Spore Print

ALBERTA MYCOLOGICAL SOCIETY

Issue 03 2023

Pluteus chrysophlebius

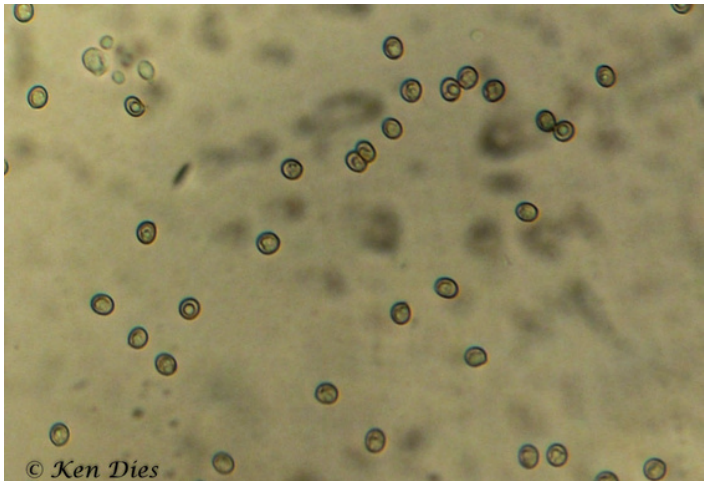
Unlike most *Pluteus* species, which are brown and somewhat boring, *Pluteus chrysophlebius* is just the opposite with its beautiful bright yellow cap. This mushroom is primarily characterized by its small size, mustard-coloured cap, yellow stem, and growth on dead deciduous wood. Its small cap (1-2.5 cm) is broadly conic when young, becoming convex to flat and sometimes with a central umbo. When young, its cap may be centrally wrinkled or veined, bright yellow becoming dull yellow or brownish yellow with age. Gills are free from the stem, close or crowded with intermediates, whitish at first, becoming pinkish at maturity. The pale yellow stem, 2-5 cm long and 1-3 mm thick, may be round or flat with white mycelium at its base. Odour is bleach-like when crushed with a similar taste or at times undistinctive. As a saprobic fungi, it grows on the deadwood of hardwoods alone or gregariously on stumps and logs and causes a white rot. It is commonly found in the spring in many areas of Alberta, especially in extreme abundance in the Peace River region.

Pluteus leoninus is very similar in appearance, but this related cousin is larger, has a velvety bright yellow cap with brown shades, and a white stem at least when young. At times depending on its age, microscopic examination may be necessary for identification between the two species.

Cap: Bright Yellow
Gills: Free, Crowded, White turning pink at maturity
Stem: Yellow, round, or flat
Spore print: Pinkish
Odour/taste: Bleach-like or not distinctive

Feature mushroom is brought to you by AMS member, Ken Dies, a fungus photographer and 2016 AMS President's Award recipient.

Above: *Pluteus chrysophlebius*. KEN DIES



Above: *Pluteus chrysophlebius* spores under the microscope. KEN DIES

Kingdom: Fungi
Division: Basidiomycota
Class: Agaricomycetes
Order: Agaricales
Family: Pluteaceae
Genus: *Pluteus*
Species: *chrysophlebius*

TABLE OF CONTENTS


Above: *Rhodotus palmatus* aka “Wrinkled Peach” mushroom. KAREN SLEVINSKY

President’s Message

Above: Finding *Hydnums* at Weald. KAREN SLEVINSKY

It is my hope that you find time to reflect on how 2023 went for you this year, both in your personal life and in your association with the Alberta Mycological Society. This year I have had the pleasure of several new (to me) fungal finds in places near to my home and far from home. In the Whitemud river valley, I found several wrinkled peach (*Rhodotus palmatus*), which was flagged by iNaturalist™ as “a declining population in Europe.” I am pleased with identifying a *Hemipholiota populnea* and finding but not identifying an impressive vertical growth of likely a *Trametes*. At the Great Alberta Mushroom Foray in Waterton National Parks, I found a *Cordyceps* lookalike! *Clavariadelphus pistillaris* is also a reasonably rare find. Upon examination, it most definitely had not emerged from an insect, as would be expected from a *Cordyceps*, but from needle litter. And finally, I was at Weald in September and part of the group that foraged for the elusive giant white *Hydnum*. A nice flush was found exactly where it was expected: in a moist, mossy old growth forest of a stand of 50- to 60-year-old pines. Our Society will be appealing to West Fraser to preserve and retain this stand of pines early in January.

If 2024 is even half as interesting, we have much to look forward to. What about your fungal finds? What ever fungal or friend they may be, it would be my pleasure if the Alberta Mycological Society played a role. For 2024, we will be bringing you more of the experiences you love: forays, speaker socials, the Expo, and the Great Alberta Mushroom Foray. It never grows old for me (it just decomposes)! See you in 2024 in Alberta’s natural places.

Karen Slevinsky
AMS President

Above: *Hemipholiota populnea*. KAREN SLEVINSKY

Above: Growth of *Trametes*. KAREN SLEVINSKY

DEATH CAP POISONING AND SOLUTION?

BY ROBERT DALE ROGERS

Mushroom poisoning is the main cause of death in food poisoning worldwide. In China alone, over ten thousand events resulting in thirty-eight thousand illnesses and nearly eight hundred deaths were reported between 2010 and 2020.

The Death Cap (*Amanita phalloides*) was responsible for more than 90% of the mortalities. It is only recently that the mushroom has made its way to North America, first sighted in California, and then up the coast to British Columbia.

Alpha-amanitin is the most toxic compound, associated with inhibition of RNA polymerase II, leading to kidney and liver failure.

In Europe, intravenous silybin derived from Milk Thistle (*Silymarin marianum*) seeds has been effective in saving numerous lives, but the drug is, inexplicably, not available in North America.

In some cases, penicillin has shown potent therapeutic efficiency in some cases of human amatoxin poisoning but without a known mechanism of activity.

A recent study by Wang et al. (2023) found that STT3B is required for alpha-amanitin toxicity, and its inhibitor, indocyanine green (ICG), can be a specific antidote. The STT3B gene is necessary for glycosylation in humans.

Initially, a drug screen identified the compound, and then in vitro and in vivo tests on mice and human cells were performed. In the mice trials, 50% given the drug died, while untreated mice

Above: *Amanita phalloides*. ROBERT DALE ROGERS

deaths topped 90%. The drug ICG is a fluorescent dye used in medical diagnostics and administered intravenously. It is eliminated by the liver with a half-life of three to four minutes. Also known as spy agent green, it is available in 20 mL vials or in powder form. It is contraindicated in those allergic to sodium iodide, used to improve solubility.

How soon it will be available, with or without prescription, in Canada is unknown. Considering its relative safety, and possible life-saving capability, more research is necessary and needed.

Source: Bei Wang, Arabella H. Wan, Yu Xu, Ruo-Xin Zhang, Ben-Chi Zhao, Xin-Yuan Zhao, Yan-Chuan Shi, Xiaolei Zhang, Yongbo Xue, Yong Luo, Yinyue Deng, G. Gregory Neely, Guohui Wan, & Qiao-Ping Wang. (2023). Identification of indocyanine green as a STT3B inhibitor against mushroom α-amanitin cytotoxicity. *Nature Communications,* 14(1), 1–15. https://doi.org/10.1038/s41467-023-37714-3

Robert Dale Rogers is a long-standing member of AMS and author of several books on medicinal mushrooms, including *The Fungal Pharmacy*, and *Medicinal Mushrooms: The Human Clinical Trials*.

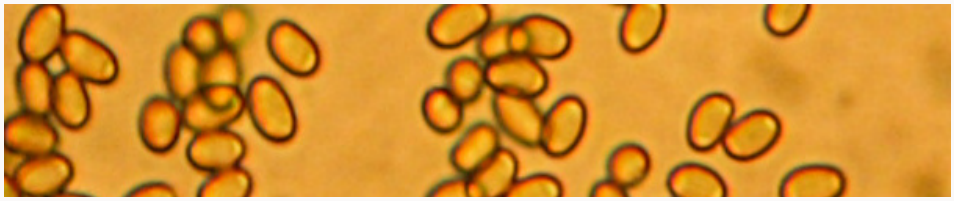
CHICKADEE STONE

Chickadee Stone is owned by Genevieve Olivier, an indigenous Anishinaabe woman who resides on Treaty 6 territory. Genevieve spends much of her time in the woods in the Parkland County region. Her art focuses on hand-foraged fungi jewelry, offering both hand-dipped natural mushrooms and encased pendants in many sizes. There is something for everyone. Reach out via Instagram to find the perfect piece for you or someone dear to you.

genevieveolivier@gmail.com

@ChickadeeStone

SPORE MORPHOLOGY



By Ken Dies

Above: *Paxillus involutus* spores. KEN DIES

Mushroom spores can help you identify mushrooms in many ways. Spore colour is one of the most diagnostic tools as all mushroom guides categorize the gilled and many pored mushrooms in the fungal world by colour. Other ways spores can aid in identification is seeing how they are produced, and by their chemical colour changes, sizes, shapes, and ornamentation. While only those who have their own microscope will be able to see all the things discussed in this article, all members of the Alberta Mycological Society, will hopefully find this article of value, since many of these things are so important to mushroom identification. Note that the AMS does have its own microscope, which can be used by anyone who wishes at larger events such as the Great Alberta Mushroom Foray.

Spore Colour

Spore colour is primarily used to place the gilled mushrooms (*Agaricales*) and boletes (*Boletaceae*) into usable groups to narrow down the search for identification purposes. In order to determine a mushroom's spore colour, you must have a mature mushroom, one that is not too young or past its prime to produce spores, to take a spore print. Cut off the stem leaving just a stub and place the spore producing side on a piece of white paper or paper which is half black and half white to show spore colours more easily. Cover the mushroom with a bowl to prevent air movement and leave it overnight. The next morning or sooner, you should have your spore print, revealing the spore colour (**Figure 1**). Oftentimes, mushrooms in the wild have deposited spores on surrounding vegetation, logs, or other mushrooms allowing you to determine the colour of the spores without further action. For most mushrooms, using the spore print in combination with other characteristics will allow you to identify a mushroom to the family level. Interestingly, unlike most mushroom families which shed spores in one major colour only, different members of the genus *Russula* produce spore colours ranging from white to deep yellow. Thus, spore print colour is even important for species-level identification in this genus.

