SPORE PRINTS

BULLETIN OF THE PUGET SOUND MYCOLOGICAL SOCIETY
Number 514 **September 2015**

52nd ANNUAL WILD MUSHROOM SHOW

October 10–11, Bellevue College **Kim Traverse**

Before she was Governor of the State of Washington, before she was Chair of the Atomic Energy Commission, Dixie Lee Ray, PhD, was Director of The Pacific Science Center. And one of the many things she was interested in was Citizen Science. With UW colleague Dr. Daniel Stuntz, she sent out an appeal for those interested in mushrooms to attend a founding meeting at the center. This was the beginning of PSMS.

By the end of that first year, 1964, there were seventy-five families signed up, and they had already held their first two-day Wild Mushroom Show! Particularly interesting in exhibit pictures from those early days (Dixie was the photographer) are a couple of photos of Hollywood's Ginger Rogers looking over trays of mushrooms with Dr. Stuntz.

Every show since then, PSMS has tried to make it "just a little better." Every show has its own personality, but every show is an exciting experience. That is true as much for those who put it on as for those who attend. If it was more fun, it probably wouldn't be legal!

If you have never attended, mark your calendar now. And if you have never volunteered to help out, now is the time to fix that sorry state of affairs. Sign-up sheets will be at the September membership meeting, and you can sign up anytime, from just about anywhere, on the PSMS website. Show posters and postcards will be available at the September meeting also. This is the biggest Society event of the year, and the one that never fails to wow that unsuspecting public when they wander in for the first time. And, Oh, are we gonna have soup this year!

FALL ID CLINICS BEGIN SEPTEMBER 28

Brian S. Luther

The Hildegard Hendrickson ID Clinics start this fall on Monday, September 28. They will be held every Monday from 4:00 to 7:00 pm at the Center for Urban Horticulture (CUH) in the Miller Library atrium area. They will run until sometime in early November. These clinics are free to members and the public, who are invited to bring in fungus collections for identification. The CUH is located at 3501 NE 41st St., south of University Village on the east campus of the UW. Please remember to bring in the entire fungus (don't just cut the specimen off on the stem) because you may be leaving behind important features we need for ID.

PHOTOGRAPHY EXHIBIT ADDED TO FALL MUSHROOM SHOW

Paul Hill

With so many great photographers out in the woods taking great photographs of mushrooms, we have decided to add a photography exhibit to the Fall Show. Start looking through your photographs and thinking about what you might like to see hanging at the fall show. Contact Paul Hill, parehill1@gmail.com, if you have questions or want details.

GOA'S APPETITE FOR WILD MUSHROOMS IS HURTING THE ECOLOGY OF WESTERN GHATS

Chryselle D'Silva Dias

http://scroll.in/, Aug. 13, 2015

Goan Termitomyces vendor.

Every July and August, Goa becomes a vibrant marketplace for muddy mushrooms. Hawkers sell the fungi, wrapped in large green teak leaves, on the pavements of Panjim and on the edges of busy highways, as Goans stop by with wallets on the ready. For them, the seasonal olmi, or wild mushrooms, are well worth the exorbitant price.

Fleshy olmi mushrooms have long been a part of the Goan menu. They are popular as a replacement for chicken in the traditional Goan xacuti, a thick, heavily spiced, coconut-based gravy, especially during the month of Shravan, when many Hindus turn vegetarian. The mushrooms are also eaten fried or served in a soup.

These *Termitomyces* mushrooms are endemic to the Western Ghats, where the thick forest cover and high humidity provide an ideal breeding ground. The mushrooms are picked in the forests of Goa, Maharashtra, and Karnataka and then brought to Goa, where the demand and the prices are high. Most Goans know the flavor, but what they don't know is that the *Termitomyces* grow on termite hills. That's why it has been so difficult to nurture them in artificial conditions.

