
FUNGI

AN INITIAL SURVEY OF MUSHROOMS IN GRASSLANDS NATIONAL PARK, SASKATCHEWAN

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Introduction

Grasslands National Park (GNP) is located in southwestern Saskatchewan (49.21809, -107.56192) and is representative of the mixed-grass prairie ecoregion.¹ It is a relatively new national park, being established in the 1980s.² It is composed of a west block and an east block,

containing a variety of vegetation types and geological features: upland grasslands, badlands, the Frenchman River valley, prairie dog colonies, restoration fields, eroded sloped grasslands, and small areas of aspen forest. Precipitation for the GNP area during the summer of this study was above average, creating ideal



A "puffball" mushroom of the genus Calvatia in the recently burned Two Trees Trail area of Grasslands National Park, Saskatchewan (June 17, 2013).

conditions for the emergence of fruiting bodies of mushrooms.³

Fungi are interestingly paradoxical: diverse yet poorly studied, vital to ecosystems yet neglected in biodiversity conservation. Of the estimated 1.5 million species of fungi in the world, macrofungi (or "mushrooms") represent a small portion estimated at 57,000 species of which less than half are known.^{4,5} Fungi play important and unique roles in ecosystems as decomposers, symbiotic partners, parasites, and as food and habitat for many species. They are not unlike other organisms needing conservation, being susceptible to common threats: habitat loss, pollution, habitat fragmentation, and climate change.⁶ In recent years the neglect of fungi in biodiversity conservation initiatives has been brought to light and there has been an increasing number of calls to action for the conservation of fungi.

Several European countries have taken initiative and produced national red lists of mushrooms. In 2003 the European Council for the Conservation of Fungi (ECCF) developed a Red List for 33 species of European fungi to propose to the Bern convention.⁷ In Canada and the United States a Handbook to Strategy 1 fungal

species of the northwest forests lists 135 species.⁹ Though these documents were well crafted, with detailed biological and management information on each species, protection of fungi at a species level has not yet been legislated.

In addition to conservation documents, research has been conducted into the viability of using mushrooms as indicator species in ecosystems. Certain ectomycorrhizal species of mushrooms have declined with increasing acid rain, suggesting their usefulness as indicators of pollution and forest health.^{10, 11} Waxcap mushrooms are sensitive to fertilizer application and have been used to identify and classify unfertilized grasslands where they are abundant.¹² The creation of fungal "checklists" for certain areas has many uses: as a step towards more detailed documents (and potentially Red Lists), to compare fungal diversity over time, for species range and habitat preference data, and to increase public appreciation for fungi.^{6,13}

Surveys of mushrooms in national parks of Canada have been undertaken in the past. Numerous fungal surveys were conducted across Canada in the 1970s, and although these included some mushroom-



A "bolete" mushroom of the genus *Leccinum* growing in mycorrhizal relationship with aspen trees in the small forest of 70 Mile Butte Trail in Grasslands National Park, Saskatchewan (Aug 17, 2013).

forming species, they were mainly focused on forest diseases such as rusts and wood rots with limited results.¹⁴ A larger survey in St. Lawrence Islands National Park, Ontario focused mainly on mushrooms and made them more accessible to the public, producing a list of 503 species.¹⁵ Kejimikujik National Park in Nova Scotia was studied over two years, producing a substantial list of species with certain ones highlighted as potential pollution indicators.¹¹ In Saskatchewan, the Prince Albert Model Forest and region had a large list of species produced from a survey

of mycorrhizal morphotypes and mushrooms.¹⁶

Grasslands National Park in southern Saskatchewan has been studied for years for its diverse and conspicuous lichen fungi and research has been conducted on mycorrhizal fungi, but none on the mushrooms.

Methods

This floristic survey was designed to identify and collect as many different species of mushrooms as possible. The study area comprised both the west and east blocks, including parcels still in

transition to park management (e.g. Dixon and Walker lands within the west block proposed boundary). Occasional trips were made to remote parts of the park representing under-surveyed communities (such as forested areas of the east block). The time period was limited to the summer months of 2013 (May 1 to August 31).

To raise awareness of the presence of mushrooms in the park and to widen the survey, visitors and park employees were encouraged to contribute by sending digital photos of

mushrooms along with location and habitat data to the principal investigator. Observations were posted on MushroomObserver.org where other mycologists who are members of the website suggested identifications and voted to arrive at a consensus and level of confidence.

The principal investigator received a permit to collect specimens for future study. Unique species were collected as soon as possible after an observation was made or reported. Photographs were taken, and GPS coordinates and habitat conditions recorded. Fruiting bodies were then carefully removed from the substrate, wrapped in parchment paper, and placed in containers for transport. After an attempt had been made to obtain a spore print, the specimens were dried in a dehydrator at 55°C for two days. Microscopy was limited to assisting with identification of difficult species.

Results

A total of 58 observations of individual mushrooms were recorded on MushroomObserver.org, and 36 specimens were collected.¹⁷ From these, 40 different species across 28 genera were identified (Table 1). These species can be assigned to nutritional guilds: saprophytic



Panaeolus semiovatus growing in abundance on bison dung in Grasslands National Park, Saskatchewan (May 30, 2013).



