IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

ISSN PRINT 2319 1775 Online 2320 7876

Research paper  UGC CARE Listed ( Group -I) Journal Volume 11, Iss 8, August 2022

# A Review Study on Fungi and the Urban Environment

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***ABSTRACT: Fungi may be simple single-celled creatures or sophisticated multicellular ones. They may be found in almost any environment, although the majority of them reside on land, mostly in soil or plant debris, rather than in the sea or fresh water. Decomposers are organisms that live in the soil or on decaying plant debris and play a key part in carbon and other element cycling. Despite the fact that fungi play an important role in ecosystems, there has been little attention paid to their involvement in urban systems and how fungi may be impacted by urbanization. This review contributes to our understanding of these topics by combining urban fungal investigations with relevant wider research on both fungal and urban ecology. We explain the ecological functions of fungus, such as their positive interactions with plants and animals, based on these findings. We also discuss the ecological factors that may jeopardize fungi's ability to survive in cities. The risks of soil contamination and alterations in the biota that establish connections with fungus are among them. Finally, we examine the possibilities for fungal conservation in cities if their ecology can be understood and conveyed to land managers, as well as possible research directions in this area.***

***KEYWORDS: Contamination, Ecology, Environment, Fungi, Plants.***

## 1. INTRODUCTION

Fungi play an important role in energy and nutrient recycling, as well as influencing plant community composition via symbiotic interactions. A wide range of invertebrate and vertebrate species, including humans, consume fungal fruiting bodies (sporocarps). Despite their obvious significance, however, little is known about fungi's diversity and ecology. Only 72,000 of the estimated 1.5 million species of fungus have been identified. The documented decrease of numerous species globally as a consequence of human activities has recently been a source of worry. More research on the variety of fungi, their ecological roles, and the impact of human activities on fungal diversity and function is needed [1]–[5].

The study of urban ecology has grown more important for the conservation of biodiversity as the world's population concentrates in cities. Between now and 2030, global urban land usage is projected to grow by 250 percent, accounting for 1.1 million km2. When cities expand, they often obliterate rural and natural regions, leaving isolated pockets of native vegetation in the middle of developed areas and green spaces with plants and structures that are new to the area. These remains and green spaces are important because they may be rich in species, offer habitat for rare taxa, and provide an opportunity for urban people to interact with nature. Understanding the ecological interactions between constructed and natural regions in cities may aid in the management and planning of urban settings in order to maintain variety and ecological function [6]–[8].

Fungus are often neglected in ecological surveys, and urban fungi research are uncommon. Only two articles are devoted to fungus among the 1176 papers mentioned in ‘The Reference Guide to

ISSN PRINT 2319 1775 Online 2320 7876

 UGC CARE Listed ( Group -I) Journal Volume 11, Iss 8, August 2022

the Ecology and Natural Resources of Melbourne.' Observations of fungal decrease, on the other hand, have been linked to the kind of human activities seen in metropolitan settings. The detrimental impact of air pollutants on ectomycorrhizal (ECM) fungus, which has been reported for several European nations, is the most prominent of them. If similar processes occur in cities, the variety of urban fungus, as well as the role of natural remains in urban environments, may be jeopardized [10].

The fungi of soil and plant detritus, which are mainly found in natural environments, are the subject of this study. Other regions have been the focus of fungal study in urban settings, and have even been the topic of review articles in certain instances. Lichens are employed as bio indicators of air quality because they are sensitive to sulphur, nitrous oxides, and other contaminants. Heavy metal and sulphur pollution may also decrease phylloplane fungus species richness and alter community structure. Studies of fungi in urban settings have focused on fungal spores in indoor and outdoor air that induce allergy illnesses including bronchial asthma and conjunctivitis. Around 80 kinds of wood rotting have been investigated in the architecture of city buildings [11],[12].

The characteristics of urban settings that may influence fungus are highlighted in this review. Fungi of soil and plant waste have been examined directly in cities in a few instances, and there are indications of specific impact mechanisms from this study. However, since there has been little study on these fungi in urban settings, this review covers numerous studies of fungi conducted in other places where evidence has shown significant ecological characteristics that may also be present in cities. The study therefore relies on a broader body of knowledge on fungi and urban ecology to uncover potential interactions between fungus and the urban environment, before recommending some topics for further research.

### *1.1. Fungi's diversity and significance:*

The variety of fungi may be categorized either taxonomically or according to their functional functions. Six phyla and four unplaced subphyla are included in the most recent categorization systems, including five main groups: Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota, and Glomeromycota. Fungi's functional functions often transcend taxonomic lines. The contrast between saprotrophic and mycorrhizal fungi is an essential one. Saprotrophs get their energy and nutrients from plant and animal waste or dead tissue. Mycorrhizal fungi establish mutualistic relationships with phototrophic organisms in which they get carbohydrates directly from their live plant partner in return for nutrients. A difference between macrofungi and microfungi is often established based on the visibility of fungal fruiting structures. Regardless of classification, all fungi are heterotrophic, which means they depend on the biota with which they form communities and are deeply connected with it.

