
The Boston Mycological Club
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In This Bulletin

Maria Pinto took the photograph on the front cover of The Bulletin. Bill Hickey took the photograph featured on the back cover.

Contribute to the Bulletin!

Boston Mycological Club members make The Bulletin! It's a place to share your fungi-ful creativity and experiences. Our editorial team encourages you to submit stories, articles, experiences, artwork, poetry, and photos of your finds. Please email Bulletin Editor Beryl Lipton and Assistant Editor Andrew Cameron.

BMC Bulletin Team

The Bulletin is a regular publication of the Boston Mycological Club. Articles, photos, and artwork are provided by our members, and The Bulletin is organized and produced by a small team of volunteers. Please send all questions, concerns, comments, and contributions to bulletinbmc@gmail.com and copy our Editor and Assistant Editor on your message.

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Mo loves to forage with his grandfather, BMC member Rich Kramer. Here's Mo with a great pile of chanterelles collected at Mo's secret location in Sharon, MA, during a July blueberry foray. Photo courtesy of Rich Kramer.

"Deliquescience, or The Beauty of Rot" — Illustration of Coprinus comatus by Andrea Seek.

"Well my trick-or-treaters thought it was Ama-neato." Photo by Pamela Morgan.

Top left: Current BMC President David Babik and past president Susan Goldhor at the annual BMC Banquet in November 2023. Top right: Susan enjoying herself at the November 2023 BMC Banquet. Photos courtesy of Carolyn McPherson.

Center: Andrea Seek's illustration of the Amanita caesarea (americana), which she found on a foraging in Oaxaca, Mexico. Bottom left: Andrea with her Amanita finds in Mexico. Photos courtesy of Andrea Seek.

Russula's Lament

DAVID BABIK

I'm just a Russula
I get no respect
The most I can hope for
Is total neglect

Squirrels chew my cap
Slugs coat me with slime
I'm usually thrown back
Or at trees sometime

My colors are vibrant
A joy to behold
I should be admired,
And allowed to grow old

So give me a try
Don't judge me too fast
I might become a lobster
Then you won't walk past

We can be really tasty
No need to peel us
We're certainly better
Than those nasty old Suillus!

So if I'm not bitter
Or hot, but delectable
Please take me home
and make me respectable!

NORTHEAST MYCOLOGICAL FEDERATION 2024 FORAY

Cape Cod Emerald Resort and Conference Center, Hyannis, MA

The Northeast Mycological Federation is devoted to promoting knowledge about fungi in the Northeastern North American region. It comprises over two dozen mushroom clubs from Quebec to New Jersey and Pennsylvania to Maine, representing over 10,000 beginners, amateurs, and professional mycophiles.
The NEMF Planning Committee is seeking volunteers for various roles.
If you're interested in helping, please email nemfsecretary@gmail.com.

Burn Site Fungi

Ellen Penso

It is well known that certain fungi prefer to grow on, or only grow on, burn sites. Some appear soon after the fire, while others appear at that site during their next growing season. Pyrophilous fungi appear to have certain characteristics. At least some of them have genes that allow them to metabolize aromatic carbon. There is speculation that these species grow on burn sites due to the soil pH or chemistry, because of the flush of nutrients from burned trees and needles (fire debris is rich in nitrogen, and the carbon to nitrogen ratio drives fruiting), because of the lessening of leaf duff, or due to the lessening of competition with other species. There appear to be fewer saprophytes on burn sites, possibly because of competition from the abundance of Ascomycetes.

In the American West, certain morels regularly appear after a fire. Apparently, the species that grow on burn sites are distinct from other species. According to Trent Blizzard, author of *Burn Morels: A Modern Forager's Guide to Finding Mushrooms*, there are five species of morels that only grow in conifer forests after fires and only in the West.

On June 12, 2023 BMC members David Babik, Claudette Beit-Aharon, Corie Costantino, Ellen Penso, Jana Harris and her son Oskar, Scott Shaffer, and Nick Kremp gathered to investigate the site of a recent fire in Lynn Woods, Lynn MA that burned 400 acres. Pictured: Pholiota highlendensis. Photo credit: Ellen Penso

These are black morels *Morchella tomentosa, Morchella exuberans*, and three others. *Morchella exuberans* has also been found in Minnesota, Ontario, and Tennessee after fires.

Dominant species on burn sites are *Thelephoraceae* (Common Fiber Vase), *Anthrocobia melanoma* (small

Top left: Peziza petersii; top right: Rhodotarzetta rosea; bottom left: Rock Harlequin; bottom right: Rhizina undulata

stalkless yellow-ochre discs with dark, hairy outer surfaces according to the Audubon guide), which can cover charred trees, and *Caloscypha fulgrens* (a yellowish-orange stalkless cup). According to the Audubon guide, a number of *Pholiota* grow only on burn sites.

On our walk which covered a very small part of the burn site, we found *Pholiota highlandensis, Rhizina undulata* ("Crustlike cup," a dark brown crust-like upside down cup attached to the ground by a tangle of whitish, tough, rootlike hairs, according to the Audubon guide), *Rhodotarzetta rosea* (pink to red cups), and *Peziza petersii*.

We also found the Rock Harlequin plant which flowers in burn sites.

We plan to return to the site next spring to look for morels.

A Mushroom Hunter's Winter Invocation

MARIA PINTO

"We must go out and re-ally ourselves to nature every day. We must take root, send out some little fiber at least, even every winter day." — Henry David Thoreau's journal, December 29, 1856

It's the first day of Spring and I'm sitting at a folding table in the corner of a rustic cabin in a state park on a mountain in Northern New Hampshire, a restless girl in self-imposed time-out. Outside my window, the occasional snowmobile glides by as unhurried flurries dust the glazed, crème brûlée surface of this trick floor, which hits birches and conifers and grizzled oaks about two feet up their trunks. If a deep draught of it hadn't confirmed that this was rarefied air, the diversity of lichens busying themselves in their slow work would tell me so: the radiant circular manes and pendulous scruffy beards and intricate, flattish glyphs and tattoos of them ornamenting bark and branch. But for the sometime drone of snow machines, and the hum click drum of the propane heat in my cabin, it's quiet here in my home for the next several days of borrowed winter, of an escape from the earth's waking up.

