The Potomac Sporophore
Spring | May 2017 Volume No. 32 | Issue No. 2
The quarterly publication of the Mycological Association of Washington, Inc. (MAW) | http://mawdc.org

Register Now For:
Spring Tasting (p.7)
Spain Foray (p.11)

In This Issue:

Hiker's Notebook: Morels

William Needham
MAW President

Common Name: **Morel**, Sponge Mushroom, Molly moocher and Merkel (Southern Appalachians), Dryland fish – The common name 'morel' is of obscure Germanic provenance, probably a simplified version of the generic name from the same etymology.

Scientific Name: ***Morchella spp.*** – Theories as to the derivation of *Morchella* include an old German name for mushroom and the genus of the mulberry tree *Morus* due to the resemblance of the morel to the mulberry fruit.

Potpourri: Morels are surely the most celebrated of edible fungi in North America. They were among the first fungi to be classified as belonging to a genetic group owing to their unique morphology: a sponge on a stalk. The Greek word for sponge – from which 'fungus' derives – may well be due to similarities between morels and sea sponges; morels may well be the first fungi named by *H. sapiens*. The type species morel, *M. esculenta* ('edible' in Latin) or 'yellow morel', is normally indicated in guide books as having been identified by Carl Linnaeus in the 18th century, the Swedish originator of the taxonomic system still in use today. The black morel *M. elata* ('exalted' in Latin) was first identified by Elias Fries, one of the first mycological taxonomists and also Swedish. Morels are


William Needham
All morels share a common morphology and roughly resemble a pitted cone on a short stalk. Yellow morels have light ridges and darker pits.

arguably the most recognizable fungus in the world, excepting only perhaps the iconic *Amanita muscaria* which, with its blood red cap accentuated with snowflake white flecks, is the template of Continued on Page 2

Epichloë coenophiala, a Livestock-Harming Fescue Endophyte

Thomas Roehl
Newsletter Editor

The fungus *Epichloë coenophiala* spends its entire life inside tall fescue, a common livestock feed grass. While it is beneficial to the plant, it sickens animals that feed on the grass. In the United States, the fungus costs the beef industry anywhere from $600 million to $1 billion or more every year. *E. coenophiala* is an unusual organism – even for the fungi – that gives us some insight into the strange world of fungal endophytes.

Endophytes

What is an endophyte? If you recognize the word's roots, you can probably guess the answer: 'endo-' means 'within' and '-phyte' means 'plant'. Therefore, an endophyte is an organism that lives within a plant. This technically includes everything from plant parasitic nematodes to nitrogen fixing bacteria. However, most scientists exclude organisms that fit another ecological group; disease-causing organisms, mycorrhizal fungi, and other "normal" symbionts are generally not considered endophytes. The resulting group contains organisms (mostly bacteria and fungi) that are mutualistic to mildly parasitic with their plant hosts.

All plants in the wild are infected with endophytes, which suggests these organisms are even more basic to plant biology than mycorrhizae. Evergreen plants contain more endophytes in their leaves than most plants do, since the slow-growing endophytes have plenty of time to colonize the long-lasting leaves. Most endophytes belong to the phylum Ascomycota, although they are present in other lineages as well. Endophytes are traditionally divided into two groups: the clavicipitaceous endophytes (C-endophytes) and the nonclavicipitaceous endophytes (NC-endophytes). The C-endophytes belong to the family Clavicipitaceae and infect grasses while the NC-endophytes belong to other lineages and infect all other plants.

In many ways, endophytes are similar to microbes that live in the human gut. Both Continued on Page 9

Morels (Continued)

Continued from Page 1 choice for everything from animation to tchotchkes. Many European languages share similar names for the English morel such as the French *morille* and the German *morchel*; however, the names can be as diverse as *smardz* (Polish) and *spugnola* (Italian).

However, depending on how you define it, the morel is not really a mushroom. While the terms mushroom and fungus are considered synonymous according to pragmatics, they are semantically different: a mushroom is one type of fungus. The kingdom Fungi has two major divisions (sometimes subphyla or phyla): Ascomycota, the so-called cup fungi, and Basidiomycota, which includes puffballs, stinkhorns, brackets and a number of other obscure physiologies in addition to the ubiquitous gilled mushrooms. According to Kendrick's *The Fifth Kingdom* a mushroom is "a fleshy basidioma, usually stalked and with a cap (pileus) beneath which gills or fleshy tubes are covered with or lined with the hymenium." The hymenium is the spore bearing surface wherein the major dichotomy of the fungi resides: basidiomycetes have basidia, the club shaped bodies in which (usually four) spores are produced, while ascomycetes have asci, sac-like structures in which (usually eight) spores reside. As language is evolutionary, 'mushroom' is trending as a more ecumenical term that can be applied to designate the fruiting body of any fungus. The important point is that morels are ascomycetes.

Ascomycetes originated in the Paleozoic Era from a common ancestor and are therefore monophyletic, somewhat surprising in consideration of their morphological divergence and extensive speciation. It is estimated about three quarters of all identified fungi are ascomycetes, about 70,000 species. Most are asexual, reproducing with spores genetically identical to the source. This comprises the majority of the yeasts and molds. The sexual ascomycetes form macroscopic fruiting bodies and typically have a distinctive cup shape (by which they are commonly known) but also include some unusual outliers like the hypogeal truffles (*Tuber spp*) and the anthropomorphic dead man's fingers (*Xylaria polymorpha*).

William Needham

Black morels have dark ridges and lighter pits. All morels are ascomycetes and produce spores on the surface of the pits.