Termite hills are considered sacred in many cultures, including in Goa. "They are venerated as the spiritual abode of the goddess Santeri by the local people in an age-old prehistoric fertility cult

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CALENDAR

Sept. 8	Membership Meeting, 7:30 pm, CUH
Sept. 14	Board Meeting, 7:30 pm, CUH Board Room
Sept. 15	*Spore Prints* deadline
Sept. 25–27	Field Trip (see PSMS website)
Oct. 3	Field Trip (see PSMS website)
Oct. 6	Membership Meeting, 7:30 pm, CUH (**one week early because of early show date**)
Oct. 10–11	Annual Wild Mushroom Show, Bellevue College cafeteria (**note change in venue**)

BOARD NEWS — Luise Asif

Desperately needed: A Publicity Chair for this year's Fall Mushroom Show. As always with a new location—this year's show is at Bellevue Community College—extra promotion is needed to inform the public of the change in venue. **Membership meeting change:** The October meeting will be one week early—the *first Tuesday*, October 6—so the final details for the show can be addressed. **Show Volunteer signup:** Signup is available on the PSMS website. We need you! **PSMS' Five Year Plan:** The five-year plan developed at the March 2012 retreat is being revitalized and updated. **On-going Projects:** The board is continuing to investigate Planned Giving and CE Credits for teachers taking PSMS Classes.

MEMBERSHIP MEETING

Tuesday, September 8, at 7:30 pm at the Center for Urban Horticulture, 3501 NE 41st Street, Seattle


Daniel Winkler

This month's speaker will be PSMS Vice-President Daniel Winker, who will speak on "Columbia's Mushroom Magic." His talk is based on three visits, accompanied by Colombian mycologist Dr. Tatiana Sanjuan, to Colombia in the search for outstanding mushrooms. Slowly peace is coming to this formerly troubled nation. Located at the intersection of the Andes, the Amazon, and Central America, bounded by the Pacific and the Caribbean, Colombia boasts an incredible biodiversity with a very rich and diverse funga [funga = all fungal organisms]. Lowland tropical rain forests are endowed with strange insect-parasitizing *Cordyceps*, exotic *Xylaria*, and colorful *Marasmius*. In the mountain cloud forest, massive Andean oaks are associated with a range of chanterelles, boletes, amanitas etc., many of which have their southernmost distribution here. High up in the Páramo, fungal diversity is reduced, but Dr.-Seuss-like plant life is mind boggling. Before the Columbia talk, Daniel will talk about the current availability of mushrooms in our area and share a few images of what to look for.

Daniel is the author of field guides to edible mushrooms of the Pacific Northwest and California (Harbour Publishing, 2011 and 2012) and *Amazon Mushrooms* with Larry Evans (2014). He grew up collecting and eating wild mushrooms in the Alps, has been foraging for 20 years in the Pacific Northwest, and volunteers for PSMS as a mushroom educator as well as being Vice-President. Daniel trained as a geographer and ecologist and worked on environmental issues of the Tibetan Plateau. Working in Tibet, he realized that Tibet's diverse mushroom industry, especially *Cordyceps sinensis*, plays a crucial role in rural Tibet, and he has thus has been researching Tibet's ethno-mycology for over 15 years. He has published over a dozen scientific papers on Tibet's ecology and ethno-mycology and is a regular contributor to magazines such as *Fungi*, *Mushroom the Journal*, etc. In recent years many articles integrated his prize-winning photos taken during his vast travels. Through his travel agency "MushRoaming," he organizes mushroom-focused eco-tours to Tibet, the Amazon, Colombia, the Alps, and the Pacific Northwest. He maintains and continuously adds to his web page at www.Mushroaming.com.

Would members whose last names begin with the letters L–Z please bring an edible treat for sharing after the meeting.

IMPORTANT NOTICE: OCTOBER MEETING DATE CHANGE

The date of the PSMS October membership meeting has been moved from the usual second Tuesday in October (October 13th) to the first Tuesday, **October 6th**. The meeting will start, as usual, at 7:30 pm at CUH. We have moved the meeting up a week so that our members can sign up to volunteer for our Fall Mushroom Show, which, this year, will be held at Bellevue College on Saturday and Sunday, October 10 & 11.

ROTTING FUNGUS CREATES BEAUTIFUL, GLISTENING "HAIR ICE"

Elizabeth Goldbaum

Live Science, July 23, 2015

A century-long puzzle over how delicate strands of glistening ice burst through rotting tree branches like heads of hair is closer to being solved.

Gisela Preuß

Hair ice sprouting from a branch.

The strands, called "hair ice," exist only when cold-tolerant fungi are present, and scientists now understand how the fungi can stimulate ice growth.

Alfred Wegener, famous for his continental drift theory, first identified and studied hair ice in 1918. At the time, he suspected the ice formation was linked to the presence of mycelium—the roots of a fungus that live on rotting wood and absorb nutrients, forming a pale, white, cobweb-like coating. However, it wasn't until about 90 years later that researchers found evidence that the fungal roots were vital precursors to hair ice. After treating mycelium-covered wood with a fungicide or dipping it in scalding water, hair ice didn't grow, they found.

