SPORE PRINTS

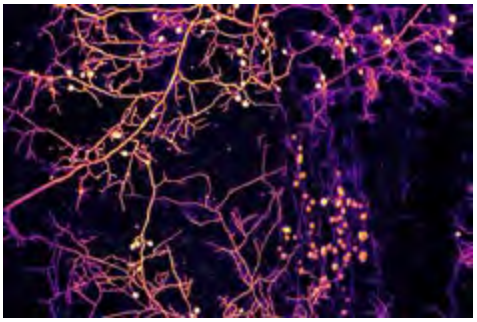
BULLETIN OF THE PUGET SOUND MYCOLOGICAL SOCIETY
Number 611 April 2025

HOW FUNGI MOVE AMONG US

Alan Burdick
The New York Times, Mar. 1, 2025

Mycorrhizal fungi are the supply chains of the soil. With filaments thinner than hair, they shuttle vital nutrients to plants and tree roots.

In return, the fungi receive carbon to grow their networks. In this way, 13 billion tons of atmospheric carbon dioxide—one-third of fossil-fuel emissions worldwide—enter the soil each year.



Mycorrhizal underground network.

These fungi cannot live on their own; they need the carbon from plants. In turn, 80 percent of the world's plants rely on fungal networks to survive and thrive. The two are dependent trade partners.

These fungi make uncannily smart choices, even without a brain or central nervous system. Scientists describe them as "living algorithms."

The trade algorithms reward efficiency: Build the most lucrative pathway possible for the lowest construction cost.

Fungal networks appear to assess demand and supply. Which plants need its nutrients the most? Which offer the most carbon? Where is the optimal payoff? This analysis shapes how the networks expand, as scientists learned when they mapped the growth in real time.

"Fungi are super clever," said Toby Kiers, an evolutionary biologist and director of the Society for the Protection of Underground Networks, a research organization. "They're constantly adapting their trade routes. They're evaluating their environment very precisely. It's a lot of decision-making."

How do fungi do it? To find out, Kiers and her colleagues grew fungi in hundreds of Petri dishes, or "fungal arenas."

Then, with an imaging robot, the team tracked the growth of the networks nonstop for days, measuring how the organisms reshaped their trade routes in response to different conditions. Their study was published on Feb. 26 in the journal *Nature*.

From special nodes, or growing tips, the fungi deploy filaments that explore and assess new territory. Over several days, the scientists labeled and monitored a half-million new nodes and mapped the expansion.

The growth revealed fungal decision-making in action. In past work, the team learned that a fungus will forgo trading with nearby roots in favor of more distant ones if the return in carbon is greater.

Fungal networks are sometimes described as the soil's circulatory system.

But in fungal networks the flow is open. Carbon, nitrogen, phosphorus, water, and even fungal nuclei move in either direction, even in opposite directions at once.

"That's physically mind-boggling," said Dr. Tom Shimizu, a biophysicist at AMOLF, a physics institute in Amsterdam, and whose lab built the robot. The fungus, he said, "is basically a microbe that plays economic games. How do you do that if you're just a tube of fluid flowing?"

They do it by obeying some basic local rules, it turns out. As the growing tips progress, new branches form behind them at a steady rate. But when one tip hits another, they fuse and form a loop.

This removes dead ends, avoids wasteful expansion and keeps resources moving quickly on the main highways. The edge of the fungal network expands like a ripple, laying down an efficient trading nexus as it goes.

Scientists still want to understand how fungi move so much carbon so far without clogging the pipes. And they hope to simulate how these ancient organisms respond to wildfires, drought, and other disruptions from climate change. "We're trying to figure out how they play the games they play," Shimizu said.

IS THE WORLD'S LARGEST COLLECTION OF FREEZE-DRIED MUSHROOMS FACING DESTRUCTION?

https://www.croatiaweek.com/, Mar. 7, 2025

AGREB, Croatia – After nearly twelve years of success and high internet rankings among Zagreb's top tourist attractions, the Educational Centre "World of Mushrooms" was temporarily closed by city authorities in December 2024, leaving its future uncertain.

Better known to the public as "The Mushroom Museum, it is unique in the world: The freeze-dried mushrooms look as if they had just been brought from the forest. Among the exhibited mushrooms are species that can rarely be seen in nature as well as many protected species.

