SPORE PRINTS

BULLETIN OF THE PUGET SOUND MYCOLOGICAL SOCIETY
Number 462 May 2010

RESUPINATE FUNGUS OF THE MONTH: *Tulasnella pruinosa* (Family Tulasnellaceae)

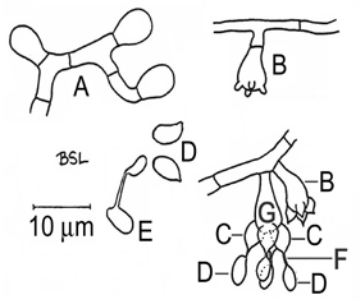
Brian Luther

The resupinate fungus I chose for this month's "feature creature" is a species that has traditionally been treated as closely allied to the "jelly fungi" using the system of classification faithfully followed by mycologists for many decades. It's inconspicuous, and you can be looking right at this fungus and not even notice it (see photo).

B. Luther

Tulasnella pruinosa *(pale gray fuzz) on well rotted log.*

What's really interesting about this fungus is that it has the classic *Tulasnella* multi-cell spore-bearing structure (basidium) with a larger, lower probasidium and (usually) four tear-drop-shaped upper epibasidia from which the spores are born on long slender stalks (sterigmata). Thus, at maturity the basidium as a whole consists of what appears to be five cells, not one. As is typical for this group and also for jelly fungi, individual spores often form their own sterigmata and secondary spores, which is a really cool mechanism for increasing spore production.



Tulasnella pruinosa
A immature probasidia
B probasidium developing epibasidium
C epibasidium
D basidiospores
E basidiospore producing secondary spore
F sterigma
G probasidium

Within the Phylum Basidiomycota, what we used to call "Basidiomycetes," we've traditionally seen two large subgroups in the Hymenomycetes: (1) "Heterobasidiomycetes," with basidia consisting of more than one cell and (2) "Holobasidiomycetes" with unicellular basidia. Some earlier references (for example, Christiansen, 1960) placed this genus in the Heterobasidiomycetes, but others (for example, McNabb & Talbot, 1973) put it in the Holobasidiomycetes. Subgroup (1) has always been considered a more primitive condition, but now DNA research has thrown a monkey wrench into the comfortable status quo that existed for 100 years. These two classification categories are no longer recognized, as DNA research has determined that they are artificial and that the mushrooms within each category are unrelated. Binder et al. (2005) state that the genus *Tulasnella* belongs in the cantharelloid (chanterelle) clade of fungi, even though it's resupinate and has been traditionally considered a Heterobasidiomycete. Unbelievable, but true. Such seemingly preposterous revelations would have been considered absolute lunacy just 20 years ago, but are a direct result of sound DNA studies.

Another fascinating DNA study by Bidartondo et al. (2003) demonstrated that the genus *Tulasnella* actually forms ectomycorrhizae with some trees and is connected to a mycotrophic parasitic liverwort, *Cryptothallus***,** which derives its carbon from the photosynthesizing trees, via the fungus, and not from the fungus associate, as would be assumed. Wonders never cease. Thus, it seems possible that mycotrophic flowering plants may derive their carbon from the photosynthetic mycorrhizal symbionts (trees or shrubs) via the fungal mycorrhizal associate acting as a conduit, but not directly from the fungal symbionts. Refer to my article on Coral Root (*Spore Prints* #460, March, 2010, pp. 5–6).

Classification hierarchy for the genus *Tulasnella*

Phylum Basidiomycota
Class Agaricomycetes
Order Tulasnellales
Family Tulasnellaceae

Collection Description: *Tulasnella pruinosa*, Brian S. Luther coll. # 2010-34-6, on well rotted Big Leaf Maple (*Acer macrophyllum*) in Discovery Park, Seattle, King Co., Washington State, March 4, 2010.

Fruiting body (basidiocarp): fully resupinate, visible only in mass and when moist, and best described as a super thin, translucent or whitish to very pale clay or grayish-violaceous coating or layer on decaying wood when fresh, drying and becoming virtually invisible or unnoticeable on the substrate.

