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First record of the occurrence of *Pleurotus* species on new hosts in Bengaluru, Karnataka, India

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 OPEN ACCESS

ARTICLE HISTORY

Received: 04 April 2022

Accepted: 13 July 2022

Available online

Version 1.0 : 09 September 2022

Version 2.0 : 01 October 2022



Additional information

Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

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Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS etc. See https://horizonepublishing.com/journals/index.php/PST/indexing_abstracting

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CITE THIS ARTICLE

Nagadesi P K, Stephen A. First record of the occurrence of *Pleurotus* species on new hosts in Bengaluru, Karnataka, India. Plant Science Today. 2022; 9(4): 934–938. <https://doi.org/10.14719/pst.1798>

Abstract

Mushrooms have wide geographical distribution, with greatest commercial importance, both in temperate areas and tropical regions of the world. The agarics mycota of tropical eco-regions of Bengaluru, Karnataka was surveyed in different seasons from 2019 to 2020 for collection and identification of fungal samples. Detailed macroscopic and microscopic study of fungal samples was identified as *Pleurotus pulmonarius* (Fr.) Quél. *P. ostreatus* (Jack.) P. Kumm. *P. populinus* O. Hilber & O. K. Mill. For the first time, *P. pulmonarius* (Fr.) Quél was causing stem decay in *Mangifera indica* L. was reported from India. New host record of *P. populinus* O. Hilber & O. K. Mill on *Spathodea campanulata* was reported from India. Three species of *Pleurotus* was reported for the first time from the study area of Bengaluru, Karnataka, India.

Keywords

Eco-regions, Bengaluru, *Pleurotus*, African tulip, Karnataka

Introduction

Tropical forests are a haven of biodiversity with richest macro-fungal diversity in the world; which supported the higher diversity in it when compared to the temperate zones (1). The number of fungal species was updated to 3.8 million from 1.5 million estimated recorded by mycologists around the world, from that only 8 % of fungal species were described; so the study of fungal diversity and systematic is required (2). Macro-fungal diversity study is required at the global level (3). The wood rotting fungi were cultivated to get bioactive compounds used as medicines in our daily life (4, 20, 21). Mushrooms were characterized by using different morphological characters such as shape of stipe, pileus, margin of fruit body, colour of fruit body, gills, flesh, annulus, pseudorrhiza and spore print (15). *Pleurotus* (Fr.) P. Kumm species is one of the mostly cultivated mushrooms in different environmental conditions and growing on different substrate materials. The fungal diversity in India is high because it has different climatic regions geographically and also different forest types, hot spots, eco-regions etc; so the conservation and domestication of fungal flora is required. Depending upon the species, the fruiting bodies of *Pleurotus* was showing different colours like white, cream, grey, yellow, pink and light brown. It have three parts like a flashy shell (Pileus), a short or long lateral or central stalk (stipe) and long furrows underneath the pileus (gills or lamellae) (5). Speciation of cultivated, temperate and tropical *Pleurotus* species was done in silico prediction method using conserved sequences (17). It was able to grow at 20 to 30 °C

temperature, and produces fruiting body at 80-100% relative humidity, on different substrates of agricultural waste (6). The present study aims at preliminary diversity of *Pleurotus* in Bengaluru, Karnataka, India.

