Rapid survey of macrofungi within an urban forest fragment in Bicol, eastern Philippines

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Zusammenfassung: Eine schnelle Großpilz-Dokumentation wurde in einem städtischen Waldfragment in der Region Bicol im Osten der Philippinen durchgeführt, um eine Aufzeichnung der Arten in der Region zu erhalten. Als Basisstudie und Dokumentation von Großpilzen in der Region zielte dies darauf ab, die Politikentwicklung zu stärken, die die Bemühungen um Erhaltung und Entwicklung insbesondere während einer Zeit des Ausbaus einer angrenzenden Universität in Einklang bringt. Es wurden 39 Arten beobachtet, von denen die meisten Basidiomyceten sind. Die Familien *Polyporaceae* und *Marasmiaceae* waren mit sieben bzw. sechs Arten die artenreichsten. Nur *Aleuria* sp., *Philipsia* sp. und *Xylaria* sp. waren Ascomyceten.

Abstract: A rapid documentation of macrofungi was done within an urban forest fragment in Bicol region, Eastern Philippines to come up with a record of species in the area. As a baseline study and documentation of macrofungi in the area, this aimed to strengthen policy formulation that will balance conservation and development efforts especially during a time of expansion of an adjacent university. Thirty-nine species were observed, most of which are *Basidiomycetes*. The families *Polyporaceae* and *Marasmiaceae* were among those with the most number of species, with seven and six, respectively. Only *Aleuria* sp., *Philipsia* sp., and *Xylaria* sp. were *Ascomycetes*.

Macrofungi, referring to ascomycetes and basidiomycetes with typically large fruiting bodies or spore-bearing structures above ground (MUELLER & al. 2007) are important elements of a healthy ecosystem. Decomposition of organic material is the basic role they play, especially of wood, and the eventual cycling of nutrients following decomposition (ZOTTI & al. 2013). Macrofungi are known to stabilize the soil in forests and may even function as remediators after an edaphic disturbance (CLARIDGE & al. 2009, KUBROVÁ & al. 2014). They serve as bio-indicators of whether habitats are disturbed and provide valuable insights into ecological conservation (ARNOLDS 1992).

Fungal diversity is estimated to be 2,2 million to 3,8 million species (HAWKSWORTH & LÜCKING 2017). Global macrofungal diversity is estimated to be within 50,000 to 110,000 species (MUELLER & al. 2007). These numbers vary, though, as approaches to biodiversity studies become sophisticated and sensitive to species delineation. What is challenging is that as much as 98 % remain undescribed particularly those that occupy unique niches (TAYLOR & al. 2014).

Man has directly benefited from macrofungi. Medicinal properties of mushrooms have long been recorded in African and Middle Eastern countries (EL ENSHASY & al. 2013). Species such as *Lentinula edodes*, commonly known as Shitake mushroom, have pharmacological properties (BISEN & al. 2010), antiprotozoal activities (BADALYAN 2004), and antitumor properties *in vitro* (Yap & Ng 2003). These properties of *L. edodes* are aside from being consumed as food in many Asian and European cuisines. The genera *Pleurotus* (oyster mushroom), *Auricularia* (tengang daga), and *Flammulina* (enokitake) are edible with medicinal properties (CHANG 1996). These likewise contribute to economic upliftment among people who rely on their domestication for income (DE LEON & al. 2013).

Macrofungi have also been part of indigenous knowledge in many countries. Aside from additives to food, traditional knowledge in Malaysia recounts macrofungi for spiritual purposes such as discouraging undesirable behavior in children (CHANG & LEE 2004). In some indigenous communities in the Philippines, macrofungi are used as insect repellent (DE LEON & al. 2016).

All these benefits make a diversity survey of macrofungi, and biodiversity in general, in specific localities warranted. In a biodiversity hotspot such as the Philippines, biodiversity surveys are important steps prior to a search for novel compounds fit for pharmaceutical or agricultural applications. What and where to look for potential cures for existing diseases or new products of societal importance starts from knowing what species remain unexplored. Further, biodiversity drives ecosystem services (PALMER & DI FALCO 2012). Thus, biodiversity surveys provide concrete information for sound conservation policies that safeguard ecological and societal services derived from them.

This research surveyed a small forest fragment, locally known as Kalikasan Park, located within an urbanized area in eastern Philippines with the primary aim of identifying macrofungi present in the locality. This rapid macrofungal assessment was conducted in order to list these species and provide baseline information on their occurrence. The continuous development of the surrounding city and the expansion of a university campus immediately adjacent to the forest fragment represent a challenge to macrofungal diversity, and biodiversity in general within the Kalikasan Forest Park. Infrastructure development in recent years have slowly shrunk the forested area and as of writing this article, parts of the sampling areas were already converted to lands suited for buildings. This research is therefore significant in strengthening documentation of flora and fauna in the area which may be used to formulate policies for conservation of this forest fragment within an urban center.

