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A preliminary study of the ecological distribution and diversity of mushrooms in the Standing Rock Indian Reservation, USA

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Abstract

Various macrofungi, commonly referred to as mushrooms, have been used since ancient times as food, as a source of natural dyes for clothing, for treating wounds, and for providing substances used as remedies to fight off infections. In nature, mushrooms are ecologically important because they have saprobic, parasitic and mycorrhizal relationships with plants. Native Americans have valued mushrooms for food as well as for their medicinal and hallucinogenic properties, but little information is available on either the occurrence or the use of mushrooms by the tribes of the Standing Rock Indian Reservation. Prior to the present study, it was hypothesized that the four major types of habitats (upland forest, riverine forest, floodplain and grassland habitats) on the reservation would be characterized by significant differences in mushroom species richness (number of species) and diversity. To assess these patterns, transect lines 10 m wide by 100 m long were established in examples of the four different habitats, and mushrooms were surveyed in July and August of 2017. At least 22 species were recorded, and differences in their distribution among the four habitats were apparent.

Key words – Ecology **–** habitats **–** macrofungi **–** Native Americans **–** North Dakota **–** South Dakota

Introduction

Various macrofungi, commonly referred to as mushrooms, have been used since ancient times as food, as a source of natural dyes for clothing, for treating wounds, and by providing substances used as remedies to fight off infections. In nature, mushrooms are ecologically important because they have saprobic, parasitic and mycorrhizal relationships with plants. Native Americans valued mushrooms for food as well as for their medicinal and hallucinogenic properties. For example, tobacco has played a role in certain ceremonies and festivities since at least 1621, and it has been suggested that *Phellinus igniarius* (L.) Quél. has often provided a fungal ash that was mixed with tobacco (Blanchette 2001). Fortuine (1996) reported that when tobacco was introduced into Alaska, the indigenous people of Alaska developed a blend of tobacco and *Phellinus* ash (punk ash) which they called "iqmik."

Mushrooms are widely distributed in many different habitats and are associated with a wide range of different substrates (McKnight & McKnight 1987, Trappe et al. 2007, Binion et al. 2008,

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Stephenson 2010). The season of the year and the environmental conditions which exist at a particular locality influence the fruiting patterns of mushrooms, but many species occur during the late summer and early fall. The present study was carried out during July and August of 2017.

The objectives of the study reported herein were to survey and document species of mushrooms and their habitats on the Standing Rock Indian Reservation, where no previous investigations of these organisms had ever been carried out. Information on the mushrooms present is important for planning habitat conservation practices and providing the direction for further research on such things as medicinal mushrooms used by the local Native Americans before this vital knowledge is lost. One of the primary questions addressed was whether or not the four main types of habitats in the reservation (upland forest, floodplain, riverine forest and grassland) support the same levels of species richness and diversity. We hypothesized that the four habitats are characterized by different levels of species richness and diversity.

The general study area was the Standing Rock Indian Reservation, which cover the southern portion of North Dakota and the northern portion of South Dakota in the United States. The reservation has a total area of 9,251.2 km^2 (3,571.9 square miles) and a human population of approximately 8,200 (2010, based on figures from the national census). It is occupied by the ethnic Hunkpapa Lakota, Sihasapa Lakota and Yanktonai Dakota tribes.

Materials & Methods

To assess local knowledge of mushrooms by the tribes on the reservation, interviews were carried out with a number of individuals. Information relating to any aspect of collecting and using mushrooms was recorded.

The tools and supplies used in the present study included a knife for uprooting fruiting bodies, a soft brush, a metric ruler, fiberglass measuring tapes, a hand basket, a dissecting microscope, hand lens, plastic bags, paper bags, a camera, compass, insect repellant, first aid kit, and sterile (latex) gloves. Belt transects 10 m by 100 m were established in nine study sites which represented the four different habitats (upland forest, floodplain, riverine forest and grassland) being investigated. Sampling was carried out by walking along these transect lines "hunting" for mushrooms on the ground as well as on other substrates such as trees, logs and dung. For all of the species encountered, photos were taken both before and after the fruiting bodies were collected, and the data recorded included the name of the study site, date collected, habitat, the particular substrate and collection number.