Microstructures: *Hyphal system* monomitic, consisting of a basal layer of cells 2.5–4.0 µm wide, thin-walled, smooth and without clamp connections. Hymeneal layer just a few hyphae thick, from which arise the probasidia. *Probasidia* 8–10 × 5–6 µm, clavate to pyriforme, thin walled, smooth and simple septate at the base (no clamps). *Epibasidia* normally four, but varying from one to four, at first appearing as little bulbous knobs on the probasidium, becoming ovate to pyriforme or lacrymoid (tear drop shaped) and up to 8 µm long, with long very narrow (hair-like) sterigmata extending out at maturity and spores forming on the ends. *Basidiospores* 4.5–5.5 × 2.5–3 µm, ellipsoid to slightly allantoid, hyaline, thin-

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PUGET SOUND MYCOLOGICAL SOCIETY

Center for Urban Horticulture, Box 354115
University of Washington, Seattle, Washington 98195
(206) 522-6031 http://www.psms.org
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EDITOR: Agnes A. Sieger, 271 Harmony Lane, Port Angeles, WA 98362
sieger@att.net

Annual dues $25; full-time students $15

CALENDAR

May 8–9	Field Trip (see website)
May 10	Master Gardener ID Clinic, CUH, 4–7 pm
May 11	Membership Meeting, 7:30 pm, CUH
May 15	Field Trip (see website)
May 17	Board Meeting, CUH, 7:30 pm Master Gardener ID Clinic, CUH, 4–7 pm
May 18	*Spore Prints* Deadline
May 24	Master Gardener ID Clinic, CUH, 4–7 pm
May 28–31	Field Trip (see website)
June 5	Field Trip (see website)

BOARD NEWS

Denise Banaszewski

The password for the members section of the website is changing, so be sure to remember to check the new password above. The online roster has also been updated, and is accessible on the members section of our website. Along with the rest of the website changes, we are hoping to add an "electronic membership" option where members can opt to receive their copies of *Spore Prints* through e-mail, rather than snail mail. More details on that later. Mushroom Maynia! is all set, but if you are planning to volunteer, make sure your name is included on the volunteer list. Also, chairs for Mushroom Maynia! are asked to please bring food for the potluck. We are dropping long distance service from the office phone, given the prevalence of cell phones. Finally, we have several field trips coming up, so be sure to attend, especially if you are a experienced member who can help new members learn morel habitat!

MEMBERSHIP MEETING

Tuesday, May 11, 2010, at 7:30 pm at the Center for Urban Horticulture, 3501 NE 41st Street, Seattle

Our speaker this month is **Dr. Steve Trudel**l. Steve's presentation is titled "The Making of a Mushroom Book," and he will discuss and present photos from his book published last fall, *Mushrooms of the Pacific Northwest*, which was co-authored with our scientific advisor Dr. Joseph Ammirati.

Steve is an affiliate professor in the College of Forest Resources and a lecturer in the Biology Department at the University of Washington. He earned his Ph.D. from the UW's College of Forestry Sciences where his dissertation research explored the use of stable isotope signatures to study the roles of ectomycorrhizal and saprotrophic fungi in nitrogen and carbon cycling in old-growth forests of the Olympic Peninsula. Steve has served as vice president of the North American Mycological Association and was president of the Pacific Northwest Key Council. He often writes for mycological publications, serves as a foray mycologist, and is invited as a lecturer for mycological societies and other nature groups. Many of you know that Steve is also a superb photographer. He has been photographing and identifying mushrooms for over 30 years. He studies their roles in forest nutrient cycling and his interests include the reasons behind and controls on fungal biodiversity. Ultimately he would like to know why there are so many different mushrooms, what are they all doing, and how they all fit in the ecosystem.

Will people with last names beginning with the letters L–M please bring a plate of refreshments to share after the meeting.

LEARNING FIELD TRIP REPORT, MARCH 27

Brian Luther

Last year at the same time we had what we thought was a record turnout of 45 people who showed up, even though it was raining most of the day and there were almost no mushrooms. This year we had a whopping 108 people sign in—an all-time record for this, the earliest of our field trips—and the weather was perfect: mild, no rain, and partial clearing. My youngest (daughter, Arnica, 20), who was on spring break from Western Wash. University, said she watched a bald eagle fly quite low right overhead when she was at a picnic table in the field. This is not surprising, since the river is lined with tall Cottonwoods and Douglas Firs, just what these majestic eagles like for aeries and watching for fish below.

Thanks to Hildegard Hendrickson, who has spearheaded this field trip for about three decades, it proved to be a wonderful outing. Since we had no formal host, both Hilda and I acted as hosts as well. We made a lot of coffee in numerous containers, she brought snacky things, and I picked up several dozen bagels, donuts, and other goodies, along with cream cheeses and OJ. The highlight of the morning treats, however, was Hildegard's fabulous home made raspberry juice from her garden. This is probably the most delicious juice I've ever had. When it was time to clean up and go, there was not a crumb of food to be found, so I'd say the members enjoyed what we brought.