Material and methodology

The study was conducted at the Bicol University Kalikasan Forest Park, a man- made agro-forest fragment situated at the back of Bicol University in Legazpi City, Bicol, Eastern Philippines. The area is composed of tree and non-tree vegetation. Site 1 is a steep landscape mostly vegetated with native trees and is primarily dominated with Nipa plant. Site 2 is the agricultural portion of the site vegetated with a combination of trees, shrubs and local crops. Banana, sweet potato and cassava are examples of crops cultivated in the area.

Sampling plots (10 × 10 m) divided into four quadrats was laid on the sampling area. A total of five plots with five-meter interval was established. Macrofungi collection was done per quadrat with the aid

Tab. 1. Macrofungi recorded from Kalikasan Park forest fragment adjacent to Bicol University main campus, Legazpi City, Eastern Philippines, *rel. frequ*. relative frequency

Family	Species	Host/substratum	Growth habit	Rel. frequ.
Agaricaceae	*Calvatia* sp.	soil	solitary	0.008
Agaricaceae	*Lepiota* sp.	soil	solitary	0.008
Agaricaceae	*Parasola plicatilis* (CURTIS) REDHEAD, VILGALYS & HOPPLE	soil	solitary	0.008
Agaricaceae	*Coprinus* sp.	soil	solitary	0.008
Auriculariaceae	*Auricularia auricula-judae* (BULL.) J. SCHROTT	dead branch	solitary	0.008
Bolbitiaceae	*Conocybe* sp.	decaying banana trunk	solitary	0.008
Clavariaceae	*Clavaria* sp.	root of tree	solitary	0.008
Ganodermataceae	*Ganoderma applanatum* (PERS.) PAT.	dead log	solitary	0.008
Ganodermataceae	*Ganoderma* sp.	dead log	solitary	0.008
Hygrophoraceae	*Hygrocybe miniata* (FR.) P. KUMM.	soil	solitary	0.008
Hymenochaetaceae	*Phellinus* sp.	dead log	gregarious	0.008
Incertae sedis	*Panaeolus* sp.	leaf litter	solitary	0.016
Inocybaceae	*Inocybe* sp.	root of tree	solitary	0.016
Marasmiaceae	*Marasmius oreades* (BOLTON) FR.	decaying branch	solitary	0.039
Marasmiaceae	*Marasmius plicatulus* PECK	leaf litters	gregarious	0.008
Marasmiaceae	*Marasmiellus ramealis* (BULL.) SINGER	nipa branch	gregarious	0.142
Marasmiaceae	*Marasmius rotula* (SCOP.) FR.	leaf litter	solitary	0.008
Marasmiaceae	*Marasmius siccus* (SCHWEINITZ) FRIES	dead log	solitary	0.008
Marasmiaceae	*Marasmius* sp.	leaf litter	gregarious	0.016
Meruliaceae	*Cymatoderma* sp.	nipa branch	gregarious	0.055
Meruliaceae	*Podoscypha petalodes* (BERK.) PAT.	soil along with grass	gregarious	0.079
Nidulariaceae	*Cyathus striatus* (HUDS.) WILLD.	decaying palm branch	solitary	0.016
Peniophoraceae	*Peniophora* sp.	leaf litter	gregarious	0.000
Pluteaceae	*Pluteus* sp.	banana	solitary	0.016
Polyporaceae	*Hexagonia* sp.	dead log	solitary	0.008
Polyporaceae	*Trametes membranacea* (SW.) KREISEL	decaying palm	solitary	0.008
Polyporaceae	*Trametes* sp.	dead log	solitary	0.016
Polyporaceae	*Lentinus* sp.	dead log	gregarious	0.008
Polyporaceae	*Microporus* sp.	dead log	solitary	0.024
Polyporaceae	*Polyporus* sp.	dead log	solitary	0.008
Polyporaceae	*Poria* sp.	dead log	solitary	0.102
Psathyrellaceae	*Coprinellus* sp.	cow dung	gregarious	0.173
Russulaceae	*Lactarius* sp.	soil	solitary	0.024
Schizophyllaceae	*Schizophyllum commune* FR.	tree branch	gregarious	0.047
Tremellaceae	*Tremella* sp.	soil	solitary	0.008
Tricholomataceae	*Tricholomopsis* sp.	woody vine	solitary	0.008
Ascomycota				
Pyronemataceae	*Aleuria* sp.	leaf litter	gregarious	0.031
Sarcoscyphaceae	*Philipsia* sp.	Tree root	solitary	0.024
Xylariaceae	*Xylaria* sp.	decaying tree branch	solitary	0.008
Total: 22 families	39 species			1.000

of hand shovel and magnifying lens. Woody samples were collected and put into paper pockets to preserve the identity of the specimen. Fleshy specimens were placed in jars with 70 % ethanol. Species habit and habitat was also noted and recorded.

