The Past and Present of Latin American Ethnomycology

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Abstract

This essay expands the boundaries of so-called “folk” perceptions or Traditional Ecological Knowledge (TEK) of Latin American mycology through a review of fungi in ethnographic and scientific research. I focus on macrofungi, but also address the microscopic ambient yeasts and molds which have been essential to fermentation since the origins of agriculture (despite a lack of documentation in ancient societies). The research of cultural uses and perceptions of mushrooms and other fungi is called ethnomycology– a field that receives far too little attention.

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Tropical rainforest biomes host 66% of the total world plant diversity, making them prime research areas for understanding mycological relationships and their interdependence with plants and animals.[39] Traditionally, research has concentrated on plant/animal communities, with fungal species receiving less attention. Globally, ~90% of plants rely on mycorrhizal relationships, the majority of which are obscured beneath the soil or within the cells of leaves /stems (e.g., fungal endophytes). This paper focuses on Latin America because of its history of mycological research, especially in the lowland tropical regions with high humidity. The ecological diversity of Central and South America has resulted in many cultural and ecological studies, but these forests are quickly becoming the most threatened ecosystems in the world. [11,17,26,30,31,40,50,51]

Ethnomycological research stemmed from the scientific discovery of *Psilocybe* rituals in Guatemala and Mexico, rituals now known to extend into Honduras and El Salvador. The earliest direct evidence of these ceremonies comes from the mid-20th century. However, the origin of these rituals is impossible to pinpoint due to the political climate and violence in the region, which has erased many oral histories. Recent civil warfare in El Salvador, Guatemala, and Honduras has threatened the lives of the countries' inhabitants and led to violence against journalists.[4] Civil unrest and violence have impacted recent and current expeditions aimed at understanding fungal diversity and its sociocultural and ecological implications.[7]

Ethnomycological research throughout the last seven decades has been hampered by issues surrounding the legality and ethics of studying fungal species with hallucinogenic properties. However, there is more to the overlap between mycology and ethnography (beyond hallucinogens) that has the potential to build our knowledge base on a broad foundation linking local ecologies, mythologies, ethnomedicinal practices, and regional economies. Emerging areas of interest include the potentials of mycology for the remediation of ecological pollution. As we face this era of global climate change, understanding the role of fungi in local ecosystems through the eyes of indigenous peoples (e.g., TEK) may provide insight into modern-day mycoremediation techniques.

THE ORIGINS OF ETHNOMYCOLOGY AND THE "MUSHROOM CULT"

Ethnomycology is a relatively new field, tracing back to the early 1950s when the American author and banker R. Gordon Wasson (1898-1986) first explored the mushroom cultures of Mexico and Central America. In 1957, his journey was popularized in LIFE magazine article, "Seeking the Magic Mushrooms," which documented psychedelic mushroom ceremonies where *curanderas/curanderos* (healers) used mushrooms to elicit visions, alter perceptions, prophesize health outcomes, and resolve internal conflicts.

Self-proclaimed in LIFE to be the "first white man in recorded history to eat the divine mushroom," Wasson initially attempted to obscure the identity of his *curandera*, Maria Sabina. However, Wasson revealed her name and hometown in a book he later published. Subsequently, droves of North Americans flooded the *curanderos/curanderas* of Mexico, resulting in both their disenfranchisement and a dilution of the dignity and respect once present in the ceremonies. Psychedelic mushrooms are now available for purchase in many Latin American countries, found in community marketplaces that target tourists seeking a traditional experience.

As early as 1956, Wasson had created a list of Latin American societies that considered lighting bolts to stimulate mushroom growth. This list has since expanded to include cultures of every continent besides Antarctica.[25] Correlations between lightning strikes and mushroom growth may, however, be a product of heavy rains that accompany lightning storms. Regardless, lighting and thunder references are found in many creation myths of Latin America (Mixtecs [38], Quiché and Tzeltal [19,43], Tzutuhil and Nahuatl [20], and Mixe [43]).

The Tzeltal of Chiapas, for example, have observed a positive correlation between lightning and mushroom abundance.[44] Similarly, the Quiché word for thunderbolt, *kaqulja*, is a synonym for the fungus *Amanita muscaria*.[19] Recent studies on associations between electrical impulses and mushroom growth have found that mushroom substrates increase up to two times their yield of fruiting bodies when subjected to intentionally applied electricity.[37,42,45] Therefore, myths between fungi and lightning have an empirical basis.

