SPORE PRINTS

BULLETIN OF THE PUGET SOUND MYCOLOGICAL SOCIETY
Number 568 January 2021

SYMBIOTIC RELATIONSHIP BETWEEN CALIFORNIA OAKS AND MUTUALISTIC FUNGI APPEARS TO PROVIDE A BUFFER FOR CLIMATE CHANGE

Sonia Fernandez

https://phys.org/, Dec. 9, 2020


Wikimedia Commons

Mutualist root fungi extend the reach of plants and trees to nutrients in faraway places.

"Happy families are all alike; each unhappy family is unhappy in its own way." So goes the first line of Leo Tolstoy's *Anna Karenina*. Little did the Russian novelist know his famous opening line would one day be used to describe microbial communities, their health, and their relationships to their hosts.

It's this idea that an unhealthy or stressed host to a microbiome has a more diverse microbiome than its healthy counterpart," said UC Santa Barbara ecologist An Bui, a graduate student researcher in the lab of theoretical ecologist Holly Moeller. The diversity, she said, is a response to variable conditions that may in turn indicate an unstable or stressed environment. "Healthy hosts are probably going to have very similar microbiomes," she said, "while unhealthy hosts are different in their own ways."

Bui and colleagues recently put the Anna Karenina hypothesis to the test in California's Tehachapi mountains as they sought to understand how climate change might affect fungal communities in woodland soil in a future California.

"Fungi are really important for woodland systems," said Bui, the lead author of a study that appears in the journal *FEMS Microbiology Ecology*. "But we don't necessarily know how they will change with climate change."

As the global average temperature rises, forests and woodlands around the world are under increasing threat, she explained.

"It's not just about temperature and rainfall, but also the organisms the trees and plants associate with," she said. Soil fungi have a variety of relationships with woodland plants. Saprotrophic fungi, for instance, decompose dead organic matter, while pathotrophs eat live organic matter.

And then there are the symbiotrophs, which engage in mutually beneficial relationships with their plant hosts via their roots. Attaching to roots and extending threadlike hyphae in every direction underground—the so-called "Wood Wide Web"—mycorrhizae give the woodland tree and plant community access to nutrients from faraway places.

"They get all of their energy in an exchange for carbon from trees and other plants," Bui said. "And then they give their hosts nitrogen and phosphorus from the soil." These fungi provide almost half of a tree's organic nitrogen budget, according to the study, and contribute the bulk of new carbon into the soil.

To get a sense of how warming could affect California's woodland soil fungal community, the team sampled soils at sites along an arid (dry) to mesic (moderately moist) climactic gradient at the Tejon Ranch in the Tehachapi mountains.

"The sites we worked at were a proxy for what we think California would look like with future climate change," Bui said. As one ascends from the warmer, drier base of the mountains into the cooler, moister elevations, the landscape changes with the temperature and relative humidity, giving the researchers a glimpse of what California woodlands might look like as climate change forces them to retract.

Of particular interest to the team were the soils around the oak trees that dot the landscape, where, in addition to the decomposers and pathogenic fungi in the soil, tree-mutualist mycorrhizae create their vast networks. The researchers were interested in how the number of species and their abundance might change between sites.

"As it turns out, the fungal communities are completely different," Bui said. "And the hottest, driest sites have the highest number and the greatest diversity in fungal species." True to the Anna Karenina hypothesis, the trees under the more arid, stressful conditions had the most diverse and dispersed fungal communities.

But, while the larger fungal communities varied from site to site, Bui said, the communities of mutualists within them tended to remain the same, save for small shifts within the mutualist populations to select for traits that could be more useful under the circumstances.

"When we looked at ectomycorrhizae and arbuscular mycorrhizae, those communities were more similar across climactic conditions than the whole fungal community," she said. "So there's a possibility that host association for mutualists at least buffers that shift in community structure the whole fungal community experiences."

If so, the benefit could be reciprocal, according to the researchers. Buffering the fungi from climate change preserves their function, which could, in turn, conserve their host trees' function in the face of a changing California woodland ecosystem.