For years we always used the old shelter across the Snoqualmie River, taking the really neat suspension foot bridge, which can be very wobbly, but because they were renovating that shelter a few years ago, it was not available. For the last few years we've been

using the "Barn," a building with much better space and proximity to parking, which did not require hauling several loads across the bridge. Because Hildegard knows one of the people in control of the facility, she was able to secure it for our use free. It would have cost us over $100. Thanks, Hilda!

Hildegard and I each spoke briefly. She first discussed proper attire, safety, and other important points of field trip protocol, then I talked about proper collecting equipment, the field trip format, and then Cottonwoods and Verpas. We split into three groups led by Danny Miller, Hilda, and myself, and others went off on their own, but all converged back at the shelter around noon. Danny also helped with ID.

My group didn't find any Verpas until the very end going back. A member noticed one near the trail, coming out of sand, so we all went into the woods around some very large Cottonwoods nearby and found several others. That's usually the case with Verpa—if you find one, slow down and carefully inspect the surrounding area and you'll usually find more. Finding the first Verpa takes concentration, and once your eyes get acclimated, it's often easier to notice others. Most other groups found at least some Verpas, so it was a successful learning trip.

More than 36 different fungi were collected. Interesting species found included the polypores *Coriolopsis gallica* on Alder, *Trametes hirsuta*, also on Alder, and *Bjerkandera adusta* on Bigleaf Maple. The pretty little *Baeospora myriodophylla,* with a brown cap and amethyst colored gills, was also brought in, as well as the lichenized gilled mushroom *Lichenomphalia ericetorum* (*Omphalina ericetorum*). A magnificent and very heavy specimen of *Phellinus igniarius* was knocked off of a tree and brought in, weighing in at 2½ pounds. Two small specimens of Oyster Mushroom (*Pleurotus ostreatus*) were found, but they were old and past their prime.

If nothing else, it was a great excuse to get out in the woods for a few hours, and I was especially delighted to see so many families with young kids. We have always emphasized that PSMS is a family-oriented society, and it's wonderful to see the kids so enthusiastic. Children love looking for and collecting mushrooms, and it's a great way to introduce kids to our wonderful outdoors and nature, which they will then have a lifelong appreciation and respect for. Also, just maybe they'll get hooked and we'll have contributing members for years to come. As an all volunteer organization, we exist and function only because of the generous time devoted to all aspects of the club by members with diverse interests and talents.

PRESIDENT'S MESSAGE

Marian Maxwell

Finally, it's May and morels! Porcini soon to follow!

You and I have been looking forward to this month since the fall season ended last year!

Early field trips are over, and we eagerly anticipate the "Highlight Event" field trips starting this month. A special field trip task force was formed at the board meeting on April 19 at the request of John Goldman, PSMS Treasurer. This task force will determine ways of improving our field trips to ensure that members (especially newer members) have a quality experience in the field and to ensure more consistent support for the identifiers. Randy Richardson, Brenda Fong, and Patrice Benson have also volunteered for this committee.

Our microscopy class taught by Judy Roger on April 11 was a great success! A thank you to Judy, Dennis Oliver, Dr. Ammirati, and Patrice Benson for their generous donation of time and instruction help during this class. Intermediate ID classes started April 15 and will continue through June 3. Patrice Benson, Hildegard Hendrickson, Daniel Winkler, and Dan Miller are all volunteering their time as instructors.

PSMS website development is proceeding. Denise Banazewski, Peter Truong, Russ Wheelwright, Molly Bernstein, Nik Weisend, Ann Polin, Patrice Benson, Pacita Roberts, and John Goldman are all working toward an electronic membership option with the ability to pay online and update the database at the same time. We thank them for their *many hours* of working together to ensure all necessary requirements are met, as they proceed with a comprehensive plan.

Thank you to Patrice Benson and the Daniel E. Stuntz Foundation and to Joanne Young and The Peg and Rick Young Foundation for inviting PSMS to join with them at Mushroom Maynia! May 2 to promote the establishment of a endowment to fund a permanent curator for the mycological herbarium at the Burke Museum. This herbarium is used in research worldwide, and establishing a curator of this collection will ensure it will continue to be a benefit for mycological research in the future. I will report more as developments occur.

I would like to thank our outgoing board members Jean Zatochill, Jamie and Dennis Notman, and Cathy and Don Lennebacker for their dedication and service on the board for the past 2 years. Thank you, Patrice Benson, for your fine tuned leadership of this organization for the past 4 years and in all that you have done and continue to do on our behalf. It's good to know that you will still be serving on the board as immediate past president as well as education chair. Cathy Lennebacker will be working with John Goldman in book ordering and sales, and Jamie and Dennis Notman will co-chair the cooking and tasting committee at the annual exhibit.