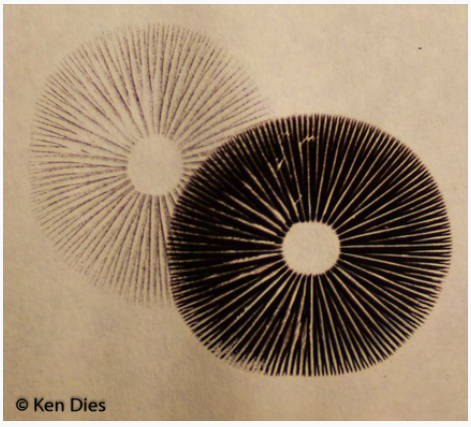


Figure 1: Spore print. KEN DIES

Figure 2: Amyloid spores (*Russula* sp.). KEN DIES

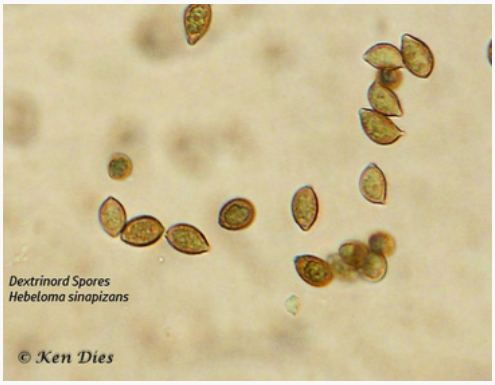


Figure 3: Dextrinoid spores (*Hebeloma sinapizans*). KEN DIES

Chemical Reagents

The spores of many species of mushrooms change colour when they come into contact with iodine solutions, such as Melzer's Reagent or a 5% tincture of iodine*. If the spore stains blue to purple, it has a positive reaction called "amyloid" (**Figure 2**). If the colour produced is brownish to reddish brown, the reaction is known as "dextrinoid" (**Figure 3**). Observation of pale yellow or clear spores is called "inamyloid". Good mushroom books and online resources, such as MatchMaker (also known as MycoMatch) and MushroomExpert.com, specifies under "microscopic features" if the spores of a particular mushroom are amyloid or dextrinoid. Knowing this colour

change could make the difference in correct species identification. You do not have to own a microscope to determine if the mushroom you are attempting to identify contains amyloid or dextrinoid spores: you can just add a drop of 5% tincture of iodine to your spore print and watch for a colour change. To get a good amyloid reaction, add a drop of reagent to the spore print of any species of *Lactarius* or *Russula*. Since they are all positive, it will turn blue. Also, amyloid *Russula* spores highlight specific spore ornamentation patterns and, along with the spore colour mentioned earlier, eliminates many species from consideration again, making identification less daunting.

*5 % tincture of iodine can be purchased at many drug stores. 5 % Lugol's iodine also works, but it is expensive.

Spore Production

In the order Basidiomycota, which includes the gilled mushrooms and boletes, spores are generated by cells known as basidia. These spore producing structures are found on the edges of the gills and in the lining of the pores in the boletes. Each spore is produced at the tip of a narrow prong or horn on the basidia called a sterigma (plural: sterigmata). How many spores each basidia forms at one time is significant and used as a diagnostic tool for species identification. Most mushrooms produce basidia with either two (**Figure 4**) or four spores (**Figure 5**), although some may produce both. In the "microscopic features" of a mushroom's description, this will be listed as "two spored", "four spored," or it may mention the number of sterigmata.

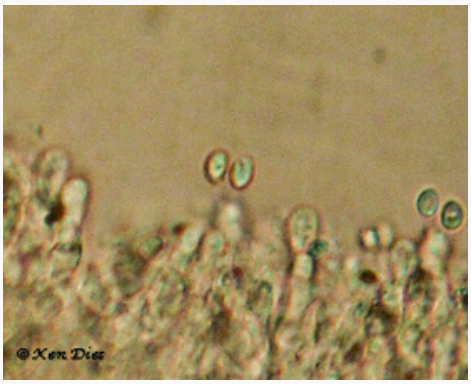


Figure 4: Two-spored basidia. KEN DIES

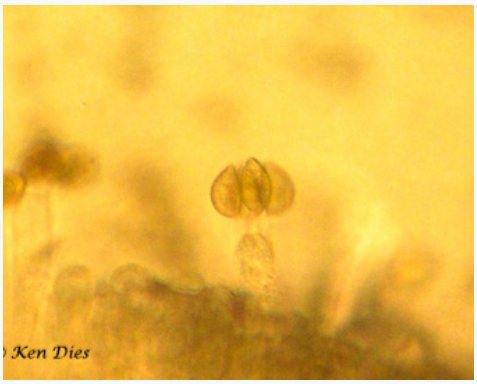


Figure 5: Four-spored basidia. KEN DIES

Spore Morphology

Mushroom spores come in many sizes, shapes, and ornamentation patterns. Many mushrooms produce spores specific to their family or genus, making identification possible to the genus level from a spore print, without actually seeing the mushroom. Knowing the genus by spore morphology helps separate look-a-like mushrooms very quickly. The following photos below are a few of the most common spore shapes out of an almost endless variety.

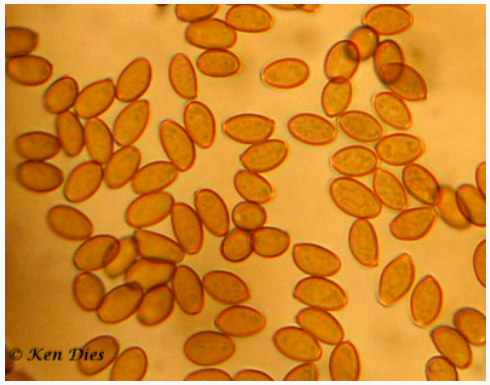


Figure 6: *Agrocybe pediades* spores. KEN DIES

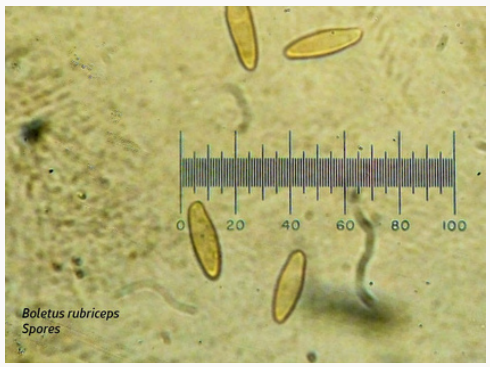


Figure 7: *Boletus rubriceps* spores. KEN DIES

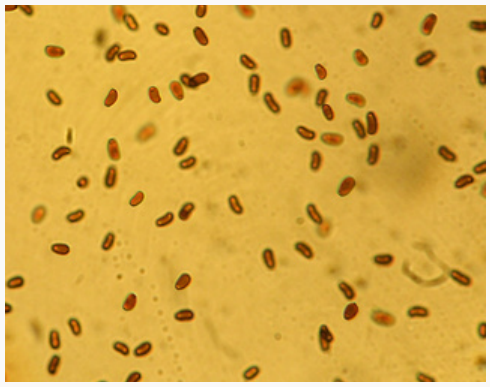


Figure 8: *Coprinellus ellisii* spores. KEN DIES

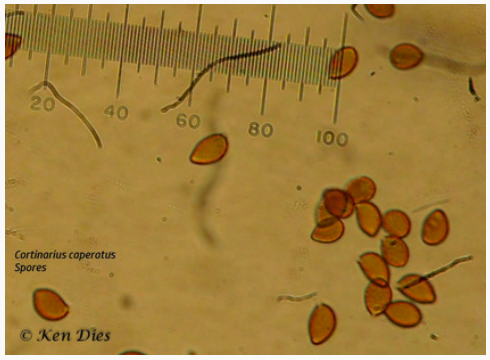


Figure 9: *Cortinarius caperatus* spores. KEN DIES

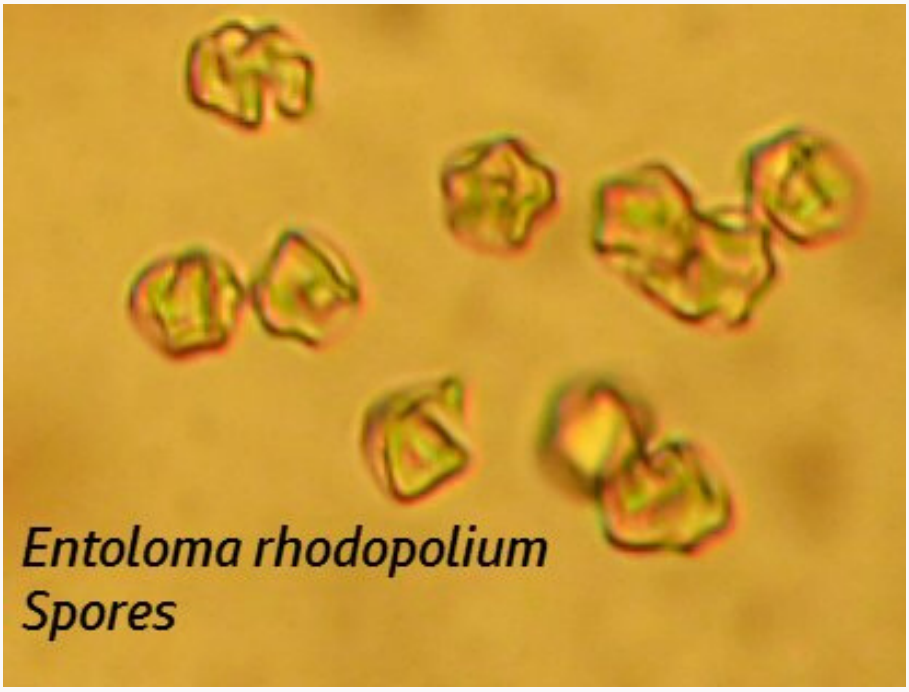


Figure 10: *Entoloma rhodopolium spores*. KEN DIES

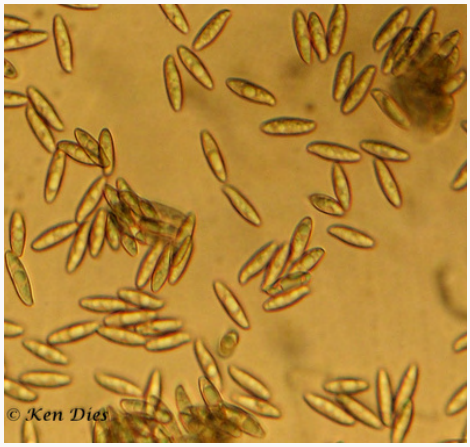


Figure 11: *Leccinum* sp. spores. KEN DIES

Here are the spores of other mushrooms you may know and find in Alberta!