More work would need to be done to understand how far this buffering effect would extend, but the results are a positive bit of

cont. on page 5

Spore Prints

is published monthly, September through June by the
PUGET SOUND MYCOLOGICAL SOCIETY
Center for Urban Horticulture, Box 354115
University of Washington, Seattle, Washington 98195
(206) 522-6031 http://www.psms.org

CALENDAR

Jan. 12	Membership meeting, 7:30 pm, via Zoom Nominations close
Jan. 18	Board meeting, 7:30 pm, via Zoom
Jan. 19	*Spore Prints* deadline

BOARD NEWS

Luise Asif

Wishing our members the very best for this New Year!

Correction to last month's article relating to the Burke Endowment for a permanent Ph. D-level Research Mycologist position. It is the Young Family Foundation that pledged $10,000 and is partnering with PSMS to provide the $20,000 matching fund for the campaign. Apology to Joanne Young and the Young Foundation for the error.

Pacita Roberts and Marian Maxwell have worked hard to redirect PSMS members and the PSMS board discussion groups from Yahoo to message groups through the PSMS website. Thank you for your hard work.

The Nominating Committee is accepting nominations through January 12. Contact Marian at outreach[at]psms.org. Needed are five trustees who serve for 2 years.

MEMBERSHIP MEETING

Marion Richards

Patrick Leacock

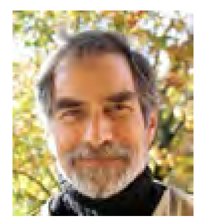
Our speaker for December will be Patrick Leacock, PhD. We will be again offering the meeting through Zoom. The link will be accessible and open to the public on January 12, 2020 at 7:30 pm PST. We will open the meeting around 7:00 pm so folks can mingle. The meeting will be held to 100 attendees, first come. The link will be available on the homepage at www.psms.org.

The topic of the meeting will be "Fungi in the Tree of Life." Our understanding of fungi and relationships of all life continues to yield new insights. Poorly understood mushrooms and molds, once treated as plants, gained status as "The Fifth Kingdom," which is more closely related to animals. We will look at how fungi fit into the total tree of all life and the new Domains and Super Groups that try to organize these relationships. Kingdom Fungi has a diverse array of life forms, and new cryptic micro-fungi have been discovered.

Patrick Leacock is a mycologist documenting the mushrooms of the Chicago region with collections going to the Field Museum of Natural History. He teaches botany and mycology at the School of the Art Institute of Chicago. He assists on forays as a scientific advisor for the Illinois Mycological Association. He started his mushroom activities with the Minnesota Mycological Society before moving to Chicago. Patrick is also active with the North American Mycological Association and served as Voucher Coordinator for 20 years. Visit Patrick's website at www.mycoguide.com.

PRESIDENT'S MESSAGE

Randy Richardson



As we look forward to the end of this long tunnel, some months hence, I optimistically expect a vigorous blooming of energy and enthusiasm. Many thanks to all the members and volunteers who have helped the club get through these times as well as we have; onlookers are impressed at how well PSMS has adapted and carried on.

Here's hoping everyone can stay well, and keep finding the patience to wait this out, so that we can enjoy together re-entering the fungal jungle, seeking and learning, in person once again.

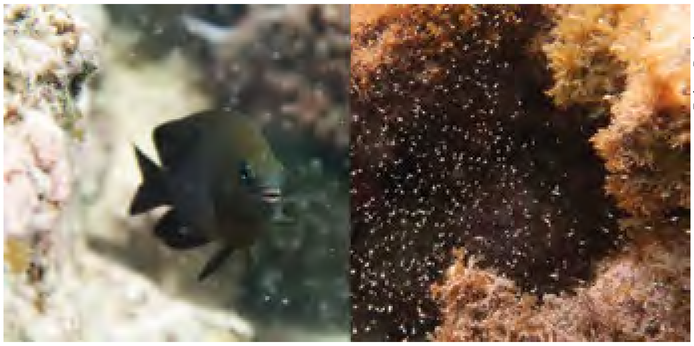
ALGAE-FARMING FISH DOMESTICATE TINY SHRIMP TO HELP RUN THEIR FARMS

William Feeney & Rohan Brooker
https://theconversation.com/, Dec. 7, 2020

Humans are experts at domesticating other species, and our world would be unrecognizable without it. There would be no cities, no supermarkets, and no pets. Domestication is a special kind of cooperative relationship, where one species provides prolonged support in exchange for a predictable resource.