Plants benefit from fungi because they increase nutrient availability and help to create a well-structured porous soil. Fungi degrade plant and animal remnants in collaboration with a variety of other soil organisms, recycling both energy and nutrients. Saprotrophic fungi, most often basidiomycetes, are among the few microbes capable of decomposing lignins, the complex phenolic chemicals that preserve plant cell walls. Decomposed material may be mineralized and made accessible for plant uptake in soil water, or it can be utilized for energy or structural components of the decomposer community. Organic acids are also exuded by certain fungus in

ISSN PRINT 2319 1775 Online 2320 7876

Research paper  UGC CARE Listed ( Group -I) Journal Volume 11, Iss 8, August 2022

order to liberate nutrients from rocks. By enmeshing soil particles with hyphae and releasing insoluble exudates, fungi play a key role in the development of large stable soil aggregates (>250m).

The direct delivery of mineral nutrients to their symbiotic plant partner is an essential ecological function of mycorrhizal fungi. The fact that 95 percent of terrestrial plant species develop mycorrhizae emphasizes the importance of this relationship. Fungal hyphae, which have a much smaller diameter than fine roots (2–20m vs. 200m) and are capable of probing tiny holes in the soil, have access to nutrients inaccessible to plants. Plants may form common mycelial networks, which can aid seedlings or low-competition species in establishing themselves by transferring nutrients from other plants on the network. Aside from feeding, mycorrhizal plants may also benefit from drought resistance and protection against soil-borne plant diseases. In general, the presence and variety of mycorrhizae may enhance nutrient extraction and overall plant production through mediating the composition of plant communities.

### *1.2.Acidity of the soil and heavy metal pollution:*

Acid rain's effects on fungal populations have also been investigated. Sulphuric acid precipitation may harm mycorrhizal fungus indirectly by harming the roots and leaves of host plants, decreasing C allocation to the fungal symbionts. Although severe acidity (below pH 3–4) may damage both functional groups, many ECM species prefer a slightly acidic soil, whilst saprotrophs prefer a higher pH. The impact of acidifying pollutants will most likely vary depending on the degree of acidity and functional groups.

Heavy metal pollution in the soil may prevent fungus from growing. In Sweden, where As, Cu, Cd, and Pb were the most prevalent soil pollutants, fungus species richness and abundance were inversely associated with pollution. ECM fungi, on the other hand, were shown to be more tolerant to contaminants than saprotrophs in this research. The mycorrhizal association's tolerance is an essential characteristic. AM and ECM fungi may survive in polluted soil and prevent or reduce harmful heavy metal absorption by their hosts. When metal concentrations reach a certain level, fungal development is decreased, but the surviving mycorrhizae prevent metals from moving into plant roots, reducing toxicity.

### *1.3. Plants and fungi:*

Fungi have developed in close connection with plants and habitat types in a wide variety of environments. Many mycologists believe that the lack of appropriate habitat is the most serious danger to fungal conservation. Fungi's biological environment requirements include mycorrhizae relationships and various kinds of plant detritus for saprotrophs. These relationships may be very specialized, with fungus species being limited to only forming mycorrhizae or using the substrate of a single type of plant. Because many species need habitat of a certain maturit, older stands of the same plant community typically include more ECM fungus. Because leaf litter is a major substrate for many species, changes in its quantity or chemical composition as a result of human habitat changes will have an impact on fungus. Also, to sustain species variety and long-term population survival, wood degrading fungus may need a high quantity of dead logs of various sizes and stages of decay.

ISSN PRINT 2319 1775 Online 2320 7876

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Although urbanization transforms agricultural or natural landscapes into developed settings, controlled and ruderal green spaces, as well as pockets of native flora, are typically preserved. In general, urban settlements are linked with a decrease in native flora, although the import and spread of non-native plants increases total species richness. Exotic species may be intentionally introduced as agricultural or decorative species, or they may arrive inadvertently as part of a shipment. The plants may be found in private and public gardens, as well as wastelands and lawns. Remaining vegetation that has been disturbed by humans is more likely to be colonized by non-native flora or to be disturbed by trampling, and it may have lower stem densities and fewer understorey species. Because urban remains are often used as leisure places, plant waste and dead trees are frequently removed. In addition, urban remains may contain fewer old trees.

Because there is a scarcity of historical and present data on fungi in cities, it is difficult to determine how they have reacted to these changes. By studying variety in and around urban settings, some research has elucidated the connection between vegetation change and urbanization. The presence of native plants affected the species makeup of AM fungal communities, according to a research conducted in Pheonix. This finding is consistent with previous studies that has linked plant diversity to AM fungus diversity. Planting exotic plants, on the other hand, may bring new fungus to cities. These unusual fungus, such as the toxic death cap found with European oaks in Melbourne, may be beneficial. Edible species, which are mycorrhizal symbionts of exotic trees, have found home in cities and are occasionally harvested by individuals who have a history of collecting wild mushrooms.