See you at the field trips!

MORELS A LA CRÈME

Patrice Benson

8 oz. fresh morels
1 cup cream
2 oz. butter
Salt, pepper to taste

optional ingredients as desired:

1 Tbs fresh Italian parsley, minced
1 large chopped shallot
½ cup of good, dry, white wine
1 small clove of minced garlic
½ tsp minced fresh herb such as thyme, basil, summer savory or chervil

Heat skillet, add butter and mushrooms. Mushrooms may be whole, sliced lengthwise or crosswise. Sauté for 5 minutes. Add wine if using it and reduce. Add cream and herbs and reduce to desired consistency—less for pasta sauce, more for serving on bread as an hors d'oeuvre. It is also incredibly delicious on grilled chicken or steak.

Tulasnella pruinose, cont. from page 1

walled, smooth, inamyloid in Melzer's reagent or IKI and often seen forming secondary spores.

The spores in this collection represent the low end of the spore size scale for this species in the literature (5–7.5 × 3–4 µm), and all other characters are consistent with *Tulasnella pruinosa*.

I can usually go out and locate several species of *Tulasnella* just about any time I want, by selectively searching for super moist, extra rotten, very soft decomposing hardwood debris. It's normally always on the underside facing the soil, if present. These fungi are fun to find, but it takes a really good eye to see them in the first place. Yes, I can just hear people everywhere saying to themselves—Brian is crazy, how can he get so excited about a virtual patch of nothing on rotting wood? Well, sorry but a certain degree of eccentricity is a prerequisite for being a mycologist.

Bourdot & Galzin (1927), Christiansen (1960), and Hansen & Knudsen (1997) provide good keys, descriptions, and illustrations of the common species of *Tulasnella*. Other studies and revisions have been made by Julich & Julich (1976), Hjortstam (1983), and Roberts (1992, 1993, 1994). Also, Rogers (1932) has a really nice paper describing and illustrating the probasidia, epibasidia, and nuclei during development, which I found useful.

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INTERNATIONAL TEAM SEQUENCES TRUFFLE GENOME

Andrea Anderson

GenomeWeb News, March 29, 2010

NEW YORK - An international research team reported in the early, online version of *Nature* yesterday that they have sequenced the largest fungal genome so far: that of the Périgord black truffle, *Tuber melanosporum*.

When the researchers—from France, Italy, and Germany—compared the genome with those of other sequenced fungi, including another mycorrhizal fungus, they found that the black truffle genome has a distinct genome structure, gene repertoire, and transcriptome.

"It's very strikingly different," lead author Francis Martin, a plant biology researcher with the French National Institute for Agricultural Research, told *GenomeWeb Daily News*, noting that these differences may reflect the fact that *T. melanosporum* belongs to one of the oldest known fungal lineages.

Those involved say the results not only hint at multiple adaptations for symbiosis in fungi, but also provide the foundation for using information in the truffle genome to improve truffle cultivation and certification.

Truffles, which form symbiotic interactions with trees such as oak and hazelnut, are sought after for their edible fruit bodies. At the moment, the researchers explained, the most popular and pricey truffles are the Périgord black truffle and Piedmont white truffle.

The Périgord black truffle grows in basic, limestone soil in southern Europe, Martin explained, as the fruiting body, which matures in December, cannot withstand frost.

While it's possible to inoculate host trees with the truffles, the approach has variable and unpredictable success. Consequently, researchers and producers are interested in the genetics behind the truffle's fruit production, reproduction, and symbiosis with its host plants.

"We would like to get better knowledge of the interaction," Martin said. "To do that, we need more information. We need the genome."

To get this genomic information, collaborators at the French sequencing center Genoscope used the Sanger approach to sequence the 125 million base pair genome of a Périgord black truffle haploid strain called Mel28.

Going into the study, the researchers predicted that the truffle genome would contain many genes, large gene families, and an extensive gene repertoire—features that the team believed to be trademarks of symbiosis based on their sequencing of the fungal symbiont *Laccaria bicolor* in 2008. In contrast, though, the black truffle genome contained relatively few protein-coding sequences: the team identified just 7,496 protein-coding genes.

Using custom microarrays, expressed sequence tag sequencing, and RNA sequencing with the Illumina platform, they were able to detect expression of most of the genes in various truffle tissues.