In morels, the spore-bearing cup surface hymenium has been compartmentalized into the characteristic honeycombed pits and carried aloft on a hollow stalk, presumably by the evolutionary advantage of increased spore dispersal. Based on modern genetic evaluation of mutation rates, morels are monophyletic with a single ancestor of North American provenance that first appeared in the Cretaceous Period about 125 million years ago; they have since morphed into many different species whose taxonomy is only now being tentatively established. The verisimilitude of morel species comes as something of a surprise; their distinctive and recognizable crenelated cone morphology belies a disparate genetic diversity.

The taxonomy on *Morchella* is complex, a fact that is only recently becoming manifest with the advent of DNA based associations. This is not all that unexpected, as the morels have one of the more varied reproductive systems, unusual even in the rarefied nuances of fungal sexuality. Morels are multinucleate to the extreme; each morel cell can have as many as fifty different haploid nuclei. Haploid or 'n' refers to organisms with only one complete set of chromosomes – fungi spend most of their lives as haploid organisms. Most other life forms, humans included, are diploid or '2n' and have two complete sets of chromosomes. Fungi become diploid for reproductive purposes whereas

Raw morels have been known to make people sick, so morels must always be cooked before being eaten. Luckily, cooking morels is commonplace because doing so greatly improves their flavor.

humans create the haploid sperm and egg which fuse to become the diploid zygote. When the morel forms a reproductive cell (called an 'ascus'), only two of the fifty-odd haploids will serve as the genetic parents for the spores produced by the ascus. As there are hundreds of possible combinations, it is likely that each ascus in a morel is genetically distinct. According to Beug and the Bessettes in *Ascomycete Fungi of North America*, "Practically, this means that in a cluster of 4 to 20 morels, each morel in the cluster is likely to be genetically distinct." Real basidiomycete mushrooms have only two nuclei per cell and therefore each mushroom's spores share the same two parent nuclei (so you see, morels really aren't mushrooms). While the work of understanding the true nature of morel relationships (morelity?) is on-going, it seems that North America has a black or *M. elata* clade of about 14 species and a yellow or *M. esculenta* clade of about 5 species; in eastern North America, as of now there are three blacks and three yellows. Despite all of the genetic differentiation and so far as is known, all morels are equally edible and – in the lexicon of mycophagists – choice.

To say that a fungus is edible is usually only half of the story. Many people who rarely if ever eat wild foods will develop nausea which may devolve to the more pronounced physical rejection of the offending substance altogether. Nausea is an evolutionary adaptation to protect animals from eating something unknown and therefore possibly harmful. In addition to their inherent alien chemistry (fungi are mostly composed of chitin, a compound not found in mammals), many fungi also have noxious volatile compounds which must be evaporated by heating; it is therefore a matter of policy among all credible mushroom organizations that edible fungi must all be thoroughly cooked. Morels are among the many edible fungi that are toxic (at least to some) if eaten raw. Fortunately, cooking imparts to a host of gourmet dishes an epicurean flavor that aficionados describe as reminiscent of hazelnuts. Thanks to this, morels are always cooked and reports of adverse reactions are therefore rare. Morels, like many edible fungi are also quite nutritious: they contain more protein than most vegetables, are rich in vitamins E, D, K and the B group, and their fiber is conducive to proper intestinal function.

Having established that morels are delectable and nutritious if cooked, it is necessary to establish how, when and where you find them. Finding morels is quite challenging, as the habitat that is likely to favor their growth is imprecise and inconsistent and the fungi are mercurial in the extreme. How to find morels is to be persistent and diligent. Pattern recognition skills are important as morels share their color palette with fallen leaf litter, betraying their presence only by trompe l'oeil stalk-borne wavy fissures. When to find morels is a matter of temperature and elevation or latitude. The most widely accepted soil temperature range for the morel mycelium to fruit is between 50 and 55 °F. Since it is not practical to go out with a thermometer and randomly probe soil temperatures, the rule of thumb is at least one full week with a minimum nocturnal temperature of 50 °F. According to this measure the morel season starts in the south and moves northward from April to May with some adjustments necessary for the cooler temperatures at higher elevations (2.5 °F drop every 1,000 feet). Another method for 'when' is to employ phenology, to use the temperature cues of other plants as surrogate thermometers. Among the many indicators, a favorite is 'when an oak leaf is the size of a squirrel's ear' (which they resemble), as this seems to best capture the wisdom of the merkel-hunting mountain people. Others include when the redbuds and dogwoods bloom or when violets first appear.

The 'where' is a matter of perennial debate and will likely never be settled. Finding morels is less science and more serendipity and secrecy, with its own lore of Elysian Fields replete with morchelloid bounty. According to myriad self-proclaimed experts, morels may be found under tulip trees, white and green ash, hickory, elm, striped maple, sycamore, oaks, in abandoned apple orchards, and, most significantly, in burned areas after a fire. In some parts of Europe, laws were passed to prevent the burning of forests that had been intentionally set to promote morel growth the following year. David Arora in *Mushrooms Demystified* captures the frustration of many in noting that "Morels usually grow outdoors: in forests (under both hardwoods and conifers) and open ground – under hedges, on road cuts and driveways, near melting snow, in gravel – In other words morels grow wherever they please – but only

Continued on Page 4

Morels can be picky about where and when they fruit. Often, finding them is all about persistence and luck. This morel was found on a recent MAW foray.

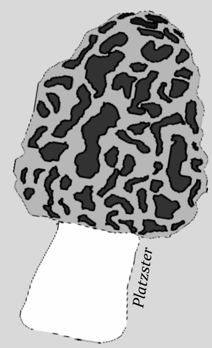
William Needham

Morels can sometimes be confused with the Brain Mushroom, *Gyromitra esculenta*.