In my own body, I'm still hibernal, a little slow, still craving soups your spoon stands up in, the kind of sad you get when deprived of fleshy, terrestrial fruit bodies for months on end. Down near my apartment in Massachusetts, they're boiling sap, the birds are trilling, the inbox is overflowing, crocuses and daffodils and the first alliums of this young year are maturing in short order. I am not ready to face that happy bustle yet. I barely made it out alive this time, dear reader — I really mean it. And that's with the month away in Florida (never mind the 12 days of it were spent in a Christmassy COVID quarantine). This past winter's melancholy really scraped my paint job, man. It was a very near thing.

And it's no mystery why — no matter your personal affinities and sensitivities — it's dark out there and getting darker. Even as the days are longer and the mica caps and platterfuls and precocious Agrocybe start planning their appearances, our human affairs are marked by sorrow. To weather eerie climate shifts alongside worsening

Photograph by BMC member Billy Hickey.

news — to find the dry bone of winter while in search of the porcini-fullness of summer—can feel overwhelming. That's why I've written a winter invocation to remember all that's left to love in a declining year, in its hoary beginning. This reminder will stand me in good stead when 3pm is day's end and real living seems beyond the horizon. I encourage you to write your own.

Now is the time to fall asleep on the glossy page of a field guide in the middle of the afternoon. Now is the time to doze between paragraphs of the latest update to the genus *Hydnum*.

I will go somewhere secluded on a windless day. I'll hitch a ride if I must, but will find the middle of the woods alone. I'll strain my ears to hear the perfect quiet. This stillness is not granted in any other season.

I will learn at least two new tree buds this year. I will mirror their readiness and promise.

I will follow the tracks in the snow till I tire, notice their depth and spacing; consider the life story of their maker.

I will bundle up on a frozen, windy day and listen to the Eastern White Pines croak and chirp.

As *Armillaria* rhizomorphs are calligraphic in their intricacy, I will try to learn their honeyed language.

I will nod at each woody conk I pass on my accustomed walk to the nearest stream, whose slowing down I'm charting weekly.

I will notice oak leaves of different browns collaged at various depths in

Photograph by Billy Hickey. Find more of his work at billyhickeyphoto.com.

ice, making an art museum of this December walk.

As the winter woods are not colorless, I will look closely: at the brilliant blues of the turkey tail, the blazing orange of *Flammulina*, the tufts of green moss peaking up from rocks in the snow-covered stream.

I will turn over no less than two logs a week during the first thaw, and crouch down with a hand lens to examine what's living there.

I will watch the springtails frolic, remembering that I have that in me, too.

As I am an outside animal at all times of year, and as the shore calls, even in February, I will go to it with blankets and hot cider in a thermos and count how many deep breaths can be had between each wave's crash.

I will watch at least one mushroom-themed feature each month: *Matango*, *Mushrooms*, *Annihilation, Phantom Thread*, *The Girl With All the Gifts*, the list goes on.

I will sketch the most beautiful lichen I find in November; send the clumsy drawing to the mushroom buddy I've been meaning to check in with. We will go on a frigid walk in the woods or through the park and compete to see who can make the other laugh the most.

The morels will be there in the spring, whether I find them or not.

A Photo Stacking Workshop with Alan Rockefeller

GARY GILBERT

Last August I hosted a rather impromptu photography workshop at my house on Cape Ann with Alan Rockefeller. The idea was that for a reasonable fee you could spend a day in the field shooting fungi, get coached on your current photography techniques as well as learn about the technique called "photo stacking". The day ended with a prepared five course mushroom dinner and fun was had by all.

Alan is one of the most well-known mycologists in the country and we knew that he has almost never hunted the woodlands of New England. Knowing he was going to be at a conference in Pennsylvania, we came up with the idea of luring him here for the workshop. The goal was to coach people on the techniques they are already using with their cameras, and even cell phones, and also to expose them to the technique of photo stacking to create remarkably clear close up mushroom photographs.

Anyone can get great, clear photographs nowadays with cell phone cameras, but as you can easily imagine, an ajustable camera will give you much better shots with greater clarity. Ones you can enlarge and don't become

Clavulinopsis fusiformis. Photograph by Gary Gilbert.

grainy. When you shoot a picture of your daughter in a soccer game, you can usually clearly see the whole field and all the players, similar to what you see with the naked eye, but if you shoot a really close-up photo of a mushroom, the opposite will be true. Often you will have a clear image of the gills, but the far edge of the cap or the details at the base of the stem will likely be out of focus. This whole range of focus is called the depth of field, and it is the biggest stumbling block in good closeup, or

"macro," photography. To improve your depth of field, one technique is to adjust the aperture, so it is smaller and lets less light in and to also use a slower shutter speed. This requires a tripod or simply setting your camera down on the ground. The result will be a foreground and background that will be sharper and more in focus. But even this technique has its limitations, the range of the depth of field might not be as large as one might like.

"Bracketing" is another approach in which you focus on the closest edge of a mushroom, then you shoot another identical photo except focusing about 1/16 inch further away. Then you continue to focus a fraction of an inch at a time until you are at the other end of the mushroom. If you then take all those photos, maybe 20 or 30 of them, and combine them into a single image, you end up with what is called a "stacked" image. A single, ultra-clear photograph.

There are many ways to shoot bracketed photographs. You can mount your camera to a movable rail system, like a train on train tracks, which smoothly slides the camera allowing you to shoot as many photos as you wish along its length. You can also mount the camera on a tripod, or set it on the earth, and simply rotate the focus adjustment ring very small increments at a time, even as small as a 32nd of an inch, and keep shooting photos until you are eventually focusing beyond the furthest edge of the mushroom. These techniques work but they are a bit cumbersome, though they don't require purchasing a special camera.

However, the very best technique is to use a camera that can do something called "autobracketing". Autobracketing allows you to set your camera to automatically shoot 20, or 40, or even 80 or more photographs, all within seconds, while automatically adjusting the focus further and further away from your starting point. When you are done, and you stack your images you will have produced photographs with clarity, very close to what the human eye sees. They can be magnificent.