"The same amount of ice is produced on wood with or without fungal activity, but without this activity, the ice forms a crust-like structure," Christian Mätzler, a co-author of the study and professor emeritus at the Institute of Applied Physics at the University of Bern in Switzerland, said in a statement.

The fungus helps the ice grow into thin hairs with diameters of just 0.01 mm (0.0004 in.), and helps to keep the strands in this shape over several hours at temperatures close to 32ºF (0ºC), he added.

Researchers blamed the century-long delayed explanation for how hair ice grows on its ephemeral nature and northern range—the glimmering threads grow predominately at latitudes between 45 and 55ºN through countries including Canada, France, Germany, India, Ireland, the Netherlands, Russia, Scotland, Slovenia, Sweden, Switzerland, the United States, and Wales.

"Hair ice grows mostly during the night and melts again when the sun rises," said Gisela Preuß, a biologist at the Wiedtal-Gymnasium in Neustadt, Germany, who captured some of the hair-ice photos for the new study. "It's invisible in the snow and inconspicuous in hoarfrost."

In the new study, Preuß examined samples of dead wood that bore hair ice from the winters of 2012, 2013, and 2014 in forests near Brachbach in western Germany. She looked at the wood pieces under a microscope and found 11 different species of fungi. One species—*Exidiopsis effuse*—appeared in every sample.

"Similar ice formations are known from soil and dead stalks of some plants, but up to now, there is no hint [of] the presence of a fungus in these cases," Preuß said.

The researchers also analyzed the melted hair ice and found fragments of the organic compounds lignin and tannin. Lignin, which is found in vascular plants including land plants like mosses and conifers, makes up about 20 to 30 percent of dry wood and helps give wood its hardness and resistance to rotting. Tannin also occurs widely in vascular plants and protects plants from herbivores, who dislike its astringent taste.

However, certain fungi and bacteria can secrete the enzyme lignase and break down the lignin, causing rot with moist, soft, and spongy bark that looks white or yellow. White rot can enhance the fungi's effects—the brightness of hair ice on wood increases as the wood decomposes, the researchers found, because the decomposed wood is brighter.

Fungus also acts as a hairspray by shaping the fragile ice hairs and keeping the strands in place, while lignin likely prevents recrystallization, which is the conversion of small ice crystals to bigger ones.

The hair ice is also influenced by the structure of the wood from which it radiates, the new study revealed. Tufts can grow outward from a branch, forming a center part much like human hair and can extend straight or curl back toward the branch. The latter radial growth pattern is more common and seems to be an extension of the natural rays that radiate in wood. All the strands grow 10,000 times longer than they are thick.

The researchers also found that the root of the hair ice—called a crystallization nucleus—is likely composed of lignin and tannin. When the air temperature drops sufficiently, water freezes into crystallization nuclei on the wood. Then, the nuclei create a passage for water to seep out of the pores of the wood and extend into ice hairs.

The study was published July 22 in the journal *Biogeosciences*.

ANTS SELF-MEDICATE FUNGAL INFECTION

Daily News, 21 Aug. 21, 2015

Large, dense colonies of social insects like ants and bees can be particularly vulnerable to parasite infections and fungal diseases. One way to manage this might be to ingest otherwise harmful substances to fight the infections, but conclusive evidence of this behavior in insects had been elusive.

Nick Bos and his colleagues at the University of Helsinki, Finland, have now shown that ants choose to eat hydrogen peroxide if they have a dangerous fungal disease—and are more likely to survive as a result.

First, his team demonstrated that hydrogen peroxide is usually harmful for ants of the *Formica fusca* species. They fed them one of two diets—either a simple honey-based solution or the same solution spiked with hydrogen peroxide.

Healthy ants given the spiked diet had a mortality rate of around 20 percent, compared with around 5 percent for those who got the harmless solution.

But when they tried the same thing using ants infected with the fungus *Beauveria bassiana*, the opposite happened. The death rate of these ants fell from around 60 percent for those on the ordinary diet to 45 percent in those given food laced with hydrogen peroxide.

When the ants were offered a choice, the healthy ants tended to avoid the spiked food, says Bos. But the infected ants ate more of the solution containing hydrogen peroxide, and chose their dosage carefully.

