The Potomac Sporophore

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Mark your calendar with MAW's 2017 events!
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Tim Geho on 2017 Morels

Tim Geho
Morel expert, former MAW member

Based on years of experience, I no longer try to predict how the current year's upcoming morel picking will be. I've seen years with the prior summer drier than any in local Shenandoah resident's memory, along with little winter snow be followed by a banner morel year. I've also seen wet summers followed by well above average winter snow falls and rain be followed by poor years. It seems to be the month or so before the normal time for morels to fruit which make the biggest difference between a poor or moderate or exceptional year.

I liken it to how commercial mushrooms are grown. The *Agaricus* species are grown in ideal substrate and have the perfect temperatures controlled to a fraction of a degree. They also control the moisture content of the substrate and relative humidity to the perfect percent. Conditions are monitored 24 hours a day and kept as optimal as they can. This all leads to maximizing their yields. If any of the conditions aren't perfect, the yields suffer.

Thomas Roehl

This morel was found last year during a MAW foray. With a bit of luck and good weather, morels will hopefully be more abundant in 2017.

This holds true to morels but nature is the one that either creates the perfect or not so ideal conditions for morels to fruit. One can only hope that the conditions are right for good morel yields. Continued on Page 3

The Mushroom Chronicles: Mycorrhizas

William Needham
MAW President

During the Devonian Period some 400 million years ago, land plants first evolved from their aquatic origins. This required adaptations to the terrestrial environment. Although the plants produced their own photosynthetic nutrients from the sun they lacked the means to readily extract necessary mineral constituents from the land, as they had no true roots. The fungi had preceded them ashore by about 100 million years and had evolved to extract minerals by using root-like tendrils called hyphae. However, as the fungi could not produce their own food, they needed carbon-based nutrients to absorb. It is hypothesized that this engendered a necessary relationship between plants and fungi that enabled them to live together on the land.

The mutualistic relationship that resulted was the mycorrhiza; the word originated in the late 19th century when botanists discovered that plant roots, though infested with fungi, were not in any way damaged or dysfunctional. They described the condition quite simply as "fungus root" and gave it a name derived from the Greek words *mykos* for fungus and *rhizon* for root. The mycorrhiza is the mutualistic symbiosis of a plant and a fungus: both organisms benefit. In the current Holocene Epoch, it is estimated that over 90 percent of all plants are mycorrhizal.

The mycorrhizal relationship between a plant and a fungus is in essence a sharing of the resources that are necessary for life. The plant supplies the fungus with hexose sugars. Since it is not "normal" for plants to exude nutrients, it is evident that one of the key mechanisms involved in the symbiosis is for the fungus to stimulate the permeability of the plant's cell membranes. The fungus converts the sugars into reserve materials such as glycogen, which is a polymer of glucose molecules. Glycogen is the primary means of storing energy in the form of carbohydrates for fungi. Mycorrhizal fungi also generally produce the disaccharide trehalose and polyhydric alcohols. Some of the plant's nutrients are thus essentially stored in their associated "fungus roots" and act as an energy reservoir.

The fungus supplies the plant with minerals from the soil, primarily phosphorous and nitrogen. Phosphorous is one of the key constituents of adenosine triphosphate (ATP), which is the primary mechanism of plant cell energy generation. Nitrogen is needed for nucleic acids, Continued on Page 2

Science

Continued from Page 1 proteins and chitin (the primary fungal cell wall material). Phosphorous and nitrogen are accessed by the fungus through the creation of an extensive branching underground network of filamentous thread-like hyphae, which scavenge soil nutrients. Thus, the fungus serves two functions: it searches out critical mineral nutrients over a wide geographic area and it builds up a reservoir of the minerals for release to the plant when needed. A mycorrhizal fungus can store enough phosphorus to provide a reserve for the tree for about ten days.

There are seven types of mycorrhizas of which two predominate: endomycorrhiza and ectomycorrhiza. The prefixes accentuate the fundamental difference between them: "endo" is from the Greek *endon*, meaning within and "ecto" is from the Greek word *ektos*, meaning outside or external. In terms of mycorrhizal morphology, this means endomycorrhizas penetrate within the root cells and ectomycorrhizas extend outside of the root cells. They are also distinctly different in their populations. Endomycorrhizas are much more common: there are estimated to be over 300,000 plant species in association with about 130 species of fungi. Ectomycorrhizas involve only about 2,000 mostly arboreal plant species; however, some 5,000 different fungi are involved.