While humans have domesticated various plants and animals, these relationships are surprisingly rare in other species. It's true some insects (ants, beetles, and termites among them) domesticate fungi, but few other examples exist outside the insect world.

In our new study, we describe what appears to be first example of a non-human vertebrate domesticating another animal.



Longfin damselfish (left) have domesticated mysid shrimps (right).

Farming Fish Domesticate Shrimps

On the coral reefs off the coast of Belize, in Central America, longfin damselfish create, manage, and feed from algae farms. We noticed they regularly have "swarms" of tiny crustaceans called mysid shrimps floating above their farms.

We found this unusual, as most farming damselfishes chase away anything that ventures near their farm. We were unsure why these species associated with one another, so we decided to try to find out what was going on.

First, to see whether mysid shrimps and farming damselfish are regularly found together, we ran a series of what's known as "transects." In other words, we conducted a series of 30 meter swims along the reef, and during each one we recorded each time we saw mysid shrimps, as well as whether they were near farming damselfish or other fish species.

We found these mysids were far more likely to be found near farming species, like the longfin damselfish, than other species.

Next, we wanted to know if the mysids specifically seek out their damselfish partners.

So, we collected mysid shrimps from the field, brought them into the lab, and exposed the mysids to water soaked with different things. For example, do they avoid the smell of a predator? Are they attracted to the smell of a farming damselfish?

We found the mysids shrimps were attracted to the longfin damselfish, repulsed by a predator, and indifferent towards a non-farming fish—and to the farm itself.

I Help You, You Help Me

Many fish eat mysid shrimps, so we ran an experiment to see if longfin damselfish provided protection to the mysids when they are in the fish's farm.

To do this, we placed mysid shrimps in a clear plastic bag and placed the bag either inside or outside a farm.

We found that when placed outside a farm, other fish tried to eat the mysid shrimps. When inside the farms, any fish that tried to come close to the bag was chased off by the longfin damselfish. This suggested the mysids seek out longfin damselfish, as they provide mysids with protection from predators.

One question remained: do the mysid shrimps provide a benefit to the longfin damselfish?

Given the damselfish eat the algae they farm, we thought maybe by hovering above the farm, the mysid shrimps waste might act as fertilizer.

To test this, we examined the quality of the algae within farms that did, or did not have mysid shrimps. We also examined the body condition of fish that did, or did not, have mysid shrimps within their farms.

We found that farms with shrimps had higher quality algae, and fish from farms with mysid shrimps were in better condition.

Insight into How Domestication Happens

These different analyses together suggest longfin damselfish have domesticated mysid shrimps. The longfin damselfish provide a safe refuge, and in exchange the mysid shrimps provide the damselfish with fertilizer for their farm.

This relationship is important, because while fantastic research has provided insight into the history of domestication in our ancestors, these things happened in the distant past.

In the longfin damselfish, we can watch the early stages of domestication occur as it's happening.

This is fascinating because it's very similar to the proposed series of events that led to our domestication of species such as chickens, cats, dogs, and pigs.

HOW SOIL FUNGI RESPOND TO WILDFIRE

https://scienceblog.com/, Dec. 10, 2020

In the wake of the 2017 North Bay fires, the golden hills of Santa Rosa, California, were unrecognizable. Smoky, seared, and buried under ash, the landscape appeared desolate, save for some ghostly, blackened—but still alive—oak trees. For Stanford University graduate student, Gabriel Smith, whose family lives in Santa Rosa, the devastation was heartbreaking, but it also offered a unique scientific opportunity: a natural experiment on the effects of wildfires on the microbes that live in soil, which Smith studies in the form of fungi.