Continued from Page 3 when conditions are favorable." The only correct answer to where to find morels is to know where the hypogeal morel mycelium grows, which can be established only by finding morels, a fungal catch-22. There is a good reason for morel inconstancy. Morel mycelia form sclerotia, masses of large cells several inches in diameter described as resembling a slippery walnut. The sclerotium is a nutrient reservoir, allowing the fungus to survive adverse conditions for decades. The upshot is that the morel mycelium can choose whether to form a primordium-cum-fruiting body or whether to await more favorable conditions. Coaxing the sclerotium to fruit is fundamental to commercial cultivation. In 1982, Ronald Ower succeeded in demonstrating a consistent process. U.S. Patent number 4,594,809 was issued in 1986 specifying the series of operations necessary and sufficient for morel cultivation. Unhappily, about two weeks after that, Ower was murdered in San Francisco.

As with many edible fungi, there is a doppelgänger: the Brain Mushroom *Gyromitra esculenta* which is suggestively known as the false morel. The species name is an unfortunate choice, as 'edible' is true only with extreme caution; while it has been consumed with impunity in some regions for centuries, it has also caused some discomfort and even death. The cautionary note arises as false morels produce gyromitrin which metabolizes to monomethylhydrazine, a component of rocket fuel. Ingestion of this chemical is inimical to the fundamental physiology of the human body and can result in symptoms ranging from nausea to death. Cooking volatizes some but probably not all of the gyromitrin, so the mushroom is potentially lethal even when cooked. Some people who eat fungi are old, and some are bold, but those who seek to be both old and bold are usually eliminated from the gene pool.

Morels Stuffed with Crab Mousse



Ingredients

4 morels

Mousse:
- 8 oz crab
- 1 shallot
- ¼ cup heavy cream
- 1 egg white

Sauce:
- 1 shallot
- ¼ cup heavy cream
- ¾ teaspoon kosher salt
- ⅛ teaspoon freshly ground black pepper
- 2 tablespoons unsalted butter
- 2 teaspoons finely chopped fresh dill or ⅛ teaspoon tarragon

Directions

1. Preheat oven to 350°F.
2. Gently wipe the morel caps and stems. Cut the stem off at the base of the cap and save for another use. Swish a little water inside each cap to remove any sand or grit and stand the caps upright on several layers of paper towels to drain.
3. Cut one of the shallots into quarters. Fit a food processor with the metal chopping blade, and pulsing the machine on and off, chop each quarter shallot until finely minced. Add the crab and process 1 minute. Scrape down the sides and process 30 seconds longer. Scrape down the sides again, then continue processing while slowly adding the egg white and ¼ cup of the heavy cream. Turn off the machine, scrape down the sides, add salt and pepper, and start processing again. If needed, add more cream—but no more than ¼ cup—a little at a time, until the mixture is like stiff whipped cream. Do not allow it to liquefy.
4. Mince the remaining shallot and combine it with the remaining cream in a small saucepan. Scald the cream (cook just until bubbles appear on the edge of the cream) and immediately remove it from the heat. Set the flavored cream aside.
5. Fill a pastry bag fitted with a straight tube with the forcemeat, and squeeze enough into each morel to fill. Stand the morels upright in a buttered baking dish just large enough to hold them and pour the flavored cram into the dish. Melt 1 tablespoon butter and drizzle it over the morels. Cover and bake in the preheated oven for 10 minutes. Baste with the pan liquids and bake 5 minutes longer. Remove the morels and keep them warm.
6. Transfer the cream sauce remaining in the baking dish to a small saucepan and cook until it is reduced slightly and begins to thicken. Add the remaining tablespoon of butter and stir until completely incorporated. Stir in the dill or tarragon. Spoon some sauce onto each plate and serve the morels upright on the sauce.

NOTE: The forcemeat may be prepared in advance and refrigerated until ready to use. Don't wash the mushrooms until you are ready to use them because the extra moisture may cause them to decay quickly.

Recipe from The Edible Mushroom: A Gourmet Cook's Guide *by Margaret Leibenstein (1986), adapted by Bruce Boyer*

Fungi in the News

Thomas Roehl
Newsletter Editor

Editor's Note: This article contains summaries of the biggest fungus-related news stories from February through April 2017. Visit the link following each topic below for a closer look.

Fungus-Farming Ant Evolution

Research from the Smithsonian Institution has helped shed light on the likely origins of ant agriculture. The new study sequenced DNA from 78 ant species that farm fungus and 41 that do not. Analysis of that data resulted in a phylogenetic tree that was then linked to known dates from the fossil record. This showed that the ants first developed complex farming systems around 30 million years ago, about the same time as the global climate shifted to a cooler phase and decreased the size of South American tropical rainforests. The study's authors speculate that ants casually farming fungi adapted to their cooler and drier climate by bringing the fungus underground and carefully regulating its environment to mimic its normal rainforest habitat. Since the aboveground environment was no longer favorable to the fungus, it became separated from its species. This allowed the ants to domesticate the fungus over millions of years and eventually resulted in the complex farming mechanisms ants use today. Read more at: **http://www.smithsonianmag.com/science-nature/how-ants-became-worlds-best-fungus-farmers-180962871/**

Bat Disease Reaches Texas

White-nose syndrome (WNS), a disease that has killed millions of bats across the eastern United States, has now been detected in Texas. Disease symptoms have not yet been observed, but DNA from *Pseudogymnoascus destructans* – the fungus that causes WNS – was detected on hibernating bats in six Texas counties. Researchers expect WNS to have a minimal impact on Texas bats; many bat species that live in Texas do not hibernate long enough for the disease to be lethal. However, those that survive WNS can become carriers and spread the fungal spores over long distances. For example, the Mexican free-tailed bat is not expected to die from WNS but will likely help spread the disease as far south as Honduras. Now that the fungus has arrived in Texas, it will likely spread west to Arizona and then to the rest of the continental United States. Read more at: **https://www.washingtonpost.com/news/energy-environment/wp/2017/03/23/a-merciless-bat-killing-fungus-is-on-the-move-again-now-its-in-texas/**