Just a few dozen transcripts were detected in only the ectomycorrhiza form of the truffle, the fruiting body, or the mycelium. For

instance, the team pinpointed 64 potential membrane transporters that are more highly expressed in the ectomycorrhiza and may help the fungus swap nutrients with its host.

The researchers also found evidence that the truffle genome contains all the enzymes needed to produce so-called truffle volatiles —flavorful compounds that contribute to the truffle's characteristic aroma and flavor. The expression of these genes seems to get ramped up during fruiting body maturation.

"All of the enzymes needed for the main, the major volatiles … all the pathways are there," Martin said. "The mushroom itself is producing most of its aroma."

And in contrast to previous theories that the black truffle might reproduce clonally, the researchers found evidence for two black truffle mating types, consistent with sexual reproduction in this fungus.

Meanwhile, the team's comparisons with other fungal genomes suggest 3,970 predicted truffle proteins are similar to those in *Saccharomyces cerevisiae*, while around 5,600 overlapped with proteins predicted in the fungal species *Neurospora crassa* and *Aspergillus niger*.

Despite its overall size, Martin explained, the researchers found that the black truffle has a small and streamlined genome when it comes to its actual gene content.

Instead, the size and complexity of the truffle genome stems, in large part, from a preponderance of transposable elements in the genome. Some 58 percent of the genome is comprised of these transposable elements, which are particularly common in parts of the genome where genes are scarce.

The overall organization of the truffle genome also appears to be distinct from other fungi. For instance, Martin noted, it shares almost no synteny with other fungi, even in conserved regions of the genome.

Such differences are consistent with the notion that the black truffle belongs to one of the oldest fungal lineages. The team estimates that the lineage leading to *T. melanosporum* diverged from other fungal lineages more than 450 million years ago.

Moreover, distinct features in the black truffle and *L. bicolor* genomes suggest symbiosis may have evolved several times using different molecular toolkits in the fungal tree of life, Martin said.

With the black truffle reference genome in hand, the team is currently taking a crack at sequencing the white truffle genome using Roche 454 Titanium sequencing and Illumina sequencing to fill in the gaps.

They also plan to genotype about 200 black truffle populations in Italy, France, and Spain to try to find DNA fingerprints that can be incorporated into a database to help truffle producers from different regions certify their products, Martin said.

The nose knows!

Other follow-up studies in the works involve using a combination of transcription analyses and mass spectrometry to try to fish out more information about the genes involved in the production of truffle volatiles, he added. The team is also thinking of developing kits to help truffle growers identify truffle mating type.

LIGHTNING REALLY DOES MAKE MUSHROOMS MULTIPLY

Lin Edwards

www.physorg.com/news190356559.html, April 13, 2010

A four-year study carried out at Iwate University in northern Japan on ten species of mushrooms (so far) has shown that for eight of the ten species a bolt of lightning-strength electricity could double the crop yield. The best improvements were found in the popular nameko and shiitake mushrooms. The experiments were carried out by seeding logs with mushroom spores and then applying high-voltage electricity pulses to the logs.

A direct hit by natural lightning would burn and kill mushrooms with up to a billion volts of electricity, so the researchers, led by Associate Professor of Engineering Koichi Takaki, thought the increase in numbers of mushrooms, if it occurred at all, could be caused by exposure to a weakened charge that would travel through the soil after a nearby lightning strike. They therefore used less damaging pulses of electricity.

The experiments showed mushrooms react best when exposed to a ten-millionth of a second burst of electricity at 50–100,000 volts. Under the best conditions the nameko yield was 80% greater than the untreated control crop, while the shiitake crop yield doubled. Takaki said the mushrooms initially decrease the enzyme and protein secretions from the hyphae (tiny filaments that spread under the surface, acting like roots and giving rise to the fruiting bodies such as mushrooms), but then suddenly increase production.

The reason for the reaction is unknown and the subject of further investigations. One of the researchers, Yuichi Sakamoto of the Iwate Biotechnology Research Center, said it is possible the reaction is a response to danger, and the mushrooms react by giving themselves a reproductive boost and increase the number of fruiting bodies so their chance of survival is maximized.

Takaki and Sakamoto think the equipment they used could eventually be adapted for use by commercial mushroom growers.

The effects of artificial lightning are also being studied by Takaki's team on daikon radishes, and by other researchers on beans, rapeseed plants, and some lily varieties. So far the early results look promising.

ROOT FUNGI TURN ROCK INTO SOIL

PlanetEarth online, July 3, 2009
via *Boston Mycological Club Bulletin*, Vol. 1, 2010

Trees help to break down barren rocks into soil, but how does that work exactly? It turns out that tiny fungi living on the trees' roots do most of the heavy work.