Endomycorrhizas are frequently called vesicular-arbuscular mycorrhizas or VAM due to their structure. When a spore from an endomycorrhizal fungus germinates in the vicinity of a receptive plant root, it sends specialized hyphal tendrils that extend into the root cells and form an arbuscule, meaning "little tree" to indicate its branching structure. Each arbuscule persists for a period that ranges from several days to about two weeks. The fungus also forms vesicles, which are membranous cavities typically filled with lipids. External to the root, the fungus also produces an extensive network of hyphae that extend several inches away from the root. This "fungus-root" provides the plant with a vastly expanded volume of soil from which nutrients can be extracted.

Endomycorrhizal fungi are taxonomically distinct enough from all other fungi to warrant their own phylum: Glomeromycota. They are obligately biotrophic, which means that they survive only in association with a plant and cannot be grown in the laboratory. They do not reproduce like traditional fruiting mushrooms, but rather produce large, thick-skinned spores intended to promote long term survival of the fungus in a subterranean dormant stage.

Endomycorrhizal plants are so ubiquitous that it is easier to list the exceptions. Aside from the 2,000 woody plants that are ectomycorrhizal, the majority of those that do not associate with fungi are what are generally characterized as weeds. That is, they are exploitive pioneer plants that germinate quickly in deficient soils with rapidly spreading, finely branched roots that can absorb adequate nutrients without assistance from VAM fungi. Examples include the cyperaceous sedge family and the juncaceous grasses and rushes. The association of fungi with plants across the broad spectrum of species is an additional insight into the nature of their co-evolution; the diversity indicates that the many branches arose from a mycorrhizal common ancestor some 400 million years ago.

Ectomycorrhizas are not as common as endomycorrhizas; however, they have a profound effect on the health of forests. The ectomycorrhizal fungus covers the outside of the roots of its associated plant with a mantle of hyphae. The hyphae penetrate and surround the root, excreting hormones that promote root growth and suppress root hair growth; 30 percent of the root's volume is actually fungal. The overall effect is that the roots of an ectomycorrhizal plant are thicker and much more branched than the roots of a plant without a mycorrhizal fungus. What this means is the ectomycorrhizal plants have a much better root system that has a surge capacity to provide extra nutrients during periods of adversity and an extended reach to pull in nutrients from a greater volume.

The plants that enter into ectomycorrhizal relationships are limited in number but significant in size and importance. This includes all trees in the families of the Pinaceae (pines, firs, spruces, hemlocks and larches), the Fagaceae (oaks, beeches, and chestnuts), the Betulaceae (birches, alders and hophornbeams) and the Salicaceae (willows and poplars) in addition to most myrtles and legumes. In general, ectomycorrhizal plant species are perennial and woody trees and shrubs. Most ectomycorrhizal trees are facultatively mycotrophic: they can survive without the fungi but assume a mycorrhizal relationship in response to stressful environmental conditions. It is this association that promotes the long-term health of the trees. Fungi engage the trees in an inter-related network that allows the pure stands of trees to predominate. Laboratory and field experiments have demonstrated the trees share carbon resources through their mycorrhizal root systems.

The fungi that enter into ectomycorrhizal relationships extend across a broad range of species of both basidiomycetes and ascomycetes. These include many from the ubiquitous agaric genera such as *Russula*, *Lactarius*, *Cortinarius* and *Amanita* in addition to the chanterelles and the boletes. Some ascomycetes, such as truffles, are also mycorrhizal. Most of the fungi can associate with a number of trees, though there is a preferential relationship between some mushrooms and certain host trees. Mycorrhizal trees can have many fungal partners; the Douglas fir, for example, is thought to be able to form ectomycorrhizas with over 2,000 different fungi.

Of the other five types of mycorrhizas, three are of some interest: ericaceous, monotropoid and orchidaceous mycorrhizas. Ericaceous mycorrhizas associate with plants of the family Ericaceae, which includes the heathers, rhododendrons and azaleas. That these plants are able to thrive in marginal acidic soil at high altitudes and colder latitudes is due to the exploitation of these habitats by their associated fungi. The colorless flowering plants of the genus *Monotropa*, such as the Indian Pipe, have an unusual life cycle. As they are achlorophyllous, they cannot make their own food. They get it from a fungus via monotropoid mycorrhizal relationship, though no one knows if the plant provides anything to the fungus in return. The key to this unusual relationship is that it is tripartite; the fungus is in an ectomycorrhizal relationship with a nearby tree. The *Monotropa* thus gets its nutrients from the fungus which in turn gets them from the tree.