Early Fossils May Upend Fungal Evolution Theories

Fossilized remains of what scientists think are early fungi were recently unearthed in South Africa. The microscopic organisms were found in gas bubbles that formed in lava deep undersea 2.4 billion years ago. If confirmed as fungi, these new fossils push back the earliest example of fungi in the fossil record by over one billion years. Additionally, they suggest that fungi first evolved deep underwater rather than evolving on land or in shallow water, as was previously assumed. However, scientists have yet to definitively confirm that the fossils are fungi. Although the tiny threads look like mycelium, they could have been formed by another branch of early eukaryotes or by giant bacteria. Read more at: **http://www.bbc.com/news/science-environment-39656089**

Virus Breaks Through Fungal Incompatibility

Researchers studying the fungal plant pathogen *Sclerotinia sclerotiorum* discovered a virus that reduces the fungus' incompatibility reaction. When two fungi of the same species meet, a series of chemical interactions determines whether or not they can fuse with one another. If the chemicals do not match up correctly, the cells at the contact point die and the fungi are said to be "vegetatively incompatible." A major benefit of being incompatible is that viruses cannot spread from one fungus to the next. However, the newly discovered Sclerotinia sclerotiorum mycoreovirus 4 (SsMYRV4) gets around this by turning down its host's incompatibility reaction. This prevents cells that contact another fungus from dying and allows SsMYRV4 to infect strains that should be incompatible. In the past, scientists have tried to control the spread of fungal diseases using mycoviruses, but these attempts were not very successful because the viruses could not spread to incompatible strains. SsMYRV4 may help researchers find a way around this problem, potentially opening up exciting new possibilities for controlling the spread of fungal pathogens. Read more at: **https://www.sciencedaily.com/releases/2017/03/170323141424.htm**

GM Corn Uses RNA Bits to Destroy Fungal Toxins

In a new use of genetic engineering techniques, researchers developed a strain of corn that prevents fungi from producing toxins. Fungi in the genus *Aspergillus* regularly infect corn and produce the compound aflatoxin, which is known to cause liver cancer. Using a technique called "RNA interference," the modified corn produces small bits of RNA that specifically target and block the fungus' mRNA molecules that encode aflatoxin. The modified corn does not prevent fungal growth, but does make infected corn safe to eat. Since a small RNA molecule is the only novel compound produced by the modified corn, it should have little to no negative impacts on humans, although that will need to be confirmed before the corn can be grown for human consumption. If the modified corn is proven safe, it could help reduce cancer rates in countries that do not have the resources to test for aflatoxins. Read more at: **http://www.newsweek.com/gmo-corn-cancer-571136**

Meeting Files

March 7: Psilocybin Research at Johns Hopkins

Thomas Roehl
Newsletter Editor

At the monthly meeting on March 7, Ethan Hurwitz, a Research Coordinator at Johns Hopkins, detailed the methods and major results from studies on psilocybin at Johns Hopkins.

Psilocybin is the main hallucinogenic compound in mushrooms of the genus *Psilocybe*. It is a classic hallucinogen and results in a wide range of effects at relatively low concentrations. Psilocybin is not known to be addictive, unlike many other psychoactive drugs. The federal government classifies psilocybin as a Schedule 1 drug, so its production and use are tightly controlled.

Studying the hallucinogenic effects of psilocybin is difficult because as, Ethan pointed out, the effects are inconsistent; the same person often reacts differently each time they take the drug. To make sure these differences are not caused by flaws in the experimental setup, the studies at Johns Hopkins use synthesized psilocybin. This ensures researchers know the exact amounts given to each patient and guarantees that the effects are not due to any other compounds present in the mushrooms.

When a patient is accepted, they first meet with two study administrators who will monitor and support the patient throughout his/her involvement. During the first meeting, participants are asked to share their life history in significant detail. This prepares the researchers to help the participant deal with any emotional problems the psilocybin may dredge up. The patients also receive advice on how to prepare for the effects of psilocybin.

On the day of the session, the participant eats a low-fat breakfast (psilocybin is fat-soluble, so foods with a lot of fat can affect the trial) before arriving at 8:00 am. Ethan commented that participants are often surprised when they see the room used for psilocybin studies; patients usually expect an aseptic hospital room, but instead they find themselves in an "aesthetic living room" designed specifically to support participants in studies that use hallucinogens.

When the session begins, participants are given a psilocybin pill, eyeshades, and headphones and allowed to experience the trip. During this time, the participants listen to a music playlist designed to follow the normal course of the hallucinations. The two monitors remain in the room for the duration to provide support.

At the end of the session, the participant is asked to fill out a survey and then driven home by a designated friend or relative. The participants are not allowed to drive themselves home to make sure they have someone they can talk to after their experience. This general outline may change depending on the focus of the specific study.

Results from the questionnaires have been very useful in establishing the general nature of psilocybin hallucinations and their long and short term effects. In the surveys from Johns Hopkins, psilocybin results were almost indistinguishable from the target score

Upcoming Events

The events listed below may change due to weather, speaker availability, etc., so read MAW emails and check our website at **http://mawdc.org** for up-to-date information on events. Exact foray dates and locations will be set closer to the event in order to take weather conditions into account.

Jun. 6 **Monthly Meeting** featuring a presentation by **Britt Bunyard** on "Fungi, Bugs, and *Doctor Strangelove*." If you plan on attending, try to watch the movie as it will make the talk more enjoyable.

Jun. 11 **Wild Foods Culinary Event:** MAW traditionally holds a tasting in the spring that features all wild foods, since mushrooms are scarce at this time of year. A morning **foray** will precede this event. Visit **http://mawdc.org/Tastings** for more information and to register.