Materials and Methods

Study area

Bengaluru (Bengaluru), a capital city of Karnataka state situated in the Mysore Plateau (a region of the larger Precambrian Deccan Plateau) at an average elevation of 920 m (3,018 ft). The Garden city (Bengaluru) is showing latitudes at 12°58' and 12°97' N and longitudes at 77°34' and 77°56' E with a different types of ecosystems. The Bengaluru city has tropical savanna climatic conditions with varied wet and dry seasons (18). The St. Joseph's College Campus (SJCC) spread over 8.44 acres in the urban areas of Bengaluru; which is one of the oldest colleges in the state of Karnataka with a strong history of 139 years in education field. The tree flora of SJCC is *Saraca asoca* (Roxb.) Willd., *Monoon longifolium* Sonn. B.Xue & R.M.K.Saunders, *Spathodia campanulata* P.Beauv., *Tamarindus indica* L., *Millingtonia hortensis* L.f., *Ficus racemosa* L., *Ficus benghalensis* L., *Ficus religiosa* L., *Melia dubia* Cav., *Caryota urens* L., *Ceiba pentandra* (L.) Gaertn., *Albizia lebbek* (L.) Benth., *Millettia pinnata* (L.) Panigrahi, *Tectona grandis* L.f., *Pithecellobium dulce* (Roxb.) Benth., *Kigelia africana* (Lam.) Benth., *Dyopsis lutescens* (H.Wendl.) Beentje & J.Dransf., *Cassia siamea* Lam., *Thespesia populnea* (L.) Sol. ex Corrêa, *Pterocarpus indicus* Willd., *Dalbergia latifolia* Roxb., *Pimenta dioica* (L.) Merr., *Moringa oleifera* Lam., *Santalum album* L., *Murraya koenigii* (L.) Sprengel, *Punica granatum* L., *Manilkara sapota* (L.) P.Royen, *Terminalia catappa* L., *Bauhinia purpurea* L., *Mangifera indica* L., *Casabela thevetia* (L.) Lippold, *Muntingia calabura* L., *Plumeira rubra* L., *Melaleuca citrina* (Curtis) Dum. Cours, *Markhamia lutea* (Benth.) Benth. ex B.D.Jacks., *Samanea saman* (Jacq.) Merr., *Peltophorum pterocarpum* (DC.) K.Heyne, *Eucalyptus tereticornis* Sm., *Tabebuia rosea* DC., *Artocarpus heterophyllus* Lam., *Phytolacca dioica* L., *Persea americana* Mill., *Michelia champaca* (L.) Baill. ex Pierre, *Elaeocarpus grandiflorus* Bojer., *Madhuca insignis* (Radlk.) H.J.Lam., *Phyllanthus acidus* (L.) Skeels, *Psidium guajava* L., *Grevillea robusta* A.Cunn. ex R.Br. *Bambusa bambos* (L.) Voss *Citrus* sp., *Araucaria* sp., *Cypress* sp. and *Podocarpus* sp. Most of the plants yield wood which will be useful for making furniture and timber related wood works.

Phenotypical identification

A survey was conducted in different seasons from 2019 to 2020, for collection of different wood rotting fungi from SJCC tree flora. The fruiting bodies of fungal samples was collected in paper bags and brought to the lab for detailed study of macro and microscopic characters used for phenotypical identification (7, 19, 22, 23).

Results

The collection of wood rotting fungal samples were identified as *Pleurotus pulmonarius* (Fr.) Quél. *P. ostreatus*

(Jack.) P. Kumm. *P. populinus* O. Hilber & O. K. Mill. These specimens were stored in museum of St. Joseph's College (Autonomous), Bengaluru with accession number such as SJCCB001, SJCCB002 and SJCCB003 respectively. All wood rotting fungi were new records to tropical urban areas of Bengaluru, Karnataka. For the first time, *P. pulmonarius* (Fr.) Quél was causing stem decay in *M. indica* was reported from India. New host record of *P. populinus* O. Hilber & O. K. Mill on *S. campanulata* was reported from India The detailed description of the wood inhabiting fungi is given below.

Pleurotus pulmonarius (Fr.) Quél. (1872)

Sporophore: convex, flat, semicircular in shape when growing on top part of log, KOH on surface of cap gives orange colour, 3.5 x 12 cm in size; upper surface: bald, creamish yellow and shining when young, whitish or pale tan when matures, fading its colour when dry, the margin in rolled when young, later wavy and sometimes very finely lined (Plate I Fig. A). Lower surface: gills running down the stem, close, short-gills frequent, whitish, discoloring yellowish with age (Plate I Fig. B). Stalk: absent, but if it present; 1.5 cm long and 0.8 to 1.5 cm thick; lateral; whitish; bald; basal mycelium white. Flesh: Thick; white; unchanging when sliced. Pileipellis cutis elements are 5.65 - 11.84 µm wide, smooth, hyaline in KOH, .Hyphal system: monomitic; Basidia: clavate, hyaline, sterigmata: four, 4.62 - 5.25 x 8.56 - 12.25 µm in size (Plate I Fig. C); Basidiospores: cylindrical to ellipsoid; smooth; hyaline in KOH; inamyloid, 6.65 - 12.85 x 3.25 - 4.25 µm in size (Plate I Fig. D); Hymenial cystidia: absent; Odor distinctive, taste mild.