When the toxic solution was weak, the infected ants tended to opt for equal amounts of this food and the pure food. When a stronger solution was offered, they only fed on it around a quarter of the time.

FALKLAND ISLANDS MYCOSTAMPS

Brian S. Luther

The Falkland Islands, South Georgia, and South Sandwich Islands are British overseas territories in the South Atlantic. The ownership of the Falklands Islands, however, has long been disputed by Argentina, which claims them as the "Islas Malvinas." In 1982 Argentina attempted a military takeover of the islands, which resulted in British Prime Minister Margaret Thatcher (Britain's "Iron Lady") sending an armada which defeated the Argentinians, but at a high cost of lives on both sides. Technically Queen Elizabeth II is the Head of State, with a Governor residing in the capital, Stanley.

If you're like me and can't live without trees around you, then the Falkland Islands are not where you'd want to spend your life. It is a place of great natural beauty, but the landscape consists mostly of grassland, low shrubs, heath, and moors with no native trees. The perennial herbs and shrubs do provide hosts for many species of mycorrhizal fungi, and there are lots of nonmycorrhizal (purely saprophytic) species as well. There are several publications on the fungi of the Falkland Islands, which currently have 350 documented species, but a complete survey is still needed.

I mentioned in an earlier article (Luther, 2015) that Great Britain has many territories and possessions, most of which have issued postage showing fungi. The Falkland Islands is one of these. For those of you unfamiliar with philately, British stamps, as well as the stamps from Royal Crown Dependencies, British territories, and possessions, will always have either a head profile (left or right facing) of the current monarch on their postage or the Royal Crown with the Latin for the monarch below it. For the current reigning Queen it's EIIR: for Elizabeth Regina (=Queen), the 2nd.

All catalog numbers are from the Scott Postage Stamp Catalogue; M = mushrooms or fungi as the main illustration; FDC = first day cover, an envelope (cover) with the stamps affixed cancelled on the first day of the postage issue and often with a colorful cachet, or envelope illustration, of the same theme; MNH = mint never hinged stamps that are pristine with no gum flaws.

Fungus illustrated stamps from the Falkland Islands.

Issue Date	Cat. No.	Value	Type	Subject
Sep. 14, 1987	469	10 p	M	*Suillus luteus*
"	470	24 p	M	*Mycena* sp.
"	471	29 p	M	*Camarophyllus adonis*
"	472	58 p	M	*Gerronema schusteri*
Oct. 3, 2013	1108	30 p	M	"*Camaophyllus*" *adonis*
Apr. 15, 2014	1114	30 p	M	*Hygrophoropsis aurantiaca*
"	1115	75 p	M	*Hygrocybe* sp.
"	1116	£1	M	*Lyophyllum* sp.
"	1117	£1.2	M	*Coprinus comatus*

Comments

The 1987 set is delightful and has recently become a hot collector's item amongst philatelists, with auction values ranging from $10 to $30 for MNH sets. A reddish orange Mycena shown on Scott 470 in this set is unidentified to species. In their fungal survey from the Falkland Islands, Pegler et al. (1980) do not list any species in that genus.

The FDC for this set shows one large, stylized gilled mushroom in the cancel, as well as six mushroom silhouettes on the cachet, representing the forms of the species illustrated. Enclosed inside the FDC is a small pamphlet that briefly describes what the fungi are and mentions the habitats and plants associated with each of these four species.

Brian S. Luther

Scott 469–472, Falkland Islands, 1987.

Brian S. Luther

FDC for Scott 469–472.

The 2013 stamp is part of a four value set which includes a penguin, duck, and a butterfly and is titled "Colour in Nature (Part II)." This mushroom species has a beautiful purple color, as you can see. Unfortunately, the genus is misspelled on the stamp (lacking the *r*) and should read Camarophyllus. It's highly unusual for stamps from British lands to have spelling errors, because they normally have very careful oversight and review before being printed.

Brian S. Luther

Scott 1108, Falkland Islands, 2013.

Brian S. Luther

For the 2014 set, two of the species shown were identified only to genus. This set also has a lovely FDC, with a stylized mushroom cancel and a gorgeous cachet showing *Camarophyllus adonis*.

Scott 1114–1117, Falkland Islands, 2014.

Brian S. Luther

FDC for Scott 1114–1117, Falkland Islands, 2014.