So, Smith and his mother spent his winter break collecting soil samples from burned areas near trees in Santa Rosa's Trione-Annadel State Park and Hood Mountain Regional Park and Preserve. For comparison, they also gathered samples from unburned locations.

"I wanted to know how these ecosystems that, on the outside, looked so burned and so destroyed might have been affected at a level that is not so obvious—the soil fungi that I study," said Smith, who is a member of the lab of Kabir Peay, an associate professor of biology in the School of Humanities and Sciences. Most people know soil fungi by their fruit—mushrooms—but there's much more to these organisms, both physically and functionally. Working alongside plant roots and other microbes that live in the soil, soil fungi play important roles in their ecosystems, including helping trees grow and aiding in decomposition.

The research, which was published Dec. 9 in *Molecular Ecology*, focused on two ecosystems in these parks: oak woodland and

cont. on page 6

LEUCOAGARICUS LEUCOTHITES :
A Mushroom to Learn and be Very Cautious About

Brian S. Luther

Leucoagaricus leucothites, showing all stages of development. Increments in quarter inches below.

Leucoagaricus leucothites is commonly encountered in North America and temperate zones around the world, often in fall but also sometimes in spring. It usually grows in grassy areas but can also occur in a variety of other habitats such as gardens, parking strips, agricultural fields, the woods, etc.

In older mushroom books it's called *Lepiota naucina, Lepiota naucinoides,* or *Leucoagaricus naucinus.* Its common names are the Smooth Lepiota or the White Lepiota. It often grows in the same habitat as Meadow Mushrooms (*Agaricus campestris*) and can even be found closely associated with them. This past fall (2020) in the meadows on our property in eastern Washington, we've had both species appearing at the same time.

I feel that the close association of these two species, plus the fact that *L. leucothites* has some outwardly similar features with the genus *Amanita*, were good reasons to describe it here and discuss the differences.

Description

Leucoagaricus leucothites (Vittad.) Wasser

Basidiocarp: *Pileus* 4–12 cm wide, convex at first remaining slightly convex to plane when mature, mostly round in outline when young through maturity and may have a slight obtuse central umbo; color bright white to creamy-white to grayish, sometimes taking on pale buff or avellaneous tones overall with age, uniform or at times with a slightly more richly colored disc; surface dry, finely silky-fibrillose, smooth to very finely granular, or breaking up into fine scales; texture kid-glove like and firm to slightly soft; margin fibrillose to slightly tomentose, normally remaining solid when moist but sometimes splitting radially at maturity based on conditions; unchanging or also staining lightly buff or yellowish when handled; context solid, white, and unchanging, up to 1 cm or slightly more thick; odor nondescript, sweet, "mushroomy," or in some specimens it is reported to be strong or objectionable; taste mild. *Lamellae* (gills) free, white at first, slowly becoming grayish or sometimes pale pinkish and then becoming dingy-brownish in old age or upon drying, close, broad, and broadest toward the cap

Table. Comparison of *Leucoagaricus leucothites*, *Agaricus campestris*, and Similar *Amanita* Species

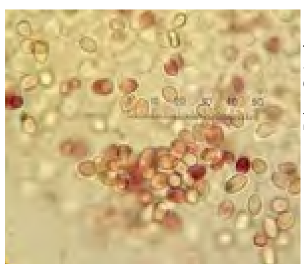
	Leucoagaricus leucothites	*Agaricus campestris*	Similar *Amanita* Species
Cap Color & Texture	Silvery white to gray & finely fibrillose or even slightly scaly in age	Silvery white & finely fibrillose	White, moist, & not fibrillose
Universal Veil Tissue Remnants on Cap	No	No	Often or sometimes
Gills	White, often becoming pale pinkish or brownish in age and drying brown	Pale at first, but going through a distinct pink stage after the veil breaks, but then all purple-brown when mature	Remaining white
Gill Attachment	Free	Free	Free
Spore Color	White	Purple-brown	White
Stem Longer Than Cap Width	Often	No	Yes
Stem Shape	Often enlarged at base	Normally tapering down to the base and often pointed where attached or equal in diameter	Pronounced bulbous base
Stem Color	White	White	White
Stem Removable/Replaceable with a Ball & Socket-like Joint	Yes	No	No
Volva at Stem Base	No	No	Yes
Ring	Distinct, white, movable, & thicker on the outer edge	Slight, white, mostly disappearing when older, not movable	Distinct, often heavy, not movable
Habitat	Often grassy areas, but quite variable (see text)	Meadows, pastures, grassland, grassy areas only	Variable, but always mycorrhizal with living trees
Edibility	Be cautious, avoid—poisonous	Choice	Deadly