If you want to experiment with bracketing and photo stacking, there is excellent software available called HeliconFocus. They offer a free one month trial so you can try your hand at photo stacking. After the trial period you can use it for a year for only about $30. It may sound trite but try it. You'll like it.

You can learn a lot more about improving your macro photography skills as well as photo stacking by attending the next Northeast Mycological Federation (NEMF) Conference to be held in Hyannis on Cape Cod, Oct. 11-14, 2024. Alan Rockefeller will lead a 3-hour workshop there and answer all of your photography questions. Registration is targeted to begin next March or April. He will also be leading an all-day photography workshop on Oct. 10, 2024. Stay tuned.

Gary Gilbert is a member of the Executive Committee of the Boston Mycological Club, lectures and leads identification walks throughout the country and is the author of "Mycocards," flashcards for learning mushroom identification (mycocards.com).

Above: Daedalea quercina. Below: Mycena inclinata. Photographs courtesy of Gary Gilbert.

Fat Moon Rising: Elizabeth Almeida

JONATHAN KRANZ

Elizabeth Almeida's journey into mushroom farming began with…indifference. "I didn't care for mushrooms," she says. But her son, Michael, very much did, and his enthusiasm led to a grow kit Christmas present that fruited on the family's kitchen counter.

Elizabeth grew up on a beef cattle farm in the Midwest. In adulthood, she felt the lure of agriculture, but struggled to find the right direction for her interests. She took a masters in nonprofit management at Case Western University and there, within a building designed by Frank Gehry (think: Guggenheim Museum in Bilbao, MIT's Stata Center), a professor shared an anecdote about the architect himself. When asked for ways to inspire creativity, Gehry had suggested that his students "take an old project and add a constraint – then reimagine the project."

For Elizabeth, the constraints were all too familiar. Eager to make a living from farming, yet short of resources, she wondered, "How can I grow food without sunshine and land? The answer was on my kitchen counter: mushrooms."

She started Fat Moon Farm, her mushroom-growing enterprise, about eight years ago; five years ago, she moved into her current location in Westford. Today, Shitakes and Blue Oysters represent ~70% of production. Other farmed species include: Yellow Oysters, Lion's Mane, Chestnuts (*Pholiota adiposa*), Hen-of-the-Woods/Maitake (*Grifola frondosa*), King Trumpets (*Pleurotus eryngii*), Black Pearl Oysters (a cross between Blue Oysters and King Trumpets), Pioppino (*Acrocybe aegerita*), and Beech mushrooms (*Hypsizygus tessulatus*).

Elizabeth Almeida "lets that shiitake go" in one of Fat Moon Farm's specially constructed grow rooms. Featured: Grifola frondosa.

Fat Moon folk display some of their harvest. Clockwise from top left: Chestnuts (Pholiota adiposa), Lion's Mane, Shiitake, Blue Oysters. Photos courtesy of Elizabeth Almeida.

Building a successful mushroom business, Elizabeth says, "is a nice combination of two different sciences: mechanical and biological. I get to build stuff and watch the nuances of getting product to grow." Her operation consists of multiple workspaces and temperature/humidity-controlled growing rooms overseen by a staff of eleven employees – one full-time and ten part-time – who work seven days a week, 365 days a year to ensure healthy, robust harvests. Elizabeth shares leadership responsibilities with Owen Hunter, the farm's production manager, and Kim Kneeland, its farm manager.

The key to success proved to be "getting business from a reputable restaurant, then building from there," says Elizabeth. Her customers have helped promote her reputation among a client base that extends from individual restaurants to farm stands, and from boutique grocers to wholesale food distributors. "The biggest hurdle," she says, "is delivering a consistent product so that chefs can rely on its availability."

Fat Moon Farm currently works with pre-inoculated "grow bricks" that they cultivate in-house. Simultaneously, Elizabeth is experimenting with earthworms and exhausted substrate to create super-potent compost. She's currently exploring options for creating and inoculating her own substrates, and is continually expanding into new markets.

If you go to a restaurant that offers locally farmed gourmet mushrooms, "Thank the restaurant," Elizabeth says. "Tell them you appreciate their serving local mushrooms."

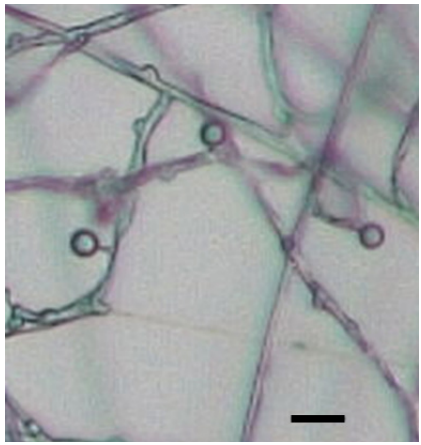
Trapping Nematodes: Prasanth Prakesh Prabhu

JONATHAN KRANZ

As a student of biology and biodiversity at Calcut University, Prasanth Prakesh Prabhu discovered a captivating chain of activity. "I became fascinated," he says, "by fungi that parasitize insects that parasitize plants." Although the chain's mechanisms remained to be explored, Prasanth arrived at a temperamental conclusion any BMC member can sympathize with: "Fungi are so cool!"

Prasanth grew up in an urban area of India without many mushrooms; the Calcut region itself provided an environment that rewarded his explorations, which in turn led to many questions. "We don't know how the fungi control the biology of insects," he notes. Do they disable the insects' ability to metamorphose? Do they regulate hormones? If so, how?"