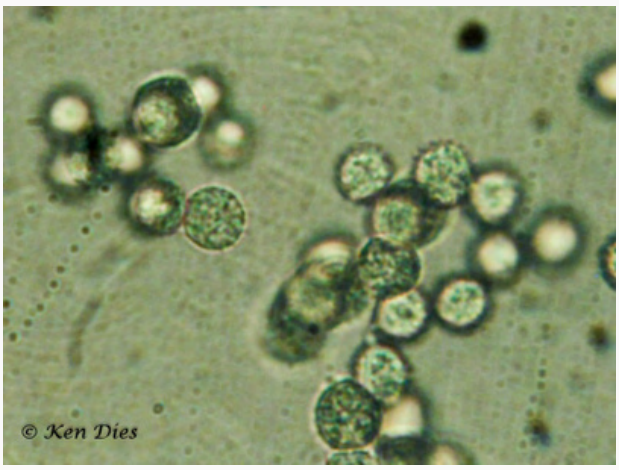


Figure 12: *Laccaria laccata* spores. KEN DIES

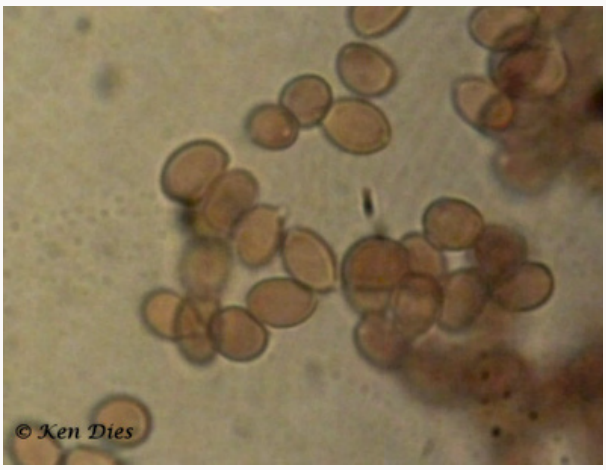


Figure 13: *Leucoagaricus leucothites* spores. KEN DIES

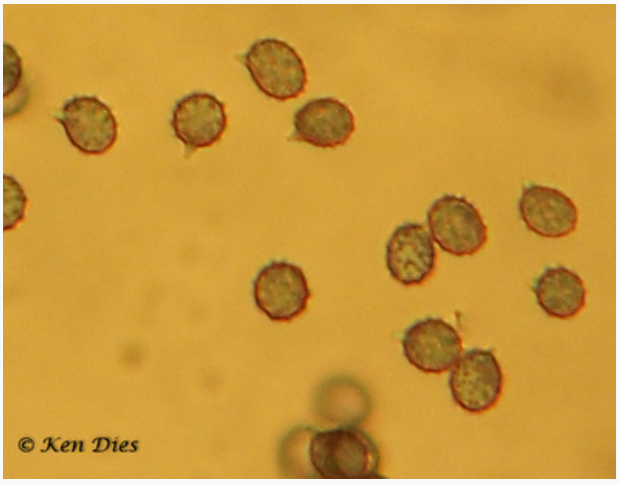


Figure 14: *Lactarius subdulcis* spores. KEN DIES

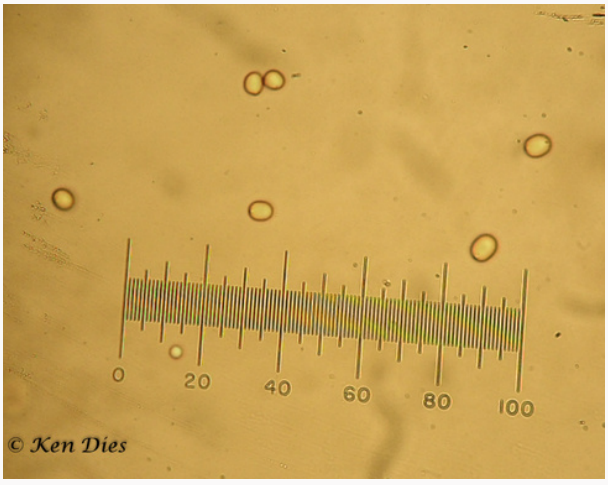


Figure 15: *Tricholoma terreum* spores. KEN DIES

THE *WILD* MUSHROOM EXPO

The Greatest Show *from* Earth!

By Melanie Fjoser

On Sunday, August 14, we held our ***Wild* Mushroom Expo** at the **University of Alberta (U of A) Botanic Garden** near Edmonton. As always, it was wildly successful! Over **1,400 people** attended the Garden that day, making it the busiest day of the year for the Garden.

The day before, we had several forays: at Pieter van der Schoot's property (near Breton) led by **Lisa Oishi**; Water Valley (Calgary area) led by **Christine Costello** and **Barb Shworak**; Burnstick Lake (near Caroline) led by **Candice Cullum**; I4C Lands (west of Edmonton) led by **Rob Simpson**, and an urban foray held at Kinsman Park in Edmonton, led by **Ryan James**. Thank you, Foray Leaders! What an incredible variety of mushrooms we collected from these diverse habitats! You'll see all different species in the list below.

AMS President **Karen Slevinsky** welcomed **Kamal Mali** of the U of A Botanic Garden, who (with his wonderful crew) was instrumental in creating this wonderful exhibit. We called on them throughout the day, and they provided us with so much support!

Many member-volunteers arrived to set up and man the tables at the Pine Pavilion and to artistically showcase the fresh, wild mushrooms on moss and grass and other habitat features. The foraged mushrooms at the **Main Display Table** are always the stars of the show! We were very fortunate for the many experts, **Martin Osis**, **Bill Richards**, **Rob Simpson**, **Candice Cullum**, **Ryan James**, **Aletheia Chaconas**, and ***so*** many others at the display tables who identified fungi and patiently answered the ever-present question: "Can I eat this?" We also had many very gracious ambassadors working the room, talking about mushrooms, mushrooms, and more mushrooms… But that's not all…

Other tables included displays on **Edible, Medicinal,** and **Poisonous Mushrooms**, and some that are all three, believe it or not. **Enoki Li** with the **U of A Mycology Club** hosted a **Medicinal Mushroom** table, and **Brett Keith** hosted a **Mushroom Cultivation** display. Samples of popular mushroom books and our *Spore Print* newsletter attracted many folks, and children were busy at our **Kids Colouring Circle**, colouring, painting clay mushrooms, and solving mushroom games. We hosted a pre-Expo craft session, with folks creating realistic and fantastical fungi of clay for the **Craft Competition**. Congratulations to **Alex Kyler** for winning the Most Fantastic Fungus category with his "**Hallo-mush**" piece! And congratulations to **Bauer Casavant** who blew people away with his "***Amanita muscaria v. guessowii***" for the Most Realistic Mushroom category!

Above: Martin Osis answering the many questions. RICK WATTS
Top: Part of the main display table at 2022 Expo. RICK WATTS

Above: For the Most Fantastic Fungi, Alex Kyler wins with "Hallo-mush". MEL HOHN


Above: For the Most Realistic Fungi, Bauer Casavant takes it away with "Amanita muscaria v. guessowii". MEL HOHN

At our ***Wild Mushroom Café***, **Liz Watts** prepared two Mushroom Soups, both in gluten-free versions; both were very delicious and sold out! The menu offered a mushroom spread, containing lion's mane, pink and blue oyster mushrooms, and *Pleurotus ostreatus* mushrooms that were generously donated by **Brett Keith.** We also offered Taber corn-on-the-cob with Lobster or Chanterelle mushroom butters and dashed with Truffle salt. We served a refreshing Chaga iced tea on that hot day. Our culinary team (led by **Erica To**, **Rose O'Bertos**, and **Nadia Shiwdin**) ran the kitchen with great aplomb, supported by **Karen** and **Richard Slevinsky** on food ticket sales. We also welcomed special guests, **Chef Elle** and **Brett** of **B&E Catering**, who cooked up some of our edible mushrooms into a fantastic risotto and provided samples to guests to show what great cuisine comes out of our earth!

Our **AMS Merchandise** table kept **Mel Hohn** and her **team** busy with visitors purchasing mushroom books, t-shirts, stickers, posters, memberships, and more. Several items were sold out as guests eagerly purchased many things mushroom! Our merchandise sales are an AMS fundraiser, so cheers to all of you who not only worked the tables but also purchased items to


Above: After tasting all the delicious food offered, it's no wonder that folks bombarded Brett Keith with questions at his Mushroom Cultivation table. RICK WATTS


Above: Chef Elle Wittke cooking up delicious samples. RICK WATTS

support your AMS!

This year, for the first time, **Mel Hohn** organized a **Vendor Zone**, where our Corporate Members were able to show and sell their wares in a lovely, tented area near the Pine Pavilion. We look forward to continuing this in future years. Mel was instrumental in creating several educational posters that were placed throughout the Garden.

Above: Vendor Zone. RICK WATTS

Above: Rachel is one of the many vendors that supplied fungi goods in the Vendor Zone. RICK WATTS

Two presentations were held a short hike away in the **Lilac Tent**. In the morning, **Christine Costello** gave a creative mushroom workshop, "**Fun with Fungi",** for children who thoroughly enjoyed the show. Expert mushroom educator, **Martin Osis**, gave the afternoon presentation, "**All Mushrooms are Medicinal!**" Attendees packed the tent with many overflowing onto the adjacent lawns.

We were reminded by **Elizabeth Lakeman**'s poster to donate to the **U of A / AMS Graduate Award** to support a deserving graduate student studying mycology or fungal biology. The winner will be awarded $2,000. These donations raise fungal knowledge and lower your taxes!

We held two "**Mushroom Walk in the Garden**" sessions – an overwhelming success as crowds of visitors followed our experts, winding their way about the Garden and exclaiming, "I found one!"

For the entire day, our venues were overflowing with visitors. It was noisy, crowded, and thoroughly enjoyable, full of "oohs" and "aahs" from the crowd at the incredible variety of fungi! It was very exciting to see so many mushroom enthusiasts out there, some of whom are now AMS members and will surely help at our future events (nudge, nudge, wink, wink).

Also new this year! Our member and veteran videographer, **Jeff Nash**, volunteered his time to film the **Expo experience** on both Saturday and Sunday.

AMS Presents the Wild Mushroom Expo 2023

Check out the Expo photos on our website, and you might recognize some friendly, fungi-loving faces!

AMS Expo Photo Gallery

Above: Jeff Nash, our Expo videographer. RICK WATTS

There are so many people to thank for this event, truly the **Greatest Show *from* Earth**!

These AMS Directors (and their partners) led and facilitated the action in so many ways: **Nadia Shiwdin**, **Mel Hohn**, **Christine Costello**, **Karen Slevinsky**, **Elizabeth Lakeman, Rob Simpson, Lisa Oishi, Liz Watts**, **Rick Watts**, **Erica To**, **Enoki Li**, **Rose O'Bertos**, and **Melanie Fjoser**. Thank you!

Most importantly, over 50 of ***you*** (AMS member-volunteers) showed up to give back to your AMS and showcase the Kingdom of Fungi to the public. We've not mentioned all your names (we don't want to miss anyone!), but this event could not have happened without you!

On behalf of the ***Wild*** **Mushroom Expo 2023** organizing team,

Thank you and see you next year!

Above: Attendees relaxing outside the Pine Pavilion. RICK WATTS

Above: Ashley, a member-volunteer, peeks out from a display table. RICK WATTS

SPECIES LIST FROM EXPO 2023

(Most found on Saturday, August 13, 2023)

These labels were displayed on the mushroom tables. This list may be incomplete as some species may not have been identified before the Expo. Some polypores were also brought from previous forays. We included some common names in amongst the Latin, just for fun!

Agaricus haemorrhoidarius, Agaricus sp., "Fly Agaric" *Amanita muscaria*, "The Grisette" *Amanita vaginata, Amanita sp., Arrhenia epichysium*, "Bitter Hedgehog" *Hydnellum scabrosum, Bjerkandera adusta, Calvatia booniana*, "Chicken of the Woods" *Laetiporus sulphureus*, "Shaggy Parasol" *Chlorophyllum rachodes, Coltricia perennis*, "Common Inkcap" *Coprinus atramentarius*, "Shaggy mane" *Coprinus comatus, Coprinus sp.*, "The Gypsy" *Cortinarius caperatus, Crepidotus mollis, Daedaleopsis confragosa*, "Tinderhoof" *Fomes fomentarius*, "Red-belted Conk" *Fomitopsis pinicola*, "Artist's Conk" *Ganoderma applanatum*, "Ghost Pipe" (not a fungus) *Monotropa uniflora, Gloeophyllum sepiarium*, "Pig's Ears" *Gomphus clavatus, Gymnopilus liquiritiae, Hemipholiota populnea*, "Butter

Above: *Hericium coralloides*. RICK WATTS

Above: *Leucopaxillus giganteus*. RICK WATTS

Bolete" *Hemileccinum subglabripes*, "Hedgehog Mushroom" *Hydnum repandum*, "Coral Tooth" *Hericium coralloides*, "False Chanterelle" *Hygrophoropsis aurantiaca*, "The Green Gill-Gobbler" *Hypomyces luteovirens*, *Hypsizygus tessulatus*, *Inocybe sororia*, *Inocybe sp.*, "The Deceiver" *Laccaria laccata*, "Saffron Milkcap" *Lactarius deliciosus*, "False Saffron Milkcap" *Lactarius deterrimus*, *Lactarius fumosus*, *Lactarius repraesentaneus*, *Lactarius uvidus*, "Aspen Scaberstalk" *Leccinum insigne*, *Leccinum spp.*, *Lentinellus cochleatus*, *Lepiota spp.*, *Lepista sp.*, *Leucopaxillus giganteus*, *Leucopaxillus sp.*, *Lycoperdon perlatum*, *Lycoperdon sp.*, *Mycena sp.*, "Bird's Nest Fungus" *Nidularia sp.*, "Brown Roll-rim" *Paxillus involutus*, *Paxillus sp.*, *Peziza sp.*, *Pholiota squarrosa*, "Birch Polypore" *Fomitopsis betulina*, "Deer Mushroom" *Pluteus cervinus*, *Polyporus badius*, *Psathyrella uliginicola*, *Ramaria abietina*, *Ramaria stricta*, "Satan's Bolete" *Rubroboletus pulcherrimus*, "Green Russula" *Russula aeruginea*, *Russula americana*, *Russula decolorans*, "The Sickener" *Russula emetica*, *Russula fragilis*, *Russula laurocerasi*, *Russula paludosa*, "Shrimpula" *Russula xerampelina*, *Russula sp.*, "Scaly Hedgehog" *Sarcodon imbricatus*, "Eyelash Cup" *Scutellinia scutellata*, "Stinky Oyster" *Phyllotopsis nidulans*, "Blue-staining Slippery Jack" *Suillus tomentosus*, *Suillus sp.*, *Stereum sp.*, *Trametes suaveolens*, *Trametes sp.*, "Witches Butter" *Tremella mesenterica*, *Trichaptum biforme*, *Tricholoma vaccinum*, *Tricholoma sp.*, "Wolf's Milk Slime" *Lycogala epidendrum*, and a few others we couldn't identify.