Jun. 29 Board Meeting

Jul. 11 **Monthly Meeting** featuring a presentation by **Gary Emberger** on tree ID with a mycological twist. This meeting will be held on the **second Tuesday of the month** to avoid July 4 celebrations.

Jul. 15 Tour of **North Cove Mushrooms farm** in Madison County, VA, and **foray** on farm grounds.

Aug. 1 **Monthly Meeting** featuring a presentation by **Noah Siegel** on mushrooms of the redwood coast.

Save the Date:

Sept. 17 **Mushroom Culinary Event**

Sept. 29-31 **MAW's Camp Sequanota Foray**

Oct. 8 **Mushroom Fair**

Unless otherwise noted, monthly meetings will be held on the first Tuesday of the month at 7:00 PM in the Kensington Park Library, 4201 Knowles Avenue, Kensington, MD. Attendees are encouraged to bring mushrooms for sharing and identification. Members of the public are welcome to drop in.

for religious experiences. The surveys also found that participants had increases in positive behavior and in their sense of well-being. However, the drug did not result in any long-term personality changes, except that participants' scores for 'openness' increased.

One of the most surprising studies tested the potential of psilocybin for treating nicotine addiction. This pilot study was small and included 15 men who had not been able to quit smoking in the past. The researchers used biological markers of smoking to assess how successful the men were at quitting after taking psilocybin. The results were amazing: after one dose of psilocybin, the participants' biological markers returned to nonsmoker levels within a matter of weeks. Although the effect of psilocybin in this study was more acute than any other treatment currently available, Ethan cautioned that the study was too small to generate significant data. However, researchers are hoping to repeat the study with a larger group in the future.

At the end of last year, the Johns Hopkins researchers released a paper detailing a recent double-blind study into the effects of psilocybin on anxiety and depression in cancer patients. This study found that a single high dose of psilocybin dramatically reduced anxiety and depression ratings and kept them down for at least six months. Additionally, participants' well-being scores began increasing and were still increasing six months after taking the drug. You can listen to some personal stories from people in the study here: **https://vimeo.com/122278721**.

Thomas Roehl

Top: Ethan Hurwitz describes psilocybin research being conducted at Johns Hopkins. Bottom: members enjoyed John Harper's Oyster Mushroom lasagna at the March meeting.

As a closing reminder to those present, Ethan reiterated that the effects of psilocybin demonstrated in the Johns Hopkins studies are inextricably linked with the experimental protocol. Anyone using psilocybin on their own should not expect to experience the same results because they would be using the drug in a completely different environment. That being the case, both Ethan and the Johns Hopkins researchers advise against recreational use of the drug.

Spring Wild Foods Tasting

Spring has sprung! Come out to cook, or just to taste.

MAW's mushroom tastings feature mycophagy (mushroom-based cooking) – delicious and educational at the same time! Taste mushrooms and other wild foods you have never tried before, and compare the results of different preparation and preservation techniques. For example, you might learn:

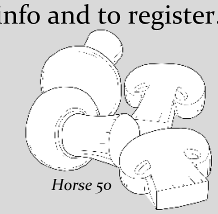
- *Which makes better broth – black staining polypore or hen of the woods?*
- *Which makes better risotto – black trumpet chanterelles or boletes?*
- *Do you prefer truffle ice cream or candy cap ice cream?*

While mushrooms will be the main feature, any wild foraged food might appear on our spring tasting menu. In past years, we have tried everything from wood sorrel to squirrel! Participants will vote for the best preparations and we will share our recipes.

Last year's tasting event sold out, so register today!

Visit **https://mawdc.wildapricot.org/Tastings** for more info and to register.

Date: **June 11, 2017**
Time: **2:00 PM – 4:00 PM**
Place: **Sandy Spring Museum**
17901 Bentley Road, Sandy Spring, MD 20860
Price: **$10 per person** (free for cooks)



Horse 50

April 4: The Bessettes' 10 Steps for Better Bolete Identification

Thomas Roehl
Newsletter Editor

On April 4, Alan and Arleen Bessette shared with the club ten steps to improve your bolete identification. Their lively presentation also featured beautiful pictures of boletes from their recently published book, *Boletes of Eastern North America*.

Bolete identification has always been challenging. Alan acknowledged this fact with a quote from Eilas Fries, one of the first mushroom taxonomists: "No genus has given me more trouble than that of the Boleti." To help make the process less painful, the Bessettes offered the following ten steps:

Step 1: make sure it's a bolete. Not all fleshy mushrooms with pores and a central stipe are boletes. Mushrooms in the genus *Albatrellus* and some in *Polyporus* can appear very similar.

Step 2: collect good specimens. To improve your chances of successfully identifying a mushroom, collect fresh mushrooms at multiple stages of development. Some boletes change dramatically as they mature, so seeing the mushroom at every life stage is extremely helpful.

Step 3: record key features. Write your observations Continued on Page 8

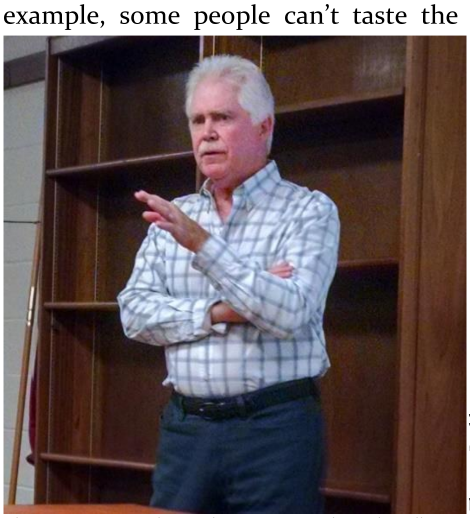
Continued from Page 7 down in a notebook when you first find the mushroom. That way you will remember what the mushroom looked like even if it changes as it is handled or dries out. Start at the top and work your way down, making sure to include shape, color, size, and staining of all the various parts. Taking descriptive photos will also help in this process.