Wasson also posited that the identity of the enigmatic Indian *soma*[1] was the iconic red and white *A. Muscaria* with a history of use by European and Asiatic shamans, as well as the Quiché of Guatemala.[19,20,29] This species contains the psychoactive chemical muscimol in addition to ibotenic acid, which has undesirable side effects if not properly prepared. This has led to unique habits of consumption, such as Siberian tribesmen drinking the urine of the individual (or reindeer) who initially consumed the mushroom, bypassing the effects of the ibotenic acid.[47]

While not all of Wasson's theories are supported, suggestions of the mystical powers of mushroom cultshave been strengthened by the discoveries of mushroom stones across Mexico and Guatemala dating from the Preclassic to Classic Mayan Periods (1000 BCE–1000 CE). These carved mushroom effigies typically have the faces of humans or animals and may be interpreted to represent spiritual experiences. Shamans often use masks or mimicry to embody animals in ceremonies; perhaps the use of psychotropic mushrooms allows shamans to feel as though they have physically embodied the animal. While Wasson has linked the stones ideologically to psychedelic rituals, evidence is lacking that demonstrates these stones and rituals were used contemporaneously. Pottery, drawings, frescoes, and stone engravings depicting mushrooms were also found in Mayan and Aztec temples and codices alongside representations of hallucinogenic plants.[29,48]

[1] The identity of soma has long been obscured, and while recently popularized in the book *Brave New World,* it can be traced back roughly 3000 years when mentioned in the sacred Hindu text *Rig Veda.* It compares to the Greek *ambrosia* or Zoroastrian *haoma.*

RECENT RESEARCH IN LATIN AMERICAN ETHNOMYCOLOGY

Wasson's research allowed him to form a conceptual dichotomy of mycophilia vs. mycophobia, dividing cultural heritages into categories based on their history and interaction with fungi. Those with cultural histories of using magic mushrooms in ceremonies were portrayed as having a predisposition to enjoy mushrooms as a "delectable food", while those who did not feared them as a "filthy poison".[49] Wasson developed his polarity further in the 1957 publication of a two-volume series entitled *Mushrooms Russia and History*:over 600 combined pages of an analysis of world-cultural mushroom perspectives co-authored by his wife, Valentina. The Spanish, for example, never "tasted the mushrooms, for they were mycophobes and this cultural heritage would reinforce an initial repugnance for native 'idolatries.'"[49]

A recent study in Costa Rica and Honduras has shown that Wasson's classifications are not definitive. It seems that regional perceptions of mushrooms may be negative despite cultural mythologies surrounding them, or positive in areas without known historical mythologies.[34] Further, it has been argued by Ruan-Soto that perceptions of mushrooms vary on a socio-economic basis, where indigenous peoples and peasants are the most mycophilic, and those of higher economic standing are more mycophobic [35]. Harvesting mushrooms is often stigmatized as being associated with poorer communities who must forage for wild foods to sustain themselves.[33] City-dwellers, on the other hand, likely buy most foods from markets where species are easier to distinguish. Ruan-Soto also notes that lowland and highland communities have different cultural knowledge of mushroom toxicities due to differing amounts of interactions with the fungi.[35] Those who cannot distinguish between edible and toxic species may be more likely to be mycophobic.

Ephemeral appearances of macrofungi no doubt add to their allure and mysticality, but the prevalence of mushrooms sold by mushroom collectors or *hongueros* across the southern half of the North American continent is a clear indication of their importance. Fungi are essential to cuisine, traditional medicine, cosmetics, and even as toys or fashion accessories. Microscopic fungi are also necessary for alcohol production and fermentation.

FOLK MAGIC, MYTHS, AND SCIENCE

Ceremonial mushroom uses have a much older history than documented by recent ethnomycology. Evidence includes the Mayan mushroom stones of Guatemala, first discovered in 1898 by Archeologist Carl Sapper. The oldest stones date to 2,200 years BP. Initially thought to be phallic symbols, these stones are now interpreted as *manos* used to crush foods (perhaps psychoactive mushrooms) on *metate* grinding stones. Their association with mushrooms started with Wasson's mycological expeditions. More recently, botanist Bernard Lowy has discovered mushroom stones in the highlands of Guatemala, which he claims to be an indication of mushroom fertility cults.[18] While I do not specifically address their spiritual meaning, their ubiquity signifies a persisting cultural lineage of mushroom use.