### *1.4.Fungi and fragmentation:*

In general, the impact of habitat fragmentation on fungus is unknown, and it may be influenced by factors such as genetic variability, population size, and spore dispersion gradients from neighboring populations. Edman et al. (2004) found smaller populations and reduced viability of spores from the wood decaying fungi Fomitopsis rosea and Phlebia centrifuga with decreasing availability of dead logs and increasing habitat isolation in a study of boreal forests in Sweden along a gradient of increasing historical impacts from logging. Some fungus species' genetic variability and long-term survival may be hampered by isolation. The ECM communities of a coastal pine forest in California were shown to be influenced by both isolation and habitat area, with a comparable decrease in species richness everywhere, highlighting the danger to populations in fragmented environments.

### *1.5. Fungi are affected by abiotic and biological factors:*

Fungi, like many other biota and ecological systems, need certain environmental characteristics in order to thrive. There may be implications for the persistence of species if they are lost or altered. If the soil becomes eutrophic or contaminated with chemicals, fungal populations may be disrupted. Chemical inputs from human sources often enhance the urban environment, providing additional nutrients and hazardous contaminants to local ecosystems. Most mycologists, on the other hand, believe that habitat destruction and alteration is the most serious danger to fungal conservation. This is due to the fact that fungi need certain biological interactions, such as mycorrhizal plant hosts or plant detritus as growth substrates. Habitat fragmentation, the loss of

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dispersion mechanisms, and invasive species may all have an impact on fungi. All of these issues are common in metropolitan environments.

## 2. DISCUSSION

In conclusion, we may anticipate urbanization to have a detrimental impact on local fungal communities. Fungi will be deprived of host plants and substrates for growth if native trees are removed and remaining habitat is altered. Due to limited spore dispersion, suitable residual vegetation is likely to be extremely fragmented, with fungal populations potentially isolated. Species that survive in this environment may be exposed to hazardous contaminants and eutrophication of the soil. Some species, however, may be able to thrive in this environment, possibly via tolerance to pollutants or by forming associations with imported plants. Also, certain novel fungi, especially those that are mycorrhizal partners of exotic trees or saprotrophs in mulch, may be brought to cities.

However, our understanding of fungus in cities is poor in general, and more study is required to better understand how urbanization impacts fungi, as well as the wider ramifications of changed fungal populations. When it comes to urban fungus in any metropolis, one of the most basic questions is what kinds of fungi are there and where they are dispersed. Apart from the Polish city of Lodz, it seems that no comparable data has been recorded. Fungi inventories may be used to show the variety of a city and taxonomic habitat relationships, as well as highlight uncommon species and critical areas for conservation.

To preserve fungi in cities, researchers must first determine which human activities may cause fungus to be excluded from certain places, and if these variables can be altered to encourage variety. A suitable starting point for investigating the ecology of urban fungus has been found via previous studies on ECM fungi and contaminants. We know that soil eutrophication may harm ECM communities in particular. Fungal and soil surveys in comparable habitats along gradients may aid in clarifying the connection between soil, fungus, and urbanization in urban studies. It's also worth considering the ratio of saprotrophic to ECM species, since an increase in saprotrophs may indicate disturbance. Many of the few urban studies have observed a change in the ratio of ECM species toward less, and it would be useful to know whether this is a common feature of urban fungal communities. Because the functional functions of these groups are so dissimilar, any change in the ratio would have an impact on ecosystem characteristics.

## 3. CONCLUSION

Natural dispersion may be limited by the fragmented character of regenerated urban vegetation. The persistence of fungal inoculum at a restoration site may be just as unclear, depending on land use history or the existence of fungi-associated residual plants. Of course, these factors will have different effects on various species, and although some fungus may be able to return, urban restored habitat is unlikely to have the same degree of variety as less disturbed settings. Fungi perform a variety of important ecological functions, thus their establishment may be critical to the integrity and long-term viability of restoration efforts. Although the data isn't clear, it seems that invasive plant species are less reliant on mycorrhizal connections than native plant species in many situations. As a result, disruptions to mycorrhizal networks may promote the spread of certain ruderal species. Questions about fungal colonization and functioning, as well as the possibility of controlled inoculation, may be useful for individuals working in the area of urban ecological restoration.

Fungi are frequently underestimated by professional land managers and the general public, in addition to being understudied. Programs and studies that attract people's attention to fungus may assist with this. In cities, soils provide a readily accessible resource for environmental education. The accessibility of metropolitan areas makes them ideal for frequent fungus surveys, which may produce a wealth of fascinating discoveries. In Australia, 'Fungimap,' a project that tries to trace the distribution of 200 target species throughout Australia using information provided by volunteers, is raising awareness. Such programs educate the wider population while also expanding the geographical and temporal breadth of the surveys by engaging non-mycologists in data collecting.

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