margin, edges usually finely fringed and becoming slightly darker; spore print white. *Stipe* 5–12 cm long and 5–15 mm thick, usually narrowest at the apex and enlarging toward the base, sometimes with the base prominently swollen, but also sometimes with a more uniform diameter or only slightly tapering upward, white overall, stuffed/cottony inside, but often becoming hollow at maturity, often very finely pruinose above the annulus (ring), but smooth to slightly silky below, often staining slightly buff or pale yellowish after being handled or bruised; apex at attachment to cap with a distinct ball and socket-like joint that is removable and replaceable; annulus (ring) prominent, persistent, distinctly collar-like, white, slightly firm, with a double-like thickened outer edge, often movable at maturity.

Brian S. Luther

Leucoagaricus leucothites, closeup showing the clean ball and socket stem to cap joint.

Microstructures: *Pileal cuticle* composed of slightly enlarged hyphal cells, with some infrequent scattered pilocystidia up to 100 × 7–10 µm; pileal contextual hyphae 3–15 µm wide, hyaline, thin-walled and smooth. *Gill* (lamellar) trama interwoven. Clamp connections none. Pleurocystidia none. Cheilocystidia 25–40 × 7–12 µm, irregular, mostly clavate but some papillate to mucronate, thin-walled and hyaline. *Basidia* 25–30 × 8–10 µm, clavate, thin-walled and four-spored. *Basidiospores* 7–10 × 5–6 µm, broadly ovoid to somewhat amygdaliform (almond shaped), thick-walled, smooth, hyaline in KOH or NH_4OH, but dextrinoid (=warm to dark brown) in Melzer's reagent or IKI (see photomicrograph), the degree of staining varying from spore to spore, with one large guttule (oil drop), a germ pore, and a prominent apiculus.



Brian S. Luther

Basidiospores dextrinoid in Melzer's reagent, varying from lightly to darkly staining at 1,000×.

Habitat: Saprophytic and non-mycorrhizal in a variety of habitats, but often associated with grass.

Comparison of Look-a-Likes With Free Gills and a Partial Veil

Fortunately, here in the PNW we don't get many pure white *Amanita* species, so the following comparison should be most helpful for people in other areas of N. America.

Some white *Clitocybe* species, notably *C. rivulosa*—the Sweat Producing *Clitocybe* (previously *C. dealbata* var. sudorifica)—often also grows in association with *L. leucothites* in grassy areas, but is a much shorter mushroom, has decurrent gills (gills running down the stem) that are not free from the stem, lacks a partial veil (annulus), and does not have an enlarged or swollen stem base.

Edibility

Opinions on the edibility of *Leucoagaricus leucothites* differ widely. Regardless of their opinions, almost all authorities stress that you must know the differences between this mushroom and similar looking, but poisonous species of *Amanita*.

In the future I'll show just how much opinions of its edibility have changed over time.

Mycorrhizal Buffer, *cont. from page 1*

news for the future of California woodlands. Further studies could broaden the scope to include how these relationships and other adaptations might affect tree health, according to Bui.

"I think this gives us a little bit of hope that the players in this ecosystem that are crucial for the survival of the habitat for many species—like the oaks—might be able to keep doing what they're doing," she said. "Even though we do need to do a lot of work in terms of conservation and mitigation, there's a possibility for them to persist. And I think that's hopeful and exciting."