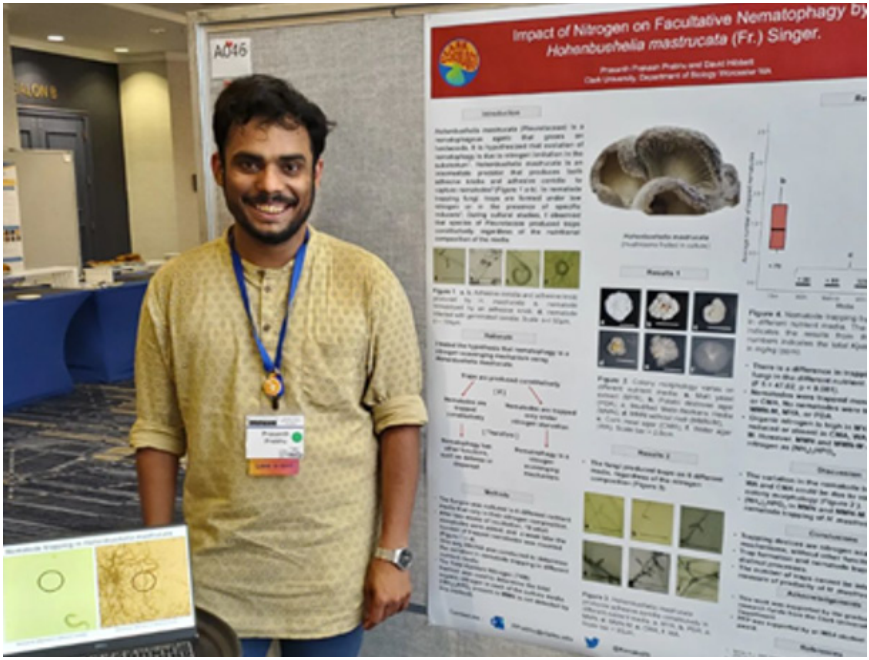
As he completed his MS in Calcut, Prasanth decided to pursue his PhD abroad, contacting Dr. David Hibbett directly to see if there were opportunities at Clark University. Today, Prasanth is approaching his fifth year at Clark where he serves as a Teaching Assistant in Introductory Biology, oversees independent undergraduate projects,



The "lollipop" formation of Pleurotacaeae toxins.

and is in the analytical phase of his own research initiative: how oyster mushrooms (*Pleurotacaeae*) attract, paralyze, and consume nematodes, microscopic roundworms found in soil, fresh water, and marine environments.

"All oysters can do this, and the only other basidiomycetes that can do the same are the Hohenbuehelia." Instead of studying the "slipknot" approach to predation, in which the fungi create an open noose that can instantly strangle an unwary worm, Prasanth is pursuing a chemical trap. In this model, the oys-



Prasanth Prakesh Prabhu presents his poster regarding Pleurotacaeae predation and nitrogen levels.

ter mycelium create a microscopic and poisonous "lollipop" in which a droplet of toxins is suspended on a vertical post; upon contact with the droplet's membrane, the nematode is overwhelmed by a neurotoxin. The paralyzed worm is then devoured by invading hyphae.

"We still need to identify the chemical compound within the droplets that attract prey," Prasanth says. However, scientists do know that oysters can produce traps in all media, but only under low nitrogen conditions. In his research, Prasanth cultures fungi in agar plates with different nitrogen sources and concentrations. So far, he has observed that the presence of inorganic nitrogen does not inhibit the trapping behavior. "My hypothesis," says Prasanth, "is that if fungi can easily access organic nitrogen, they won't produce nematode traps."

Today, Prasanth is busy analyzing data he has collected over the previous four years. His goal: "understanding the mechanisms of genes involved in trapping nematodes." In the meantime, he forages local state parks and, when he isn't overwhelmed by lab work, joins the BMC on its seasonal walks. When asked by the Mycological Society of America to pinpoint what he has learned through his mycological studies, Prasanth responds with passion. "Fungi are real bad ass," he says, "and they can show fascinating adaptations that thrive in different ecological niches."

Exploring the Hidden Virtues of Familiar Fungi: Dr. Primrose Boynton

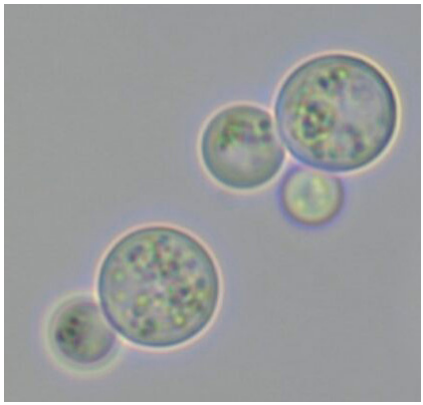
JONATHAN KRANZ

A few Octobers ago, a BMC foray scheduled on Halloween inspired many club members to get creative. Some arrived in *Amanita muscaria* costumes, others were dressed as milk mushrooms, toothed hydnums, and other species-related attire.

One person stood out with simply a hat. But this hat masqueraded as a basidium hosting four vertical sterigma, each with a spherical spore perched on top. This modest but clever costume spoke to a mycological phenomenon club members touched virtually every day but hardly ever saw.

Dr. Primrose Boynton, Assistant Professor of Biology at Wheaton College, was the club member under the hat. While the costume was playful, it spoke to a serious interest: uncovering the hidden qualities of very familiar fungi.

Among these are yeasts, single-celled fungi; the most familiar yeast, *Saccharomyces cerevisiae,* AKA "baker's yeast," is not only responsible for our breads and beer, but by virtue of its fermenting power, has played a critical role in human history. Through her work with environmental (as opposed to commercial or lab-grown) yeasts, Primrose



Yeast found by Primrose's students working with soil in Wheaton Woods. Photo courtesy of Wheaton College.

wants to "draw attention to the fact that yeasts are really diverse."

How diverse? Many of us who reach for a packet of Fleischmann's for home baking would probably be shocked to learn that carnivorous pitcher plants play host to significant yeast communities – multiple species that co-exist in shared environments. Primrose and her students trawl local bogs for New England's only native pitcher plant, the *Sarracenia purpurea*, to study these yeast communities.

"Louis Pasteur started using Sac-

Dr. Boynton hunting for the otherwise neglected single-celled fungi living in our soils. Photo courtesy of Primrose Boynton.

charomyces as a model organism for understanding microorganisms," says Primrose. Subsequent studies have helped scientists "drill down into how genetics work." But intense laboratory research often fails to address how these organisms work within their native, natural habitats.