Step 4: recognize variation. Even within a species, mushrooms can take on a range of colors, shapes, and sizes. Genetic and environmental factors can influence a mushroom's morphology, so minor differences are not always indicative of separate species. Experience is the best way to tell when a morphological difference matters.

Step 5: color is subjective. Everyone interprets color differently; even Alan and Arleen often disagree about mushroom colors. Different lighting conditions can also appear to alter colors. Assess color under sunlight or a broad spectrum light source.

Step 6: develop a keen nose. For boletes, smell often greatly simplifies keys. If you have a cold or don't trust your own sense of smell, ask someone for a second opinion. Not everyone can smell everything. For example, smokers may not detect the ash-like smell of the Ashtray Bolete.

Step 7: trust your sense of taste. Taste is actually useful in many bolete keys. However, there are a number of factors that can affect taste. For example, some people can't taste the bitter compounds in *Tylopilus* spp. Additionally, alcohol can temporarily dull your taste buds.



Thomas Roehl

Alan Bessette Responds to audience questions during his talk on bolete identification at the April meeting.

Step 8: macrochemical limits. Color change reactions to ammonia, iron salts, and potassium hydroxide are commonly used to separate bolete species. However, different authors can report different reactions. Age, storage, concentration, and application method can all affect the results.

Step 9: you can't ID everything. Some mushrooms are simply unidentifiable due to age, parasitism, or less than ideal environmental conditions. Sometimes, you have to consult keys with no pictures or check microscopic features, both of which can be difficult and confusing.

Step 10: note habit and habitat. Note any nearby trees, the micro-habitat, the location, and how the mushrooms grow in relation to one another (the 'habit').

At the end of the talk, Alan had one last piece of advice: "What's important is you enjoy what you're doing!"

May 2: Gretchen Kuldau Explains Mycotoxins' Activity and Effects

Thomas Roehl
Newsletter Editor

The monthly meeting on May 2 featured a presentation on mycotoxins from Gretchen Kuldau, a professor in the Department of Plant Pathology and Environmental Microbiology at the Pennsylvania State University.

Gretchen began her talk with an overview explaining what mycotoxins are. In the broadest sense, mycotoxins are chemicals produced by fungi that are toxic to humans and animals in low doses. Mycotoxins can be found anywhere fungi grow, including – and perhaps most importantly – in food.

The first mycotoxin to be identified was Aflatoxin, which was isolated from *Aspergillus flavus*. Aflatoxin is the most important mycotoxin worldwide because *A. flavus* grows on oil-rich seeds, which include many staple foods. If consumed in large quantities, aflatoxin can cause gastrointestinal problems, liver damage, and death. This is fairly rare and people are more often harmed by the effects of long-term exposure to the toxin. Chronic exposure can reduce growth rate, reduce weight gain, cause a "failure to thrive in children," and cause liver cancer. In fact, aflatoxin is one of the most potent carcinogens. These effects are prevalent in developing countries because they have to export their best food to make money and are left with the lower quality and possibly fungus infected crops.

Thomas Roehl

At the May meeting, Gretchen Kuldau provided MAW with an overview of the most important mycotoxins.

Deoxynivalenol (DON) is another significant mycotoxin. It is produced by *Fusarium graminearum*, – which grows on grasses – and other *Fusarium* species. DON blocks protein production and primarily impacts the gastrointestinal tract and immune system. The fungus produces DON because DON also harms plant cells and makes it easier for the fungus to spread within the plant. Although grain producers adhere to the recommended limits very closely, the sheer amount of grains consumed means that DON is probably the toxin to which people in the United States are most exposed.

Fumonisins are strange toxins that cause different effects to different animals. In horses, which are the most susceptible animals, it liquefies brain tissue and is fatal at a concentration of 8 parts per million. In pigs, the toxins cause pulmonary edemas and prevent them from getting oxygen. Fumonisins are linked to esophageal cancer and neural tube defects in humans.

Ergotism is a disease caused by eating ergots (large resting structures produced by *Claviceps purpurea* that take the place of seeds in heads of grain). The ergots contain a variety of mycotoxins and can cause both hallucinogenic and gangrenous symptoms when ingested by animals. The primary toxins are ergotamine and lysergic acid. The former is now a pharmaceutical approved to treat postpartum bleeding and migraines while the latter led to the development of the hallucinogen LSD.

At the end of her talk, Gretchen posed the question, “Should you be worried?” For people living in the United States, probably not. Regulations on food keep these toxins below harmful levels. However, if you raise livestock you should definitely remain diligent to protect your animals from mycotoxins.

Mycology Vocabulary

Taxonomic Color Words

Many taxonomic names seek to describe the thing they name; understanding root words can help you remember both the name and the organism. Some of the most common root words found in mushroom names are color words. The color words listed below are often modified with a prefix or suffix or to fit the gender of the genus name, so they may not appear exactly as they do here. This list is not exhaustive and taxonomists use many more color words. Some of those are nearly identical to English words and are easy to spot (e.g. *Lactarius indigo*).