Above: The puffballs we dream of. RICK WATTS

Left: *Laetiporus sp.* RICK WATTS, Right: Artist's conk. RICK WATTS

A Tough Guy and a Gorilla at the GAMF

Keith Seifert
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Over the long weekend at the beginning of September, I was an honoured guest at the Great Alberta Mushroom Foray at Waterton Lakes National Park hosted by the Alberta Mycological Society (AMS). Both Alberta and Waterton are dear to my heart, and it was a joy to infiltrate the wonderful group of people in your club. And it was also quite a shock, after a forty-year absence, to see the state of Waterton's forests, thankfully in robust recovery. Much has changed, but I still recognized the spot on the beach where Andy MacKinnon, a park ranger, and I met at 6 a.m. one morning in August 1982, jostling to use a spotting scope that we set up to spy on grizzlies on the far shore.

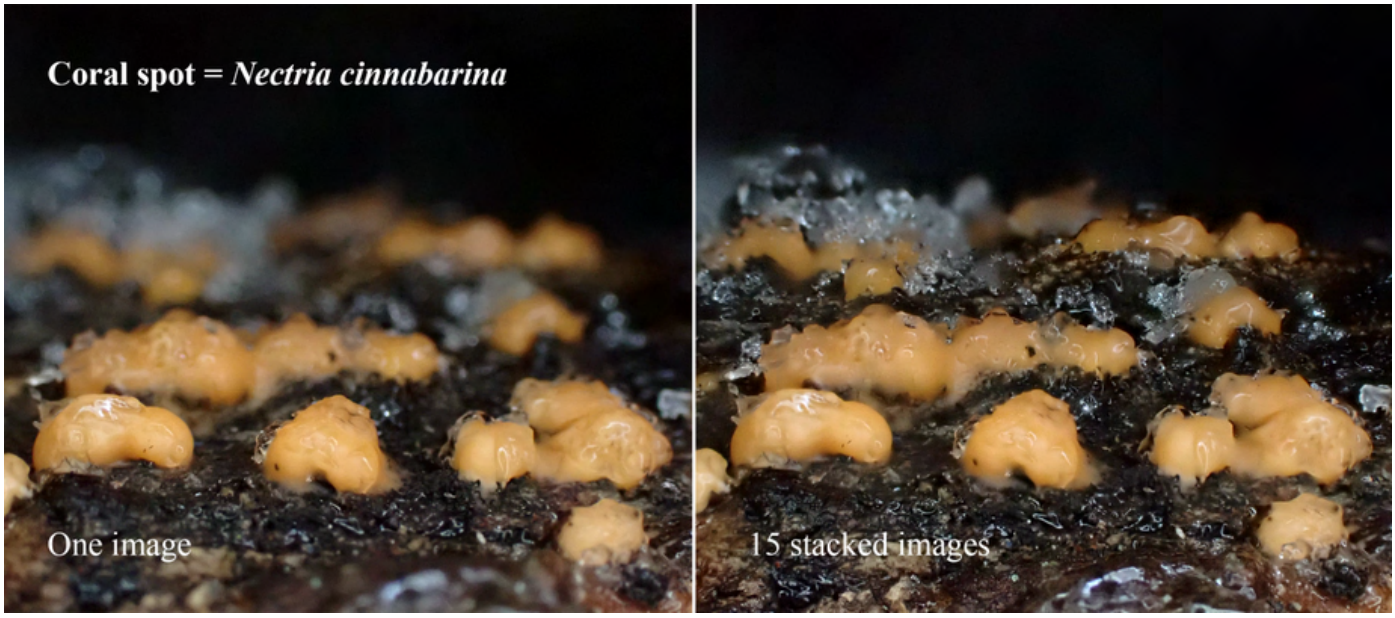
With the 2023 drought, none of us GAMFers saw many fungi. As some of you noticed, I like to look for tiny things in the field, and I left the fleshy things to experts like Andy, Paul Kroeger, Larry Evans, and Martin Osis. With the dry conditions, there weren't many microfungi to find either. But there were a few.

A reliable microfungus nerd indicator is a hand lens or jeweler's loupe, dangling from some kind of lanyard. High quality loupes have triplet lenses that give a nice flat optical view of about a 10× magnification, illuminated by built-in LED lights. You can see a lot with 10 X magnification once you have trained your eyes. But it isn't easy to show other people what you are looking at. It's impossible for two people with normally-shaped heads to look through one lens at the same time. I ***have*** taken pictures with phone cameras through loupe lenses, but you need three hands to make this work.

But now we have the Olympus Tough Guy, the go-to camera for many microfungal enthusiasts because it combines a fairly high-quality macro capability with built in Z-stacking. I have version six, the TG-6 (version 7 is out now and version 5 can sometimes still be found). Don't ask me why lenses used to zoom in on microscope objects are called macro lenses. Just accept that this is what they do—magnify things a bit, delivering an image very similar to what you'd see with a hand lens.

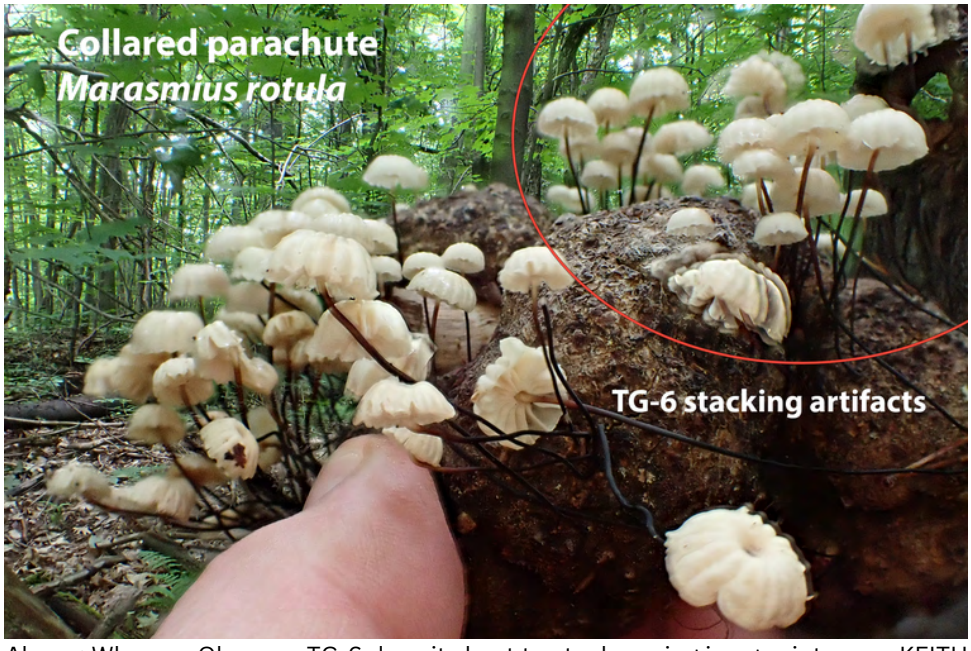
Above: An Olympus TG-6 with a Gorilla tripod and lanyard. KEITH SEIFERT

Z-stacking is incredibly cool. The camera automatically snaps a series of up to fifteen exposures, each at a slightly different plane of focus, and then it combines the in-focus parts of each into one composite image. The result is a depth of field from the nearest to the farthest focus of all the individual pictures. In the past, you had to photograph each layer separately then combine them with software. Now, the TG does this for you in the field while you still have the living thing in front of you in case you want another shot. This works from the tiniest of moulds up to a typical mushroom size, any time you really wish for a depth of field that is more like what you see with your eyes. This example below shows the asexual state of the coral spot fungus, which many of you will know as a mild pathogen of woody plants. The image on the right is z-stacked and you can easily see the depth of focus, and the melting snow left after I dug the specimen out of the lumber pile yesterday. Each of those spore blobs is about a millimetre across.



Above: Z-stacking technology from the Olympus TG-6 camera applied to the coral spot fungus. KEITH SEIFERT

To get the most out of a TG, it helps to have a fifteen-year-old or a grad student around who can show you how they work. These cameras are not exactly user friendly, but once you figure out your work flow, they are fine. For the z-stacking to work, both your hands and your subject need to remain still for a few seconds. A little Gorilla tripod helps stabilize the camera, but it's challenging to convince a thin-stiped *Marasmius* not to wobble around in gravity or in the wind. Sometimes, the camera just gives up and displays an error message. And sometimes, it tries to fake it, as the upper right corner of the example shows.



Above: When an Olympus TG-6 does its best to stack waving images into one. KEITH SEIFERT

Further, in my experience, the camera's GPS tagging of images is temperamental. The built-in WiFi designed to beam your captured images to your favourite device (phone, tablet,