Orchidaceous mycorrhizas are necessary for orchids to survive; they are obligately mycorrhizal. The unusual thing about the relationship is that the fungus provides carbon to the orchid, carbon that it has extracted saprophytically from the soil. So far as is known, the fungus gets nothing in return; like the monotropoid mycorrhiza, it is not a mutualistic association. This is of prime importance when the orchid is a seedling, as the seeds of the orchid are very small and have inadequate resources for development. Without the colonizing fungi, the orchid perishes. The provisioning of the orchid plant with carbon by the fungus can be a long-term proposition, as some orchids do not produce their first chlorophyll bearing leaf for over ten years. That this is a successful relationship is manifest in the great diversity of orchids: there are tens of thousands of species.

Board Minutes

Minutes from Board meetings are now available on MAW's website. Log into your account and click on "Meeting Minutes" or go to **https://mawdc.wildapricot.org/Meeting-Minutes**.

Morels (Continued)

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This can vary from the early area morels to the later fruiting areas. For instance: one year my wife Judy and I picked 31 pounds of the small *deliciosa* type in two days in one small area but have never picked as much as a pound in the same area before or since. However, an area less than ½ mile away and 250ft higher elevation has had some poor years and other years with abundant morels. A good year in one of these two areas did not relate to how well the other area fruited. I feel it was moisture (rain) at just the right time with good air and ground temperatures which led to each area having a good or poor year.

My best advice is first to get to know a few areas very well. Know where you normally find morels in a good year so you don't have to spend too much time scouting. Then observe the conditions when you do find ample morels. I look when the may apple leaves begin to flatten out and when the spicebush leaves mature. This normally happens at the time morels grow, if other conditions are right. If one looks closely at spicebush, tiny flowers can be seen. They also tend to produce loads of pollen which collects on boots. Spicebush is also a sign of moisture. It fares poorly in areas with soil that dries out quickly. Other general things I look for are when the tulip poplar leaves are at least ¾ grown and when the true leaves come out on ash trees.

Don't be in too much of a hurry after a heavy rain. Wet poplar leaves tend to stick together like papier-mâché, which makes it hard for the small morels to push up through. Last year we had 17 days in a row of rain which kept the small morels unable to push through the ground leaf cover and those that did manage to come through were ruined by rain for the most part.

Many long-term MAW members have seen years when just about everyone was able to find paper bags full of morels with little effort spent searching for them. In a great year morels seem to be everywhere. However, these super years occur only one in a while. Let's hope that this is one of the years with ample morels for everyone. Judy and I will be out looking – and hoping.

Meeting Files

Dec. 6: Dr. Benjamin Discusses Myths of Mushroom Toxins

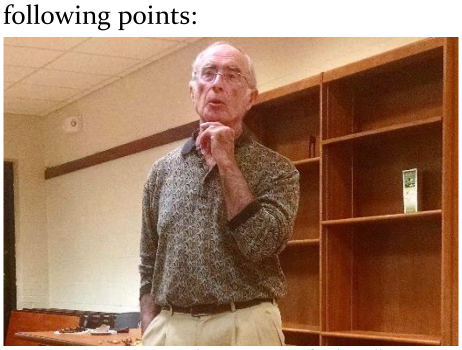
Thomas Roehl
Newsletter Editor

The December 6, 2016 meeting featured Dr. Denis Benjamin, a pediatric doctor, amateur mycologist, and painter. Denis' talk covered common myths and misconceptions about mushroom poisoning.

To begin his lecture, Denis examined the sources of mushroom myths. We get our information on mushrooms from a variety of sources, including: friends, social media, journalism, and mycological literature. All of those sources can generate and propagate myths.

These myths generally rely on sources that are not based on evidence. Anecdotes, webcast lectures, news articles, and proclamations of "experts" are all not sources of evidence. Even sources like encyclopedias and mycological association newsletters often contain errors. The news is perhaps the worst offender, as comedian John Oliver explained in his segment on "Scientific Studies" (**https://www.youtube.com/watch?v=oRnq1NpHdmw**). In order to properly evaluate these sources, always check their references. The best sources will refer back to scientific papers published in peer-reviewed journals.