Yeasts are essential to fermentation but, Primrose notes, "fermentation is not an efficient way of extracting nutrients from sugar. So why would it be useful or advantageous in an environment like soil?" Potential contenders include competition – perhaps the resulting alcohol is used to kill competitors. Or maybe speed: fermentation is inefficient, but fast; it could be important to consume sugars quickly. "In a natural environment, it's just hard to test," says Primrose.

This coming fall, Primrose will work with her undergraduate students to isolate yeasts from the forest, identify filamentous fungi that might interact with those yeasts, and "look at the different ways forest fungi break down cellulose or sugar."

"Single-celled fungi are diverse, mysterious, and ubiquitous," Primrose says. "People may miss them, but they're there."

The Final Four

DAVID BABIK

2023 has been an unbelievable season with tons of rain. I don't know about the rest of you, but I had to hide my smile when everyone was complaining about the rain this summer. We saw record numbers of some choice edibles, especially Black Trumpets and had record attendance at our club forays.

As the season winds to a close it is easy to stop looking but late fall produces its own crop of interesting edibles. Many of them may keep appearing all through December if we have a warm end to the year. Most people know that Oyster mushrooms, Pleurotis ostreatus, can appear throughout the year, whenever we get enough rain. The fall oyster, Panellus serotinus, is another commonly collected edible. Hedgehogs, Lion's Mane, Bricktops and Hen of the Woods are all pretty well known too.

I'd like to focus on four fungi that are not so commonly collected but are actually quite good edible species. All four are in the group known as Waxcaps (*Hygrophorus*). Many late season waxcaps are not fazed by early frosts and even some dips below freezing. They tend to some characteristics in common, especially viscid (slimy) caps and white spore prints. The slime actually helps them survive the lower temperatures. They usually grow on soil in the forest duff layer.

***Hygrophorus sordidus*:** I bet you have all walked by this one and assumed it was just another white Russula or Lactarius. Sordidus roughly translates to "dirty" and makes sense considering how much debris is usually stuck to the cap. This is a large mushroom that is pure white except for a slight yellow blush in the center of the cap which is often very pale. If you look at the gills , this will alert you that it is not a Russula or Lactarius. The gills are not brittle, they are instead waxy and pliable. The color is more of an off white, almost pink color. If the fruiting body is fresh, the cap will be slippery but if conditions are dry, it may appear smooth and shiny but will have lots of litter stuck to it. This one really is meaty and cooks up nicely. It is seldom collected for the table because it looks so much like the many large white mushrooms in the fall that are not good to eat.

Hygrophorus sordidus — note the off white gill color. Photograph by David Babik.

Hygrophorus russula: As the name suggests, this one is often mistaken for a Russula. In fact, whenever it comes back to the ID table on forays, it is inevitably placed in the pile of red Russulas. It is a larger white mushroom that has a lot of pink shades in the cap and stipe, making most people assume it is a Russula. The main color of the cap is white but there are pink patches all over this mushroom. Like most waxcaps, it is the gills that will tip you off. They don't stain but feel waxy and are not brittle. This one is one of my favorites for the table in late fall. It has a light pleasant taste and cooks up nicely with a little butter and shallots.

Hygrophorus flavodiscus: A little smaller than the rest but often really large flushes appear quite late in the year. I have collected this one frozen solid more than once. Like the others, it is slippery when wet. The overall coloration is white but there are strong yellow tones. Unlike the sordidus, flavodiscus will clearly present with a good amount of yellow coloration in the cap, sometimes all yellow, Most commonly, it is white with a yellow center. When young, there will be some bits of sticky web-like material between the cap margin and the stipe. The gills are slightly decurrent. This waxcap is not as flavorful as the first two but has a mild pleasant taste and often grows near white pine.

Hygrophorus fuligineus: This waxcap is seldom picked for the table because the sliminess (if that's a word, probably viscosity might be better) is intense. It is covered with a thick glutinous layer of goop that is really intimidating. The common name is Sooty Waxcap. The coloration is dark grey/brown, often almost black. I have found huge flushes of this mushroom in late fall.

The young buttons look like black marbles sunken into pine duff. These are big meaty mushrooms that seldom have any insect issues, They, also, like flavodiscus, tend to appear with conifers. The slippery goop is impossible to wash off. And if you try, it seems to increase. I recommend throwing them, goop and all, in a hot frypan, The goop becomes a crunchy coating that is not unpleasant. You can also use the slimy layer to your advantage. Slice up these fungi and throw them in panko bread crumbs. The goop will hold the crumbs and they cook up well in a fry pan or air fryer.

David Babik is the current president of the Boston Mycological Club.

Above and below: Hygrophorus russula, exhibiting the trademark pink coloration. Photographs by David Babik.

Cooking with Chanterelles

BIAGIO DISALVO

Chanterelles have been considered one of the most culinarily important mushrooms in the western world since they became a favorite food amongst European nobility in the 18th century. The epithet "chanterelle" is the common English name of several species of edible mushrooms found in temperate zones in the northern hemisphere across North America, Europe, and Asia. Often described as having a peppery flavor with the aroma of apricots or plums, these mushrooms are usually funnel-shaped and yellow, orange, or white in color. They are part of the *Cantharellaceae* family of ectomycorrhizal fungi, meaning they form a symbiotic relationship with living plant tissue, and they are found in summer and fall under both conifers and deciduous trees. Chanterelles are popular in many different cultures and have many names in different languages such as "finferli" in Italian, "Pfifferling" in German, and "girolles" in French to name a few.

Identification

Of this esteemed group of mushrooms, the golden chanterelle, *Cantharellus cibarius*, is considered to be the most prized. Mushrooms fitting its illustrious description have been found across the United States and had previously been lumped under this species, but more recent DNA studies have shown a delineation into several different species including *C. lateritius, C. californicus, C. spectaculus, and C. cinnabarinus*.

Identification of the golden chanterelle is pretty straightforward as their golden color allows them to stand out against the forest floor. There are four common rules to follow when it comes to identifying these flavorful mushrooms. First, they have a distinct funnel shape, which is how this mushroom derived its name from the Greek word "kantharos," meaning "cup." Second, they have false gills or veins under their caps. Third, they grow right out of the ground and not out of trees or fallen logs. Fourth, they usually grow as singular mushrooms and not in clusters.