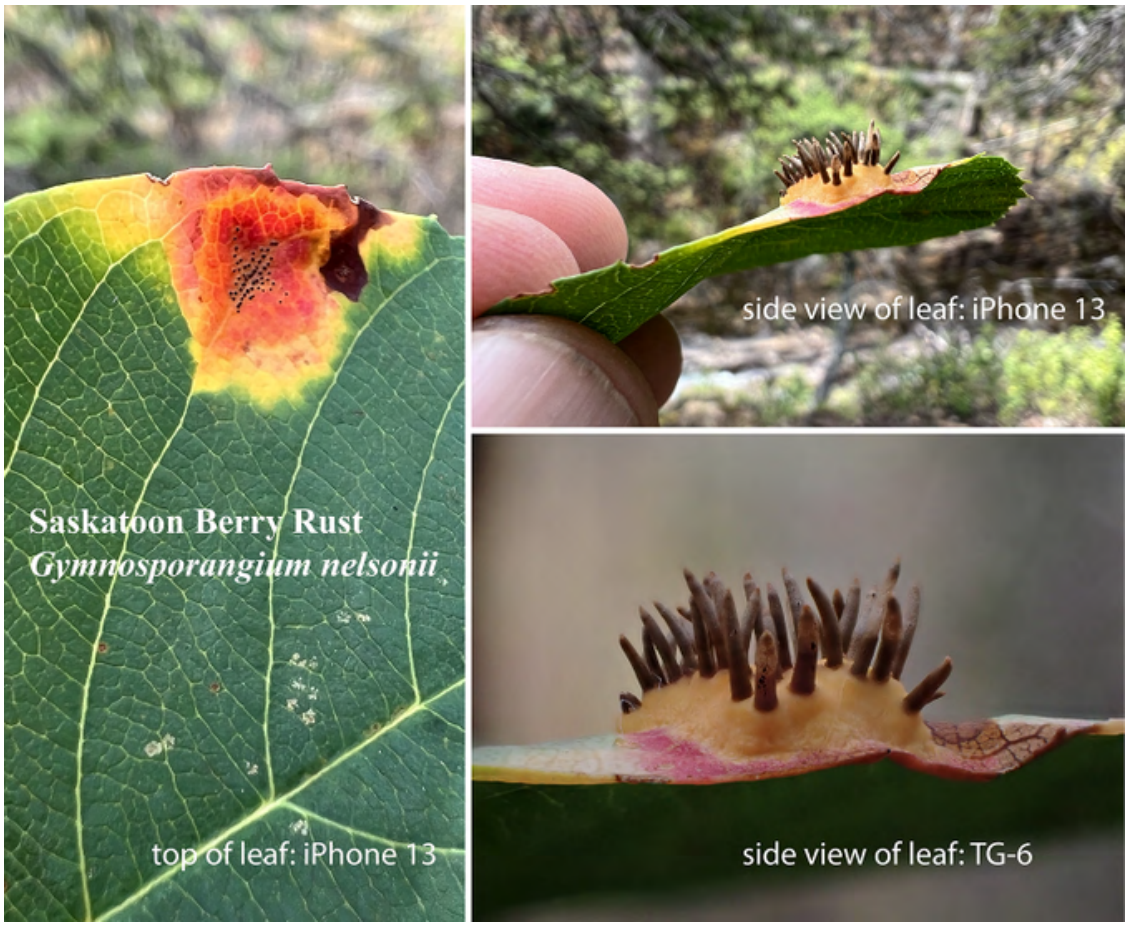
computer) often just shrugs, rolls its eyes, and looks the other way.

TGs are not cheap. At about $700 on Amazon, they are still cheaper than an iPhone! And if you are interested in macro photography, you'll want a ring guide attachment (LG-1) to even out the illumination. That's another 50 bucks or so. One downside of this is that subjects with a shiny background often end up with a halo of potlights around them, reflections of the individual LEDs in the ring light.

But for me, the stunning images overcome these idiosyncrasies. Just to be clear, the photos do not match the professional-quality, high-resolution images captured by the team led by Rick Watts at the AMS foray table. But they do match what you see in the field with a hand lens, and that's a great tool for teaching and learning. It opens a door to the microscopic world that a lot of mushroom enthusiasts would love to step through.

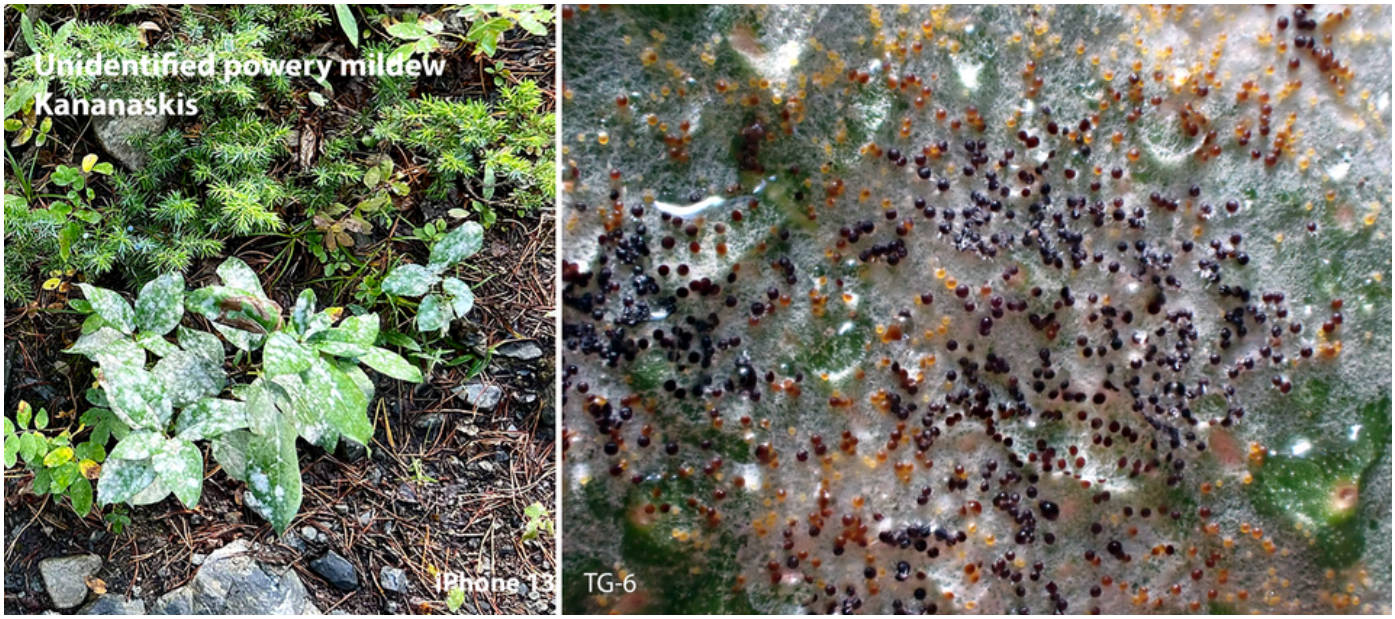
Usually, a microscope is standard issue for those of us interested in moulds, but there are a few microfungi you can identify without one, and a hand lens and/or a TG can help. I'm thinking of rusts and powdery mildews in particular. These parasites grow only on living plants and tend to be host specific, so if you can identify the plant, you can identify the mould. Unfortunately, I'm not a talented botanist and had forgotten most of my Rocky Mountain plants. But fortunately, we had an Andy for that on our walks in Waterton. After decades managing forest research and writing field guides to plants in British Columbia, my former lab-mate Andy MacKinnon was always there to answer the question, "What's this plant?" … even if he was annoyed to be asked about plants instead of mushrooms.

Rusts and powdery mildews both put on modest shows at GAMF. The example below compares photos of Saskatoon berry rust taken with an iPhone 13 to my TG-6. The horn-shaped *aecia* produce asexual spores that spread the fungus from one bush to another during the growing season. Rusts are one of the largest groups of *Basidiomycetes* with about 8,000 known species and probably tens of thousands of species still unrecorded.



Above: Comparison of photos of Saskatoon berry rust taken with an iPhone 13 versus an Olympus TG-6. KEITH SEIFERT

Powdery mildews hardly penetrate their hosts but nevertheless suck away enough nutrients to do significant harm. They are Ascomycetes with about 1,000 species described so far. The powdery mildew of grapes stimulated the invention of fungicides in the 19th century. As the photos below show, they begin as felty white asexual growths on leaves and stems (left photo) and eventually, a ball-like asexual state develops on the surface (right photo), turning from white to yellow then orange or red and finally black as they mature. I didn't have Andy with me in Kananaskis, so I wasn't sure about the identity of the plant, and thus the name of the powdery mildew remains a guess. Unlike eastern Canada, Alberta is blessed with a multitude of *Salix* species, which are often attacked by a powdery mildew called *Erysiphe adunca*. So maybe it's that one.



Above: Powder mildew found in the Kananaskis park. KEITH SEIFERT

While you are waiting for your next Great Alberta Mushroom Foray, you might watch out for powdery mildews in your garden. They are really common on pumpkins, squashes, melons, and cucumbers. Or if you try to overwinter plants in your window sill, watch your rosemary or sage for that tell-tale fuzz.

KUDOS TO ALL WHO ATTENDED THE 2023 GREAT ALBERTA MUSHROOM FORAY

Waterton Lakes National Park

As the 2023 Great Alberta Mushroom Foray (GAMF) wound down in Waterton Lakes National Park, there were many individuals to acknowledge for its fine success. To start, we had an outstanding turnout — 60 participants! The highest number in recent years with five speakers and many expert identifiers. Special thank yous to Dr. Keith Seifert, Andy MacKinnon, Paul Kroeger, Larry Evans, and Martin Osis for their intellectual stimulation of our minds with their presentations throughout the weekend. However, not surprisingly, though our fungal numbers were lower than a foray in the Aspen parkland or boreal forest. Waterton Lakes National Park sustained a devastating fire five years ago. The regrowth is encouraging, and the fungi are doing their part to return the nutrients to the soil. Polypores dominated in our collection.

While having the GAMF in Waterton did not result in the *Last of Us* with no *Cordyceps* found, all our participants working together were able to collect and identify 220 potential specimens for the AMS Fungarium. Our leading expert identifiers clocked in as follows: Mike Schulz identifying 61; Bill Richards at 47; and Paul Kroeger at 42 of the total 220 doubly-identified specimens. A very great big thank you to all participants for collecting and identifying, and all the experts for verifying and finalizing the identifications.

A recognition and thank you to the following AMS board members is also in order: Mike Schulz, Vice President; Lisa Oishi, Secretary; Melanie Fjoser, Treasurer; and Directors-at-Large: Christine Costello, Mel Hohn, Robert Simpson, Liz Watts, and Rick Watts, thank you for all your work in supporting the success of GAMF 2023. Thank you to Barb Shworak for gathering and maintaining the on-site data of the double-identified specimens. Although she was unable to attend the GAMF, Erica must be commended for the preparation of the GAMF brochure and poster. My final thank yous and heartfelt recognition goes to the spouses and family of AMS board members: Leslie MacDonald (Robert Simpson), Brent Martell (Lisa Oishi), Raelyn Schulz (daughter of Mike Schulz) and Richard Slevinsky (Karen Slevinsky) for their undying support of our personal pastime. From doing dishes to serving wine, cleaning campsites, or setting chairs, no task was too little or too large. All these tasks were completed without protest. Thank you, family and friends, for making GAMF such a success! Mush appreciation to all!

Karen Slevinsky
AMS President

Above: *Clavariadelphus pistillaris* found at 2023 GAMF. KAREN SLEVINSKY

Top: 2023 GAMF Attendees. RICK WATTS

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FORESTRY AND FUNGI

By Ryan James, P. Biol.

I spend much of my time in forests professionally and for leisure as a botanist observing plants and as an ecologist observing the relationships of organisms with each other and their environments. In this article, I will describe my observations of forestry and some fungi; based on the research I participated in and the bushwhacking I've done through forests of different ages. Before I begin, I want to share how I became interested in mushrooms in the first place.

Photo 1: *Hygrocybe conica* aka "witch's hat" found during 2012 GAMF. RICK WATTS

Mushrooms caught my interest while I was examining wildflowers. I would often see colourful mushrooms (e.g. Witch's Hat/*Hygrocybe conica* (**photo 1**), *Russula* species, *Cortinarius violaceus*/Purple Cortinarius) nearby and wonder what they were. During the summer of 2012, I was working in Edmonton as a student intern at what used to be Alberta Environment and Sustainable Resource Development and discovered Mike Schulz, our current Alberta Mycological Society (AMS) vice president, was teaching an introductory weekend course on mushroom identification at the University of Alberta (U of A) Botanic Garden. I jumped at the opportunity to take the course and managed to get one of the last seats. From his course, I learned the basics of mushroom identification, some edible species, and their poisonous look-a-likes. The edible fairy ring mushroom (*Marasmius oreades;* **photo 2**) and the poison pie mushroom (*Hebeloma crustuliniforme;* **photo 3**), which can grow intermixed, are two such species we need to be careful with. In this course, I also learned about the AMS, which I joined in the following year. The AMS quickly became a second family, and attending forays, especially the Great Alberta Mushroom Foray, helped me quickly progress my mushroom identification skills. Having a background in botany was incredibly helpful because of the connection and relationships between plants and fungi. For example, many plants exchange sugars for nutrients and water from fungal partners. The fine mycelium of fungi can access nutrients and water from the tiniest spaces between soil particles that plant roots are too large to access. This is an ancient relationship. In a paloeobotany class, I remember looking through a microscope in amazement at fossilized plant roots with attached mycelium from before the existence of dinosaurs. As mushroom foragers know, we can find mushrooms more easily when we can spot associated plants nearby (**photo 4**). We inevitably end up foraging in the forests since most edible mushrooms are associated with woody plants.