Denis then moved on to debunk some of the most common myths about mushroom toxicity. He made the following points:



Thomas Roehl

Dr. Denis Benjamin responds to questions after his talk on mushroom poisoning myths.

- The Shaggy Mane can be eaten with alcohol. Other inky caps cause symptoms with alcohol, so the Shaggy Mane suffers from "guilt by association."
- Morels can be eaten with alcohol. Some people report gastric upset when eating morels with alcohol, but this ratio is the same as the ratio of people who react poorly to plain morels.
- Morels are edible but they will poison you if they are not cooked.
- *Verpa bohemica* is edible for most people, but noted mycologist A. Smith reacted poorly to it so field guides now list it as poisonous.
- The Man-on-Horseback does cause rhabdomyolysis, but only when eaten in very large amounts. Denis noted that quail sometimes causes the same problems in Eastern Europe but is still eaten.
- Angel Wings are generally harmless unless your kidney function is already impaired.
- Polypores can make you sick. For example, about 10% have a bad reaction to Chicken of the Woods.

As Denis sees it, "The reason we tell people, 'don't eat it,' is so we don't get into trouble." To compound the problem, we lack the data to properly assess the edibility of most mushrooms. "Every time you go out into the field and eat stuff, you are guinea pigs," and are helping to fill in some of this missing data, Denis explained.

He ended his talk with a discussion of health benefits. There is very little credible evidence, he said, that mushrooms can improve your health. Instead, Denis explained that "the main health benefit of mushroom hunting is the act of mushroom hunting." Getting some exercise outside will improve your health more than any of the mushrooms you collect. However, there is a flip side, as Denis noted: "The main health risk of mushroom hunting is also the act of mushroom hunting." Most injuries and deaths related to mushroom hunting are the result of falls, getting lost, encountering wildlife, trespassing, and other risks associated with the outdoors rather than actually eating mushrooms.

Thomas Roehl

William Needham discusses the biology of mycorrhizal fungi during the February monthly meeting.

For a final thought, Denis encouraged club members to practice critical thinking, check references, and put some effort into finding credible data. As he reminded his audience, that applies to his own lecture (and this article) as well!

Feb. 3: New Year Business and Introduction to Mycorrhizas

Thomas Roehl
Newsletter Editor

MAW's first monthly meeting of 2017 was held on February 3. The meeting began with a discussion of administrative items. Members of MAW who were present at the meeting voted to approve the proposed 2017 budget. Members who want more information about this year's budget should contact the Treasurer, Elizabeth Hargrave (**treasurer@mawdc.org**), or the President, William Needham (**president@mawdc.org**). During the meeting, MAW members also voted to approve Shannon Nix as the club's new Science Advisor. The Science Advisor post was vacant for the past few years, so Shannon is a welcome addition to the team.

The second half of the meeting featured a presentation by club President William Needham, who gave an overview of the ecology and morphology of mycorrhizal fungi. His article "The Mushroom Chronicles: Mycorrhizas" is printed in this newsletter and closely follows the lecture.

— MAW 2017 Calendar —

Below is a tentative schedule of the events MAW has planned for 2017. The events listed 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.

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.

Mar.	7	**Monthly Meeting** featuring a presentation by **Ethan Hurwitz**. This presentation will cover the history of psilocybin research at Johns Hopkins, starting from its resurgence at the turn of the century, highlighting important findings, its impact, and future directions of the therapeutic applications of psilocybin.
Mar.	30	Board Meeting
Apr.	4	**Monthly Meeting** featuring a talk by **Alan and Arleen Bessette** on Eastern North American Boletes
Apr.	Early	First **Morel Foray**
Apr.	15/16	**Morel Foray**
Apr.	22/23	**Morel Foray**
Apr.	29/30	**Morel Foray**
May	2	**Monthly Meeting** featuring a presentation by **Gretchen Kuldau**
May	9/10	Last **Morel Foray**
Jun.	6	**Monthly Meeting** featuring a presentation by **Britt Bunyard**
June	TBD	**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.
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**
Aug.	1	**Monthly Meeting** featuring a presentation by **Noah Siegel** on mushrooms of the redwood coast
Sep.	5	**Monthly Meeting:** Mushroom identification workshop
Sep.	7-10	NAMA Northwoods Foray in Cable, WI. Visit **http://www.namyco.org/** for more information and to join NAMA. Only NAMA members may attend this foray.
Sep.	16	Fall Forays Begin
Sep.	28	Board Meeting
Sep.	29-31	MAW's annual **Camp Sequanota Foray** in Jennerstown, PA
Oct.	3	**Monthly Meeting** featuring a presentation by **Rick Kerrigan**
Oct.	7	**Foray** to collect mushrooms for the Mushroom Fair
Oct.	8	**Mushroom Fair:** Annual event where MAW members share their love of mycology with visitors to Brookside Gardens. There will also be a **foray** beforehand to collect mushrooms for the Fair.
Oct.	TBD	**Mushroom Culinary Event:** At MAW's second tasting event of the year, members prepare and eat mushroom dishes. This event sold out last year, so register early! A morning **foray** will precede the tasting.
Nov.	7	**Monthly Meeting:** Speaker TBD and 2018 Board nominations
Nov.	30	Board Meeting
Dec.	5	**Monthly Meeting:** Speaker TBD and 2018 Board elections