References

Luther, Brian S. 2015. Fungus-Illustrated Stamps from Great Britain (excluding British Crown dependencies, territories, possessions, etc.). *Spore Prints* 511 (April), pp. 4–6. Online and in color at www.psms.org and on the PSMS homepage website under "Education".

Pegler, D. M., B. M. Spooner & R. I. Lewis Smith. 1980. Higher fungi of Antarctica, the subantarctic zone and Falkland Islands. *Kew Bull. 35* (3): 499–562.

PRESIDENT'S MESSAGE — Kim Traverse

I guess the big news right now is the new location of the fall show. We will be holding our 52nd annual Wild Mushroom Show at Bellevue College this year on October 10 and 11. We are hoping that this location will make all the prep and tear-down much easier. In addition, the spaces we will use are quite nicely close together with a single point of entry and plenty of free parking. Bellevue College is quite easy to get to, adjacent to the I-90 Park and Ride for anyone traveling by bus and also accessible from 148th Ave SE. There will be covered, lighted space for receiving mushrooms, and because it is a commuter college they have a ton of parking for their thirty thousand students and it is free on the weekends. Volunteers will have space to park close to the space for the Friday setup.

Over the years, since our first show in 1962 at the Pacific Science Center, PSMS has held the show in about a half dozen locations. We are pretty adept at doing what needs to be done wherever we are, but we always look for improvements. John Goldman has led the search over the past few years, paying visits to many sites in the area. I think we have a real winner this year. We will have more details on access and parking in the October *Spore Prints* and posted on our website, but mark your calendars now!

Also, because of the slightly earlier show date, we have moved our October membership meeting up a week to October 6—the FIRST Tuesday of the month rather than the second. Make that on your calendars too. The posters and postcards for the show will be available for everyone to take at our meeting September 8—we especially need members from the East Side of Lake Washington to be there to take and help distribute posters! The recent rain has me hoping we might see a mushroom or two before the end of the year. Otherwise, it has been a pretty fine summer.

SNAKE POPULATIONS THREATENED WITH EXTINCTION BY NEW FUNGUS — Wilson Ring

Andrew Jackson

Massasauga rattlesnake.

NEW HAVEN, Vt. (AP) - Hidden on hillsides in a remote part of western Vermont, a small number of venomous timber rattlesnakes slither among the rocks, but their isolation can't protect them from a mysterious fungus spreading across the eastern half of the country that threatens to wipe them out.

In less than a decade, the fungus has been identified in at least nine Eastern states, and although it affects a number of species, it's especially threatening to rattlesnakes that live in small, isolated populations with little genetic diversity, such as those found in Vermont, New Hampshire, Massachusetts, and New York. In Illinois the malady threatens the eastern massasauga rattlesnake, which was a candidate for the federal endangered species list even before the fungus appeared.

It's unclear if *Ophidiomyces ophiodiicola*, the fungus that causes snake fungal disease, was brought to the United States from elsewhere, as was the fungus that causes white nose syndrome in bats, or if it has always been present in the environment and for some unknown reason is now infecting snakes, biologists say.

"I think potentially this could overwhelm any conservation effort we could employ to try to protect this last remaining population," said Doug Blodgett, a biologist with the Vermont Department of Fish and Wildlife who has been studying the state's rattlesnake population for 15 years. "We don't have any control over it. It's just completely out there in the wild."

In New Hampshire, the disease helped halve the population of rattlesnakes—now estimated at several dozen—after it was first spotted in 2006, although it was only afterward that scientists linked the fungus to the decline, officials said.

Vermont's population of timber rattlesnakes is down to two locations near Lake Champlain in the western part of the state with an estimated total population of several hundred.

An Associated Press reporter was allowed to accompany wildlife officials to a rattlesnake habitat on condition the exact location not be revealed out of concern that too much attention could further threaten them. Blodgett led an hours-long search for some of the elusive creatures until he found a pair hiding in a rocky crevice, though it wasn't clear if they were infected. Later, a healthy single snake was found on the forest floor.

The disease can cause crusty scabs and lesions, sometimes on the head.

Jeffrey Lorch, a microbiologist with the U.S. Geological Survey's National Wildlife Health Center in Madison, Wisconsin, said he's been getting reports of snake fungal disease from all over the eastern United States. Not every location is reporting that the disease is threatening snake populations. "It does seem to be a disease that has different effects in different areas," Lorch said.