More quantitatively, golden chanterelles can stand up to 4 or 5 inches tall and their caps can be 0.5 to 4 inches in diameter. The flesh beneath their yellowy surface is white and they produce

a cream-colored spore print. When foraging, take a cross-sectional slice to make sure the flesh is still firm and compact. Older specimens can be soft and mushy or riddled with insects.

In addition to the species found in the genus *Cantharellus*, several mushrooms in the genus *Craterellus* are also considered to be chanterelles. In New England, the most common of this group is the yellowfoot chanterelle, *Craterellus tubaeformis*. Its flavor is more mild than its golden cousin and its stalk is hollow; sometimes forming an open tube from the top of the cap down through the stalk. Dissimilarly from *Cantharellus cibarius*, it can be found growing out of logs and in groups resembling clusters. Its false gills and white to light yellow spore print can help confirm its identity.

Chanterelles do have some look-alikes to be aware of which can be found growing in similar locations. The Jack O'Lantern mushroom (*Omphalotus olludens*) is its most toxic look-alike. They grow in clusters on dead trees and have true gills. They also have orange-colored internal flesh. They have a pleasant aroma that might make you think they are edible, however, once ingested, they can cause severe gastro-intestinal problems, cold sweats, vertigo, and nervous disorders. While unlikely to be lethal, medical attention may be required.

Another look-alike is the wooly chanterelle, *Turbinellus floccosus* (formerly *Gomphus floccosus*; its genus changed due to molecular analysis). This mushroom does have false gills and has similar singular growth patterns out of the forest floor. While not as toxic as the jack o'lantern mushroom, it can cause an upset stomach. This being said, some native communities do consume them. In my experience, I have found that the funnel shaped caps can be slimy which is another distinguishing feature from the golden chanterelle.

Cooking

With an abundance of chanterelles in New England this summer, I had the privilege to cook several amazing dishes and experiment with methods of preservation to continue to enjoy them into the winter months. There are many chanterelle recipes available on the internet, ranging from exquisite ice creams to decadent lasagnas. However, my personal favorite way to enjoy them is to sauté the chanterelles in a good quality butter and a pinch of salt to bring out their rich flavors, before eating them over a slice of toasted country bread.

Common methods of mushroom preservation include dehydrating, freezing, and pickling. This summer, I experimented with two of these strategies: dehydrating and freezing. After collecting my first harvest of golden chanterelles, I thinly sliced the ones I did not immediately eat and allowed the pieces to air dry for three days. Unsurprisingly, the flesh reduced significantly and I found it difficult to reconstitute them for later use. I subsequently discovered I could powder them to add their flavor into dishes. More successfully, however, I found that I could freeze pre-cooked chanterelle dishes such as linguine in a chanterelle butter

sauce and chanterelle risotto for later consumption and the freezing/thawing process did not alter the taste too much. This method has become my primary means of preservation.

I can't emphasize enough the importance of proper identification before even taking the chanterelles or any mushrooms into the kitchen. While this article can serve as a guide, it should not be used as an absolute key and it is best practice to consult a local expert to confirm the identification of the mushrooms you've found. Mushrooms can make you seriously ill and can even be deadly. This being said, there is something magical about properly identifying your own edible mushrooms and cooking them up in a meal to enjoy either by yourself or with family and friends. Freshly picked mushrooms have flavors and aromas that store bought mushrooms can lack. You can almost taste the hard work you put in to forage them. Here are two recipes that are quick and easy and allow the chanterelles to really shine.

Linguine in a Chanterelle Butter Sauce

½ box of linguine
4 tablespoons butter
1 large shallot, thinly sliced (or a small sweet onion)
10-20 chanterelles (or as many as you have if you have fewer than 10)
2 tablespoons extra virgin olive oil
Sprigs of thyme to taste
Salt to taste

A beautiful bowl of linguine in Chanterelle butter sauce. Photo credit: Biagio DiSalvo

1. Rinse and clean the mushrooms to remove any dirt and debris. Roughly slice them and set aside.
2. In a large skillet, melt the butter and saute the shallot for 3-5 minutes. Once translucent, add in your mushrooms, thyme, and salt. Allow the mushrooms to release their juices and cook down a bit.
3. Add in the olive oil and coat the mushrooms by stirring gently, but thoroughly.
4. Cook the pasta according to the maker's instructions and add it into the skillet. Toss to coat the linguine with the sauce.
5. Serve warm with a sprinkle of Parmigiano Reggiano cheese and enjoy!

Chanterelle Risotto

2 cups arborio rice
5 cups of chicken broth
½ cup white wine
2 tablespoons extra virgin olive oil
2 tablespoons butter
2 large shallots, thinly sliced (or a medium sweet onion)
10-20 chanterelles (or as many as you have)
1 cup Parmigiano Reggiano, freshly grated
Sprigs of thyme to taste
Salt to taste

A bowl of mushroom risotto featuring boletes. Photo credit: Biagio DiSalvo

1. Rinse and clean the mushrooms to remove any dirt and debris. Roughly slice them and set aside.
2. In a large pot, bring the chicken stock to a simmer.
3. In a second large pot, melt the butter and saute the mushrooms for 3 - 5 minutes. Remove from the pot and set aside.
4. To the same pot that the mushrooms were cooked in, add the olive oil, shallots, and thyme and saute until translucent.
5. Add in the arborio rice and mix until all the grains are coated in oil. Allow to cook for one minute.
6. Gradually, add the simmering chicken broth one cup at a time, allowing the rice to absorb the broth before adding the next cup.
7. Between the third and fourth broth addition, add in the wine. Allow the wine to cook off and be absorbed before adding the fourth cup of broth.
8. With the fourth cup add in the mushrooms and stir.
9. Once the rice is soft and palatable, add in the cheese and incorporate thoroughly.
10. Serve warm and enjoy with an extra drizzle of olive oil and a sprinkle of Parmigiano Reggiano!