The fungi first bend the structure of certain minerals, weaken their crystals, and then remove any useful chemical elements to pass on to their host tree. During the process, the rocks change their chemistry, lose their strength, and in the long-run become soil.

These hard-working fungi are called mycorrhiza and cover the roots of trees like gloves. They are extremely small and thin, but they are everywhere: "it is estimated that every kilogram of soil contains at least 200 km of fungi strands," says Dr. Steeve Bonneville, from the University of Leeds.

Bonneville explains: "Mycorrhiza have a perfect business relationship with plants and especially trees." They help the plant to

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FUNGI ECOLOGY: How Ecosystems Work

Kit Marx

It occurred to me that before digging into the wonderful world of fungi ecology, we should first talk about what ecology is, and a little about how ecosystems function.

(Note: I make an arbitrary distinction between ecology and environmental issues. Ecology concerns natural environments without considering human influences. Environmental issues concern those human influences. There are essentially no environments we have not affected.)

Ecology is the study of how organisms relate to their surroundings, both biotic and nonbiotic (abiotic). The word ecology is derived from *eco-* (Greek: dwelling place) and *-logy* (G: study of).

An ecosystem is supposedly a distinct collection of interacting organisms and physical (abiotic) conditions. No such thing exists naturally. Ecosystems contain internal subgroupings and overlap with surrounding ecosystems. However, in order to focus, we call such relatively concentrated groupings ecosystems.

If you were a conscious fungus (no slight intended), biotic influences that might concern you would include having the right species of tree nearby so you could bond to its roots to obtain food and whether you can disperse your offspring (spores) before a deer eats your sex organs (mushrooms). Abiotic concerns would include whether it's moist enough and cool enough to pop those reproductive organs above ground.

In an ecosystem, what eats what is the trophic structure. Trophic comes from the Greek *troph* (= nourishment). For our purposes, there are two types of organisms: those that make their own food (producers) and those that obtain it other organisms (consumers).

- Plants generate biomass from raw materials. Thus, they are the first type of organism, producers, also called autotrophs (from the Greek *auto* = self). Plants are an ecosystem's first trophic level.
- Animals have to get their nourishment from other organisms. Thus, they are the second type of organism: consumers, also called heterotrophs (from the Greek *hetero* = other). Depending on what they eat, animals are divided into herbivores (Latin/*herb* = green plant, L/*vor* = devour) and carnivores (L/*carn* = flesh).

  Herbivores make up Trophic Level 2. First level carnivores make up Trophic Level 3, and so on up to the top predators, usually no higher than Trophic Level 5. An eagle could be a top predator, Carnivore Level 3, Consumer Level 4, Trophic Level 5. (Do I hear a HUH?! I hope not; but you can reach me via kit@kit-the-naturalist.com.)

Processors are a separate functional group within ecosystems, and have their own trophic structure. They fall into two groups.

- Detritivores (e.g., earthworms and mites): break down small pieces of organic material into organic particles.
- Decomposers (mostly fungi and bacteria): turn those organic particles into raw materials which plants can absorb.

Fungi often decompose rocks and absorb the minerals; but, since they are unable to photosynthesize, they cannot make their own food. Having to obtain nourishment from other organisms, they also are heterotrophs. It is difficult to place fungi at a trophic level. They can't make their own food, so, they have to get it from others.

- From mutual symbioses with living plants = mycorrhizae.
- From dead organic material = decomposers or saprobes
- From live organisms.
  - Parasitic fungi attack plants, animals—and other fungi.
  - Carnivorous fungi capture invertebrates.
  - Pathogenic fungi infect plants and animals.

So what do bacteria, insects, slugs, rodents, deer, humans—and so many other creatures—have in common? We are all fungus eaters (mycophagists, if you're partial to Greek, or fungivores, if you prefer Latin). Gotta go, I'm getting hungry.

P.S., If you visited my Fungi Ecology display at Mushroom Maynia!, I would appreciate your input on how to make it better. I hope to have an improved version at our Annual Show. E-mail me at kit@kit-the-naturalist.com, or look me up at the membership meeting on May 11.)

SCIENTISTS AND WINEMAKERS WORK TO UNRAVEL YEAST MYSTERIES

Daniel Pilkington

winespectator.com, 23 December 2009, via *The Spore Print*, L.A. Myco. Soc., January 2010

New Zealand scientists and winemakers are trying to solve part of the puzzle of *terroir* by researching yeast varieties indigenous to one West Auckland winery.