Word	Meaning	Example
ruber, rubr-	red	*Amanita rubescens*
ruf-	reddish	*Peniophora rufa*
ferrugo	rust	*Tylopilus ferrugineus*
aurantius, aurantiacus	orange	*Aleuria aurantia*
fulvus	dark/tawny yellow	*Amanita fulva*
chrys-	golden	*Xerocomellus chrysenteron*
crocos	yellow	*Crepidotus crocophyllus*
luteus	yellow	*Suillus luteus*
xanthos	yellow	*Agaricus xanthodermus*
citrina	lemon yellow	*Amanita citrina*
flavus	light yellow	*Aspergillus flavus*
chloro-	pale green	*Chlorophyllum molybdites*
viridis	green	*Microglossum viride*
cyano-	blue-green	*Psilocybe cyanescens*
caeruleus	blue	*Terana caerulea*
purpureus	purple	*Claviceps purpurea*
atro-, atri-	dark	*Tapinella atrotomentosa*
melano-	black	*Stropharia melanosperma*
nigr-	black	*Geoglossum nigritum*
canus	gray	*Cantharellus roseocanus*
cinera	ashen	*Clavaria cinerea*
fuligo	soot	*Fuligo septica*
albus	white	*Cortinarius alboviolaceus*
leuco-	white	*Leucocoprinus birnbaumii*
pallidus	pale	*Boletus pallidus*

Other Color-Related Words

-ascens, -escens, -icens	tending toward; becoming	*Amanita brunnescens*
bicolor	two-colored	*Boletus bicolor*
chroma	color	*Harrya chromapes*
maculatus	spotted	*Rhodocollybia maculata*
striatus	striped	*Cyathus striatus*
versicolor	many-colored	*Trametes versicolor*

Endophyte (Cont’d)

Continued from Page 1 sets of organisms are secretive, living inside their hosts mostly without producing symptoms. Because of this, scientists have only recently begun examining the functions and impacts of both groups.

One of the most thoroughly studied fungal endophytes is *E. coenophiala*, thanks to its impact on livestock. In order to fully understand this unusual organism, we must first understand its host, the feed grass tall fescue.

Tall Fescue

Tall fescue (*Festuca arundinacea*) is a perennial grass from Europe that is used in a variety of contexts, including as livestock feed, as turf, and for controlling erosion. It was first introduced to the United States in the early 1800’s. In 1931, a strain was discovered in Kentucky that had adapted to growing conditions in North America. This strain was named “Kentucky 31” and became very popular as a feed source for livestock beginning around 1945.

Kentucky 31 is resistant to many insects and nematodes, tolerant of poor soil, and survives well during times of drought. All these qualities make it very easy for farmers to establish and maintain stands of tall fescue. Importantly, the grass also produces a good yield of leaves and seeds that can be eaten by grazing livestock. Today, tall fescue is planted on over 36 million acres in the United States.

Fescue-Related Diseases

Soon after the use of tall fescue became widespread, farmers began noticing that animals grazing on fescue produced inconsistent results. On many farms, animals fed tall fescue performed poorly and Continued on Page 10

Continued from Page 9 developed health problems. Some would even lose weight despite grazing constantly. Cattle, sheep, horses, and deer were all susceptible to these effects, though to different degrees. There are three main diseases associated with tall fescue: fescue toxicity, fescue foot, and bovine fat necrosis.

Fescue toxicity affects cattle, deer, and sheep (to a lesser extent), which will demonstrate reductions in feeding, weight gain, milk production, and reproductive success and increases in respiration, body temperature, and salivation. Horses also have problems during reproduction, including: abortions, unusually long pregnancies, and birthing issues that can result in the loss of both the mare and foal. Most of the foals that survive are born with developmental, mental, and immunological problems. Pregnancy relies on very accurate chemical signaling, so even low levels of toxic fescue will cause problems in horses.

Fescue foot is a gangrenous condition that results from extremely decreased blood flow to the extremities and is especially problematic in colder weather. It often causes lameness and the loss of tail or ear tips. In its most extreme form, animals may lose their hooves or even their feet. Cattle and sheep are the two animals most often affected by fescue foot.

Bovine fat necrosis affects cattle and is characterized by the production of hard, fatty masses in the tissue surrounding the intestines. These fatty masses can interfere with both digestion and calving. This disease is a problem only in fields that are heavily fertilized.

Epichloë coenophiala

It was not until the 1970's that the cause of these problems was discovered. Researchers managed to isolate *Epichloë coenophiala* from the disease-causing fescue. Scientists discovered that this small fungus grew between the cells of tall fescue and did not produce any directly observable differences between infected and uninfected plants. Even today, a lab test is required to tell whether or not endophytes are present in tall fescue.

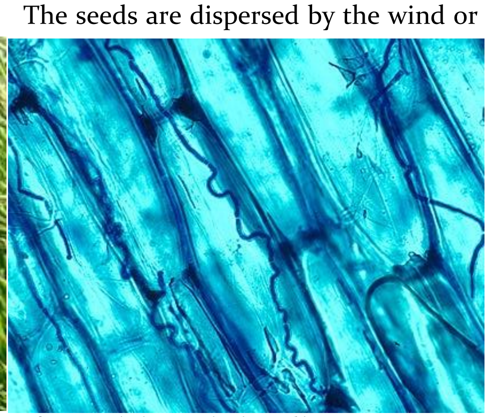
Further research showed that the fungus produces a variety of alkaloids that deter predation. These alkaloids are very similar to those produced by the fungus *Claviceps purpurea* (Ergot of Rye), which causes similar disease symptoms in humans. Some have suggested that *C. purpurea* had a role in the Salem witch trials, but that is a story for another day. *E. coenophiala*'s similarity to *C. purpurea* is hardly surprising; both organisms belong to the phylum Ascomycota and family Clavicipitaceae. Because it belongs to this family, *E. coenophiala* is categorized as a C-endophyte.

E. coenophiala has a very simple life cycle. It begins its life inside a fescue seed, where it can survive for up to a year. When the seed germinates, the fungus grows into the base of the leaf. The "infection" remains there until the plant forms reproductive structures. Then, the fungus grows into the stem and eventually into the plant's seeds. The seeds are dispersed by the wind or by animals (especially humans), thereby spreading the infection. Under normal conditions, *E. coenophiala* does not produce spores. Therefore, infection is spread only from the parent grass to the child grasses and plants remain infected or uninfected for life.