In Science

Despite being widely consumed and considered the second most foraged edible mushroom in Europe, chanterelles seem to have little impact in mainstream American culture and are often only found in expensive, fancy restaurants or the plates of experienced foragers. However, in the scientific community, recent studies are now elucidating the nutritional and medicinal properties of the golden chanterelle (*Cantherellus cibarius*) in addition to exceptional aromas and flavors. These golden mushrooms are rich in saturated fats (monounsatu-

rated (MUFA), and polyunsaturated (PUFA) fatty acids). The most represented PUFA is linoleic acid, which is an essential omega fatty acid in the human diet, making the chanterelle a great source for this nutrient (Rezic Muzinic et al. 2023; US National Library of Medicine). They have also been found to be rich in vitamins A, D (in particular D2, also known as ergocalciferol), E, and C. In terms of micronutrients, chanterelles are also a good source of important trace elements like zinc which boosts the human immune system and has anti-inflammatory actions (Galgowska and Pietrzak-Fiecko 2022).

In addition to these nutrients, chanterelles have been found to contain a number of biologically active compounds to promote human health. While the zinc found in them can help boost the immune system, chanterelles can also produce antibiotics that can directly kill microbes such as bacteria (Nowacka-Jechalke et al. 2018). Furthermore, chanterelle extracts have also been recently studied for their cytotoxic or anti-cancer properties, showing some in vitro capabilities to stop proliferation of certain types of cancer cells (Nowakowski et al. 2021).

While proper identification is key, it is important to know the area in which you are foraging and to know about potential heavy metal contaminants too. Edible mushrooms can be contaminated with nonedible and toxic substances, such as cadmium, which can come from waste burning, burning of fossil fuels, and leaking sewage sludge into fields and forests (Rahimzadeh et al. 2017). Mushrooms such as the chanterelle can hyper-concentrate these heavy metals in their flesh. This hyper-concentration of toxic heavy metals can lead to stomach irritation and more serious health problems. One study done in Poland aimed to see which household mushroom preparation methods reduced the amount of toxins the most. They found that of drying, blanching, freezing, and pickling, pickling the chanterelles reduced the amount of cadmium the most (Drewnowska et al. 2017). In addition to preserving them, the acidic pickling juices draw out the toxic metals from the mushrooms making them safer to eat. That being said, don't sop up the pickling juice with a piece of bread, because then there won't be a reduction in consumption at all.

Conclusion

You might be lucky enough to find chanterelles fresh in a specialty grocery store during the summer or fall, but they can be quite pricey, going for $40-50/pound if not more. For an amateur mushroom forager, the benefit of finding them in a specialty store is that they are most likely identified correctly and safe to eat. But, if you're even luckier enough to find chanterelles in the wild (properly identified and found in a safe, uncontaminated space, of course), I recommend giving them a try. Their flavor is definitely worth a taste and will hopefully inspire further safely practiced mushroom foraging!

For more references, please visit: bit.ly/bmcwinter2024references

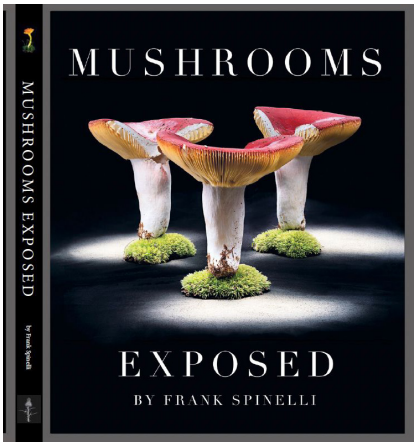
BOOK REVIEW

Mushrooms Exposed by Frank Spinelli

DAVID BABIK

The multitude of great field guides in print makes it easy to skip over some of the other mushroom literature out there. I recently came across a new book at the NEMF convention this fall in the Catskills. A group of BMC members had the opportunity to meet the author and join him on a foray. Frank Spinelli is a commercial photographer by trade and a mushroom enthusiast. Mushrooms Exposed is a beautiful new book Frank has produced. It is not meant to be an ID book and only features mushrooms in the woods near his home in Woodstock, NY. That is not to say that there is not an educational element and even the veteran mushroomer will learn some new facts.

The real focus though is an artistic endeavor on many levels. Aside from Frank's breathtaking photographs, the book features poetry, historical facts and scientific information on many different fungi. Many of the photos are studio shots taken with great care to create stunning compositions, not only of pristine mushrooms but also some found in less than perfect shape. Franks' photos really capture the natural beauty of many of these specimens along with just enough of the surrounding environment



to demonstrate where they can be found in the wild. One of the unique features of Frank's work is that he has created a way to duplicate many of the photos with the color removed to highlight the features of each fruiting body and to be able to point out technical data as an educational tool.

This volume makes a great addition to any fungi library. I find myself going back again and again to enjoy the spectacular photos and interesting tidbits of poetry and mushroom facts.

Mushrooms Exposed can be purchased at Frank's website: www.frankspinelliphotography.com.