The fungus poses a greater risk to snakes that reproduce slowly, such as rattlesnakes, which can live up to 30 years, experts say.

In Illinois every year the disease infects about 15 percent of the population of about 300 of massasauga rattlesnakes, most of which are in Clinton County, with a mortality rate of 80 to 90 percent, said Matt Allender, a wildlife veterinarian and epidemiologist at the University of Illinois. The mortality rate in infected timber rattlesnakes is estimated between 30 and 70 percent, he said.

The fungus' impact on the massasauga is expected to play a part in the U.S. Fish and Wildlife Service's determination on whether to list the snake as endangered, officials say.

Fungus-infected rattlesnake. The fungus is similar to the one that causes white nose syndrome in bats.

THIS FUNGUS EATS THE BUTTS OF CICADAS

Helen Thompson

smithsonian.com, July 27, 2015

Periodical cicada broods famously come out of hiding for a few weeks in spring to shed their skin, eat, mate, and die—while ruining a few summer weddings and enlivening some barbecues along the way. During this time, they lay their own eggs, and the 13- or 17-year cycle starts again.

M.J. Raupp

Cicada with broken off butt, exposing a white, chalky mass of fungal spores.

After years of living beneath the soil, teenage cicadas wiggle up through the soil, as Anna Rothschild explains in a PBS Digital Studios video. In that soil, spores of a gnarly fungus *Massospora cicadina* lie waiting for them. The spores infect the cicada's abdomen and spread like an STD as the bugs mate.

Eventually, the fungus splits the bug's abdomen, and its butt falls off, as Rothschild put it. Despite the gruesome image, cicadas don't seem too bothered by it, continuing about their short existence as if losing your butt is totally normal. Perhaps that's no surprise, since Rothschild says the bizarre fungus actually poses less of threat to periodical cicada survival than predators or habitat destruction.

THE FUNGUS THAT GIVES US BEER CAN NOW PRODUCE PRESCRIPTION PAINKILLERS

Katherine Ellen Foley

http://qz.com/, Aug. 13, 2015

Most of the medicines we use today have been derived from substances found in nature, like plants or bacteria. Though we can grow some of these compounds in crops, this can take a long time, and crops are subjected to pests and other environmental hazards that may reduce their viability.

To bypass some of these challenges, scientists have found a way to alter yeast so that it can produce opioids, a class of painkillers, that come from chemicals found in the opium poppy plant. While opioids have a high potential for abuse, the majority of people in the developing world have limited access to them to manage pain.

In a new paper published in *Science*, researchers from Stanford University successfully engineered two strains of yeast to produce opiates: one that made low levels of thebaine, a chemical found in the poppy that can be turned into to these types of painkillers, and one that produced low levels of hydrocodone, a narcotic opioid painkiller.

"When we started this project, people said this was impossible," Christine Smolke, a bioengineer at Stanford and co-author of the paper, told *Quartz*. Usually, yeast takes in sugar and produces alcohol and carbon dioxide—relatively simple molecules—through fermentation. Thebaine and hydrocodone, the latter of which is created from thebaine in a lab, are incredibly complex molecules. Growing either one of these from yeast could cut down on production time for medicinal painkillers, from over a year to mere days.

The production of this genetically modified yeast is nowhere near ready to tackle the market of current opioid production—legal or illegal. When Smolke and her team finally produced hydrocodone from yeast, it was at a rate of 3 micrograms per liter. This yeast would have to produce 100,000 times that amount per liter before it could meet current opiate painkiller demands. Because highly addictive substances like opioids run the risk of being produced and sold illegally, researchers also experimented by fermenting this yeast in home-brew-like settings. They found that outside of the lab, they couldn't produce any thebaine or hydrocodone.

Inside the lab, Smolke and her team had to create and insert genes, or large sections of DNA, into the yeast. These genes instructed the yeast to produce different enzymes, which can manipulate different chemicals in different ways, all of which ultimately led to the production of thebaine and hydrocodone.

She compared the process to detective work: "With advances in DNA sequencing, there's been a lot of a larger consortium effort to sequence different organisms." By the time the unique strain of yeast was complete, it was capable of producing 23 different enzymes, including some similar to those found in different types of poppy, a brown rat, and a type of bacteria.