The fruiting bodies of most mushrooms are delicate, but a knife was used to carefully uproot the entire specimen without inflicting any damage, and the soft brush was used to gently remove any dirt and debris that had lodged in the gills or pores of the mushroom. After the specimen was photographed, it was placed in a small paper bag and then put into a basket to be returned to the laboratory for identification and further analysis. Hosford et al. (1997) used a similar method when collecting the commercially harvested *Tricholoma magnivelare* Peck (American matsutake) mushroom from forests in the Pacific Northwest. Uprooting the entire specimen is necessary for accurate determination of the members of some genera such as *Amanita* which have certain structural features such as the remnants of a universal veil (volva) attached to the base of the stipe, which sometimes may occur below ground level. After uprooting specimens, the remaining exposed mycelium was then covered with dirt or debris to keep it from desiccation.

Data were analyzed for species richness and diversity. The Simpson's Reciprocal Diversity Index (1/D) was used to compare diversity among the different habitats. JMP statistical software was used to carry out an analysis of variance (ANOVA). The F-test was used to investigate if there were any statistically significant differences among the four habitats.

Results

At least 22 species (Table 1) were recorded from the nine transects. Out of the 22 species, 47% are considered to be edible, 19% to have medicinal properties, 5% to be hallucinogenic, 24% to be poisonous, and 5% to be homeopathic. All of the 22 species encountered belong to the phylum

Basidiomycota. Some of the representative species encountered (Fig. 1) were *Amanita daucipes* (Mont.) Lloyd, *Bovista longispora* Kreisel, *Clavulina cristata* (Holmsk.) J. Schröt, and *Phellinus everhartii* (Ellis & Galloway) A. Ames.

Table 1 Mushrooms recorded during the present study, with information provided on the family to which each belongs, overall frequency, frequency per habitat and category. Note: F = Frequency; Habitats (FP = flood plain, UF = upland forest, RF = riverine forest and G = grassland).

	Species	**Family**	**F**	**FP**	**UF**	**RF**	**G**	**Category**
1	*Amanita daucipes* (Mont.) Lloyd	Amanitaceae	1	0	1	0	0	Poisonous
2	*Amanita virosa* (Fr.) Bertillon.	Amanitaceae	1	0	1	0	0	Poisonous
3	*Bovista longispora* Kreisel	Agaricaceae	2	0	1	1	0	Homeopathic
4	*Cantharellus lateritius* (Berk.) Singer.	Cantharellaceae	1	0	0	1	0	Edible
5	*Cheimonophyllum candidissimum* (Berk. & M.A.Curtis) Singer.	Cyphellaceae	2	0	1	1	0	Poisonous
6	*Chlorophyllum molybdites* (G. Mey.) Massee.	Agaricaceae	3	0	0	0	1	Poisonous
7	*Clavulina cristata* (Holmsk.) J. Schröt.	Clavulinaceae	2	0	1	1	0	Edible
8	*Coprinellus niveus* Fr.	Psathyrellaceae	7	0	0	1	0	Poisonous
9	*Cyathus striatus* (Huds.) Willd.	Nidulariaceae	1	1	0	0	0	Medicinal
10	*Gymnopus dryophilus* (Bull.) Murrill	Marasmiaceae	2	0	0	1	0	Edible
11	*Hygrocybe coccinea* (Schaeff.) P. Kumm.	Hygrophoraceae	2	1	0	0	0	Edible
12	*Laetiporus sulphureus* (Bull.) Murrill.	Polyporaceae	12	0	0	1	0	Medicinal
13	*Leccinum insigne* A.H.Sm., Thiers & Watling.	Boletaceae	1	0	1	0	0	Edible
14	*Leucopaxillus gentianeus* (Quél.) Kotl.	Tricholomataceae	2	0	0	1	0	Edible
15	*Megacollybia platyphylla* (Pers.) Kotl. & Pouzar.	Marasmiaceae	2	0	0	1	0	Edible
16	*Panaeolus papilionaceus* (Bull.) Quél.	Incertae sedis	6	0	1	0	0	**Hallucinogenic**
17	*Phellinus everhartii* (Ellis & Galloway) A. Ames.	Hymenochaetaceae	5	0	1	1	0	Medicinal
18	*Phellinus igniarius* (L.) Quél.	Hymenochaetaceae	13	0	1	1	0	Medicinal
19	*Russula brevipes* Peck.	Russulaceae	1	0	0	1	0	Edible
20	*Suillus cavipes* (Opat.) A.H.Sm. & Thiers.	Suillaceae	10	1	1	1	0	Edible
21	*Trametes versicolor* (L.) Lloyd	Polyporaceae	5	0	1	1	0	Medicinal
22	*Volvopluteus gloiocephalus* (DC.) Vizzini, Contu & Justo.	Pluteaceae	1	0	1	0	0	Edible
	Total			**3**	**11**	**13**	**1**	