A truly good book is something as wildly natural and primitive, mysterious and marvelous, ambrosial and fertile, as a fungus or a lichen. —Henry David Thoreau

DOCTORS AT DELHI HOSPITAL SEE CASES OF DEADLY FUNGAL INFECTION IN COVID-19 PATIENTS

https://indianexpress.com/, Dec. 15, 2020

Doctors at Sir Ganga Ram hospital have witnessed more than 12 cases of COVID-19 triggered mucormycosis—which causes loss of eyesight, removal of the nose and jaw bone, and 50 per cent mortality in cases where it affects the brain—within 15 days.

Mucormycosis… is a serious but rare fungal infection caused by a group of molds called mucormycetes which exist in the environment. Mucormycosis mainly affects people who have health problems or take medicines that lower the body's ability to fight germs and sickness.

Dr. Manish Munjal, Senior ENT surgeon at the hospital, said, "The frequency with which we are witnessing the occurrence of COVID-triggered mucormycosis with high morbidity and mortality is alarming. Early clinical suspicion on symptoms such as nose obstruction, swelling in the eye or cheeks, and black dry crusts in the nose should immediately prompt a biopsy and start of the antifungal therapy as early as possible."

The symptoms are face numbness, one-side nose obstructions, swelling of eyes, or pain. The ENT surgeons take samples for culture and start definitive medical treatment which might prevent medical loss.

In one case, a 32-year-old who had recovered from COVID-19 experienced a nagging left-side nose obstruction, which rapidly became an eye swelling within two days, after which he reached out to the doctors. The left side of his face had become completely numb, and he was brought to the hospital emergency room in a partially disoriented and obtunded state.

"His tests revealed the presence of steeply elevated sugar and infection levels, but even more deadly, the presence of a rare killer fungus [in the genus] *Mucor*, which was sampled from his nose debris. An MRI revealed that the infection had already destroyed a significant part of his left side sinuses, eye, upper jaw bone, and muscles, and even had made passage into the brain," said Dr. Munjal.

An extensive surgical debridement was undertaken by a team of ENT and eye surgeons, and the patient had to be subsequently put on life-saving antifungal medication and vital critical care support for more than two weeks.

Soil Fungi Response to Fire, *cont. from page 3*

mixed evergreen forest. As the researchers expected, analysis of dozens of soil samples established that, among the areas that had not burned, the ecosystems contained a different mix of soil fungi. The analysis also showed that, when comparing burned and unburned areas, the oak woodland soil fungal community was less altered by the fires than those in the evergreen forests. This aligns with the fact that oak woodlands depend on regular fire to thrive, whereas evergreen forests are less dependent on fire to survive. The researchers have continued this work by planting seedlings in some of the soil samples— those results will be detailed in a future paper. They are also hoping to find out more about the physiological mechanisms that could explain the responses of the fungi.

"There has been renewed interest in how climate change is influencing the frequency of fires and how that's going to affect fire-mediated ecological processes in California going forward," said Peay, who is senior author of the research. "So it's important to have specific details about how changes in the fire regimes in California, and the West Coast in general, are going to be influencing ecosystems."

Looking Deeper

Oak woodlands benefit from fire to the extent that many parks, including Trione-Annadel, are treated with prescribed burns to keep their oaks healthy. Fire clears leaf litter and dead branches, creates improved conditions for some seeds, and controls insects and pathogens that might otherwise cause disease. Most importantly, fire can prevent other trees—such as those found in evergreen forests—from invading the oak forests. While mature evergreens can survive, and even benefit from, fires, encroaching seedlings may not.

To understand how the 2017 fires altered soil fungal communities in these two ecosystems, Smith and his mother dug up the top 10 centimeters of soil from 12 sites in Trione-Annadel and six at Hood Mountain, with guidance from the California Park Service. While Smith was home for break, the samples had to be temperature regulated.

"We ended up filling not only my parents' fridge but also my grandmother's fridge and my aunt's fridge. We also rigged a top-loading chest freezer to keep the right temperature," said Smith, who is lead author of the research. "There was a great deal of family support that went into this research."