"Infection" is a strange word to use to describe the relationship between *E. coenophiala* and tall fescue. It is technically accurate, since the fungus lives inside the plant's tissues and gets all of its nutrients from the plant. However, unlike a normal disease, *E. coenophiala* confers many benefits to its host. Plants infected by the tall fescue endophyte show increased resistance to insects and nematodes, increased drought tolerance, and increased tolerance of many types of stress. Of course, the endophyte-infected grass also harms large animals that eat it, which benefits the plant by decreasing the amount of grass those animals eat. Most of these effects appear to be mediated by various alkaloids produced by the fungus. However, only a few of those compounds are harmful to livestock.

So why would the fungus produce extra compounds just to help the plant survive? Wouldn't the fungus be able to grow more if it didn't devote resources to making those molecules? Not quite; the fungus chooses to aid the plant because doing so improves the fungus' reproductive success. *E. coenophiala* reproduces only by growing into the plant's seeds. Consequently, the more seeds the fescue produces, the more plants are infected by the fungus. *E. coenophiala* therefore has an incentive to help make the plant as productive as possible.

However, supporting the fungus does come at a cost to the plant. Some of the plant's energy is required to feed the fungus, so endophyte-free grass does better under ideal conditions. Combined with the fact that the endophyte is passed only from parent to child, this means that a properly managed stand of grass can remain free of endophytes for years. Endophyte-free stands do best in cooler climates with

Left: Tall fescue (*Festuca arundinacea*) is widely planted as a forage crop for cows and other animals. *Photo: Bildoj, CC BY-SA 3.0*
Right: The endophyte fungus *Epichloë coenophiala* grows between tall fescue cells and produces alkaloids toxic to animals. *Photo: USDA*

readily available moisture and when the grass is not grazed or only lightly grazed during the summer. The more stress a stand of tall fescue is exposed to (by intensive grazing, more pests, warmer and drier weather, etc.), the more likely it is to become dominated by endophyte-infected plants.

Fescue Endophyte Management

There are a number of things farmers can do to reduce the impact of *E. coenophiala* on livestock. One of the most interesting is to plant tall fescue infected with "novel endophytes." Researchers have identified a number of endophyte strains that do not produce the alkaloids that are toxic to livestock. The first commercially-available product using these novel endophytes came onto the market in 2000. tall fescue infected with novel endophytes has stress tolerance comparable to tall fescue infected with wild, toxic endophytes. This confers the benefits of endophytes without having to worry about the toxic effects on livestock.

Tall fescue endophytes can also be managed by conventional agricultural methods. The simplest method is to kill off all the infected grass and re-seed with uninfected fescue. To keep the new stands endophyte-free, livestock must be fed something else for a few days to prevent endophyte-infected seeds from being introduced to the new pasture through the animals' feces.

A variety of other methods are used to when endophytes cannot be eliminated completely. These seek to control the amount of endophyte toxins to which animals are exposed. Through proper management, the percent of endophyte-infected plants in a stand can be kept low enough to prevent disease. Diversifying the animals' diet, reducing the use of fertilizers, and adding ammonia to fescue hay can also minimize the effect of the toxins.

Additionally, the medicine Domperidone can be given to pregnant horses to mitigate the effects of the toxins. Unfortunately, this drug is not cost-effective for other animals and is therefore not widely used.

Mycological Foray Trip: Extremadura, Spain

October 29 – November 10, 2017
12 days – 11 nights

This next mycological – and cultural – foray trip abroad is one of a series that started in 1995 especially intended for the MAW membership. A former MAW member, Ennio Giusti, returned to visit and offered to develop a tour cosponsored by the Parma Mycological Society. From the first trip that covered Tuscany, the Dolomites, Piedmont, the Italian Riviera in a sixteen days' rush of enjoying *B. edulis* and *T. magnatum*, paired with great wines, we then started to focus our visits in a single area. Since then we have forayed in every Italian region, even more than once.

The singular element that made, and still makes, these trips unique is the camaraderie and developed friendships with our host mycologists. Their welcoming attitude has been an unexpected revelation: they opened their clubs, in some cases their homes, to welcome us and share their picking areas, their knowledge, and their culture openly and without reservations or expectations.

That has been the experience for several long-time MAW members. The word about the first experience expanded to the Boston, the Puget Sound, the Eastern Pennsylvania, the California associations and that brought 14-20 persons every year since (We had to offer two foray trips some years). Among them were mycologists familiar to MAW members such as Dennis Benjamin, Britt Bunyard, Harley Barnhart, Larry Leonard, Milton Tam, Patrice Benson and more.

About four years ago, I decided to "broaden our horizons" and finally last year we made our "maiden voyage" to Castilla-Leon, Spain. The attraction continues, and amazingly enough, it will be led by an American scientist, Christine Fischer, expert on truffle cultivation who lives in Spain and is developing a program in Extremadura that promises to excel in expectations.

There are planned forays to pine, oak and chestnut forests accompanied by local mycologists. We shall indulge in the mycological gastronomy of this region, and enjoy wines and tapas, the famous Iberian ham, the fragrant regional pimiento, cured meats and unusual cheeses, such as the unique *"Torta del Casar"*. We shall visit several World Heritage locations, and join in a most outstanding folk celebration of *Carbochá*, a remembrance of ancestors on All Saints' eve, 10/31, with roasting of chestnuts, music and dance.

For full details and information contact:
Albert J. Casciero: **ajcasciero@gmail.com**
or see him at the next MAW meeting

TALES OF THE FUN GUY