A Question About the Names of Lichens

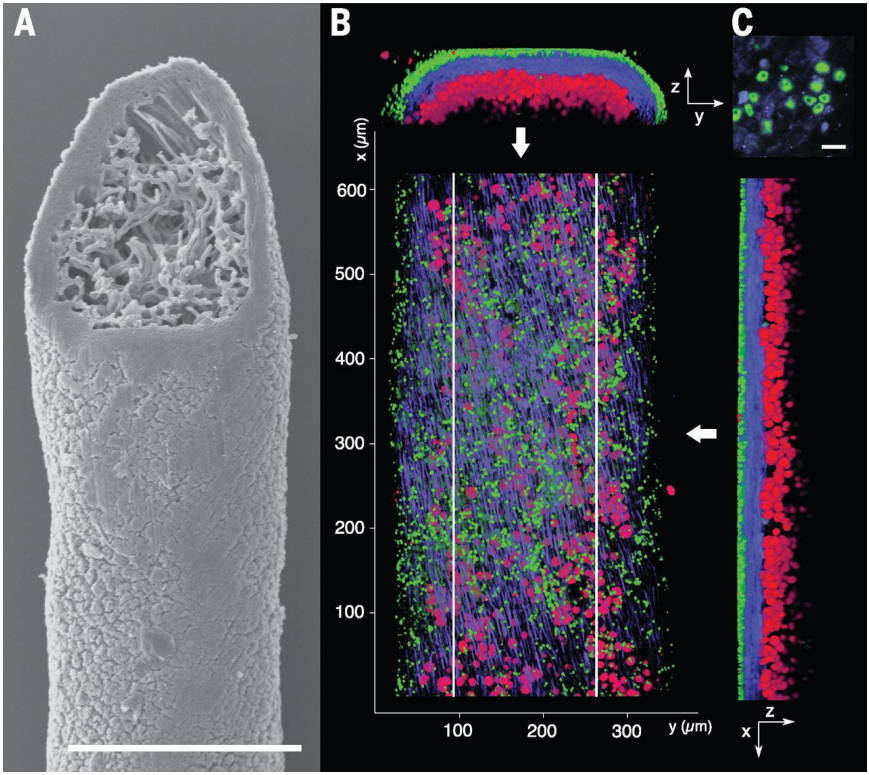
SUSAN GOLDHOR

The first thing we all learned about lichens is that they're a dual organism consisting of captured photosynthetic algae (or cyanobacteria) and the fungus that has captured them. Since the fungus is the dominant organism, and the same species of algae are in many different species of lichens, the lichens are named for the fungal partner.

Lichens are weird creatures (did you know that a lichen was once fastened to the outside of a space shuttle, exposed to the vacuum, cold and cosmic ray bombardment of outer space, and returned completely unharmed?) and one of the ways in which they are weird is their production of bizarre acids, acids with names like norstictic, vulpinic, perlatolic, lecanoric, sjizopeltic, fumarprotocetraric, thamnolic...there are more but I think you get the point. Since it's difficult to describe lichen species accurately by appearance, the acids that they produce have become criteria for identifying certain species, so you might read that one species resembles another except for the production or lack of a specific acid. For those of us poring over our copies of the massive book by Brodo et al., *Lichens of North America*, the listing of acids is a big part of the description of species.

For a long time, this worked. Until one researcher focused on two *Bryoria* species: *B. tortuosa* which is yellow because of its vulpinic acid production and *B. fremontii*, which is brown and lacks vulpinic acid. Nothing special — similar to many such groupings of related lichens, which differ only by chemical production. But in the case of this particular pair, the researcher looked at gene activation, and he discovered a problem. If the fungal partner of tortuosa was producing the acid, it should have shown signs of gene activation that were different from those of fremontii. But it didn't. And the algal partner wouldn't have been producing the acid.

Now the fungal partner of lichens is generally an ascomycete, so this researcher had been looking only at ascomycete genes, but without luck. So, he started to look for any genes being activated and he found them —



A figure from the pertinent publication, showing (A) a scanning electron microscope image of a Bryoria lichen thallus (scale bar, 200 μm), (B) an image of the various species within a Bryoria lichen thallus, with the ascomycete fungus fluorescing in blue, the algae fluorescing in red, and the newly-discovered basidiomycete yeasts in green, and (C) an image of these new yeasts in more detail (scale bar, 5 μm). Figure retrieved from Spribille, Toby et al. "Basidiomycete yeasts in the cortex of ascomycete macrolichens." Science (New York, N.Y.) vol. 353,6298 (2016): 488-92.

but they were in the basidiomycetes, and even careful microscopy didn't show any basidiomycete cells.

The way that genes actually manufacture proteins or complicated acids or other molecules is that when a specific gene is activated, its DNA makes RNA and that RNA leaves the cell nucleus and carries its coded message out into the cell. It's the RNA that does the work, and this makes sense since the DNA composing the genes must be protected and conserved.

How the RNA does its job is actually really complicated but, to cut to the chase in this story, there's a way to target the RNA sequences of one type of organism, and make them light up. So it was possible to sepa-

rately target the ascomycete fungus, the alga and the unknown basidiomycete fungus, and make each one fluoresce a different color. And as soon as this was done, it became possible to focus on and see basidiomycete yeast cells in the lichen thallus, and it was those yeast cells' DNA that was being activated and producing the RNA that produced the vulpinic acid.

This discovery led to a massive amount of publicity for a finding that seemed unlikely to be of great public interest, and a lot of the publicity seemed to focus on the fact that the lead researcher, Toby Spribille, had grown up in a trailer park, and had somehow learned sufficient genetics to get a doctorate without ever having gone to college. So when the key popular article appeared in The Atlantic, the title was, "How a Guy From a Montana Trailer Park Overturned 150 Years of Biology." No mention of lichens until you actually read the article. (The original article announcing the finding was published in Science and was less coy about the subject.)

There are a lot of complex biological issues that this brings up. To my mind, the major one is that no organism is an island, composed only of itself (or itself as we simple-minded humans define it). If half of our cells are organisms other than us, why should lichens be different? Why shouldn't they have a microbiome? I bet yeasts just happened to be discovered first. And now that they've been discovered, it turns out that there are yeast cells all over the place in lichens; the yeast species are specific to the lichen species; it's a global phenomenon with the same yeast species in the same lichen here and in Europe (and probably everywhere else as well) and we won't know what each yeast is doing for each lichen, without testing.

But all those complex biological issues aside, my question to you now is: if lichen names have been based on the ascomycete fungus that forms the thallus, with species differentiated by production of acids which we've assumed were manufactured by that ascomycete thallus species, and if it turns out that the acids may be produced by a totally different fungus, hidden within that thallus, how do we name lichen species? And, for that matter, how do we name the ascomycete fungus forming the thallus, since it turns out to be the same fungus in tortuosa and fremontii, but called by two different names?

Maybe we should follow Nicholas Money's suggestion (in a paper that got a LOT of angry responses from mycologists) that we stop using Latin binomials for fungi and start using common names for the mushrooms that we amateurs like to hunt, with barcodes for all the rest. But even barcodes wouldn't solve the lichen problem. Each lichen would have a cluster of barcodes. This is the kind of thing I think about when I'm lying in bed and can't sleep.

Susan Goldhor is the former president of the Boston Mycological Club and a current member of the Bulletin editorial team.