Because of the exceptional educational value of this collection and the public's growing interest in the biological Third King-

cont. on page 3

Spore Prints

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CALENDAR

Apr. 8	Membership meeting, 7:30 pm, CUH and virtual via Zoom
Apr, 14	Board meeting, 7:30 pm, CUH board room and virtual via Zoom
Apr. 29	*Spore Prints* deadline
May 3	Field trip (see psms.org members' page)
May 10	Field trip (see psms.org members' page)

BOARD NEWS

Caroline Kohler

Monday, March 17, marked the final board meeting for the officers and trustees whose terms came to an end on March 31. As is tradition, both the trustees already in office and those stepping in in April were present at this meeting, which allowed for some great and lively conversations.

Election Results: Leaving their seats to the newly elected board members are President Colin Meyer, Secretary (yours truly), trustees Wren Hudgins, Sandra Ruffner, and Tara Henry, Immediate Past President (Randy Richardson), and two alternates (Vern Hodgson and Shaojun Wang). Kelsey Hudson and Valerie Costa will take over the roles of President and Secretary, respectively. Shannon Adams, Derek Hevel, Marian Maxwell, and Marion Richards will be our new trustees, together with former alternate Clay Dawson, who has been appointed to fill the position vacated by Kelsey. Lifeng Jin, Laurie Wu, and Pamela Pakker-Kozicki will be our new alternates. Colin will be stepping down as PSMS President, but will remain on the board as Immediate Past President, replacing Randy Richardson. *Thank you to all board members*, both departing and arriving, for devoting your time, energy, and vision to our club!

After the usual approval of last month's meeting minutes and the current treasurer's reports, the board addressed a last-minute agenda item: **Photography Chair** Paul Hill has announced his resignation, and PSMS is looking for a replacement. You will see calls for this position coming out soon, so keep your eyes open if this is something that might interest you. Don't hesitate to contact Volunteer Coordinator Peg Rutchik (volunteer@psms.org) if you have any questions.

Next, the board discussed a topic that has been on the table for the past several meetings: **how to meaningfully acknowledge the volunteers** that keep our organization running. You may be tired of hearing me say this, but PSMS is fully run by volunteers, and recognizing their effort and dedication has become a heartfelt priority. The board discussed ways to achieve this (monetary retribution? social events? swag?) and would love to have your input if you have any thoughts.

Following this, the board received several updates on ongoing business. The **Policies and Procedures** task force has sent out the three policies they have been working on (Fiscal Management, Code of Conduct, and Conflict of Interest) for committee chairs to review, and the **Scholarship Committee** reported that eight applications for the Ben Woo Scholarship have been submitted and will be reviewed in the coming weeks, with the awardees being announced at the end of April.

Next on the agenda was a brand-new item: a proposal for an **Oral History Project** for PSMS. The board brainstormed who could be valuable contributors to this and will be discussing things further. This will be a long-term project, and defining its scope will be the first course of action.

The newly established **Website Improvement** task force also briefed the board on their progress; a survey has been sent out to committee chairs to find out what strengths and weaknesses users are encountering on our current website and this information will shape the next steps to take.

Closing the agenda, the board gave the final touches to the **PSMS Art Contest** that has just been launched, seeking designs for logos, posters and/or merch. We are really looking forward to seeing your submissions! This promises to be a lot of fun!

Goodbye, fellow members. It has been a truly wonderful experience to share with you my term as PSMS Secretary. It's been two years of intense learning, forging connections, and deepening the understanding of everything that makes PSMS the club we love. A very warm welcome to new Secretary Valerie Costa; thank you for taking over the baton! May your time here be as enjoyable as mine. Happy mushrooming, everyone. See you on the trails!

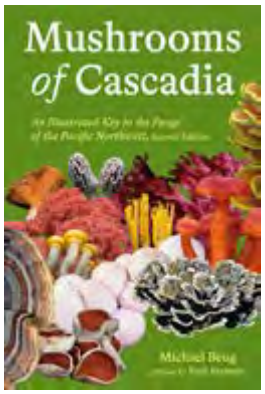
—*Carolina Köhler*

MEMBERSHIP MEETING — Joseph Zapotosky

Few people have the knowledge and experience of our next speaker, Dr. Michael Beug, who has been involved with the Pacific Northwest mushroom scene since the 60s. Classically trained as chemist, he has a unique insight to the metabolic functions that fungi are capable of. Fungi are powerful chemical factories, producing many compounds that have been used as medicine for centuries. We are looking forward to hearing what he has to say.

Michael Beug.