Collected samples were initially identified on site with the use of a pictorial guide obtained from publications (DE LEON & al. 2016, LAZO & al. 2015, SIBOUNNAVONG & al. 2008). Morphological characters such as size and color as well as host and substratum of identified and unidentified species were also noted at the time of collection. Fungal species were verified in the laboratory after thorough inspection of fungal structures. Vouchers are deposited in the fungarium of Bicol University College of Science Department of Biology.

Results and discussion

Thirty-nine species of macrofungi belonging to 31 genera and 22 families were recorded during the rapid survey (Tab. 1, Fig. 1). The families *Polyporaceae* and *Marasmiaceae* were among those with the most number of species, with 7 and 6, respectively. Only *Aleuria* sp., *Philipsia* sp., and *Xylaria* sp. were Ascomycota while the rest of the recorded macrofungi were all Basidiomycota.

Substrates of recorded species were either directly on the soil or decaying wood, leaf litters and logs. *Coprinellus* sp. was recorded growing on cow dung which is typical for many species of this genus. Most recorded species are saprobic and no one species dominated the surveyed area. Clearly, the nutrient cycling within this forest fragment may be hypothesized to be functional because of the presence of these fungi, the backbone of biogeochemical cycles in an ecosystem. For example, *Xylaria* species are vigorous decomposers (OSONO 2003), indicative of the rapid turnaround of nutrients in this forest fragment. Moreover, majority of the observed species of fungi are wood decomposers. Wood decomposition is a decisive process in nutrient cycling and may be studied to be biological indicators for conservation (LONSDALE & al. 2008).

Some species may be of interest because of their use in food and medicine. *Auricularia auricula* is known for its culinary uses, along with species of *Lentinus* and *Tremella* (ZHOU & al. 2015). *Ganoderma* species have medicinal properties especially among Asian countries (BISHOP & al. 2015). More importantly, the potential for mining new metabolites from macrofungi is high especially in an isolated forest fragment such as the Kalikasan Park because it is unexplored and recorded only for the first time.

This rapid assessment of macrofungi was simply to record the species present in the area as part of a baselining effort of the forest fragment. Authors acknowledge that rapid biodiversity surveys are useful tools for biodiversity conservation (TANALGO & al. 2019). Known as Kalikasan Park, this forest fragment is adjacent to a university campus where much infrastructure development is underway. This expansion threatens the loss of species without making it on official record. While no species in the survey were listed as threatened or endangered, their presence signals a thriving biodiversity and the cycling of nutrients brought by their fundamental function as decomposers.

Macrofungi, unlike the more known flora and fauna, are usually at the bottom of the trophic levels because of their general role in decomposition. It is somehow difficult to directly equate their presence towards conservation efforts. Their attributes, however, are necessary to maintain forest health (TAPWAL & al. 2013) because decomposition precedes nutrient cycling. Thus, nutrient and energy flow are dependent on a functional decomposer trophic level, where fungi play an indispensable role. Their sustainability is related to the productivity of an ecosystem, whether an agricultural or forested area (TIBUHWA & al. 2011). Not only should macrofungi be seen as potential sources of

Fig. 1. Macrofungi observed in Kalikasan Forest Park: ***A*** *Calvatia* sp. (Agaricaceae), ***B*** *Auricularia auricula-judae* (Auriculariaceae), ***C*** *Cyathus striatus* (Nidulaeriaceae), ***D*** *Podoscypha petalodes* (Meruliaceae), ***E*** *Poria* sp. (Polyporaceae), ***F*** *Schizophyllum commune* (Schizophyllaceae). Bars A, B 5 cm; C 6 cm; D, E, F 3 cm.

medicines or other services, their role in the ecosystem should also be considered as premium and fundamental.

It is important to acknowledge that the forest fragment is home to a spectrum of species. Forest fragments offer unique habitats for organisms, including macrofungi (BROWN & al. 2006), and may buffer them from impacts of high urbanization. However, urban areas continue to creep towards the fragment boundaries, potentially endangering unique flora, fauna and microfauna in the process. In this current study, Kalikasan Park forest fragment have been partially shaved to make way for development. This equates to a loss of habitat, a potential loss of species and the shrinking of this forest fragment that sits within an expanding university campus.

The dilemma of where to draw the line between conservation and development requires a thorough understanding of ecology. While the university requires space to meet its growing needs, it also needs to be aware of the repercussions of reducing adjacent forest fragments. Providing a definite boundary where the small patch of forest may thrive without undue disturbance may be a good policy to formulate. Further, a follow up research may be done to analyze the effects of these developments, not only to macrofungi, but to the many species dependent on this small forested area.

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