Want to know what fossilized plant roots and mycelium look like? Find out on from **Fossil Hunters**!

Photo 2: *Marasmius oreades* aka "fairy ring mushroom" found during 2012 GAMF. RICK WATTS

Photo 3: *Hebeloma crustuliniforme* aka "poison pie mushroom". MICHAEL KUO from www.mushroomexpert.com

While studying conservation biology at the U of A, I participated in a large-scale forestry research project, the Ecosystem Management Emulating Natural Disturbance (EMEND) Forestry Research Project located northwest of Peace River, Alberta in the Clear Hills. This project, which began in 1998, will last 80 to 100 years or one forestry harvest rotation. The experiment attempts to mimic the patterns of wildfire with logging.

Photo 4: *Hygrophorus camarophyllus* aka "smoky waxgill," which are commonly found growing near old growth spruce trees. RYAN JAMES

While logging can never completely have the same effects as fire, some of the differences being how much deadwood is left behind, the absence of fertilizing ash inputs, and the poor regeneration of access roads, logging can somewhat mimic the spatial pattern of wildfires. When a wildfire occurs, the flames hop and skip across the landscape, leaving random patches of unburned trees, a few standing live trees, and many standing dead trees (**photos 5, 6, 7**). The experiment tests the effects of leaving varying amounts of standing live trees on the landscape, called green tree retention, both as large patches and as dispersed standing trees. Over time, the dispersed trees are expected to fall down and provide logs that are important for a variety of organisms, including wood decomposing fungi, such as honey mushrooms (*Armillaria* species), combs tooth (*Hericium coralloides;* **photo 8**), and oyster mushrooms (*Pleurotus populinus*). The experiment compares the effects of clear-cut (2% retention) and partial harvest (10%, 20%, 50%, or 75% retention) to unharvested (100% retention) areas on a variety of organisms, like leafy plants, invertebrates, amphibians, birds, and animals.

Photo 5: 2013 Nordegg burnsite (photo taken in 2014). RYAN JAMES

Photo 6: 2013 Nordegg burnsite across Hwy 11 from the site in photo 5 (photos taken in 2014). The difference in visible plant growth is due to differences in burn severity. RYAN JAMES

The experimental area was harvested in the winters of 1999 and 2000. Winter harvesting has fewer negative impacts on soil and species that regenerate from roots, such as aspen and poplar. Some negative impacts are soil compaction, erosion, and root damage from heavy logging equipment. I was involved at the tail end of the forest re-establishment phase of the EMEND project, which was 15 years after the harvest. One of the benefits of working in the forest is that you get

Photo 7: Light intensity burn after 6 years (EMEND location). RYAN JAMES

Photo 8: *Hericium coralloides* aka "Coral Tooth" mushroom. MEL HOHN

Photo 9: *Gomphus clavatus* found during 2016 GAMF. RICK WATTS

to pick mushrooms while working, so I learned what edible mushrooms are found in different retention levels. I didn't find anything in clear-cuts and found very few edible mushrooms in 10% retention areas. In broadleaf (aspen, birch, poplar) forests with 20% retention and higher, there were tons of rough-stem mushrooms (*Leccinum* species) that would come out in multiple flushes throughout the summer and fall. I would also find the occasional morel (*Morchella* species) and Verpa (*Verpa bohemica*) in the spring. These mushroom fruiting observations show that when aspen and poplar roots are protected from damage and when adequate amounts of large trees are retained to support the root system, the typical aspen and poplar-associated mushroom species can recover and will fruit again, ready to pick, in at least 15 years.

This wasn't the case with spruce-dominated conifer forests. I only found the conifer-associated mushrooms, such as pigs ears (*Gomphus clavatus*, **photo 9**), hedgehogs (*Hydnum repandum* and *albertense*), and northern pestels (*Clavariadelphus borealis*) in old growth unharvested areas and fewer of the above mentioned species in minimally harvested areas (50-75% retention). Clear-cut and 20% retention areas had no conifer-associated mushrooms. Although, the EMEND Forestry Research Project didn't have any pine-dominated conifer forests, I have seen a similar pattern while wandering through regenerating pine harvest blocks — a lack of conifer-associated mushrooms in low retention areas contrasting with their presence in unharvested forests with old trees (100+ years old). These conifer-associated mushroom species need old trees and also probably the moister conditions of a closed tree canopy that provides shade for moisture

retaining mosses. These mushroom observations suggest it takes longer for conifer forests to recover fruiting mushrooms than aspen or poplar forests. Another important observation is that the wood decomposer fungi, such as combs tooth and honey mushrooms, did better with more retention, likely because the shadier conditions allowed logs to retain moisture (**photo 10**). In clear-cut and 20% retention areas, the logs were often very dry due to exposure to the drying sun.

So, what does all this mean? It means that to manage a forest for mushrooms, especially in coniferous forests, one needs to retain old trees and shaded deadwood, logs, stumps, and standing dead trees, on the local and regional landscape scales for mushrooms to persist. The recently released *State of the World's Plants and Fungi 2023* report by the Royal Botanic Gardens, Kew, lists the reduction of deadwood and old trees from the conversion of primary non-intensively managed forests to industrial forestry as one of the main threats to fungal biodiversity. The report also states that globally, researchers estimate that more than 90% of fungi have yet to be described, and of those that have been described, only 0.4% have their conservation status assessed (how endangered they are). Citizen science initiatives, such as our annual Great Alberta Mushroom Foray, go a long way in contributing to understanding where and what mushrooms occur in Alberta and their conservation status.

A good example of a poorly understood and rare mushroom that is impacted by forestry has been found during our annual edible mushroom foray at Weald near Robb and Edson in the foothills. The area surrounding Robb is the only confirmed location in the province where we find the delectable large white hedgehog mushrooms (*Hydnum* species) and we are not certain of the exact species (possibly *Hydnum albomagnum* or *Hydnum vagabundum*, **photos 11, 12, 13**). There is also an undescribed giant *Leccinum* species (**photo 14**) that often grows with the white hedgehogs. In the last 10 years, most of our regular white

PHOTO 14: Giant rough-stems found at the 2016 Weald Foray (right side of table). These are some of the largest specimens we have found, and they weren't even buggy! RYAN JAMES

PHOTO 10: Honey mushrooms, growing from a moist stump in a 15-year-old harvest block with adequate shade from retention and aspen regrowth. RYAN JAMES

PHOTO 11: Close up of white hedgehog species. RYAN JAMES

PHOTO 12: White hedgehog (*Hydnum* species) from above. RYAN JAMES

PHOTO 13: Underside of white hedgehog species. RYAN JAMES

Photo 15: Clear-cut harvested in 2022. This used to be a good white hedgehog spot. RYAN JAMES

hedgehog foray locations have been lost due to logging (**photo 15**), and we only have one good spot left that provide a predictable harvest (**photo 16**). White hedgehogs are only found in moist forests older than 50 to 60 years and dominated by lodgepole pine. I have still found white hedgehogs in smaller retention patches left as buffers (**photos 17, 18**), consisting of mature trees, shrubs, and leafy plants along water courses or slopes too steep for logging. While this leaves a source population of mushrooms to recolonize the harvested areas as the forest regrows, the recolonization timeframe is outside of most of our lifetimes. Longtime AMS member, Bill Richards, reminded me of this important point when we were reminiscing about several picking areas lost to logging in the last couple years.

Photo 16: Basket full of white hedgehogs from 2020 picked in about 30 minutes! RYAN JAMES

Photo 17: Thin buffers along streams and very small retention patches on mostly forested wetlands near Robb. Retention along streams and lakes doesn't count towards retention levels within a harvest block according to AB government rules. GOOGLE EARTH

To understand why rapid logging is occurring in our white hedgehog picking spots, we need to understand Alberta's forest management policy system. The Alberta government divides the forest into forest management units and grants forestry companies the right to harvest and manage the land on these units. Receiving the right to harvest and manage land is done through 20-year forest management agreements (FMA) or timber quota licences and permits. Most companies with forest management agreements use a 200-year planning period or two full harvest rotations. The province requires that FMA holders update and submit forest management plans (FMP) for approval every 10 years. These plans are required to follow sustainable forestry practices that consider ecological, social, and economic sustainability. These considerations make things tricky because sustainable forestry practices, as determined by forest ecology research, can be very different from what the government approves as adequate in FMPs. For example, most FMA holders write in their plans that they are using a natural range of variation to harvest sustainably while also providing a steady supply of wood for various uses.

Photo 18: Example of 15% retention in the Clear Hills, AB with various-sized and shaped retention patches on mostly wet areas and streams (incl. upland). This is on the Mercer Peace River FMA with logging starting in 2014/16. Lighter areas are 1-2 years post-logging. Circled area is a 10 ha retention patch. GOOGLE EARTH

Natural range of variation is a type of ecosystem-based management. It picks a baseline moment in time that is considered "natural" for a forest area and then manages the forest to be within this defined natural range of variation for a variety of forest attributes. To a forest ecologist, this approach means that deadwood, tree age classes (proportion of old and young trees), understory plant communities, and wildlife populations (just to

Photo 19: Clear-cut with coal mine in background, two human disturbances that forests are responding to (photo taken September 2023). RYAN JAMES

name a few) need to be within the range of what is considered "natural." The baseline that is often chosen in Alberta is the range of variation that occurred before forest fire suppression began in roughly the 1930s. In other words, it is based on the historical fire frequency, size, and type before 1930. Before 1930, most fires occurred approximately every 100 years, were mostly small in size with a few large fires that burned the majority of the total area burned in a year. These large high intensity fires killed most of the trees in a given year. It may sound logical to try to mimic fire patterns with logging for sustainable regrowth; however, forests are incredibly complex and constantly adapting to changes, both natural and human caused, in addition to fire and forestry. Windthrow from storms, floods, climate change, industrial impacts (mining, oil and gas), and recreational impacts (trails, random roadside camping, off road vehicles) are just a few examples of changes that forests must adapt to (**photo 19**). The forest is in constant flux and managing for historical conditions may not be the best strategy for sustaining the values we want and need from forests today, such as mushroom foraging, lumber for housing, toilet paper, steady forestry jobs, relieving stress, and spiritual experiences.