His talk, entitled "Medicinal/Culinary Mushrooms: Fantastic Fungi to Save Body, Mind, Spirit, and the Planet," consists of two parts. Part 1 is on psychotropic fungi, and Part 2 on general medicinal/culinary fungi. Part 1 deals briefly with mushrooms in the *Amanita muscaria*, *A. gemmata*, and *A. pantherinoides* groups, where the principal toxins are muscimol and ibotenic acid and then explores in depth the species containing psilocybin and psilocin as the main active compounds. Part 2 examines mushroom food value and nutrition and the vast range of potential functional foods and medicinal uses of fungi. It also briefly examines evolving uses of fungi to grow homes and make recyclable materials to replace plastics as well as synthetic dyes and thus ease adverse human effects on the environment.



Please join us April 8, at the Center for Urban Horticulture, University of Washington, on in this journey into the mind / body/and environmental considerations of fungi. This will be a hybrid meeting both in-person and virtual via Zoom. Doors open at 7:00 pm. The lecture will start around 7:30 pm.

PS: Dr. Beug will have copies for his best-selling field guide *Mushrooms of Cascadia: An Illustrated Key* for sale and signing after the lecture.

Freeze-Dried Mushrooms, *cont. from page 1*

dom of fungi, alongside flora and fauna, the number of visitors and positive reviews continues to grow.

The Educational Centre was established in 2013 by the City of Zagreb, the Zagreb Tourist Board, and the Kamilo Blagaić Mushroom Society (the oldest society of this kind in Croatia), an initiative of Professor Božac, a tireless researcher, author, educator, and promoter of mushroom knowledge.

It is located at an attractive site on Zagreb's main square. For formal reasons, the City of Zagreb "entrusted the management" of this now-renowned educational center to the Public Institution of Nature of the City of Zagreb (formerly PI Maksimir).

"Unfortunately for all mushroom enthusiasts and valuable volunteers of the mushroom society, tourists, teachers, and university professors who brought their students and pupils, as well as all friends of the World of Mushrooms, the Public Institution Maksimir proved to be "uninterested, uninformed, and inadequate in managing the Educational Centre, and has hindered the Centre's work and development in various ways for many years," the Kamilo Blagaić Mushrooms Society (GDKB), Zagreb says, before adding.

"The once favorable and excellent location has obviously become a site of dispute between the city and state over the use of this attractive piece of real estate and this dispute has become a real threat to the survival of this truly magnificent heritage treasury of the history of mushrooms, their use, and medicinal qualities."

This drama concerning the above-mentioned dispute took an unexpected negative turn in July 2024. The Public Institution informed the center's volunteers that the State had taken over part of the space which is now legally State's property.

"Without technical preparations or a plan, the Public Institution unilaterally mandated the relocation of the mushroom collection, completely disregarding the technical requirements of such an undertaking and the high-risk assessment of destruction to the exhibits provided by the committee of mycological experts, and mushroom enthusiasts," GDKB adds.

Namely, freeze-dried mushrooms are dehydrated during preservation and therefore fragile, sensitive to changes in ambient temperature and humidity as well as mechanical changes, so any rough relocation would mean the complete destruction of the collection.

The Mushroom Museum and its original experts and caretakers have received numerous inquiries from other countries' experts, about the possibility of opening "museums of lyophilized mushrooms" in other countries. They all see the value of such a museum as the unique place of education for the broader public on the important kingdom of fungi.

Nowhere in the world except Croatia are mushrooms presented in this way. Experts from various scientific fields who have visited have been amazed by the splendid collection and its excellent display and presentation.

GDKB says that it is obvious to many, therefore, that Zagreb could easily become a reference and information center for mushroom lyophilization, and The Mushroom Museum could serve as a model for similar museums worldwide.

When walking through the collection, visitors become familiar with the ecological aspects of mycelium in construction and design, [and] the medicinal properties of mushrooms, as well as the appealing gastronomic side. More important they become aware and learn about how to identify the deadly and dangerous poisonous mushroom species. During mushroom season, visitors bring mushrooms to the Educational Centre for identification, which is extremely important for the public and their families, to prevent accidental poisoning.

GDKB says that The collection urgently needs protection and support from all mushroom enthusiasts, educators, and experts and is calling on the help of the public.

The Mushroom Museum

Close-up of a Mushroom Museum display.

CLITOCYBE SCLEROTOIDEA: Description of This Parasitic Mushroom and Transfer To The Genus *Atractosporocybe*

Brian S. Luther

On our last PSMS fall 2024 field trip, a small collection of the fungus described below was brought in for me to ID. I was surprised and actually thrilled because I hadn't seen *Clitocybe sclerotoidea* in many years, but recognized it right away. It's a very unusual *Clitocybe* because it only grows as a parasite on *Helvella* species (one of our Elfin Saddle mushrooms) which, unlike the *Clitocybe*, is an Ascomycete. The host fungus is always unrecognizable as a result of being deformed by the parasite, but microscopic study of the tissue has proven it's a *Helvella*. So far *Clitocybe sclerotoidea* has been found only in the greater PNW area of North America, including California.