Early ethnographic records from the 1930s described a white fungus (*rupe*) that was consumed by a shaman's apprentice in Guyana. This *rupe*, eaten in preparation for the cannibalistic *Kanaimà* hunt, allowed hunters to move rapidly.[12] Similarly, Peruvian Matsigenka (or Machiguenga) hunters chewed the roots of a *Cyperus* bush, often infected by the ergot-producing fungus *Claviceps,* to increase their

endurance.[40,51]*Claviceps* is the same genus from which LSD was synthesized, and indigenous groups used these psychoactive species commonly until Protestant missionaries prohibited their use.[40] It is now known that the phytochemical interaction between *Cyperus* and *Claviceps* sharpens sensory skills, but the hunters' ritual offers a window into cultural perceptions of physical and spiritual environments.

The Hotï, who inhabit portions of Venezuela and Guyana, also use mushrooms for hunting magic, and are known to consume the "spider monkey bile fungus" to restore hunting prowess when arrows miss the prized spider monkey on a hunt.[51, 52] This fungus is visually similar to a spider monkey's bile, symbolically linking the fungus to the monkey's power. All mushrooms are mystical in the eyes of the Hotï, who consider mushrooms to be the food of the spirits and believe that they can interact with forest spirits through potions concocted with local species of fungi and plants. One fungus, aptly named the "devil fungus", is used by shamans to inflict injury or death upon another person.[52]. The only way to counteract a curse is to consult the spirits who listen to the plea of the afflicted and can potentially return the inflicted effects to the issuer of the poison.[52] In the same way that a fungus can be symbolically linked to an animal based on its resemblance, indigenous origin stories have linked mushrooms to environmental phenomena–specifically rain. For example, Tzeltal Mayans of highland Chiapas have a creation myth stating that after God flooded the earth for 13 days and nights, the crops were decimated and all that was left after the water receded were newly sprouting mushrooms. These mushrooms have been referred to as the "grace of the flood".[41]

Ongoing observations of mushrooms as "bioclimatic indicators" have been documented among the Mixtecs of southeastern Mexico, where sprouting mushrooms indicate the start of the rainy season.[38] The Mixtecs and Zapotecs have also noted that the pine mushroom[2] (*Agaricus campestris*) appears one week after the first rain of a season, and that some bird's nest fungi (*Cyathus berkeleyanus, C. olla, and C. striatus*), fungi shaped like small birds nests, contain egg-like nodules that explode with spores when hit by raindrops. The number of "eggs" in each "nest" indicates whether a good rainy season and crop yield are to come.[15] Another group of basidiomycetes called puffballs are rain indicators; their dry and mature fruiting bodies puff out a plume of spores when raindrops hit them. The *Nuu savi* (People of the Rain) of southeastern Mexico also say specifically that the species *Neolentinus lepideus* appears as an indication of the oncoming rainy season, in contrast to mushrooms in general for the Mixtecs.[38] In Huyupan-, Spanish- and Nahuatl-speaking communities, people have linked hallucinogenic species with the ability to contact *asuadores* or *quiotlazque* (the rainmakers). While these hallucinogenic species may be culturally significant, five non-hallucinogenic species deemed "fungi of the weather" seemed to be of similar importance.[1]

As mentioned above, fungi are used for a variety of purposes outside of the realm of pure sustenance. Medicinal fungi are of prime interest, as fungi often contain unique compounds not found elsewhere in nature. In the central Mexican state of Quarétaro, Otomí and Mestizo populations have reported that the popular edible fungi *Ustilago maydis* (also known as corn smut) can be placed on burns to promote

[2] Not to be confused with the "pine mushroom" *Tricholoma matsutake,* famous in Japanese cuisine or the American variety *Tricholoma Magnivelare*

faster healing or eaten to combat vomiting.[36] Robles-Garcia and colleagues also found that the species *Exsudoporus frostii* is used to treat diabetes, the spores of *U. maydis* are used as veterinary treatment for horses, and *Leccinum spp.* basidiocarps (fruiting bodies) are not consumed but are often used by children as toys. In northern Mexico, *Lycoperdon marginatum* is used by shamans to "travel undetected" through their environment, while Mixtecs to the south use the related species *L. mixtecorum* to "induce a half-sleep state."[25]