Specimen examination

India, Karnataka state, Bangalore urban, Langford town on dead and living trees of *Mangifera indica* wood causing a white rot 15th August 2021, coll. N. Praveen Kumar, (Acc no: SJCCB 001), 20th February 2022, coll. A. Stephen, (Acc no: SJCCB 005).

Pleurotus ostreatus (Jack.) P. Kumm. (1871)

Sporophore: broadly convex, depressed and funnel shaped; fan-shaped in outline when growing on logs, KOH negative on surface of cap, 4.2 x 14.8 cm in size; upper surface: greasy shining, fresh, bald, pale brown when young, fading to buff when drying, the margin was in rolled when young, wavy at maturity (Plate I Fig. E). lower surface: gills running down the stem, close, short-gills frequent, whitish, yellowish and developing brownish edges also (Plate I Fig. F); Stalk: rudimentary when it growing on sides of log of trees and central when it growing on top part of logs; 1.6 - 3 x 1.8 - 2.9 cm in size, whitish, hairy, tough (Plate II Fig. A); Flesh: thick, white, unchanging when sliced; Pileipellis a partially gelatinized, tangled cutis elements 2.65 - 10.85 µm wide, smooth, hyaline to yellowish in KOH, inconspicuously clamped; Hyphal system monomitic; Basidia: clavate, hyaline, sterigmata: four, 3.62 - 6.25 x 7.56 - 10.25 µm in size (Plate II Fig. B); Basidiospores: cylindrical to ellipsoidal, white to yellowish, smooth, hyaline in KOH, inamyloid, 8.24 - 12.65 x 3.25 - 5.63 µm in size (Plate II Fig. C); Hymenial cystidia not found. Odor distinctive; taste mild. Edible and few people are allergic to it.