A study by Auckland University scientists at Kumeu River Estate uncovered close to 100 new varieties of wine yeast, each of which is specifically indigenous to the greater Kumeu wine region and unlike any other strains of yeast in the world, according to lead researcher Dr. Mat Goddard.

He believes this scientific breakthrough could have wide-ranging benefits. "The use of New Zealand-specific wine yeasts may prove a powerful tool to further differentiate New Zealand wine," said Goddard. "They more faithfully reflect the New Zealand sense of place than overseas wine yeasts."

The use of so-called wild versus cultured strains of yeast is a long-running debate for winemakers. Yeasts, the single-cell fungi that ferment grape sugar into wine, come in hundreds of different varieties. Some winemakers prefer to buy commercially cultivated strains and inoculate the grape must with them. The advantage is that these strains usually work efficiently and don't break down in the middle of fermentation.

But other winemakers prefer the yeast strains that enter a winery on the grape skins themselves. While they're more unpredictable in the vat, these yeasts have evolved in the vineyard and produce distinctive local flavors, argue these winemakers. What's more, indigenous yeast advocates believe commercially cultivated strains produce uniform flavors in all the wines they're used in. Winemakers can request yeast strains that will produce particular flavors or aromas. Inevitably, multiple yeast strains end up taking part in a fermentation.

The Auckland study has helped Kumeu River Estate Wines winemaker Michael Brajovich understand the unique microbial world of his vineyards and winery, but the results won't change the

way he goes about crafting his wines. Brajovich has long been a believer in using wild yeasts for his winemaking. After he became disillusioned with commercial strains while studying winemaking in Australia during the early 1980s, an eye-opening vintage in St.-Emilion prompted Brajovich to forgo the use of commercial yeasts from the 1986 vintage on.

And his wines have never tasted better, he says. He believes a commercial yeast strain tends to dominate a ferment, which often leads to a lack of varietal definition and lessens the expression of the vineyard. But subtle wild yeasts seem to let the geography show.

"With wild yeasts, the yeast character retreats a lot, allowing the expression of variety and vineyard," he says. 'This makes the wine much more expressive of it's place. It allows the vineyard to show better. That, and because the yeasts are unique to us, which has been shown through DNA analysis, they are, arguably, part of the *terroir."*

The recent study also uncovered similar, related indigenous yeasts at nearby Matua Valley, five miles up the road. Since yeast cannot travel unassisted, this proves the yeast has been moved via either human contact or bees, he says.

"This proves that the population is not static," Brajovich says. "There is always new generic material coming through."

HALLUCINOGENS HAVE DOCTORS TUNING IN AGAIN

John Tierney

The New York Times, April 12, 2010

As a retired clinical psychologist, Clark Martin was well acquainted with traditional treatments for depression, but his own case seemed untreatable as he struggled through chemotherapy and other grueling regimens for kidney cancer. Counseling seemed futile to him. So did the antidepressant pills he tried.

Nothing had any lasting effect until, at the age of 65, he had his first psychedelic experience. He left his home in Vancouver, Washington, to take part in an experiment at Johns Hopkins medical school involving psilocybin, the psychoactive ingredient found in certain mushrooms.

Today, more than a year later, Dr. Martin credits that six-hour experience with helping him overcome his depression and profoundly transforming his relationships with his daughter and friends. He ranks it among the most meaningful events of his life, which makes him a fairly typical member of a growing club of experimental subjects.

Scientists are taking a new look at hallucinogens, which became taboo among regulators after enthusiasts like Timothy Leary promoted them in the 1960s with the slogan "Turn on, tune in, drop out." Now, using rigorous protocols and safeguards, scientists have won permission to study once again the drugs' potential for treating mental problems and illuminating the nature of consciousness.

Researchers from around the world are gathering this week in San Jose, Calif., for the largest conference on psychedelic science held in the United States in four decades. They plan to discuss studies of psilocybin and other psychedelics for treating depression in cancer patients, obsessive-compulsive disorder, end-of-life anxiety, post-traumatic stress disorder and addiction to drugs or alcohol.

Because reactions to hallucinogens can vary so much depending on the setting, experimenters and review boards have developed guidelines to set up a comfortable environment with expert monitors in the room to deal with adverse reactions. They have established standard protocols so that the drugs' effects can be gauged more accurately, and they have also directly observed the drugs' effects by scanning the brains of people under the influence of hallucinogens.

The results so far are encouraging but also preliminary, and researchers caution against reading too much into these small-scale studies. They do not want to repeat the mistakes of the 1960s, when some scientists-turned-evangelists exaggerated their understanding of the drugs' risks and benefits.