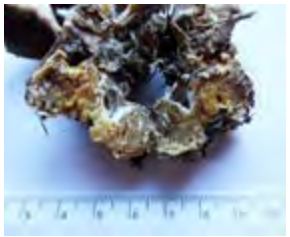
To give you some background, *Clitocybe sclerotoidea* was originally described as *Tricholoma sclerotoideum* by Morse (1943), who noted that the *Helvella* and the *Clitocybe* fruited from the same masses; however, she did not recognize the parasitic relationship between the two at the time. This fungus was transferred to the genus *Clitocybe* by Bigelow (1958), but the parasitic nature of this situation was *still* not understood. Trappe (1972) was the first to prove that the mass of tissue the *Clitocybe* was growing from was definitely a *Helvella*. More recently Bigelow (1982) in his monograph of the genus *Clitocybe* also notes the discovery by Trappe (1972). The host fungus at the time was thought to be *Helvella lacunosa* (a European species), but a DNA study found we have two distinct (new) species here, and the one that occurs in our PNW conifer forests is now called *H. vespertina* (Nguyen et al., 2013).

The following is a detailed description and photos I took of this collection. Colors in quotes are from Ridgway (1912).

Brian S. Luther

Atractosporocybe (Clitocybe) sclerotoidea, parasitizing Helvella vespertina. BSL coll. # 2024-112-1.

Brian S. Luther



Atractosporocybe (Clitocybe) sclerotoidea. Close up of the deformed Helvella sclerotium in section.

Species Description

Atractosporocybe (*Clitocybe*) *sclerotoidea* comb. nov.

BSL coll. # 2024-112-1. Nov. 2, 2024, Mason Co., WA.

Basidiocarp

Pileus 1–3.5 cm wide, up to 0.5 cm thick, at first convex overall with the disk slightly umbonate when young, then becoming somewhat plane; mottled watery grayish-brown with a distinct but irregular whitish flush overall and super finely fibrillose as seen under magnification; drying to a pale uniform tan color as "Honey Yellow"; margin slightly inrolled on the extreme edge at first and mostly uniformly chalky whitish-gray (canescent); context up to 1 cm thick, pale brownish; odor and taste not distinctive. Somewhat soft and fragile overall.

Lamellae a pale grayish buff, as "Light Drab" to "Drab," adnate at first becoming slightly emarginate to subdecurrent; somewhat distant, occasionally forked, up to 0.5 cm broad, slightly thick, lamellulae present.

Spore deposit white.

Stipe 1–2.5 cm long, up to 0.5 cm thick; mostly cylindrical but can be tapered slightly up or down; mostly central or slightly eccentric, solid, and fleshy, basically concolorous with the pileus, but with distinct white mycelial tomentum at the base where arising from the host fungus.

Microstructures

Hyphae 5–12 µm in diameter, clamp connections common. *Pileal surface* cutis, the hyphae cylindrical, 2.5–5 µm wide. *Hymenophoral trama* cells up to 16 µm wide, some inflated. *Pleurocystidia* and cheilocystidia not present. *Basidia* 23–36 × 5.5–8 µm, clavate, 4-sterigmate. *Basidiospores* 8–10 × 3.5–4 µm, subfusiform to elliptic-fusiform, slightly inequilateral in side view, often with a distinct slightly hooked apiculus appendage, thin-walled, smooth, hyaline & inamyloid.

Brian S. Luther

Habit & Habitat

Parasitic in cespitose clusters on an unrecognizable mass of deformed *Helvella vespertina* tissue (presumably), growing in conifer duff, primarily that of Douglas Fir (*Pseudotsuga menziesii*). This collection had 13 tightly clustered basidiocarps arising from the host. See photos.

Comments

In a recent publication by Alvarado, et al. (2015), the authors suggest that *Clitocybe sclerotoidea* may fit into their new genus *Atractosporocybe*, having subfusiform to elliptic-fusiform basidiospores. At least at this time I'm not aware that it has been formally transferred to that genus; I'm doing that for the collection I studied here.