Venezuelan Hotï were found to use an unidentified dark purple fungus as earrings, which may have carried sexual connotations.[52] Ascribing sexual qualities to mushrooms is shared among the Tzeltal- and Tzotzil-speaking Mayans of highland Chiapas; for example, the word *lu'* refers to mushrooms in general, but it is also a homonym for vagina. Some mushrooms are thought to represent female qualities with their "volvas"[3] and "veils", while others share the word *yat* (meaning penis) such as the "horse penis" or "demon penis" mushrooms.[41] Shepard Jr. and colleagues found that languages in the neighboring regions Oxchuc, Tenejapa, and Aguacatenango all share a symbolic linguistic relationship between mushrooms and sexuality. These communities prescribe the spores of earthstars and puffballs as treatments for warts or wounds, and also use several polypores for inflictions "ranging from stomach aches to mouth sores and insanity."[41]

The use of microscopic fungi is essential not only for traditional medicine and mythology, but also as a critical ingredient in fermenting drinks such as the Peruvian/Ecuadorian *chicha* or *masato*, Mexican *pulque*, or Guyanese *parakari.* Fermented beverages play an important role in many traditional societies because the alcohol production process ensures drinking water is relatively free of harmful bacteria. While many familiar culinary processes[4] rely on the ambient yeast *Saccharomyces cerevisiae* to ferment, *parakari* is interesting because of its dependence on a different microfungus:a domesticated mucoraceous mold of the genus *Rhizopus.*

Parakari is a beverage made from the tuber called cassava, manioc, or yucca, depending on the community (*Manihot esculenta*). The bitter variety of cassava contains cyanide and is toxic if not prepared properly, while sweet cassava requires no extra processing. Two studies in Guyana by Henkel in 2002 and 2005 found that out of the nine indigenous tribes in the country, only three make *parakari.*[13,14] The Wapisiana, Macusi, and Patamona partake in a thirty-step process that extracts the toxic fluids of bitter cassava before inoculation with a domestic species of bread mold (Rhizopus spp.). This is the only known example of indigenous New World fermentation prescribing use of an amylolytic mold, though the complex process is similar to the fermentation processes of indigenous Chinese *lao-chao* and the Indonesian rice beer, *pachwai.*[14]

Chicha is produced regionally from cassava or other starchy ingredients such as plantain/ maize. *Chicha* differs from *parakari* in that part of the fermentation process entails the mastication (chewing) of the

[3] The term *volva* is used to describe the cup-like morphological feature of gasteroid fungi (basidiomycota). It is found in all *Amanita* species, and bears resemblance to the human anatomy term *vulva*

[4] Processes such as making bread, beer, wine, and chocolate

plant material to partially break down the starch molecules with salivary amylase, which becomes sugary and more susceptible to further yeast-hosted fermentation.[24] Interestingly, the Shuar of Ecuador and Peru make another variety of *chicha* called *sankuch chicha,* which involves a roasting and chewing cassava that has been inoculated with a species of red mushrooms[5] to stimulate decomposition.[24]

As commonly as mushrooms are consumed, especially those with toxic lookalikes, poisoning risks are concerning. There is not an abundance of information on hospitalizations for mushroom-related poisoning across the region. Most records come from hospitals in Mexico that make no distinction between the effects of intoxicating and deadly mushroom species.[32] The difference between intoxication and death may simply be a matter of quantity consumed, after all. Most poisonings occur when those less familiar with mushrooms start collecting species that most in the region would know to avoid.[41] Some species require specific processing before consumption and therefore are considered toxic by most communities even if commonly eaten in another. For example, mushrooms from the genera *Gyromitra and Gomplus* are consumed by Nuahua of Tlaxcala, but only after boiling out and rinsing off water-soluble toxins.[11] Nahua women partake in scientific exploration by gathering new species in times of food scarcity, choosing based on shared characteristics with known edible species, and feeding them to dogs to determine if they are safe before sharing with family members.[11] These forms of knowledge are passed down matrilineally, continually expanding and adapting to stressful conditions. Traditional foraging patterns are becoming threatened by modernization, clear-cutting of forests, acid rain, and oil spills across the globe. Garibay-Orijel and colleagues recorded growing concerns of mushroom-collecting women who must increasingly travel further lengths to find the same species.[11] As the opportunities of finding species are diminished, the passing of TEK to new generations disappears.

EXPANDING ECOLOGICAL CONCERNS

Conservation of threatened ecosystems is generally seen solely from an environmental standpoint. However, the cultural loss felt by indigenous peoples is of similar importance; without millennia of careful environmental observations and interactions, our species would have never made any scientific advancement. These stewards of our natural spaces still hold knowledge of our ecosystems that can be understood and replicated outside of a laboratory environment. They hold perspectives often overlooked in the rigid frameworks of mainstream academia.