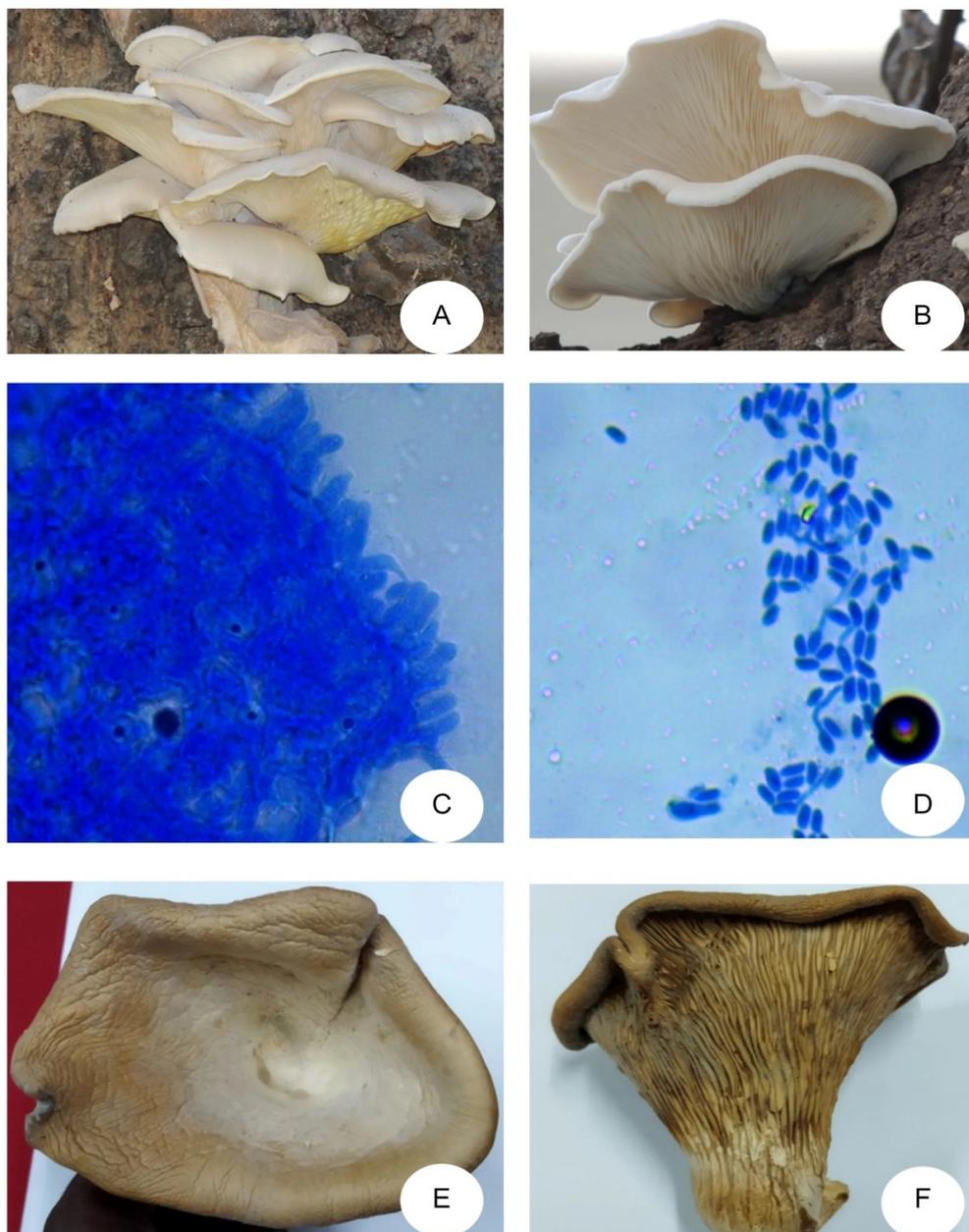


Plate I. Fig. A. Upper surface of *Pleurotus pulmonarius* in clusters on dead tree trunk of Mango, Fig. B. Lower surface of *P. pulmonarius* showing gills, Fig. C. Gill cross section of *P. pulmonarius* showing basidia and paraphysis, Fig. D. Basidiospores of *P. pulmonarius* with inclusion particles, Fig. E. Upper surface of *P. ostreatus* looks like funnel shaped, Fig. F. Lower surface of *P. ostreatus* showing the gills starting from the stalk.

Specimen examination

India, Karnataka state, Bangalore urban, Langford town on dead and living trees heard wood causing a white rot, 27th August 2021, coll. N. Praveen Kumar, (Acc no: SJCCB 002), 25th February 2022, coll. A. Stephen, (Acc no: SJCCB 006).

Pleurotus populinus O. Hilber & O. K. Mill. (1993)

Sporophore: broadly convex, flat, fan-shaped, nearly circular in shape if it growing on top part of logs, KOH on surface of cap give yellowish colour, 4.8 - 15 cm; upper surface: greasy shining, bald when young; whitish to pinkish gray when matures, creamish yellow when drying; the margin incurved when young, later wavy at maturity (Plate II Fig. D); lower surface: gills running down the pseudo stem, close, short-gills frequent, whitish to creamish yellow; Stalk: present when it grows on the tops of logs or branches, creamish white, slightly hairy near the base 2.4 x 6.8 cm in size. Flesh: thick, white, unchanging when sliced;

Pileipellis acutis elements are 2.56 - 6.35 μm wide, smooth, hyaline in KOH; Hyphal system: monomitic; Basidia: clavate, hyaline, sterigmate: four, 2.35 - 6.25 x 8.56 - 12.25 μm in size (Plate II Fig. E); Basidiospores: cylindrical, whitish, smooth, hyaline in KOH, inamyloid, 10.65 - 14.86 x 4.25 - 5.65 μm in size (Plate II Fig. F). Hymenial cystidia not found. Odor distinctive; taste mild.

Specimen examination

India, Karnataka state, Bangalore urban, Langford town on dead and living wood of *Spathodia campanulata* causing a white rot, 20th September 2021, coll. N. Praveen Kumar, (Acc no: SJCCB 003), 15th January 2022, coll. A. Stephen, (Acc no: SJCCB 007).