In her original description of *Tricholoma sclerotoideum* (Morse, 1943) gave the basidial measurements as "average length 15–18 µm." Bigelow (1982) says the basidia are "17–28 × 5–7 µm." As you can see, most of the basidia in this collection were somewhat larger than what's documented in the literature for this species. I also found some basidia on the fresh specimen ranging up to 40 to 50 µm in length; however, after examining the dried specimen I was unable to consistently find basidia that large. A DNA sequence of this collection would be needed to determine if this collection is conspecific with *C. sclerotoidea* or not. It's possible that my description of this collection here will merely provide mycologists with a greater variation in the features of this species, which were not previously known.

For *Clitocybe sclerotoidea* Morse (1943) gives the habitat as conifer woods. Bigelow (1982) says that *C. sclerotoidea* occurs "Under pine." *Clitocybe sclerotoideum* is found wherever the *Helvella* host grows and is mycorrhizal, which can include several species of conifers.

Because the parasitic host is quite amorphous, superficially lacking obvious structure, it doesn't usually appear distinct, but rather just as an enlarged basal portion of the *Clitocybe* mushrooms. See photos.

Clitocybe rubella (Bigelow, 1958), described from Michigan, also grows from a sclerotial mass, but I'm not aware of any studies that have been done to determine if this is a parasitic relationship, like the fungi discussed here.

References

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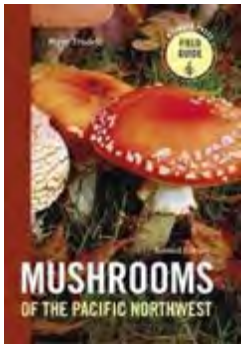
A MUSHROOM BOOK FOR PACIFIC NORTHWEST FORAGERS

Dick Sieger

This will be a frequent feature emphasizing books of interest for our newer PSMS members.

Fifty-five years ago when I became interested in mushrooms, we had just one book devoted to local species. It was the classic *The Savory Wild Mushroom* written by PSMS co-founders Professor Daniel E. Stuntz and local legend Margaret McKenny. Published in 1962, it was updated several times by various authors. The latest version is called *Mushrooms of the Pacific Northwest* and was written by PSMS scientific advisor Dr. Steve Trudell. It comes highly recommended.

Around here we have some 4700 mushroom species big enough to be seen at arm's length. Not quite all of them will fit into *Mushrooms of the Pacific Northwest*, but you'll find the common ones and many, many more. Modern examination of mushroom DNA often demands that new names be given to our species. You'll find the latest terminology here. Photos that accompany the text not only help with identification but also highlight the beauty of mushrooms. Is it edible? Yes, you'll find notes about that too. The book is portable and spilled red wine won't stain the cover.



Next time you are on a field trip, take a look at one or two of the mushrooms that were identified. Compare what you see with what's written in this field guide. That will help you remember your selected species, it will hone your observation skills, and it will give you a feel for how one goes about identifying mushrooms. When you are puzzled by something, PSMS field trip chair Brian Luther is right there to answer questions.

Mushrooms of the Pacific Northwest, Revised Edition; Steve Trudell; Timber Press; 2022; ISBN 978-1-64326-086-0; $29.99.

Please buy your books from PSMS or an independent bookstore.

CALIFORNIA MAN HAD KIDS HARVEST MAGIC MUSHROOMS AND ALSO GAVE THEM MICRODOSES, FEDS SAY

various sources, Mar. 21, 2025

A man accused of using 9- and 11-year-olds to harvest mushrooms containing psilocybin sent a photo of one of them holding a "large" hallucinogenic mushroom, writing that the child "cultivates and microdoses," federal prosecutors said.

"It's good for kids' brains," Randal Vance wrote in the same message to another person involved in the drug trafficking scheme, according to the U.S. Attorney's Office for the Southern District of California.

Randal Vance told customers that children helped produce the hallucinogens at two locations in San Diego County, where authorities found more than 250 lbs of fresh and dried psilocybin mushrooms, as well as an estimated 40 lbs of psilocybin chocolate bars in October 2024 prosecutors said at a hearing on March 20. In addition, authorities discovered psilocybin capsules, molds for chocolate bars, and six unsecured guns.

www.nbcsandiego.com/

Some of the items seized in North County.

Law enforcement officials arrested Randal Vance, 42, and his 41-year-old wife, Rebecca Vance, as well as Randal's friend Keir Ceballos-Rivera, 33, on Wednesday, and the following day, they were indicted in federal court on a host of felonies, including conspiracy to employ or use minors to violate the Controlled Substances Act, a charge that carries with it a sentence of up to 40 years in prison; as well as conspiracy to distribute a controlled substance; distribution of a controlled substance to minors; possession of a firearm in furtherance of a drug trafficking offense; and conspiracy to obstruct justice. Prosecutors allege the defendants also attempted to destroy evidence by deleting text messages and taking down websites that Randal Vance used to sell the drugs.