How Fungi Break Down Soil, *cont. from page 5*

get nutrients from the soil and in return they receive part of the carbon produced during photosynthesis.

About 90 percent of tree roots in boreal forests have this symbiotic association with mycorrhiza.

Mycorrhiza play a major role in soil formation, but how do they do it? "We created the first experiment that closely copies a natural system to find out how mycorrhiza help to break down minerals," says Professor Liane G. Benning, the Leeds principal investigator of the project.

Together with colleagues at Sheffield the team planted a Scots pine seedling with the fungus *Paxillus involutus*, a mycorrhiza species. "This is a very common tree–fungus association that occurs naturally in boreal forests," says Bonneville. The tree and fungi were allowed to grow together for about 10 weeks and were then placed in a transparent pot with flakes of biotite, a common rock-forming mineral rich in potassium, iron, and magnesium.

The seedling's roots became covered with fungi, which soon attached to the biotite. After three months, the scientists removed the biotite from the experiment and sampled the crystal along a single strand of fungi-covered root from the tip, middle, and close to the root.

"The first change we observed in the biotite, at the tip of the mycorrhiza, was mechanical stress," says Benning. The fungi can apply a pressure onto the minerals that can be as high as the pressure in an average car tire. This pressure value is "very high" for a tiny organism, but unsurprising to Bonneville: "these fungi evolved to penetrate minerals and rocks and some species are capable of even higher pressures."

As a consequence of the pressure at the tip, the biotite starts to bend and to lose its strength. "Once the crystal structure is weakened, the chemical changes start," explains Benning. The mycorrhiza then proceeds to remove the potassium and other useful nutrients from the biotite, passing them on to the roots and ultimately the tree. Without potassium, the biotite breaks down into vermiculite and ferrihydrate, two minerals common in soils.

The mechanism—bend the structure first, steal nutrients later—is an efficient way for the fungi to break down minerals and at the same time gather essential nutrients for its host tree, write the authors of the report, published in July's edition of the journal *Geology*.

"This is a significant advance on previous simplistic ideas of mineral breakdown," says Benning.

DERIVATION OF FUNGUS NAMES

Agaric: from Latin "Agaricum" and the Greek "Agarikon," called after Agaria, a town in Sarmatia where it grew abundantly.

Fungus: from the Latin "fungus," a cognate or derivative of the Greek "sphoggos" (sponge). The Romans used the term for certain varieties only, not for fungi as a whole.

Morel: from a Teutonic word represented by Old High German "morhila," from which the modern German "morchel" is derived.

Mushroom: various hypotheses as to its derivation. (1) from French "mousseron," generally considered to be from "mousse" (moss) because the species grows in moss or short grass, or is soft. (2) from a combination of the Welsh/Old British "maes" (a field) and "rhum" (a thing that bulges out). (3) from the French "mousche" (from the Latin "musca"), a fly.

Puffball: a corruption of "puck" or "pouk" ball; "puck" is of Celtic origin and means elf, hobgoblin, or demon.

Toadstool: various hypotheses. (1) from the Anglo Saxon "toad" for the animal—toads were regarded as poisonous—and "stool" from its shape. (2) from the Icelandic "tad" (dung). This is Webster's derivation. (3) from the Norse "tutna" (to swell or be blown up). (4) from Saxon "tod," meaning bunch, cluster, or bush. Stool from its shape.

Lynne Elizabeth Elwell
February 11, 1938, to March 20, 2010

We are sad to report that Lynne Elwell, a long-time member of PSMS, died Saturday, March 20, of Amyotrophic Lateral Sclerosis (ALS).

Lynne was born in Kenosha, Wisconsin, in 1938 and moved to Washington State in 1981.

A retired animal trainer for TV and film and a pet groomer for over 40 years, she lived a long and active life: mushroom hunting; climbing mountains; hiking with friends; sailing the great oceans of the world; traveling the world and making friends everywhere she went. She was a wine lover; wonderful pet lover, groomer and teacher; gardener, and friend to any animal she came in contact with during her life. Her gift of gab was with her even when she only had the computer to speak for her.

Our condolences to her family: daughter Barbara Rasmussen of Kenmore, WA, son and spouse Scott and Edna Rasmussen of Kent WA, and brother and spouse John and Grazyna Elwell of Racine, WI. She was a very dear person and will be greatly missed by all who knew her.

Note: The *username* and *password* for the PSMS website have been changed. See the issue bloc at the top of page 2.

Puget Sound Mycological Society
Center for Urban Horticulture
Box 354115, University of Washington
Seattle, Washington 98195

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