*Polyporus alveolaris* (DC.) Bondartsev & Singer (Fig. 2g)	Polyporaceae	Dead branches of Akashmoni (*Acacia auriculiformis*)	It is a wood-decaying fungus that grows on dead hardwood species. The fruiting body was 8 cm × 3.6 cm, growing on deadwood. The Fruiting Body was reddish yellow to orangish in colour. The pore surface became pale to yellowish white as it descended towards the stem.

-	*Fomes lamaoensis* (Murrill) Sacc. & Trotter (Fig. 2h)	Polyporaceae	Mahogany (*Swietenia mahagoni*), Jarul (*Lagerstroemia speciosa*), Segun (*Tectona grandis*)	It is a wood- decay fungus. It is also known as plant pathogen causing diseases on agricultural crops including tea plants.The upper surface was plain, with some darker brown spots. The lower surface had very small, rounded pores. The colour of the fruiting body was lighter brown. The fruiting body was 5 cm × 4.2 cm.
-	*Fomes pachyphloeus* (Pat.) Bres. (Fig. 2l)	Polyporaceae	Mahogany (*Swietenia mahagoni*)	It is a wood-rotting saprophytic fungus and also a parasite that attacks living trunks of angiosperm trees.The fruiting body was 6 cm × 4.5 cm, and the colour was pale brown to deep brown. The upper surface was very smooth and conta ined some darker, large, rounded spots. The lower surface was very rough, with some semi -circular lines and darker spots.
Artist's conk	*Ganoderma applanatum* (Pers.) Pat. (Fig. 2J)	Ganodermataceae	Mahogany (*Swietenia mahagoni*)	It is mainly a saprophytic fungus but sometimes acts as a parasite. The fruiting body was self-similar and grew on dead wood with a pseudo-stipe. The cap was 5.6 cm×3.3 cm and grey in colour; the lower surface was white in colour. The fruiting body was dry, woody, and brittle.
Lingzhi mushroom	*Ganoderma lucidum* (Curtis) P. Karst. (Fig. 2K)	Ganodermataceae	Debdaru (*Polyalthia longifolia*), Chickrashi (*Chukrasia tabularis*)	It is an ediblemushroom having the characteristics of both saprophyte and parasite.The fruiting body was 7.5 cm × 6.4 cm. The margin was curved and smooth, with no stipe. Pileus was kidney- or funnel-shaped and umbilicate.
-	*Trametes lactinea*(Berk.) Berk. & Cooke (Fig. 2l)	Polyporaceae	Muli Bamboo (*Melocanna baccifera*)	It is a wood-decaying polypore fungus. The fruiting body was 2.8 cm×6.2 cm. On decaying wood, saprobic. The cap's surface was a creamy white colour. The entire margin was thick. The pore surface was white in tone and had tiny angular pores. The fruiting body was thick and woody.
The Gilled Polypore	*Lenzites betulina* (L.) Fr. (Fig. 2m)	Polyporaceae	Dead Muli Bamboo (*Melocanna baccifera*)	It is a saprophytic fungus causes decay on hardwood deadwood. The fruiting body was semicircular, irregularly bracket-shaped, densely hairy, and had radially bumpy or ridge d texture zones with whitish, greyish, and brownish colour zones. The cap was 10 cm × 4.5 cm, and the gills were pale.
King Alfred's Cake	*Daldinia concentrica*(Bolton) Ces. & De Not. (Fig. 2n)	Hypoxylaceae	Woody debris, Forest floor	It is an inedible saprobic fungus that grows on dead and decaying wood. It was dark Brown. Stipes were not prominent. The cap was 5 cm × 2 cm.