THE BURKE HERBARIUM: AN AMAZING RESOURCE IN OUR BACKYARD **Wren Hudgins**

The *New Oxford Dictionary* definition of "herbarium" is deceptively simple:

- a systematically arranged collection of dried plants.
- a room or building housing a collection of dried plants"

I say "deceptively" because this doesn't begin to tell the story of "our" herbarium. Its official name is The University of Washington Herbarium at the Burke Museum. I call it "our" herbarium because it serves the area where we live and communities within those areas and we as a club constitute one of those communities.

The herbarium collections manager is David Giblin, PhD, a botanist specializing in vascular plants. Carrie Tribble, PhD, another vascular plant specialist, was just hired as curator, essentially a UW faculty director of the herbarium. The geographic focus of the herbarium collections includes WA, OR, ID, MT, BC, YT and AK. The three main collections are vascular and nonvascular plants (hereafter "plants"), macrofungi and lichenized fungi (hereafter "fungi"), and algae.

The primary purpose of the herbarium is to document the diversity and distribution of Pacific Northwest plants, fungi and algae. The large geographic area covered and the large number of specimens collected make "our" herbarium by far the largest in the PNW and among the 20 largest in the country. Specimens are dried, databased, photographed, made available online, and stored in steel cabinets.

Another interesting aspect of the collection is a separate section for "type specimens." Just focusing on fungi for a moment, when an expert determines that s/he has a species new to science, a thorough description of that specimen is created, and often a drawing and/or photograph, based solely on the characteristics observed in that one "typical" specimen. Of course it's not the first of that species to exist, but it's the first recognition by science of that species and so it is named and described in great detail, preserved, cataloged, and stored. Henceforth that specimen is considered the reference point for that species. The Burke Herbarium has about 700 fungal types dating back to the 1800s.

It's easy to see from the table below that the plant collection is much more complete than the fungal collection, which itself is more complete than the lichen collection. Explanations for this imbalance include the facts that there is more study focused on plants than on the other two categories, plants are easier to identify than the other two, there is more plant expertise in total, and finally, the collections manager is a vascular plant specialist. The extensive plant catalog, with photos, allows the website (https://burkeherbarium.org/imagecollection/) to offer help to anyone trying to identify a plant in WA via photos and a dichotomous key. Neither the collection of fungi nor that of lichens is complete enough to offer such a service to the inquiring public.

But—this is where we come in, or could. The recent hiring of Dr. Tribble has stimulated some conversations between the PSMS Board of Trustees and Drs. Tribble and Giblin regarding ways we might be able to help each other. There are plans to hire a research mycologist, funding allowing. This person would conduct their own research (as do Tribble and Giblin) but possibly also be able to interact with us in yet to be defined ways.

Another reason for why we are having these conversations right now is that the macrofungi collection will soon be moving from the basement of Hitchcock Hall on the UW campus to the 5th floor of the same building. The space into which they are moving has yet to be configured to their needs, so the time to explore ideas on mutual collaboration is now, or at least soon. For example, the herbarium has not, up until now, conducted it's own DNA research, but the new space could be configured to allow that. Part of the new space is a former molecular biology lab, facilitating setting it up as a different sort of lab.

As another example, many years ago Dr. Joe Ammirati, PSMS scientific advisor at that time, opened his lab in Hitchcock Hall one evening a week, for quite a number of weeks, and invited serious club members in to study together. We were able to use his microscopes, discuss, ask questions, and learn from each other and from him. It was a golden learning opportunity. Something like that might be possible again.

How could we help the herbarium? You can see from the table that the herbarium has 96,741 photos of vascular plants compared to 4,911 of fungi. This suggests that we may be able to contribute photographs.

The herbarium sometimes organizes forays to collect specimens, and it's possible several of us could come along and help in that effort. Few of us in the club have the expertise to determine that we have a new species, but some do and identifying a new species would definitely help the herbarium. There is also the possibility of just volunteering at the herbarium for whatever lower level help they need. A few of our members are doing this now.

In summary, we have an amazing resource here in the Burke Herbarium and they are in a transition time moving into a different space and also hiring a research mycologist. They want to collaborate with us, a golden opportunity. Rather than have club members fire off random and possibly repetitive ideas to Drs. Tribble and Giblin, I'm willing to receive and organize any ideas from club members, at least for now, and act as liaison between the two organizations.