Two young Protostropharia semiglobata looking like egg yolks - yellow and slimy - on bison dung in Grasslands National Park, Saskatchewan (July 9, 2013).

(25 species), lignicolous (7 species), and ectomycorrhizal (6 species). Saprophytic fungi obtain nutrients from dead organic matter, "lignicolous" refers specifically to fungi that consume wood, and ectomycorrhizal fungi have mutually beneficial symbiotic relationships between their underground hyphae and the roots of plants.

By far the most common mushroom in the park was *Marasmius oreades*. Also known as the "fairy ring mushroom" it was found almost anywhere with grass, often in clusters and sometimes several growing in an arc to form a large circle. Coprophilous (dung-loving) mushrooms were



*Mature Protostropharia semiglobata on bison dung in Grasslands National Park, Saskatchewan. They are similar in appearance to the hallucinogenic *Psilocybe cubensis* and were once placed in the same genus, though they are considered "inactive".*

also common and conspicuous, without apparent preferences for dung of bison or cattle. Their range and abundance directly corresponds with that of the grazing animals in the park because of their exclusive habitat needs. Several species of the gasteroid fungi (puffballs) were found in the grasslands, but also on disturbed trails and even the badlands (notably the relatively rare *Battarrea phalloides*). The most common puffball, *Calvatia cyathiformis*, ranges in size from a golf ball to soccer ball but is easy to identify because of its purplish spore powder.

One outcome of the study was an increased appreciation for fungi. A presentation of mushrooms in the park was given on August 8, to good attendance from park staff, researchers, and Val Marie citizens. Several contributors were surprised at the number of fungi present and at least one person admitted they used to be uninterested or disgusted but are now intrigued.

Discussion

Species in Table 1 are organized into general taxonomic categories.¹⁸ Each species was assigned to a nutritional guild (saprophytic, lignicolous, or ectomycorrhizal) and more specific habitat needs are noted

according to observations over the study. Tentative ranks are given as to rarity based on the principal investigator's impressions from personal observations and collective observations and conversations with other contributors. These should be taken with caution given the limited scope of this study and because fruiting body abundance is known to be unpredictable. It should be noted that slime moulds are now only considered fungi in a traditional sense ("myxomycota") and that although *Apiosporina morbosa* (black knot) is not often considered a "mushroom" it is still included since it is a conspicuous non-lichenized macrofungi.

Forests represent a very small area of the park. They are primarily of aspen trees (*Populus tremuloides*) and the largest area is located in the east block and difficult for tourists to access. A small forest can be found along a portion of the popular 70 Mile Butte trail in the west block. These areas were home to a strikingly different set of mushrooms representing most of the species that are lignicolous (consuming wood) and ectomycorrhizal (symbiotic with plant roots). As might be expected, the forests housed an abundance of diverse fungi, though they were not extensively studied in this project.

Table 1. Mushroom species observed in Grasslands National Park.

<u>Name/Category</u>	<u>Authority</u>	<u>Guild</u>	<u>Specific Habitat</u>	<u>Rarity*</u>	<u>Specimen**</u>
Myxomycetes (Slime Moulds)					
<i>Physarum</i> sp.	Pers.	N/A	Forest	U	X
<i>Stemonitis</i> sp.	Gled.	N/A	Forest	U	X
Ascomycetes (Cup Fungi)					
<i>Apiosporina morbosa</i>	(Schwein) Arx.	Lignicolous	<i>Prunus</i> spp.	C	X
<i>Pezizaceae</i> sp.	Dumort	Saprophytic	Disturbed areas	R	
Basidiomycetes (Polypores, Stereum, and analogues)					
<i>Fomes fomentarius</i>	(L.) J. Kickx f.	Lignicolous	Wood	C	X
<i>Ganoderma applanatum</i>	(Pers.) Pat.	Lignicolous	Wood	U	X
<i>Polyporales</i> sp.	sensu lato	Saprophytic	Moss	R	X
<i>Trametes</i> sp.	Fr.	Lignicolous	Wood	C	X
<i>Trichaptum biforme</i>	(Fr.) Rywarden	Lignicolous	Wood	C	X
Basidiomycetes (Clavaria and similar fungi)					
<i>Aromyces pyxidatus</i>	(Pers.) Jülich	Lignicolous	Wood	U	X
Basidiomycetes (Hygrophorus and related species)					
<i>Hygrocybe conica</i> ?	(Schaeff.) P. Kumm.	Saprophytic	Grasslands	R	
<i>Hygrocybe miniata</i> ?	(Fr.) P. Kumm.	Saprophytic	Grasslands	R	
Basidiomycetes (Tricholoma and related fungi)					
<i>Arrihenia</i> sp. ?	Fr.	Mycorrhizal?	Moss (Grassland)	U	X
<i>Clitocybe</i> sp.	(Fr.) Staude	Saprophytic	Moss (Grassland)	VC	X
Basidiomycetes (Marasmius, Mycena, Collybia and allies)					
<i>Marasmius oreades</i>	(Bolton) Fr.	Saprophytic	Grasslands	VC	
Basidiomycetes (Coprinus and Panaeolus)					
<i>Coprinopsis atramentaria</i>	(Bull.) Redhead, Vilgaly & Moncalvo	Saprophytic	Forest (terrestrial)	C	X
<i>Coprinopsis nivea</i>	(Pers.) Redhead, Vilgaly & Moncalvo	Saprophytic	Dung	C	X
<i>Panaeolus papilionaceus</i>	(Bull.) Quéf.	Saprophytic	Dung	VC	X
<i>Panaeolus semiovatus</i>	(Sowerby) S. Lundell & Nannf.	Saprophytic	Dung	U	
<i>Protostropharia semiglobata</i>	(Batsch : Fr.) Redhead, Moncalvo, Vilgaly	Saprophytic	Dung	U	X