"It's important to recognize that there's a large unmet global need for both this particular class of medicines and other medicines… [this research] means we can access many times of complex molecules that have a lot of value to us," Smolke said. This research will help to develop other medicines and complex chemicals from yeast, like anti-cancer compounds.

MUSHROOMS PLANTED TO HEAL ROOFTOP SOIL

Mary Slosson

Telluride Daily Planet, Aug. 12, 2015

TELLURIDE (AP) - Right as the sun rises over the steep Telluride-area ridgeline and the shadow line begins to retreat across the roof of the Pandora Water Treatment Plant, nestled along the final switchbacks of Black Bear Road, local mushroom expert Scott Koch digs his hands into the nascent soil of his latest ecosystem rehabilitation project and smiles.

Koch jokingly calls himself the local mushroom man, referencing a centuries-old tradition in European hamlets where mycological knowledge is passed down from generation to generation and visitors to the area have a person to turn to for information about local mushroom varieties, what's edible, what may be poisonous and where to hunt for nature's healthful bounty.

Alas, that tradition never really made it across the Atlantic, and the fine art of mushroom hunting and cultivation is a lost one in most of the United States. But, for reasons unknown, Southwest Colorado has become a hub for aficionados of fungi.

In Telluride, Public Works Environmental and Engineering Division Manager Karen Guglielmone dreamed up the idea of a mushroom roof after one too many days of pulling weeds from the living roof of the local wastewater treatment plant. When the town dug completely through the layers of soil on

Mary Slosson / Telluride Daily Planet

Scott Koch spreads Turkey Tail mushroom spores on the roof of the Pandora Water Treatment Plant.

that roof during a solar panel installation, it drove home that the ground just wasn't healthy. There was something missing.

Enter Koch, along with 200 pounds of mushroom spawn that will eventually—hopefully—blossom into the full versions of the three varieties he planted: Lion's Mane, Turkey Tail, and King Stropharia.

"This goal of this remediation project is to create soils and establish the foundations of an ecosystem so that the plants that we put up here can grow and have a really good chance.

We don't want a big scar on the land. We want something that blends in," he said.

His projects divert waste whenever possible, and this one is no exception.

The aspen wood chips used to increase humidity and create ideal incubation conditions for his mushrooms are a waste product from local arborist companies. He uses burlap bags from a local coffee roaster to help the little mushrooms grow.

And his base soil comes, in part, from leftover soil provided by a local marijuana grower.

The rooftop is part ecosystem remediation project and part science lab. Half of the roof—just over 2,000 square feet of space—has been constructed with care to create ideal growing conditions. The other half has been covered with the soil that tumbles down from the surrounding steep canyon walls: a concrete-like mix of rocks and earth that looks and feels devoid of nutrients. The unaltered side will serve as a control so that the town can conduct long-term monitoring at the site and, if the project thrives, replicate it elsewhere.

"I pour my heart into this kind of thing because I believe in our environment," Koch said, adding that he sees the rooftop soil remediation project as part of a larger goal of healing the local land of mining scars and toxic heavy metal material. "As long as I'm here, I want to do something that helps better the environment of every place I live."

The roof has also been seeded with native grasses and wildflowers, Guglielmone said, to help jump-start getting organic matter into the soil.

"It's wonderful to have a project where it's so easy and it makes so much sense," she said. "We're always looking for these types of opportunities."

The rooftop mushrooms, if successful, will be given space to run through their normal life cycle. They will not be available for harvesting because the water treatment plant is not open to the public—but that doesn't necessarily preclude the lucky few water plant employees from enjoying what may be a fruitful bounty in a couple months' time.

IDENTIFYING GRAPEVINE FUNGI MAY HELP FIGHT DISEASE

Dan Wheat

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PULLMAN, Wash. - Washington State University researchers believe they have taken a step forward in combating grapevine trunk disease in Washington vineyards.

WSU photo

Fungal growth on discolored, cankered wood samples.

Scientists said they have documented seven fungal species that cause cankers in grapevines, more than previously known, and that knowing them and their varying biology and dispersal will allow better, customized management.

The work was done by Leslie Holland who completed her master's degree in plant pathology in June. She worked under the guidance of Dean Glawe, a WSU plant pathology professor who retired in June, and Gary Grove, director of the WSU Irrigated Agriculture Research and Extension Center in Prosser.

Building upon research by Glawe, Holland conducted a statewide survey to gauge how common grapevine trunk diseases are. Fungi infect trunks or cordons through pruning wounds, resulting in cankers that enlarge over time and ultimately kill the plant.