Because pre-fire suppression was used as the baseline for natural range of variation, the forest is considered to be "out of balance" with more old trees in the roughly 120- to 130-year range than what is considered "natural." Unfortunately, our best white hedgehog locations fall in this 120- to 130-year-old tree age class, which is rapidly being logged to bring the forest back into "balance" based on forestry management that uses the younger tree age classes for maturity for logging. For example, 50-99 years for harvest origin versus 70-119 years for fire origin early mature age class, the youngest harvestable age class. This difference in age ranges for an age class is due to forestry tree management techniques that result in trees maturing for harvest at an earlier age. When the younger end of the old tree age class is used, the forest is converted to a system where just as the trees are old enough to produce old growth mushrooms, they are soon logged again. This logging system makes the window of time for our children, grandchildren, or nieces and nephews to forage for these mushrooms very short and limited before the trees are logged again. These fleeting windows are the result of 70 to 100 years logging rotations. To put things in perspective, if one logs 1% of the forest each year, then in 100 years everything will be logged once. At 2%, everything is logged every 50 years, and at 0.5%, everything is logged every 200 years. So, for mushroom foragers, the pace of logging really matters for mushroom habitat recovery in conifer forests because it impacts our own ability to harvest edible mushrooms, as well as the ability of future generations to harvest. Currently, in the Hinton FMA area where the white hedgehogs occur, the harvest rate is 2% per year in the pine stands, which is why we have seen our picking spots vanish so rapidly. This harvest rate is not sustainable, and some who work in industry refer to it as the "120-year cliff" because once the old trees, except for the small proportion considered "natural", are harvested, the harvest rate will have to be greatly reduced until trees are old enough to log again. This can lead to job losses in the forestry sector, similar to what British Columbia is currently experiencing now that all the trees that were killed by pine beetles have been logged. A much slower harvest rate could be used to bring the forest back to the hypothetical "natural" range of variation, but logging 70 to 130-year-old trees is the most profitable — the profit declines as trees age and succumb to fungal attacks, insects, or other diseases (**photo 20**).

Portion of Forest Logged (%)	Logging Rotation (Years)
0.25	400
0.5	200
1.0	100
1.5	67
2.0	50

So, what about the inclusion of retention and deadwood in Alberta's forestry management? Unfortunately, they are barely considered and inconsistently applied across Alberta, despite their importance to healthy forests. The Hinton FMA only requires 1% retention (clear-cut only) with the averages in most other FMAs being within the minimum 3-5% range (required for timber quota licences and permits not on FMAs). The Hinton FMA's exception to the minimum retention range is a mystery. Approval for its 1% retention requirement is dated in 2023.

The highest retention level used is 15% in broadleaf (aspen, poplar, birch) forests on Mercer Peace River Pulp Ltd.'s FMA, where the EMEND project is located. They are one of the main participants in the EMEND project and have changed their operational practices in order to maintain their Forest Stewardship Council certification and to sell their paper products into the lucrative European market where their customers were asking if they were using the retention research they participated in. Mercer Peace River's use of higher retention rates shows that higher retention can be economically viable. Even though the EMEND project doesn't succeed at actually mimicking nature, its lessons about the importance of leaving higher levels of retention should be implemented by the forestry industry as a whole. All logging has impacts on soil, the water cycle, the seed-bank for understory plants, and the spore-bank for fungi. These things in turn affect plant composition. When the plant composition of an area changes, these changes may not provide the habitat for the animals, berries, fungi, essentially all organisms, that were there before to grow and thrive. Small changes in forest cover can lead to the loss of shade-loving moss species, and it's these shade-loving mosses that recent studies are suggesting are important spore-banks for fungi to recolonize forests after a natural or human disturbance because they retain the moisture that helps keep spores viable (**photos 21, 22, 23**). Increasing the amount of retention left after harvesting both as dispersed trees and patches contributes greatly to maintaining the old trees and deadwood that mushrooms require to persist on the landscape (**photos 24, 25, 26, 27**). Of note, Sweden and

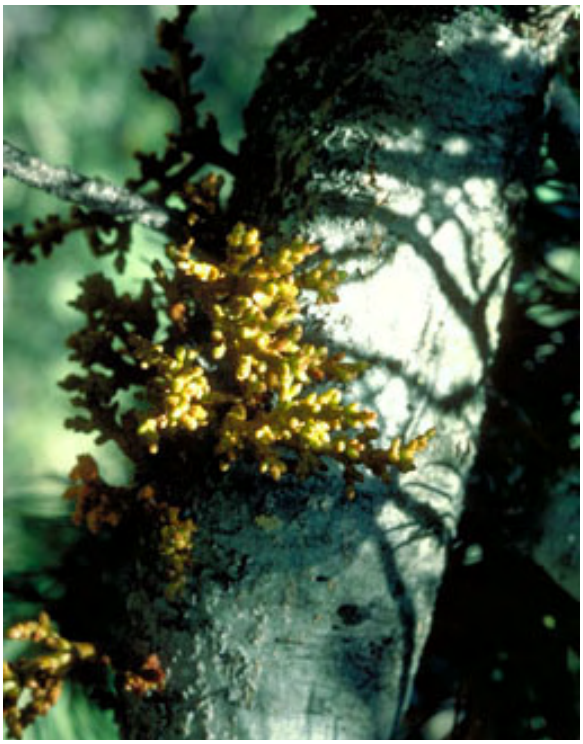

PHOTO 20: Dwarf mistletoe (*Arceuthobium cyanocarpum)* is a parasite on pine trees that causes branch swelling and also one of the causes of Witch's broom. DAVE POWELL, USDA Forest Service (retired), Bugwood.org

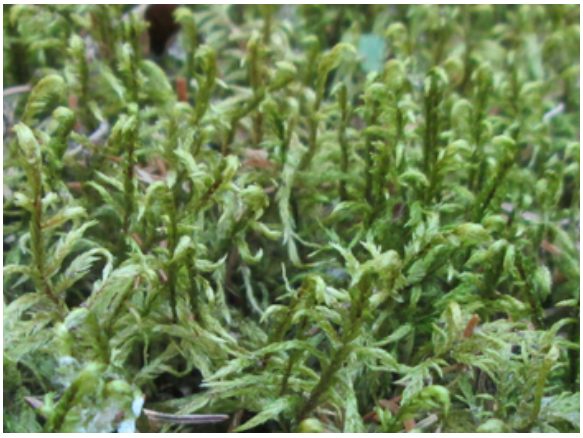

PHOTO 21: *Pleurozium schreberi* aka "Big red stem moss." RYAN JAMES

PHOTO 22: (Above) *Rhytidiadelphus triquetrus* aka "electrified cat's tail moss" aka "rough goose neck moss." RYAN JAMES

PHOTO 23: Aspen stocking moss (*Pylaisiella polyantha*) with a pixie-cup lichen (*Cladonia* species) on a log. A potential spore-bank. RYAN JAMES

PHOTO 24: (Left) Clear-cut spruce-dominated forest 15 years after harvest with noted reduced deadwood. A few unmerchantable white spruce were left behind and have grown larger, but no old trees to support conifer-associated mushrooms. Aspen is taking advantage of the light to grow quickly. The forest is transitioning to an aspen-dominated forest with a spruce understory. With time, the forest can become a mixed-wood forest and then return to a spruce-dominated forest as the aspen dies from old age. RYAN JAMES

PHOTO 25: A spruce-dominated harvest block 15 years after harvest with 20% retention left as dispersed trees and patches. Small retention patch seen in background, and some retained dispersed white spruce in left foreground. Note the presence of standing and fallen deadwood. RYAN JAMES

PHOTO 26: A mixed-wood harvest block 15 years after harvest with 50% retention left as dispersed trees and patches. Note the mix of old and young trees creating a mixed age forest that would still be able to produce mushrooms. RYAN JAMES

PHOTO 27: A log with a diverse host of saprophytic fungi. ERICA TO

Finland now require old trees be retained and some trees be cut down and left as deadwood to maintain habitat for mushrooms. These countries have a much longer history and more experience with intensive forestry management than Alberta. As mushroom-loving countries, they recognized what could be lost if they didn't make changes to their forestry practices.

The natural range of variation forest management concept, as applied in the Hinton FMA, is essentially an experimental hypothesis in sustainable forest management. This concept hasn't been applied long enough for us to confirm if it's actually sustainable, but the evidence so far on the effects on white hedgehogs doesn't bode well. None of us will be around long enough to see if the white hedgehogs will recolonize in the clear-cut areas. Clear-cuts have no similar natural equivalent. The forestry community is already aware that forests, once clear-cut, do not grow back as quickly as predicted nor do the trees grow as big as they did before. Some of this can be attributed to a drying climate, but much of this change is believed to be due to changes in the soil's microbial organisms, which include fungi, and are caused by current logging practices. The research in this area is in its infancy. Our research and field observations show that all things are interconnected, so every decision we make about forests has an ecological effect. If we don't manage habitats for a variety of species and ensure connectivity between habitats at a landscape level, we will end up with blocks of even-aged trees with varying ages classes, but without the forest structure needed to provide the variety of habitats required for multiple species (logs, retained old trees within harvest blocks) and no guarantee that the

mushrooms we now enjoy will be present for future generations.

There are things we can do differently in forest management that can benefit fungi and biodiversity in general. Changes that would make a huge difference are:

1. **Forest Ecosystem Recovery:** A slower pace of logging, suggestion of between 0.75-0.50% of forest area per year.

2. **Biodiversity Conservation:**

   a) Planting multiple species instead of just one species to increase biodiversity.
   b) Increasing retention patches to at least 10 hectares (100,000 square metres/0.1 square kilometres), which provide enough interior habitat for old growth species to survive until they can recolonize harvested areas.
   c) Managing at both the local and landscape scale to maintain and create contiguous connections between patches of old forest.

3. **Old Tree Conservation:**

   a) Including higher retention levels—20-30% would be a good compromise level combined as patches and dispersed retention.
   b) Feathering of retention and harvest block edges of old forest to reduce harvesting induced windthrow of old trees by cutting trees at different heights along harvest block edges to break the wind.

Some windthrow is good for decomposers, but too much windthrow causes loss of old trees that are need to serve as "life boats" for old growth forest fungi.

These changes as a whole in combination with effects monitoring and adaptive management that allows for adjustment as more is learned could provide habitats for spore-bank mosses and provide fungal hosts to assist with the recolonization of old-growth forest fungi; hence conserving the fungi that emerge only in old-growth forests.

So, what can we do about it? We can be more vocal about logging practices and advocate for the inclusion of non-timber values, such as mushrooms, berries, and wildlife, in forest management. If we don't share information with others or speak our concerns, we won't be seen as a stakeholder in the forests around us. Forest management agreements, agreements between the province and forestry[ks1] companies, about how the company manages the forest are updated and signed every 20 years and forest management plans are updated and signed every 10 years. Both FMAs and FMPs provide public comment periods to receive input. We can also contact forestry companies and work with them to conserve our important mushroom picking areas (**photo 29**). In fact, West Fraser in Hinton, which is the forestry operator in our white hedgehog picking areas, agreed in their forest management agreement to solicit new groups annually to join their management committee and request feedback on harvest plans. There's no reason that we can't have representation on the committee or ask to review harvesting plans. If we remain silent, the AMS won't

Alberta has many defined natural subregions, such as Alpine, Central Mixedwood, Boreal Subarctic, and Athabasca Plains, that are mapped out. You can view a map of the subregions in the ***Natural Regions and Subregions of Alberta Report***.

Some Major Forestry Companies:

- West Fraser
- AlPac (Alberta-Pacific)
- CanFor
- Mercer
- Tolko
- Vanderwell Contractors
- Weyerhaeuser

Want to view the existing Forest Management Agreements that are currently in place?

You can view them on the Government of Alberta website:

Current Forest Agreement Holders

Photo 29: Typical white hedgehog habitat of old growth lodgepole pine-dominated forest. Subalpine fir, black spruce, Labrador tea, and a thick layer of feather mosses are also present, indicating a moist environment, perfect for white hedgehog mushrooms. RYAN JAMES

be considered as a stakeholder. As individuals, we can also email or write to our political representatives, our city councilors, and members of the legislative assembly (MLAs). The AMS is one of the largest nature-based societies in Alberta. If we all wrote letters to our political representatives, we would have a strong voice for the inclusion of non-timber values in forest management in the province. If we don't exercise our voice, rights, and responsibilities, we risk losing important picking areas for us and for our children and grandchildren. Complaining over coffee doesn't yield results or change, but active advocacy and engagement does. So, let's get at it and use our voice!