In order to analyze the link between ecosystems and their inhabitants, it is essential to dig deeper, in a literal sense—beneath the ground. Mycelium is not only glue for the fabric of ecosystems, but it also unites the environment with indigenous foodways and cultural practices. This mycelial glue occupies an interstitial space between soil particles or plant cells. Some plants even allow the hyphae to penetrate the cell membranes themselves. These systems can redistribute nutrients and water to plants, and in select species, allow the plant to grow without any chlorophyll for photosynthesis. Understanding the

[5] Unfortunately, the authors did not provide specific details about the red mushrooms

role of fungi mycelium in ecology is a difficult task. While new scientific breakthroughs continue, it is crucial to understand the cultural and historical implications of fungi collection and forest ecologies—the latter of which has been shaped by indigenous populations since antiquity.

Indigenous societies (globally) shape their landscapes with cultural and ethical perspectives developed over centuries of observation and refinement. TEK has been developed out of observations made by ancient peoples interacting with their environments over millennia. Studying traditional ecological practices, therefore, gives us a window into possible empirical connections between folk knowledge and ecological outcomes, essentially generating novel research questions informed by diverse cultural-ecological relationships.

In the current era, oil spills and forest degradation are both environmental and cultural problems, as they threaten the local ecologies of indigenous groups throughout the world. Indigenous techniques of harvesting and managing fungi can offer a unique perspective on protecting the diversity of habitats at risk of extinction. Moreover, new scientific perspectives, such as decades of harvesting records and associated mushroom numbers, comparisons between plucking and cutting mushrooms, and experimental forms of mycoremediation are worth considering as a means of protecting these environments for future generations. It is also useful to understand how indigenous populations attempt to mitigate the decreasing number of mushrooms available for harvest.

FORAGING ETHICS

Some regional populations take it upon themselves to institute harvesting practices intended to extend mushroom harvests without formal regulations. One common folk practice in Michoacán for ensuring the continuation of wild mushroom harvests is to only harvest the top (cap and stipe) of a mushroom, leaving the base to grow.[6] However, this is a fundamental misunderstanding of how fungi differ from plants and does not result in larger future harvests. Fungi are only the fruiting body of a much larger organ. This is comparable to plucking fruit off of a tree; the fruit will not grow back if a portion of it is left. Mushrooms are sexual organs of a fungus, intended to spread genetic information through spores once they reach maturity. For most economically viable edible varieties such as the *Amanita caesarea* complex and *Boletus* complex, it is common practice to harvest mushrooms before they are fully mature.[26] These species are tastier in their mid-development stages and sell for higher prices. However, immature plucking does not allow the fruiting body to drop spores and further propagate, thus leading to population loss. The commercial value of these desirable culinary mushrooms has drastically increased the number of opportunistic harvesters searching for them, which only further exacerbates the issues of plucking immature mushrooms and trampling of colonies.

On the other hand, there is speculation that cutting mushrooms above their base rather than plucking them may be less damaging to the mycelium of a fungal colony. This assumption is due to the mycelial threads visible at the base of a freshly plucked mushroom. A 29-year analysis of measured plots in Switzerland shows that repeated harvests of a systematic nature "reduces neither the future yield of fruit bodies nor the species richness of wild forest fungi, irrespective of whether the harvesting technique was picking or cutting,"[8] However, this study did find evidence of a decreased number of

fruiting bodies caused by trampling the forest in the process of harvesting edible mushrooms. While trampling impacted the overall number of fruiting bodies in particular patches, it did not decrease the species diversity—this was more of a matter of climatic conditions in the area.[8] A similar study conducted over nine years on the Oregon coast suggests not only that there is little difference between plucking and cutting mushrooms, but also that the removal of the fruiting body "may slightly stimulate subsequent [mushroom] productivity." [28] This may be the result of harvesters, as they pluck mature fruiting bodies and carry them through the forest, spores dispersing along the way.