Jelly fungus	*Calocera cornea* (Batsch) Fr. (Fig. 2O)	Dacrymycetaceae	Woody debris	It is a yellow jelly like saprophytic fungus that gr ows on dead and decaying organic matter.The fruiting body was cylindrical, with rounded to sharpened tips and a shallow fork. It was silky and fluid, with a bright orange-yellow colour. The fruiting body was 2 cm × 0.3 cm.
Paddy straw mushroom	*Volvariella hypopithys* (Fr.) M.M. Moser (Fig. 2P)	Pluteaceae	Litter and soil	It is a saprophytic mushroom like fungus.The fruiting body was brownish-white, measuring 5.4 cm × 3.2 cm. Pileus colour was brownish. The texture of the fruiting body was soft, and the gi ll colour was light brown.
Club coral	*Clavariadelphus occidentalis* Methven (Fig. 2Q)	Clavariadelphaceae	Soil	It is a mycorrhizal fungus and does not attack any living tree or feed on dead or decaying organic matter. The fruiting body was creamy-coloured and 4cm × 2.2 cm. The spore-bearing surface stayed underneath the cap's ridges. The fruiting body texture was rough, and the odour was unpleasant.
Turkey tail	*Trametes versicolor* (L.) Lloyd (Fig. 2R)	Polyporaceae	Muli Bamboo (*Melocanna baccifera*)	It is primarily a saprophytic fungus. However, sometimes acts as a parasite.The fruiting body was yellow and 9.8cm× 4.2cm. The texture was rough, and the odour was unpleasant. The veil was likewise missing, as was the stipe.
Lawyer's wig	*Coprinus* sp. (Fig. 2S)	Agaricaceae	Soil	It is a genus which includes mushroom-forming saprophytic fungi. The basidiocarp was 8 cm × 3.5 cm. The fruiting body was grey, soft, and unpleasantly odoured. The gill colour was pale black, and the gill spacing was close. Stipe was present.
Penny bun	*Boletus* sp. (Fig. 2T)	Boletaceae	Soil	It is a genus of mushroom forming fungi which includes mycorrhizal species.The fruiting body was 5.6cm × 4.2 cm. Margin was thin throughout. The upper section of the pileus was white, while the lower portion was light brown. The cap had a bell-shaped design with a smooth circular edge.
Milk-white toothed polypore	*Polyporus tulipiferae* (Schwein.) Overh. (Fig. 2U)	Polyporaceae	Muli Bamboo (*Melocanna baccifera*)	It is a saprophytic fungus that feeds on dead and decaying hardwood branches.The fruiting body was whiteish-brown. It had a crust-like surface. The surface was flat to the substrate, and the pores were breaking into teeth.
Orange pinwheel	*Marasmius siccus* (Schweinitz) Fries (Fig. 2V)	Marasmiaceae	Soil, litter, Dead branches of koroi (*Albizia procera*)	It is mushroom like saprophytic fungus. The fruiting body was 3.8 cm × 1.2 cm in size. Pileus had a brick-red tint. The cap was ovate, with a crenate margin. The hat had a fleshy red scale on it. The underside of the cap was regularly formed, with bright, brick red colored gills.

Jelly fungus	*Calocera cornea* (Batsch) Fr. (Fig. 2O)	Dacrymycetaceae	Woody debris	It is a yellow jelly like saprophytic fungus that gr ows on dead and decaying organic matter.The fruiting body was cylindrical, with rounded to sharpened tips and a shallow fork. It was silky and fluid, with a bright orange-yellow colour. The fruiting body was 2 cm × 0.3 cm.
Paddy straw mushroom	*Volvariella hypopithys* (Fr.) M.M. Moser (Fig. 2p)	Pluteaceae	Litter and soil	It is a saprophytic mushroom like fungus.The fruiting body was brownish-white, measuring 5.4 cm × 3.2 cm. Pileus colour was brownish. The texture of the fruiting body was soft, and the gill colour was light brown.
Club coral	*Clavariadelphus occidentalis* Methven (Fig. 2q)	Clavariadelphaceae	Soil	It is a mycorrhizal fungus and does not attack any living tree or feed on dead or decaying organic matter. The fruiting body was creamy-coloured and 4 cm × 2.2 cm. The spore-bearing surface stayed underneath the cap's ridges. The fruiting body texture was rough, and the odour was unpleasant.
Turkey tail	*Trametes versicolor* (L.) Lloyd (Fig. 2r)	Polyporaceae	Muli Bamboo (*Melocanna baccifera*)	It is primarily a saprophytic fungus. However, sometimes acts as a parasite.The fruiting body was yellow and 9.8cm× 4.2cm. The texture was rough, and the odour was unpleasant. The veil was likewise missing, as was the stipe.
Lawyer's wig	*Coprinus* sp. (Fig. 2s)	Agaricaceae	Soil	It is a genus which includes mushroom-forming saprophytic fungi. The basidiocarp was 8 cm × 3.5 cm. The fruiting body was grey, soft, and unpleasantly odoured. The gill colour was pale black, and the gill spacing was close. Stipe was present.
Penny bun	*Boletus* sp. (Fig. 2t)	Boletaceae	Soil	It is a genus of mushroom forming fungi which includes mycorrhizal species.The fruiting body was 5.6 cm × 4.2 cm. Margin was thin throughout. The upper section of the pileus was white, while the lower portion was light brown. The cap had a bell-shaped design with a smooth circular edge.
Milk-white toothed polypore	*Polyporus tulipiferae* (Schwein.) Overh. (Fig. 2u)	Polyporaceae	Muli Bamboo (*Melocanna baccifera*)	It is a saprophytic fungus that feeds on dead and decaying hardwood branches.The fruiting body was whiteish-brown. It had a crust-like surface. The surface was flat to the substrate, and the pores were breaking into teeth.
Orange pinwheel	*Marasmius siccus* (Schweinitz) Fries (Fig. 2v)	Marasmiaceae	Soil, litter, Dead branches of koroi (*Albizia procera*)	It is mushroom like saprophytic fungus. The fruiting body was 3.8 cm × 1.2 cm in size. Pileus had a brick-red tint. The cap was ovate, with a crenate margin. The hat had a fleshy red scale on it. The underside of the cap was regularly formed, with bright, brick red colored gills.