Discussion

The present study is the first of its kind to be carried out in the Standing Rock Reservation of North and South Dakota. The results obtained suggest that there are differences in mushroom diversity among the four habitats (Table 1). However, since there are differences among the four habitats in terms of substrates and potential hosts, moisture levels, land use and soil type, it was not surprising to discover that differences in diversity also exist. This finding concurs with other studies, including the one carried out by Tsiarasa & Domakinisb (2013), who described the relationships they found between mushrooms and forest habitats, the geology of the area they studied and the particular tree species (host) infected.

The Standing Rock Reservation has a number of medicinal mushrooms, with one of the more common being the species (*Phellinus igniarius*) mentioned earlier (Fig. 2, Table 1), which is used by the local tribes. The fruiting bodies are reduced to an ash, and the latter mixed with shredded tobacco leaves and smoked, snorted and chewed (personal communication). Other mushrooms are collected for food and other purposes, as is often the case in other areas, too (e.g. Lincoff 1981, Kuo 2007, Trappe et al. 2007, McFarland & Mueller 2009). Fruiting bodies of mushrooms collected for food by individuals on the Standing Rock Reservation are typically cleaned and cooked while still fresh, but on some occasions they are cleaned and dried for later use.

The mushrooms considered to be the most desirable are morels, which were not considered in the present study because morels fruit earlier in the year than the period during which the study was carried out. In the summer, chanterelles are the primary target species, and in the late summer various puffballs and other species listed as edible in Table 1 are collected. The particular sites where edible mushrooms appear are considered the "property" of a given household or family, who do not make these sites public due to the fear that others will collect the mushrooms present. The poverty level is high within the reservation (42% of all individuals live below the federal poverty level), so the fact that mushrooms represent a "free" source of food is greatly appreciated.