Discussion

The Karnataka state has 38284.3 km² forest areas which contributes 20 % its geographical area. The fungal diversity is rich

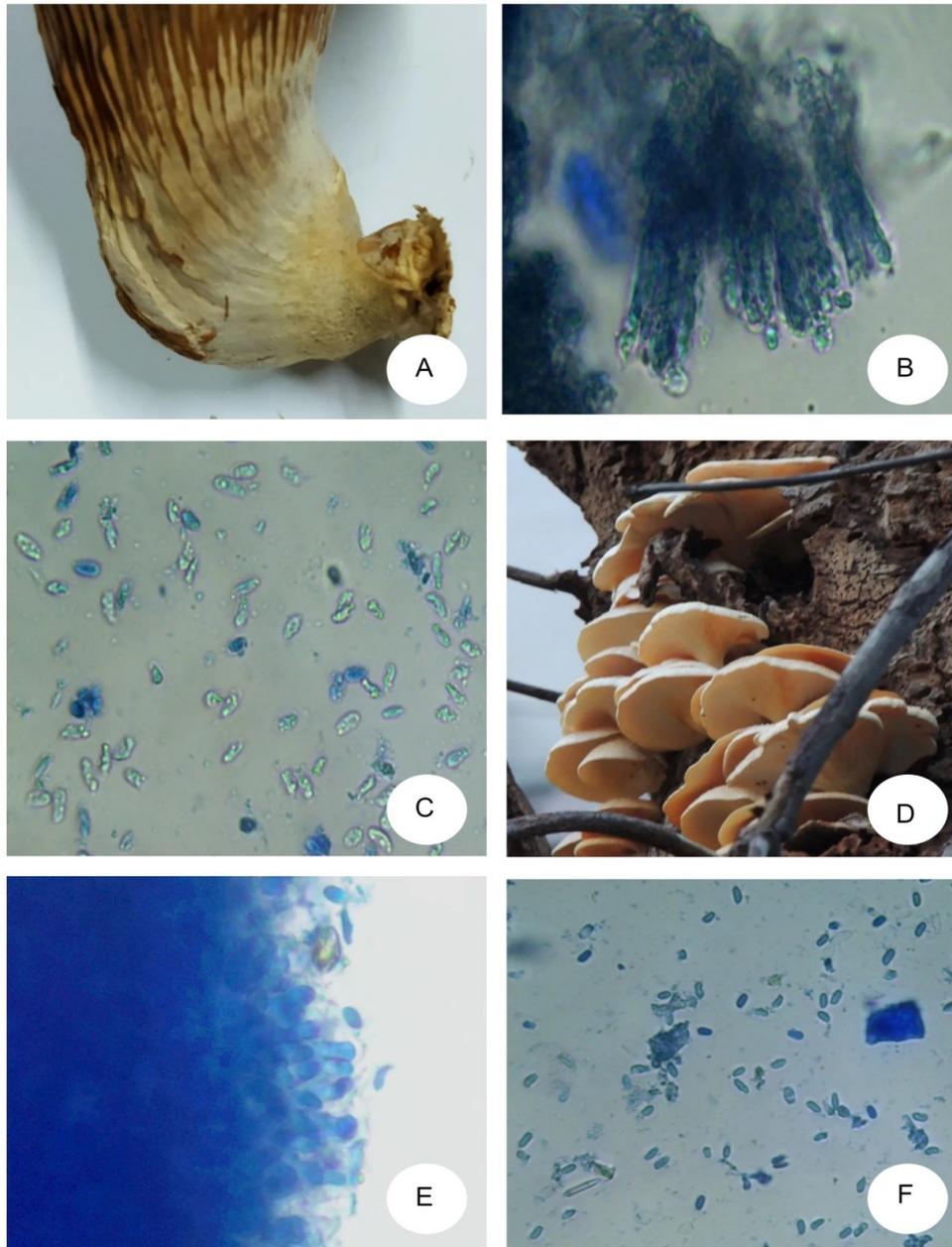


Plate II. Fig. A. Basidiocarp of *Pleurotus ostreatus* showing small stalk, Fig. B. Gill cross section of *P. ostreatus* showing basidia with spore attachment, Fig. C. Elliptical shaped basidiospores of *P. ostreatus*, Fig. D. Upper surface of *P. populinus* in clusters on dead tree trunk of African tulip, Fig. E. Gill cross section of *P. populinus* showing basidia with spore attachment, Fig. F. basidiospores of *P. populinus* with cylindrical shape.