-	*Antrodia albida* (Fr.) Donk (Fig. 2w)	Meripilaceae	Garjan (*Dipterocarpus turbinatus*)	It is a saprophytic fungus that grows on branches and trunks of deciduous trees. Annual, pileate, reflexed, or effuse basidiomata were observed. The pileus was strong and roughly 3 cm broad. Pileus had a white to cream - coloured surface.
Veiled lady mushroom	*Phallus indusiatus* Vent (Fig. 2x)	Phallaceae	Soil	It is a saprophytic fungus commonly known as bamboo mushroom. They had a spongy, white stem with a hood with coloured section ends. The height of the fruiting body was up to 25 cm. It had an indusium, a lacy white skirt, which was almost touching the ground as it hung from the cap. Indusia were puffy and white.
Scurfy twiglet	*Tubaria furfuracea* (Pers.) Gillet (Fig. 2y)	Tubariaceae	Muli Bamboo (*Melocanna baccifera*) debris	It is a saprophytic fungus commonly known as scurfy twiglet. The cap was convex and nearly flat at the margin, measuring 4 cm wide. The edge was striate e, and veil pieces frequently adhered to it. The stipe was 5 cm in height. The stipe was dingy buff-brown and covered in cottony white mycelium.
Agaric fungus	*Marasmius capillar is* Morgan (Fig. 2z)	Marasmiaceae	Wood and litter debris	It is a tiny saprophyti c fungus that is found on fallen wood and hardwood leaves.The fruiting body was 3.8 cm×1.2 cm. Pileus had a brick -red tint. The cap was ovate, with a crenate margin. The underside of the cap was regularly formed, with bright brick-red gills.
-	*Spongipellis delectans* (Peck) Murrill (Fig. 2*i*)	Polyporaceae	Dead Garjan (*Dipterocarpus turbinatus*)	It is a saprophytic fungus responsible for decay of wood. The basidiomata were sessile to somewhat effusive. The pileus was solitary, measuring 7 cm in diameter, 15 cm in length, and 4 cm in thickness. The surface colour was mostly white. The pores were circular and had a white surface.
Hairy bracket fungus	*Trametes pubescens* (Schumach.) Pilát (Fig. 2*ii*)	Polyporaceae	Dead Chickrashi (*Chukrasia tabularis*)	It is saprobic fungus causes white rot on dead hardwoods. The basidiomata were annual and sessile. The pileus was slender and leathery.
Split gill mushroom	*Schizophyllum commune* Fr. (Fig. 2*iii*)	Schizophyllaceae	Muli Bamboo (*Melocanna baccifera*)	It is saprophytic fungus responsible for wood decay.The cap was hairy and white, with a purple tint. Fruiting body 1.8 cm × 0.7 cm. The gills were pinkish - grey and radiated from the attachment point. Stems were exceedingly short and rarely visible. Fruiting bodies were linked to dead wood in the centre via the infertile surface.