Glawe linked grapevine trunk disease to the fungus *Eutypa armeniacae* in the 1970s when looking at Concord grapes. Wine grapes were not widely grown in Washington then. Holland expanded the research to wine grapes.

Holland analyzed diseased wood and identified canker-causing fungi based on morphological features and gene sequencing. Not only did she discover more fungal species could cause cankers in Washington than was previously known, but she also saw a correlation between vineyard age and symptom incidence.

She found the highest incidence of trunk disease in a vineyard with 33 percent of its vines showing symptoms. This was also the oldest vineyard sampled, with plants from 40–42 years old. The trend continued as she crunched the numbers.

"Washington is at an advantage because the wine industry is young, with most vineyards planted from 10 to 30 years ago, and we have had scientists involved since the beginning," Glawe said. "The predictive value of Leslie's research is substantial, as we are just beginning to see trunk disease become a bigger problem."

Holland plans to continue studying canker fungi on other perennial crops when she begins a Ph.D. program at the University of California, Davis in September. Through sequence analyses, she found that fungal isolates in Washington are similar to fungal isolates in other grape-growing regions of the world, including California, Portugal, and Australia.

Goa *Termitomyces*, *cont. from page 1*

of the earth mother goddess," said Dr. Nandkumar Kamat, a microbiologist, a professor at Goa University, and a leading expert on Goa's wild mushrooms. "The life cycle of these mushrooms has been shown to be an 'ecological magic' for the cult followers in Goa and south India."

Kamat has studied termitophilic mushrooms extensively since 1986 and has documented over 35 varieties. Over the last few decades, the popularity of the fungi has led to a decline in the

cont. on page 8

Goa *Termitomyces*, *cont. from page 7*

number of species sold in the market. Kamat says that in 1986, a random market survey revealed 15 species, but in 2004 barely five species were available. Prices, of course, have increased proportionately, from Rs 5 for 100 mushrooms in 1975 to Rs 450–750 (US $6.85–11.40) for 50 mushrooms this year.

"By overharvesting, we are depriving the termites of their food and also damaging the fragile forest ecosystem," Kamat said. "By removing the mushrooms, you are depriving many species of their food. The mushrooms left over are the ones that the termites collect and use to restart a new food cycle—we cannot interfere with this."

In the past, the mythological lore around goddess Santeri protected the termite mounds—but no longer. The overharvesting of the wild mushrooms prompted the government of Goa to ban the plucking of mushrooms in 1992. The ban was amended in 1993 to be limited to wildlife sanctuaries in the state, though no embargo was placed on the collection of mushrooms for self-consumption of people living within the sanctuaries. The enforcement of the ban has proved to be a problem, with little political support and the high demand making it a lucrative seasonal trade for villagers and forest dwellers.

"We don't allow anything to go out of the sanctuaries," said Prakash Salelkar, Range Officer at the Netravali Wildlife Sanctuary. "The tribals living in the sanctuaries have a stake in the edible plants, which they harvest for their own consumption but not for sale outside."

In Panjim farmers from nearby villages of Taleigao source the mushrooms from vendors in the forested areas. "I got these mushrooms from someone in Mollem," said Laxman, an elderly farmer, who has been selling the fungi for decades, ironically right outside the District and Session court. Mollem is home to the Bhagwan Mahaveer Wildlife Sanctuary, and another elderly vendor, perhaps aware of the ban and its implications, is quick to point out that the mushrooms she is selling are from Banastarim, around 16 km from Panjim.

Despite the ban, the high prices, and the chore of several rinses to get rid of the forest mud, the sales of mushrooms continue to be brisk.

MUSHROOM ASTROLOGY — Bob Lehman, LAMS

Virgo (Aug. 23–Sept. 22): While others go after big, showy, edible mushrooms, you appreciate any mushroom that is a fine example of its species. You may drive other people crazy with the LBMs (little brown mushrooms) you find, admire, and ask questions about. You enjoy making detailed examinations of mushrooms and will be a good taxonomist if your mushroom interest is strong enough. Whereas fire signs (Aires, Leo, and Sagittarius) and Pisces like to identify mushrooms by flipping through pictures, you insist on keying them out. You enjoy edible mushrooms but are more particular than others about their freshness, purity, and flavor. Like Cancer, you are attracted to mushroom cultivation.

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