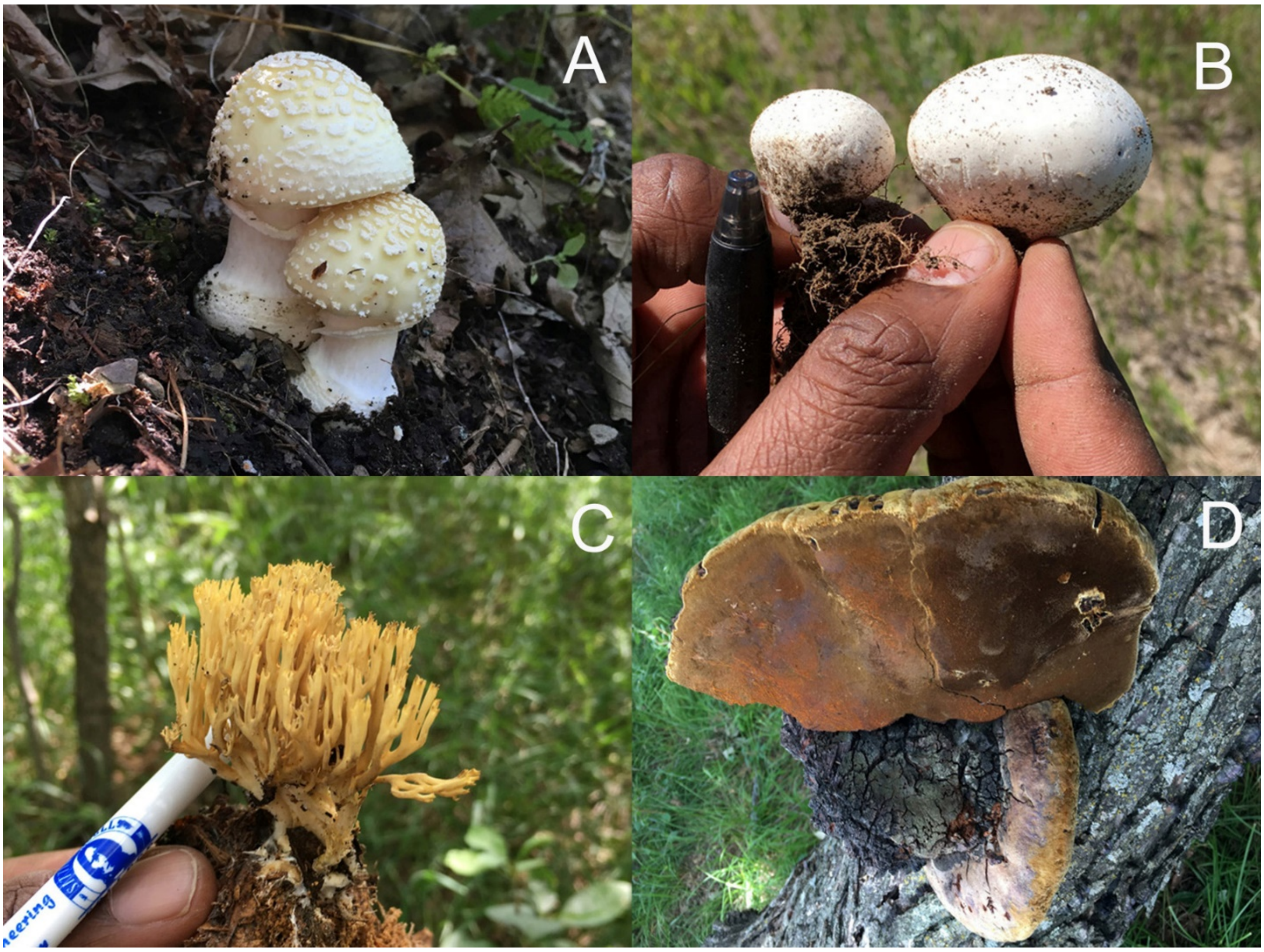

Fig. 1 – Representative mushrooms found on the Standing Rock Indian Reservation. A *Amanita daucipes*. B *Bovista longispora*. C *Clavulina cristata*. D *Phellinus everhartii*.