I hope to write another *Spore Prints* article, perhaps in a few months, sharing ideas for collaboration and possibly news about the hiring of a mycologist. —Wren Hudgins

Table 1.

	Estimated No. of Species in WA	*No. of Species in Herbarium with Photos*	*Percent of Total with Photos*	*Total No. of Photos by 707 Photographers*
Plants	3445	3214	93.3%	96,741
Macrofungi	2536	1139	44.6%	4,911
Lichenized fungi	1195	254	22.6%	816

BRAIN-EATING FUNGUS CAUSES THE IMMUNE SYSTEM TO ATTACK NEURONS Jordan Joseph

https://www.earth.com/, Mar. 4, 2025

Infections often conjure images of bacteria or viruses, but certain fungi can also take their toll on us. They can hide in unsuspecting corners of the environment and interact with living organisms in ways that raise many questions.

One particular fungus, *Beauveria bassiana*, has captured attention because of its interactions with insects.

Its spores settle on an insect and then germinate and penetrate through the cuticle. The insect dies within days and forms the substrate for a white fungal mold that grows and flourishes.

Prof. Alicia Hidalgo, from the University of Birmingham, directed a recent investigation into infections in insects by this devastating fungus.

Immune Responses to Brain Fungus

Fruit flies became the chosen subjects for this study because their immune system shares some features with that of more complex creatures. Researchers often turn to these small insects when exploring disease processes in a simple model.

The researchers analyzed the effect of the fungus on the brains of flies and found that flies infected with *B. bassiana* suffered a reduction in the number of brain cells.

They identified that the fly's own immune system was "tricked" by the invading fungus to start destroying brain cells.

In flies, Toll receptors are agents of the immune system. When infected with the fungus, the Toll-1 receptors in the flies triggered the release of antimicrobial peptides that attack and kill pathogens.

However, the fungus also provoked the Toll-1 receptors to produce another molecule, called Sarm, that suppresses the immune response and destroys brain cells instead.

"We have shown a process for how fungi have evolved to trick the immune system to get into the brain," said Prof. Hidalgo. Her findings suggest that a normal line of defense can accidentally turn against the very organ it's meant to protect.

Sarm's Link to Neurodegeneration

When the immune system tries to confront this fungus, the Sarm molecules step up their activity; they have the potential to sabotage defenses by encouraging cell damage in the brain.

"The key antagonist in the immune process is Sarm, a so-called master of destruction, that is causing cell death in the brain. The ability of *B. bassiana* to trick the fruit fly immune system into activating the master of destruction Sarm and kill cells enables spores to beat the blood-brain barrier and start feeding on brain cells," commented Hidalgo.

The process, known as neurodegeneration, describes the gradual breakdown of nerve cells. If immune signals become confused, the result might be nerve destruction in the brain.

Experts note that this fungus, hazardous to insects, is widely used for insect management in agriculture. It is developed into a type of pesticide and used to kills certain insects.

The findings offer a curious look at how a single microbe might manipulate host biology for its own benefit.

What Does This Fungus Mean for Humans?

"It is important to stress that *B. bassiana* cannot affect humans," explained Dr. Deepanshu Singh, now a post-doc at the University of Manchester. The fungus targets insects, but it stays clear of mammals.

Still, other fungi are known to reach the human brain under certain conditions. These discoveries hint that parallel strategies might pop up in different species, especially when fungal organisms are trying to survive inside a host.

A Broader Perspective on Fungal Threats

Some scientists believe that future work could explore whether similar immune-system misdirection happens in other animals.

Understanding how these pathogens find loopholes in the immune system may help researchers develop new interventions.

Fungal infections often get less attention than bacterial or viral illnesses, yet they can still pose serious threats.

The possibility that a fungus might slip into the human central nervous system and confuse its defenses encourages further research.

Implications for Neurodegenerative Diseases

The discovery that a fungal infection can manipulate immune responses to attack brain cells raises questions about similar mechanisms in humans.

Some neurodegenerative diseases, such as Alzheimer's disease and Parkinson's disease, involve immune system dysfunction and excessive inflammation in the brain.

If certain pathogens can trigger destructive immune pathways, this could offer new insights into how inflammation contributes to neurodegeneration.

Researchers may investigate whether similar immune evasion tactics occur in human infections, potentially linking fungal exposure to long-term neurological effects.

Possible Next Steps in Fungal Research

Scientists hope to identify molecules that can protect nerve cells when the immune system is tricked. Pinpointing the exact signals could spark novel medical approaches for people at risk of certain fungal infections.