Above: Moisture retaining mosses with a scatter of mushrooms. RYAN JAMES

When we look at satellite images of forested areas, we need to be aware of "green blindness."

"Green blindness" is a perception that if the vegetation looks green, then there are no problems.

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Ryan James is a Professional Biologist and a former Director at Large for the Alberta Mycological Society who grew up in the mountains of the Bow Valley in Treaty 7 Territory and in the Battle River Territory of the Alberta Métis. He has worked in technical roles in environmental and biodiversity conservation for government and non-profit organizations. Ryan enjoys writing, drawing, and wandering the province looking for interesting plants and fungi.

Ryan is also a foray leader and dedicated volunteer. If you see him at the *Wild* Mushroom Expo or Great Alberta Mushroom Foray, stop by and say hi!

FORESTRY AND FUNGI

Additional Reading

1. Alberta Forestry and Parks – *About forest tenure in Alberta*. https://www.alberta.ca/forest-tenure-overview
2. Alberta Forestry and Parks – F*orest Management Agreements*. https://www.alberta.ca/forest-management-agreements
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5. Bartels, S. F., Macdonald, S. E., Johnson, D., Caners, R. T., & Spence, J. R. (2018). Bryophyte abundance, diversity and composition after retention harvest in boreal mixedwood forest. J*ournal of Applied Ecology*, *55*(2), 947–957. https://doi.org/10.1111/1365-2664.12999
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7. Davey, M. L., Kauserud, H., & Ohlson, M. (2014). Forestry impacts on the hidden fungal biodiversity associated with bryophytes. *FEMS Microbiology Ecology, 90*(1), 313–325. https://doi.org/10.1111/1574-6941.12386
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9. *Ecosystem Management Emulating Natural Disturbance (EMEND) Project*. https://emend.ualberta.ca/ (More on the project and research findings)
10. Foothills Research Institute. https://friresearch.ca/ (See the various publications on ecosystem-based management.)
11. Girona, M. M., Morin, H., Gauthier, S., & Bergeron, Y. (Eds.). (2023). Boreal Forests in the Face of Climate Change: Sustainable Management (Vol. 74). Springer International Publishing. https://doi.org/10.1007/978-3-031-15988-6 (Open Source book with a good overview of ecosystem-based forest management, including fungal conservation in Finland and Sweden)
12. Niskanen, T., et al. (2023). Pushing the frontiers of biodiversity research: Unveiling the global diversity, distribution and conservation of fungi. *Annual Review of Environment and Resources, 48*. DOI: doi.org//10.1146/annurev-environ-112621-090937

Pickled Wild Mushrooms

COURTESY OF CANDICE CULLUM

INGREDIENTS

12 cups water

4 cups pickling vinegar

1 cup pickling salt

Garlic (whole cloves)

Fresh dill (or dry) whole

Honey Mushrooms (*Armillaria* sp.)

Slice of hot pepper (optional)

DIRECTIONS

1. Make your brine by combining the water, pickling vinegar, and pickling salt in a large pot and bring it to a rolling boil. We recommend you make your brine in batches until you finish pickling the amount of wild mushrooms that you have.
2. Add your honey mushrooms (or other wild mushroom variety) to the pot and return to a full boil for at least 10 minutes to cook them.
3. While the mushrooms are boiling, add one or two cloves of garlic, a head of dill (or a teaspoon of dry dill), and a slice of hot pepper (optional) to each jar.
4. Once your mushrooms are cooked, strain them out. Don't toss your brine!
5. Then fill each jar 2/3 full with mushrooms. Do not overfill the jars, or they won't pickle properly.
6. Fill the jar with brine, leaving 1/4 inch of space.
7. Wipe the brim of each jar with a clean cloth and quickly place and tighten the lids and bands on the jars. **Trapping the heat is what will seal the jar.**
8. Wait 4-6 weeks for the pickling process to finish before cracking the jars open to eat your mushrooms. Otherwise, they just taste like salt!

IMPORTANT

For mushrooms that are toxic when raw, such as morels and honey mushrooms, it is EXTREMELY important to cook them for at least 10 minutes. It is advised that you cook all wild mushrooms.

Full Baskets Facebook Page

2023 FORAYS

Above: *Xylaria* species. MEL HOHN

Edmonton Region

- Ministik Lake x 2, Karen Slevinsky & Rose O'Bertos (May 21)
- City of Edmonton x 2, Karen Slevinsky & Rose O'Bertos (Jul. 8)
- NE River Valley, Ash Johannesen & Mel Hohn (Jul. 8)
- Dunluce, Elizabeth Lakeman & Rob Arthur (Jul. 13)
- NE River Valley, Brett Wittke & Mel Hohn (Jul. 29)
- Kinsmen Park, Ryan James (Aug. 14)
- East of Edmonton, Karen Slevinsky (Aug. 26)
- Lac Ste Anne County, Elizabeth Lakeman & Rob Arthur (Aug. 27)
- Edmonton SE, Brett Wittke & Mel Hohn (Sep. 8)

Calgary Region

- Porcupine Hills, Christine Costello & Ethan Wheeler & Sean Campbell (May 27)
- Kananaskis Country (Pine Top), Christine Costello & Barb Shworak (Jun. 7)
- Innisfail Area, Christine Costello & Barb Shworak (Jun. 24)
- Kananaskis Parks, Barb Shworak & Taylor Routledge (Jul. 15)
- Kananaskis Wilderness, Christine Costello & Barb Shworak (Aug. 2)
- Water Valley Area, Christine Costello & Barb Shworak (Aug. 14)
- Water Valley Area, Christine Costello & Barb Shworak (Aug. 27)
- Porcupine Hills, Martin Osis (Sept. 1)
- Dickson Dam, Christine Costello & Barb Shworak (Sept. 9)

Other

- Entwistle, Cassandra McKenna & Chris Peet & Enoki Li & Joshua Key (May 20-21)
- Poplar Creek Natural Area x 2, Enoki Li & Mel Hohn (May 28)
- Pieter van der Schoot's woodlot x2, Elizabeth Lakeman & Rose O'Bertos (May 28)
- Nordegg Area, Martin Osis (Jun. 11)
- Shady Nook Hall (Summer Solstice), Liz Watts (Jun. 23-25)
- Gainford (AB), Enoki Li (Jul. 22)
- Poplar Creek Natural Area, Lisa Oishi (Aug. 13)
- Burnstick Lake, Candice Cullum (Aug. 14)
- I4C Lands, Robert Simpson (Aug. 14)
- Weald Weekend Foray, Elizabeth Lakeman (Sept. 15-17)

Above: Mel Hohn identifies mushrooms for foray attendees. MEL HOHN

Above: Young puffballs. MEL HOHN

Above: Ministik Lake foray on May 21. ERICA TO

Above: Rose O'Bertos (aka "Mushroom Mama") sharing her wealth of knowledge. ERICA TO

Above: Water Valley foray attendees on Aug. 12 stand proudly before their jackpot of mushrooms. CHRISTINE COSTELLO

Above: Edmonton is full of mushrooms (Jul.8 foray). KAREN SLEVINSKY

Above: Mushroom found at the Water Valley foray on Aug. 27. CHRISTINE COSTELLO

Above: Dickson Dam foray attendees on Sept.9. CHRISTINE COSTELLO

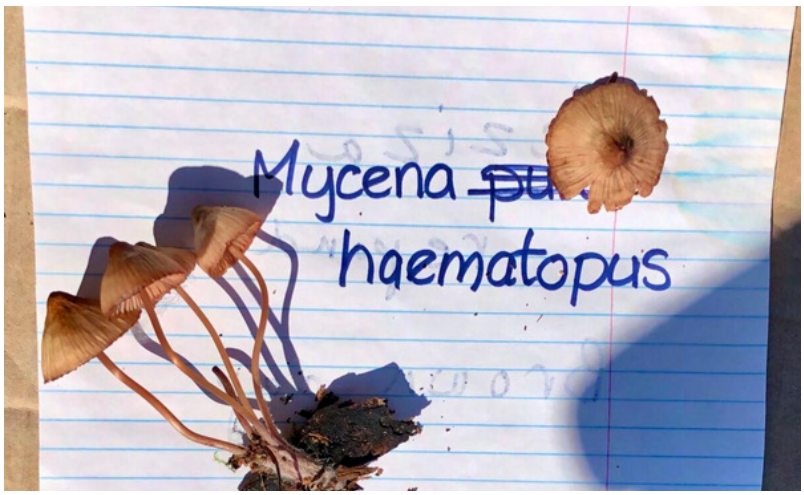
Above: Satisfied Kananaskis Country foray attendees on Jul. 15. CHRISTINE COSTELLO

Above: A diverse spread of mushrooms found during the Kananaskis Country foray on Aug. 2. CHRISTINE COSTELLO

Above: Kananaskis Country (Sibbald Pluz) foray on Jun. 7. CHRISTINE COSTELLO

Above: *Royoporus badius or Picipes badius,* commonly known as the black-footed polypore or black-leg (Porcupine Hills foray on May 27). CHRISTINE COSTELLO

Above: Mushrooms found on Pieter van der Schoot's woodlot on May 28. ELIZABETH LAKEMAN



Above: Innisfail Natural Area foray on Jun. 24. CHRISTINE COSTELLO

Above: Pieter van der Schoot's woodlot for a late morel foray on May 28. ELIZABETH LAKEMAN

Above: Possibly *Caloscypha fulgens*, also known as snowbank orange peel fungus (Porcupine Hills foray on May 27). CHRISTINE COSTELLO

Above: I4C foray at the CHANGE Centre (Gainford, AB) on May 20-21. MEL HOHN

CULTIVATE MYCOLOGICAL SCIENCE

Above: *Leccinum* sp. MEL HOHN

We know fungi have a vital role in our ecosystem, but how exactly? There's so much we have yet to discover!

Through research and ongoing monitoring, we can better understand their relationships with other plants, their role in promoting biodiversity, and their ability to help remediate natural environments affected by human activity. Research is also essential in identifying and protecting fungal species at risk.

A key objective of the Alberta Mycological Society (AMS) is to "educate ourselves and others in the field of Mycology."

The AMS Graduate Award

UNIVERSITY OF ALBERTA

The AMS is proud to champion the AMS Graduate Award with the University of Alberta (U of A).

With this award, the AMS aims to inspire university students to pursue fungal research to foster an appreciation for fungi and their role in our ecosystem. The AMS hopes that many more people will become just as enthralled and interested in mushrooms as we are.

The AMS has committed to funding $2,000 per year towards this award for five years. If donations towards this award exceed $50,000 in five years, the funds will be placed in the Endowment foundation at the U of A, and the award will be granted to a student each year in perpetuity. All donors will receive a taxable donation receipt from the U of A. Please donate to support fungal research.

Donate

Learn more about the AMS Graduate Award.

Above: *Lepiota* sp. MEL HOHN

Above (2): Likely *Amanita muscaria*.
EFFIE PENNER

ANNUAL GENERAL MEETING & PRESIDENT'S DINNER

Scheduled for late **March 2024**. Stay tuned for a save-the-date email announcement in January!

Thank you,
Karen Slevinsky
President

Spore Print Newsletter
The *Spore Print* is published up to four times per year by the Alberta Mycological Society. Read previous issues online on our website.

Producer Erica To
Editors Barb Shworak, Karen Slevinsky, Mel Hohn, Erica To
Front Cover Header Photo Effie Penner
Other Photo Contributors Ken Dies, Rick Watts, Ryan James, Keith Seifert, Robert Dale Rogers, Mel Hohn, Karen Slevinsky, Christine Costello, Elizabeth Lakeman, Erica To

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