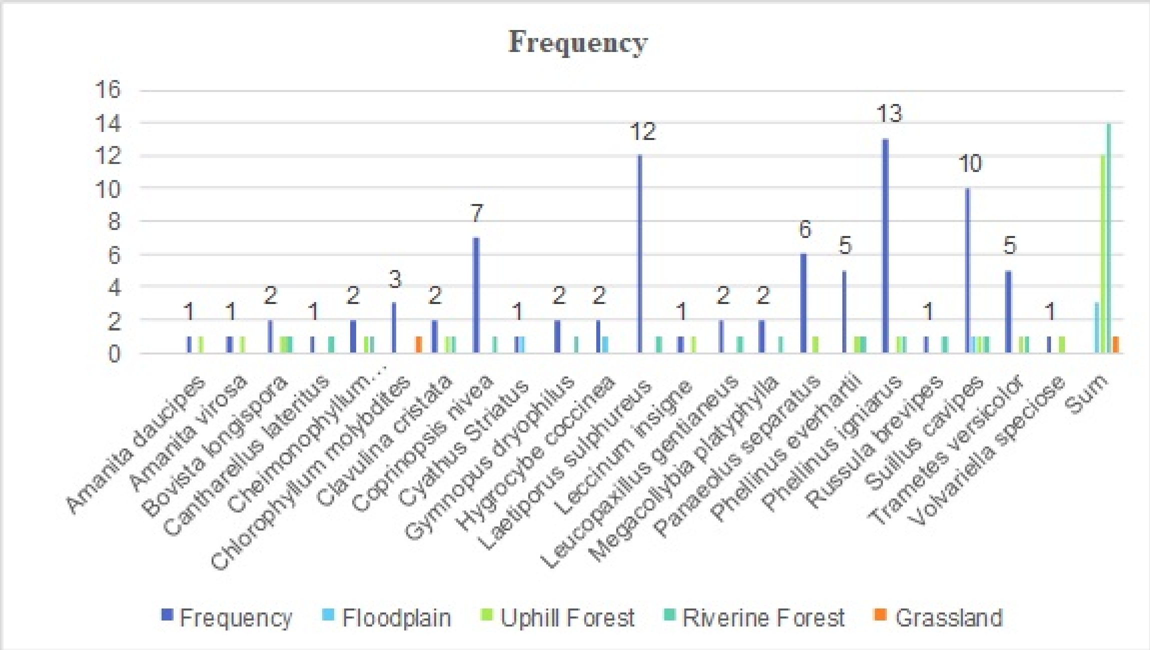

Fig. 2 – Frequency of mushrooms on the Standing Rock Indian Reservation and the habitats in which they occur.

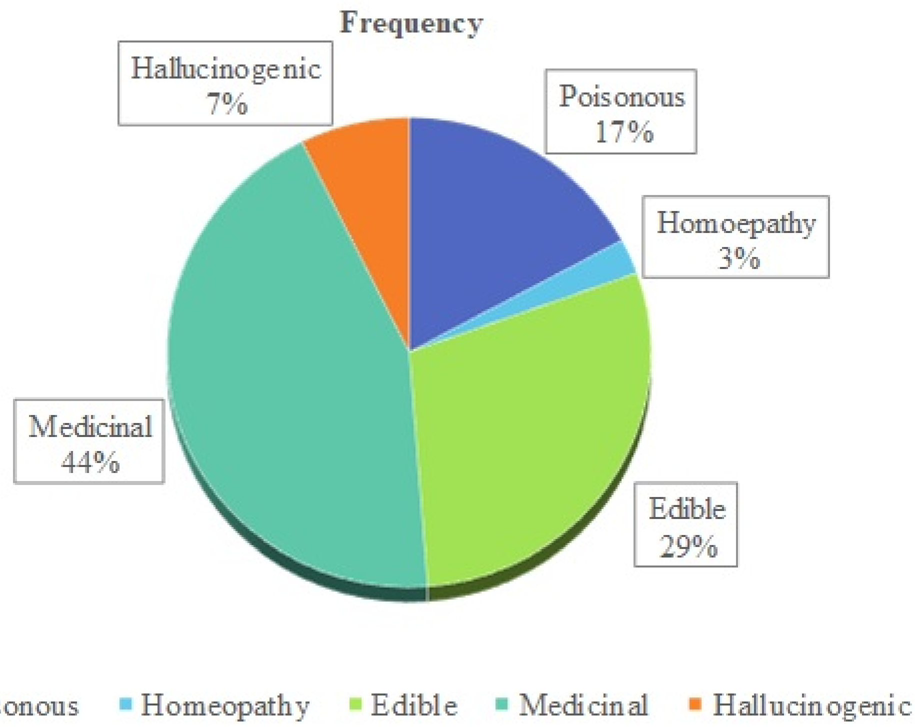

Fig. 3 – Frequency of occurrence of the various types of mushrooms found on the Standing Rock Indian Reservation.