Basidiomycetes (Agaricus and Lepiota)					
<i>Agaricus bitorquis</i>	(Quél.) Sacc.	Saprophytic	Grasslands	U	X
<i>Agaricus campestris</i>	L.	Saprophytic	Grasslands	C	
<i>Agaricus</i> sect. <i>Arvense</i>	Konrad & Maubl.	Saprophytic	Grasslands	U	X
<i>Chlorophyllum</i> sp.	Massee	Saprophytic	Grasslands	R	
Basidiomycetes (Pluteus and related fungi)					
<i>Pluteus</i> sp.	Fr.	Lignicolous	Wood	U	X
<i>Volvariella</i> sp.	Speg.	Saprophytic	Disturbed areas	U	X
<i>Volvopluteus gloiocephalus</i>	(DC.) Vizzini, Contu & Justo	Saprophytic	Disturbed areas	U	X
Basidiomycetes (Lactarius and Russula)					
<i>Russula lutea</i>	(Huds.) Gray	Ectomycorrhizal	Forest (terrestrial)	C	X
<i>Russula</i> sp. #1	Pers.	Ectomycorrhizal	Forest (terrestrial)	C	X
<i>Russula</i> sp. #2	Pers.	Ectomycorrhizal	Forest (terrestrial)	C	X
<i>Russula</i> sp. #3	Pers.	Ectomycorrhizal	Forest (terrestrial)	C	X
Basidiomycetes (Boletes and related fungi)					
<i>Lecicinum</i> sp.	Gray	Ectomycorrhizal	Forest (terrestrial)	C	X
Basidiomycetes (Gasteromycetes)					
<i>Battarrea phalloides</i>	(Dicks.) Pers.	Saprophytic	Desert (Grasslands)	R	X
<i>Bovista pusilla</i>	(Batsch) Pers.	Saprophytic	Exposed soil (Grasslands)	C	X
<i>Calvatia bovista</i>	(L.) Pers.	Saprophytic	Grasslands	U	X
<i>Calvatia cyathiformis</i>	(Bosc) Morgan	Saprophytic	Grasslands	VC	X
<i>Lycoperdon excipuliforme</i>	(Scop.) Pers.	Saprophytic	Exposed soil (Forest)	U	X
<i>Lycoperdon perlatum</i>	Pers.	Saprophytic	Disturbed areas	C	X
<i>Phallus hadriani</i>	Vent.	Saprophytic	Exposed soil (Grasslands)	R	X
<i>Tulostoma</i> sp.	Pers.	Saprophytic	Grasslands	U	X

* VC = very common, C = common, U = uncommon, R = Rare (within respective habitat)

** X represents at least one representative specimen collected (some doubles)

Further study into certain mushrooms not identified to species may yield new records of endemic or rare species. A white, minute-sized *Arrhenia* sp. was spotted only a few times in grasslands where spike moss (*Selaginella densa*) was common. It was sometimes growing in an interesting microhabitat - along the sides of soil in depressions from bison hoof-prints. In similar mossy grassland habitats an unidentified species of *Clitocybe* was very common while a mysterious *Polyporales* was very rare. Brightly coloured waxcap mushrooms (*Hygrocybe* spp.) were only recorded from a few submitted photographs.

More detailed information on individual species from this study has been provided to park staff as a basis for future studies and to facilitate incorporating conspicuous mushrooms (such as the fairy rings, large puffballs, and dung fungi) into interpretive programming. All photos and data are available for viewing online at MushroomObserver.org. Further studies and increased public awareness at GNP will help us to understand the unique fungi of the prairies.

Acknowledgements

Thank you to staff at Grasslands National Park for granting me the

collection permit. Special thanks to everyone that contributed photos and GPS locations to the project or made me aware of areas to search: Ryan Boxem, Jordan Steingass, Nick & Krista Cairns, Heather Sauder, Kelsey Van-Dyke, Dennis Morgan, Ashley Wruth, Colette Schmidt, Alais Nevert, Sarah Ludlow, Lacey Hebert, and Martin Kastner.

Thanks also to curator Dr. Cory Sheffield and assistant Adam Crosby of the Royal Saskatchewan Museum for accepting specimens of this study into the RSM collections. Diana Robson of the Manitoba Museum provided valuable feedback on an earlier manuscript of this submission.

Finally thanks to the mycological community on MushroomObserver.org for assisting in the identification process.

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