in forest and urban areas of Karnataka; but these eco-regions were not studied for mushrooms diversity (8). *Pleurotus salmoneostramenius* (WGM-2), was found on Branch of tree in forest area of Theerthahalli Shimoga district of Karnataka, India (16). In the present study the *Pleurotus* species is reported from urban area of Karnataka. The *Cyptotrama asprata*, *Hygrocybe acutoconica*, *H. alwisii*, *Oudemansiella furfuracea*, *Hypholoma subviride* and *Lactocollybia epia* are reported for the first time from Karnataka State (8). In the present study the *P. pulmonarius* (Fr.) Quél. *P. ostreatus* (Jack.) P. Kumm. *P. populinus* O. Hilber & O. K. Mill. was reported for the first time from urban Eco-regions of Bengaluru, Karnataka, India. From 8 different places in an around Bengaluru like scrub jungles and urban areas; a total number of 90 fungal species was reported, which belonging to 19 families, 05 orders and 48 genera. 28 species of mushrooms were recorded for the first time from India (9). In the present survey, one *Pleurotus* genus with 3 species were added newly to the mushroom biodiversity of

Bengaluru. The different bioactivities like anticancer, anti-inflammatory, antioxidant and antihyperglycemic activity of *P. pulmonarius* was scientifically proven (10), *P. pulmonarius* isolate numbers MF037415 was found on dead *Mangifera indica* log (11). In the present study, the *P. pulmonarius* was causing stem trunk decay on living tree of *M. indica*. *P. ostreatus* isolate number MF037419 was found on dead wood log of *Elaeis guineensis* and on wild local mango wood logs (*M. indica*); which is reported for the first time from Goa part of the entire Western Ghats region (12). In the present study, the *P. ostreatus* was isolated from the paddy straw samples used for cultivation in the SJCC, Bengaluru. Earlier it was reported that *P. cystidiosus* from Agumbe (13), Karnataka. A single sample of oyster mushrooms was collected from Navsari district on the bark of African tulip tree (*Spathodea campanulata*) at a height of 1.5 m; identified as *P. cystidiosus* (14). In the present study, for the first time the new host record for *P. populinus* was reported on dead tree of tulips. All three species of *Pleurotus*

were new record to the mushroom diversity of urban area of Bengaluru, Karnataka, India.

Conclusion

Mushroom was a complete, healthy food suitable to all kind of peoples from child to old age. So the Agaricales in tropical eco-regions of Bengaluru, Karnataka was surveyed in different seasons from 2019 to 2020 for collection and identification. Based on macroscopic and microscopic study of collected mushroom were identified as *P. pulmonarius* (Fr.) Quél. *P. ostreatus* (Jack.) P. Kumm. *P. populinus* O. Hilber & O. K. Mill. For the first time *P. pulmonarius* (Fr.) Quél was causing stem decay in *M. indica* was reported from India. New host record of *P. populinus* O. Hilber & O. K. Mill on *S. campanulata* was reported from India. The identified *Pleurotus* mushrooms were new record to the urban areas of Bengaluru, Karnataka, India.

Acknowledgements

Authors wish to thank the management especially Rev. Fr. Swebert D'silva SJ, Pro Chancellor, Rev. Fr. Dr. Victor Lobo SJ, Vice Chancellor, Rev. Fr. Dr. Xavier Savarimuthu SJ, Research Director St. Joseph's University, Bengaluru Dr. Jayarama Reddy, Ex Head, and Dr. V. J. Jacob Paul, HOD, Department of Botany, St. Joseph's University, Bengaluru for providing all the necessary facilities, encouragement and congenial environment for research and teaching at SJU. We would also place on record our gratitude to the management of St. Joseph's University, Bengaluru for funding this study through 'Seed-Money Grant'

Authors contributions

The authors collected the samples, identified it based on the macroscopic and microscopic characters. The co-author was helped in collection of ecological data, flora identification and taken the pictures for preparation of papers.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None.

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