Research also continues on ways to control fungal spread in agricultural settings without harming beneficial insects. *Beauveria bassiana* remains a useful tool for pest management, though its tactics highlight the complexity of the microbe-host relationship.

The study is published in *PLOS Biology*.

Here's to a long life and a merry one. A quick death and an easy one.
A pretty girl and an honest one.
A cold beer-and another one!
—Irish toast

INVITATION TO JOIN THE DNA MYCOBLITZ SUBCOMMITTEE AT PSMS

Shannon Adams

Ever wondered how to ID that mystery mushroom you found? Curious about how DNA sequencing fits into the world of mycology? The **Puget Sound Mycological Society DNA MycoBlitz Subcommittee** is looking for new members!

We're a small, curious, and sometimes confused group figuring out the world of fungal DNA together as part of national efforts to sequence fungi. You don't need to be an expert—just bring your curiosity to learn more about ID through DNA (and like to eat and drink together)!

Why join?

- *Meet other fungi enthusiasts* who want to dig a little deeper (literally and figuratively).
- *Learn how to interpret DNA sequences* (no science background needed).
- *Get comfortable with iNaturalist (iNat)* to document and share finds.
- *Tag along on serious specimen-collecting trips*—in mushroom season.

We meet **monthly in North Seattle**, and we're always learning as we go. If you're interested, **reach out and join us!** Our next meeting is 7 pm April 16th in Maple Leaf. Email me at moonshell@gmail.com for details.

DISCOVERY OF A FUNGUS THAT PRODUCES MORPHINE AND CODEINE

Adrien

https://www.techno-science.net/, Mar. 15, 2025

In an article published in the journal *Scientific Reports*, Iranian researchers and a team from Laval University announce the discovery of a microscopic fungus species that produces morphine and codeine. This fungus is believed to be part of the microbiota of a poppy species, the bracteate poppy, which grows naturally in Turkey and Iran.

Bracteatum poppy, Papaver bracteatum.

"More and more research shows that plants contain fungi or bacteria, called endophytes, with which they live in symbiosis. These endophytes are, in a way, the microbiota of plants," explains one of the study's authors, Roger Levesque, a professor at the Faculty of Medicine and researcher at the Institute for Integrative Systems Biology (IBIS) at Laval University.

For a long time, scientists believed that fungi living in plants were latent pathogenic organisms. In the last quarter century, studies have shown that endophytes and their hosts maintain mutually beneficial relationships.

The host plant protects the fungus and provides it with essential elements for its survival. In turn, the fungus produces molecules that promote plant growth, increase its resilience to stress, or contribute to its defense against pathogens or insects," summarizes Levesque.

Three members of IBIS joined forces with Iranian researchers to study the endophytes of four poppy species that grow naturally in Iran. It is worth noting that the poppy family includes species that produce alkaloids such as morphine, codeine, papaverine, and thebaine, which are used in medicine.

Their work led to the isolation of six strains of fungi that produce morphine and other opioids like codeine. This is the first study to report the production of such molecules by endophytes.

One of these fungi, isolated from the bracteate poppy, is a new species named *Pithoascus kurdistanesis*. The bracteate poppy produces thebaine but does not produce morphine or codeine.

"Endophytes have co-evolved with their hosts for hundreds of millions of years, which explains why they are not eliminated," explains Professor Levesque. "Natural selection may have favored endophytes that synthesize molecules similar to those that promote the growth and survival of their host. It is also possible that this similarity results from gene exchange between an endophyte and its host."

To determine whether it was possible to cultivate *P. kurdistanesis* in vitro, the research team placed this fungus in a medium containing potato carbohydrates in solution. "The results were conclusive," reports Roger Levesque. "We obtained 23 mg of morphine and 3 mg of codeine per gram of fungus produced. This is a yield that can be described as very good," he estimates.

The research team then sequenced the complete genome of *P. kurdistanesis*. "We identified the fungus genes responsible for morphine production. The next step is to integrate these genes into bacteria that can be easily cultivated in bioreactors. We will then have a complete and efficient system that could be used for the production of morphine for medical purposes."

The Toadstool House

I wish I lived in a toadstool house,
Beneath an old oak tree,
With a tiny door and a chimney pot,
and windows—one, two three.

I'd play with each wee squirrel,
Who chanced to come my way,
I'd get to know the woodland birds,
And feed them every day.

And if you ever wandered by,
I'd ask you in to tea,
Inside my little toadstool house,
Beneath the old oak tree,