Suggestions for protecting future yields in central Mexico have been offered, such asavoiding trampling, monitoring the forests with GIS, and plucking the fungi gently rather than cutting to avoid accidentally cutting other species, or smaller fruits growing alongside the mature fruits.[9] Understanding the impact that mushroom harvests have in central Mexico is vital, as 66% of the forest is under high harvest pressure and human activity is causing at least thirty-six species to decline in number.[9] In San Pedro Tlalcuapan communities, 42% reported that they actively try to conserve mushroom "seeds" for future harvests and believe that they also fertilize trees.[3] Harvesters in the Meseta Purépecha search for mushrooms every three days so they can mature fully before cutting. Once the mature fungi have already dropped spores, harvesters blow off spores (the reproductive units) as they walk through the forest to ensure further expansion of colonies.[6] It is also common in the region to only collect mushrooms and other non-forest timber products (NFTP) in the wet season when pine resin and firewood are not available to harvest and sell. In communities near the volcano *La Malinche*, swidden agricultural techniques are commonly used to manage the forest for firewood and mushroom species, the latter of which thrive after fires (eg. *Morchella sp)*. These fires, however, generally cause much more damage to mushroom growth than they solve because many mushroom species die along with their host trees.[9,26,27]

There is a general lack of research on different community perceptions related to mushroom decline, especially outside of Mexico. It would be interesting to compare these conservation tactics and beliefs with other regions and countries. Some practices should be considered for implementation in all ecosystems, including avoiding plucking the leading edge of an expanding mushroom patch, blowing off the spores after plucking/cutting, and only harvesting those that are mature rather than the smaller or the older specimen, allowing the spores to be spread.[46] Saprobic fungi (decomposers) grow in big circles, spreading out from a central point where fruiting bodies pop up towards the outside. Harvesting fungi from the leading edge of an outward growing patch may make it harder for the mycelium to expand its range in search of new food sources, therefore impacting the future growth of mushrooms in the patch. Many mushrooms also grow in the disturbance of human walkways, such as alongside forest paths of national parks where the mycelium can sense that there is a new front of soil to grow into that is otherwise uncolonized.[46] Soil compacted by walking makes it hard for mycelium to grow directly on paths, but the edges along the sides of the paths are great spots for mushroom collection.

Collecting fungi or any other NTFP from the edges of walkways in areas of industrial or agricultural development also presents us with social justice issues of marginalized communities. These areas

represent a “fringe ecology”,[6] where “wild nature produces a diversity of products that are not often the priority species for dominant land management regimes.”[16] As new areas of Latin American forests are turned into spaces for cattle pasture or oil drilling, foraging in these fringe ecologies may have many repercussions for those who historically used the areas for resources. As many of these foraging zones are used by indigenous communities, the spread of urbanization and trespassing industrial corporations upon indigenous land represent hegemonic processes of displacement. This displacement forces minorities farther away from self-sufficient household economies dependent on the acquisition of food, medicine, and other cultural products of the land. These minority populations may also experience political tensions with other groups occupying the same region. Aside from the legal repercussions that rural communities may face when attempting to harvest fungi from fringe ecologies, there may also be health-related implications due to improper waste management practices of industry, cattle farms, and urban neighborhoods. After all, fungi are detritivores and are known to absorb many dangerous compounds from their substrates such as the heavy metal copper (Cu II) from mining, or polycyclic aromatic hydrocarbons (PAHs), crude oil, and even plastics.[2,22,23,36] Fungal bioaccumulation of pollutants is beneficial to the soil-landscape overall, but these bioaccumulators could be toxic to humans and animals that consume them. Compounding these issues of declining biodiversity and overexploitation of forest ecosystems are the illegal extraction of wood, and more broadly, climate change.[6]

It is easy to measure the damages of environmental pollution in terms of loss of species diversity, but it is impossible to calculate the intangible cultural loss of human communities facing this destruction. Foraging patterns, ceremonial landscapes, and emotional wellbeing are all damaged by the pollution and rezoning of the natural spaces. It is essential to start working on not only environmental remediation, but also with these displaced communities for appropriate compensation. While this paper does not attempt to identify particular methods of compensation for communities affected, it does represent a call to the scientific community to address the topic of displaced peoples and to explore possible solutions for preserving cultural traditions and knowledge.

CONCLUSIONS

The potential for future mycological research is very promising. Ethnomycology can show us a new perspective on cultural ethnographies, while mycoremediation focuses on ecological interactions. The field of ethnomycology was established in a time of emerging psychedelic understanding and has largely left out the recognition of everyday varieties that have been essential to cuisine, medicine, and general utilities. To better understand how cultural relationships have intertwined and evolved with fungi, researchers must borrow new methods of identifying fungal remains from similar fields, such as paleoethnobotany. Expanding our means of identifying the foodways of our ancestors is essential to painting a broader picture of our history. Similarly, mycelium's ecological role is drastically

[6] This phrase was defined in a 2008 paper on urbanization impacts on indigenous harvesting methods in South Carolina

underappreciated and should be developed further for a more informed future of environmental understanding.

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