Evan Hanusa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Fungi in the News

Thomas Roehl
Newsletter Editor

Editor's Note: This article contains summaries of the biggest fungus-related news stories from late 2016 and the early 2017. Visit the link following each topic below for a closer look.

Psilocybin Trial for Depression in Cancer Patients

Two clinical trials of psilocybin, one from researchers at New York University and the other from Johns Hopkins University, found that psilocybin could potentially be used to treat patients with cancer-related depression. About 80% of the patients involved in the two studies reported decreased anxiety and depression. This effect began immediately and lasted over half a year. All patients also received psychological care throughout that time, so these results cannot be used to support recreational use of the drug. Read more at: **https://www.nytimes.com/2016/12/01/health/hallucinogenic-mushrooms-psilocybin-cancer-anxiety-depression.html**

New York Company to Make Fungus Furniture

Ecovative, a company based in New York, is expanding its range of fungus-based products to include office chairs and desks. The structural components are made from Ecovative's toxin-free version of engineered wood while all other components are grown from a combination of agricultural waste and fungal mycelium. The resulting products are biodegradable and quickly break down when left outside. Ecovative already sells its fungus products as packing materials, but hopes that its furniture will help reduce waste and improve indoor air quality even further. Read more at: **http://www.cnn.com/2016/09/16/world/ecovative-mushroom-furniture/**

Little Brown Bats Develop Disease Resistance

Researchers from the University of New Hampshire and the University of California Santa Cruz discovered that some populations of little brown bats in New York are no longer in decline. Bat populations across the United States have dropped dramatically in recent years because of the disease white-nose syndrome. Analysis of the population data suggests that some little brown bats have developed a resistance to the disease. The mechanism of resistance is not yet known. Read more at: **https://www.unh.edu/unhtoday/news/release/2017/01/09/unh-research-some-bats-develop-resistance-devastating-fungal-disease**

C. albicans Hides from Immune System

Candida albicans, the yeast that causes thrush and other diseases, modifies its cell structure to evade the immune system. According to research from the University of Aberdeen, *C. albicans* does this in two steps. First, the fungus detects the presence of lactic acid, which is naturally produced by human cells. Second, it changes the makeup of its cell surface to evade the immune system. Normally, the immune system recognizes molecules on the surface of the fungus and attacks it. However, once *C. albicans* detects lactic acid, it produces compounds that mask those molecules, essentially hiding itself from the immune system. Read more at: **https://phys.org/news/2016-12-stealth-fungus-thrush-immune-experts.html**

Slime Molds Learn and Teach

Scientists from France's National Center for Scientific Research found that slime molds can learn new skills and share those skills with one another. The researchers first taught the slime molds to ignore bitter but harmless compounds. The compounds were placed between the slime mold and its food. Initially, the cells would avoid exploring the bitter area but they eventually learned the bitterness was harmless and were able to quickly get their food. When these slime molds were allowed to fuse with 'naïve' ones, the naïve slime molds also began ignoring the bitter compounds. This demonstrates a simple form of learning and teaching. The authors suggest that other organisms capable of fusion may also be able to pass on skills using these mechanisms. Read more at: **https://www.washingtonpost.com/news/speaking-of-science/wp/2016/12/30/the-strange-case-of-the-slime-molds-that-can-learn-and-teach-one-another/**