Values of species richness differed among the different habitats (Fig. 2, Table 1), and only a single species, *Suillus cavipes* (Opat.) A.H.Sm. & Thiers., was recorded in as many as three different habitats (floodplain, upland forest and riverine forest). Five additional species (*Bovista longispora* Kreisel, *Clavulina cristata* [Holmsk.] J. Schröt, *Phellinus everhartii* [Ellis & Galloway] A. Ames, *Phellinus igniarius* [L.] Quél and *Trametes versicolor* [L.] Lloyd) were found in both upland forest and riverine forest. Values for Simpson's Reciprocal Diversity Index (1/D) were 6.8, 5.6, 1.8 and 1.0 for riverine forest, upland forest, floodplain and grassland, respectively (Table 2). The ANOVA test value ($P < 0.0001^*$ at $\alpha = 0.05$) indicated that the observed differences in mushroom species biodiversity were not due to a chance event. Instead, there is a statistically significant difference in mushroom diversity among the four studied habitats.

Table 2 Mushroom species diversity among the four habitats considered in the present study.

Index	Flood plain	Upland forest	Riverine forest	Grassland
Simpson's Diversity Index = D	D = 0.5522	D = 0.1919	D = 0.1568	D = 1.0000
Simpson's Reciprocal Index = 1/D	1/D = 1.8111	1/D = 5.2107	1/D = 6.3792	1/D = 1.0000

Note: The analysis of variance (ANOVA) F-test run calculated with the JMP software package testing the differences in species diversity between the four habitats gave $P < 0.0001^*$ at $\alpha = 0.05$ for O'Brien, Brown-Forsythe and Levene tests.

Conclusions

The data collected in the present study indicated that mushroom species abundance and diversity vary with habitats and substrates. While some species are found across several different habitats, some other species are habitat and host specific. As such, the null hypothesis of equal mushroom species richness and diversity across habitats was rejected. Moreover, the general study area has many medicinal mushrooms, and future studies will focus on medicinal species, documenting their remedial properties as well as using genotyping to investigate genetic linkages which exist for particular species. The cultural aspects surrounding the use of mushrooms for food and other uses also will be considered.

References

Binion DE, Stephenson SL, Roody WC, Burdsall HH et al. 2008 – Macrofungi Associated with Oaks of Eastern North America. West Virginia University Press, Morgantown, West Virginia.

Blanchette RA. 2001 – Fungus ashes and tobacco: the use of *Phellinus igniarius* by the indigenous people of North America. Mycologist 15, 4–9.

Fortuine R. 1996 – Historical notes on the introduction of tobacco into Alaska. Alaska Medicine 38, 1.

Hosford D, Pilz D, Molina R, Amaranthus M. 1997 – Ecology and management of the commercially harvested American matsutake. General Technical Report PNW-GTR-412. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, Oregon.

Kuo M. 2007 – 100 Edible Mushrooms. The University of Michigan Press, Ann Arbor, Michigan.

Lincoff GH. 1981 – National Audubon Society Field Guide to North American Mushrooms. Alfred A. Knopf, New York.

McFarland J, Mueller GM. 2009 – Edible Wild Mushrooms of Illinois and Surrounding States. University of Illinois Press, Champaign, Illinois.

McKnight KH, McKnight VB. 1987 – A Field Guide to Mushrooms of North America. Houghton Mifflin Company, New York.

Stephenson SL. 2010 – The Kingdom Fungi: The Biology of Mushrooms, Molds, and Lichens. Timber Press, Portland, Oregon.

Trappe M, Evans F, Trappe J. 2007 – Field Guide to North American Truffles: Haunting, Identifying, and Enjoying the World's Most Prized Fungi. Ten Speed Press, Berkeley, California.

Tsiarasa S, Domakinisb C. 2013 – Assessment of the relationship between forest habitats of mushrooms and geology in Grevena, Greece using geographic information systems (GIS). Procedia Technology 8, 122–129.