Back at the Stanford lab, Smith and Lucy Edy, a co-term student in earth systems who worked on this project as part of the Stanford Biology Summer Undergraduate Research Program, determined what fungi resided in each sample through DNA analysis. What he found suggests that how fungal communities respond to fire below ground mirrors how other parts of their ecosystems respond to fire above ground.

"There was a much greater difference between the burned and unburned points in evergreen forests than there was in the oak woodland communities," said Smith. "We predicted there would be a difference between the two ecosystems, but the extent of that difference was actually more than we expected."

It will take additional research to understand why this is the case, but the researchers hypothesize that part of the reason may be that the soil fungal community "resets" when it burns. This would mean that the soil fungi associated with the oaks have less time between fires to change from their reset form, and the evergreen soil fungi have longer, leading to the greater differences seen in the soil of burned and unburned evergreen forests.

The Future Forest

For much of the history of studying fungi, researchers had to depend on what they could see above ground, including mushrooms. But increased access to DNA sequencing has opened up the field, helping scientists detail the complex relationships between various soil microbes, plants, and ecosystem functions. Still, many questions remain concerning the effects of microbial diversity in the soil—for example, the consequences of losing half the population of one microbe versus two-thirds or all of it, and the net impact of losing microbes that could cause disease in certain plants in addition to losing microbes that benefit those plants.

"As fire regimes increase in intensity and frequency with climate change, we must understand the ecological responses of these ecosystems in order to determine our necessary responses in relation to them," said Edy, who is a co-author of the paper. "Fungal ecology is perhaps outside the realm of first consideration when people think about the impact of wildfire, but these below-ground microbial interactions fuel and sustain entire ecosystems."

This project, born from terrible circumstances, will likely produce many more studies, like the seedling experiments, and further investigations into how the fungal communities in the oak woodlands withstand fire.

"This was not originally part of Gabriel's PhD project. He had the foresight to recognize that this is not just something that was interesting on a personal level, but also that there's nice intellectual potential here," said Peay. "Works like this can advance our understanding of how the changes we see in the soil might then play a role in changing what future ecosystem types look like."

SCIENTISTS IN SPAIN IDENTIFY OLIVE GENES RESISTANT TO COMMON PATHOGEN

Paolo DeAndreis

https://www.oliveoiltimes.com/, Dec. 15, 2020

A team of Spanish scientists at the Andalusian Institute for Agricultural and Fisheries Research (IFAPA) have identified genetic variations that allow some olive tree varieties to resist Verticillium wilt, [a disease caused by the fungus *Verticillium dahliae*] for which there is no cure.

Their findings could pave the way for the introduction of new olive cultivars that are able to resist the fungus that causes the disease while preserving their productive capacity. Frantoio, Changlot Real, and Empeltre are among the varieties that display resistance to the disease.

Verticillium wilt causes the deterioration of the vascular system in a tree, with severe consequences such as fruit and leaf drops. Over time, many of the affected trees die as a result of the infection.

IFAPA researchers have found a set of genes that seem to act together as a response to the pathogen.

In their study, which was published in *Scientia Horticolturae*, the researchers analyzed 77 different genotypes from cultivated and wild subspecies of the olive, including *Olea europaea* and its subspecies *guanchica* and *cerasiforis*.

Howard F. Schwartz, Colorado State University

(*left*) *Wilt-resistent and* (*right*) *nonresistent olive shoots.*

They found that genes such as TLP1 and PFN2 have shown genetic variations that could be vital to develop future cultivars that are able to resist the pathogen.

As stated in the research paper, they are considered the first markers "associated with Verticillium wilt resistance genes in olives and can contribute to establish a set of valuable markers for the management of germplasm collections and selection process in breeding programs."

Alicia Serrano Gómez, one of the authors of the study and a researcher at IFAPA, told the Andalusian Desqbre Foundation that the results hint "at the need to give birth to a wide collection of genotypes, from multiple sources and with well-evidenced reactions to the Verticillium wilt, with which to confirm the usefulness of the [observed] genetic variations."