New Cartoonist

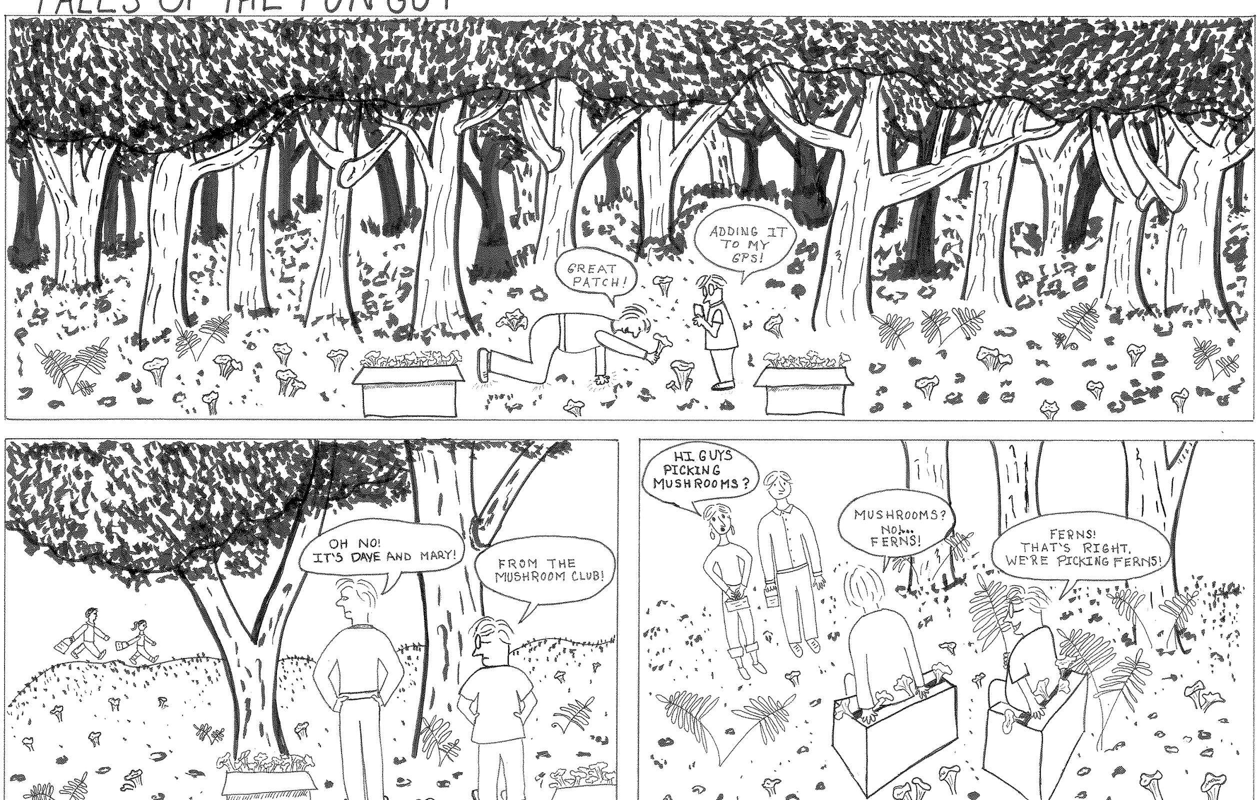
Please welcome our new cartoonist, **Loretta Chi!** Her first contribution is in three parts, but future editions of *Tales of the Fun Guy* will be shorter. **Enjoy!**

Mycelium Improves Bacterial Gene Transfer

A key facet to bacterial adaptation and evolution is the ability to swap genes with one another. This process is called "horizontal gene transfer" and it happens only when bacteria are in close contact. Researchers at the Helmholtz Center for Environmental Research discovered that fungal mycelium increases the rate of horizontal gene transfer among bacteria. Fungal hyphae surround themselves with a thin film of liquid. Bacteria can easily swim through this film, which allows them to access new food sources. This "fungal highway" increases bacterial mobility and improves the chances of two bacteria bumping into one another, thus increasing the frequency of horizontal gene transfer. The researchers suggest this could help create more robust soil communities that might be better equipped to break down harmful compounds such as complex hydrocarbons. Read more at: **http://www.ufz.de/index.php?en=36336&webc_pm=53/2016**

TALES OF THE FUN GUY

TALES OF THE FUN GUY




TALES OF THE FUN GUY
HELLO
14 HOURS? MUST HAVE BEEN A LOT OF AIR IN THOSE TIRES.
PHEASANT WITH CHANTERELLES IN RIESLING?
GREAT!
BUT WHO IS GOING TO CLEAN ALL THOSE...
...MUSHROOMS
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