Table 2 : Quantitative measurements of macrofungi recorded in Khadimnagar National Park (KNP), Sylhet, Bangladesh

Species	F (%)	RF (%)	D	RD (%)	A
Amanita vaginata	8.00	3.03	12.00	2.36	1.50
Antrodia albida	18.00	6.82	26.00	5.12	1.44
Auricularia cornea	4.00	1.52	10.00	1.97	2.50
Boletus sp.	4.00	1.52	12.00	2.36	3.00
Calocera cornea	4.00	1.52	8.00	1.57	2.00
Clavariadelphus occidentalis	4.00	1.52	10.00	1.97	2.50
Coprinopsis lagopus	18.00	6.82	26.00	5.12	1.44
Coprinus sp.	6.00	2.27	10.00	1.97	1.67
Daldinia concentrica	2.00	0.76	8.00	1.57	4.00
Fomes lamaoensis	2.00	0.76	10.00	1.97	5.00
Fomes pachyphloeus	2.00	0.76	8.00	1.57	4.00
Ganoderma applanatum	4.00	1.52	12.00	2.36	3.00
Ganoderma lucidum	2.00	0.76	8.00	1.57	4.00
Lentinus tigrinus	2.00	0.76	10.00	1.97	5.00
Lenzites betulina	26.00	9.85	44.00	8.66	1.69
Marasmius siccus	4.00	1.52	10.00	1.97	2.50
Marasmius capillaris	4.00	1.52	10.00	1.97	2.50
Microporus xanthopus	38.00	14.39	50.00	9.84	1.32
Phallus indusiatus	2.00	0.76	10.00	1.97	5.00
Polyporus alveolaris	6.00	2.27	20.00	3.94	3.33
Polyporus tulipiferae	24.00	9.09	34.00	6.69	1.42
Polystictus sanguineus	6.00	2.27	20.00	3.94	3.33
Schizophyllum commune	18.00	6.82	28.00	5.51	1.56
Spongipellis delectans	2.00	0.76	8.00	1.57	4.00
Trametes lactinea	20.00	7.58	36.00	7.09	1.80
Trametes pubescens	6.00	2.27	14.00	2.76	2.33
Trametes versicolor	16.00	6.06	26.00	5.12	1.63
Tubaria furfuracea	2.00	0.76	8.00	1.57	4.00
Volvariella hypopithys	10.00	3.79	20.00	3.94	2.00

Note: (F) Frequency, (RF) Relative frequency, (D) Density, (RD) Relative density and (A) Abundance

Diversity Status

The Shannon-Wiener index (H=3.18), the Simpson index (D=0.95), the Species diversity index (SDI=0.11), and the Species richness index (R=5.06) indicated higher fungal diversity in the study area. The Species Evenness index (E) was 0.94, indicating an even distribution of macrofungi at KNP.

DISCUSSION

Macrofungi are among the primary agents of biological degradation in forest ecosystems, helping break down and recycle carbon and nitrogen, turning plant waste into humus (Kakdeand Gaikwad, 2014; Tanni *et al*. 2020). In our study, 29 fungal species from 16 families were identified.Similarly, Tanzim *et al*.(2019) reported 25 macrofungi under 15 genera from the evergreen tropical forests of Bangladesh.Besides, in our study *Lentinus*, *Fomes*, and *Phallus*were recorded as dominant genera. In contrast, *Ganoderma* was identified as the dominant genus, with *Trametes* and *Inonotus* as co-dominant generain the mangrove forests of Bangladesh(Das and Aminuzzaman, 2017).*M. xanthopus*was recorded with the highest frequency (38.00%) and relative frequency (14.39%), respectively, in Khadimnagar National Park, however, *Ganoderma tsugae* and *Pleurotus ostreatus* were the most frequently distributed fungal species (37.5%) in the other forests of northeastern Bangladesh (Tanzim *et al*. 2019). Furthermore, the diversity indices indicated a rich macrofungi diversity in KNP, results similar to those of Aghajani *et al*. (2018),who conducted a study in forests of Iran. Macrofungi require optimal environmental conditions and food sources to grow and survive.The optimal temperature range for macrofungi to grow is 20-40°C, with humidity ranging from 35% to 70% (Verbist *et al*. 2019).Situated in a tropical climate,the availability of food sources in the forest ecosystem of KNP may significantly contribute to the abundance and diversity of macrofungi (Purkayastha and Chandra, 1985).

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DECLARATION

Conflict of Interest.The authors declare no conflict of interest.

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