Those responses might include physical barriers such as lignin, which prevents the fungus from invading the cells of the plant, or bioactive compounds such as phenols that inhibit the growth of the pathogen.

"The problem is that most of the grown cultivars nowadays are very vulnerable to this disease," Serrano told *Olive Oil Times* in a January 2020 interview. "And those that are a little more resistant are not interesting from an agronomic point of view."

No treatment is currently available to prevent the fungus that causes the disease from attacking the roots and the tissues, which are responsible for transporting nutrients throughout the olive tree.

The fungus can easily be found on cultivated lands and is easily spread further by means of irrigation or crop residuals. That is why scientists believe that farmers will have to adapt to the new practices that are being investigated by the researchers.

"The high persistence of this fungus in the soil and the reduced number of resistant [olive tree] varieties make it necessary to develop new varieties that meet the characteristics of replication and productivity desirable for the sustainability of the crop," Serrano said.

CORVALLIS TEAM WINS AGAINST BAT FUNGUS

https://www.corvallisadvocate.com/, Dec. 6, 2020

Researchers from Oregon State University and the University of California-Santa Cruz recently teamed up to win a U.S. Fish and Wildlife Service National Prize Challenge. The goal? To fight against white-nose syndrome, a lethal fungus that has caused the death of millions of bats in North America.

According to an article by *OSU Newsroom*, the team won $20,000 for their proposal, which presented an aerosol spray that will genetically silence the fungus which leads to the disease.

White-nose syndrome is caused by a fungus (*Pseudogymnoascus destructans*) that often appears as white fluff on the nose and wings of bats. It spreads easily in cold and damp areas and usually infects bats while they are hibernating. The syndrome has been confirmed in 35 states and seven provinces in Canada. In some areas, 90–100 percent of the bats have been killed by the disease.

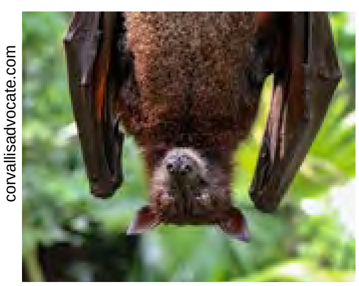
There is no cure for white-nose syndrome, so scientists are working to study it and learn how to control it. The U.S. National Response to White-nose Syndrome is a multi-agency effort led by the U.S. Fish and Wildlife Service that is overseeing much of the research being done worldwide.

The recent challenge was launched by the service's White-nose Syndrome Program to try to develop management tools to combat the disease. Forty-seven proposals were submitted to the challenge, and a panel of 18 experts from academic institutions, federal agencies, and nongovernmental organizations chose the winners based on topics including deployment scale, ease of use, readiness, risk, and resources.

The spray proposed by the research team will help prevent the disease without harming bats, their habitat, or other organisms. It was developed by Oregon State researchers Emily Dziedzic, Jenny Urbina Gonzalez, Jared LeBoldus, Michael Gordon, and Taal Levi, along with A. Marm Kilpatrick from UC-Santa Cruz.

The Director of U.S. Fish and Wildlife Services, Aurelia Skipwith, told *OSU Newsroom*, "White-nose syndrome is devastating native bat populations at unprecedented rates, and this proposed solution from the Oregon State University and University of California team may be just the catalyst we need to give bats across North America a better chance at survival. I thank all of the individuals and teams who joined the challenge, including a high school science club. It demonstrates how people of all ages and backgrounds care about wildlife and want to help conserve species and their habitats long into the future."

Emily Dziedzic, an OSU graduate student, co-led the research alongside post-doctoral researcher Jenny Urbina Gonzalez.



corvallisadvocate.com

"My team and I are extremely excited to be contributing to collective efforts to combat the fungus that causes white-nose syndrome in bats," Dziedzic said. "We greatly appreciate being recognized for our achievements on this front, and the funding will provide an essential boost to help us further our research and accomplish our goals."

The Mushrooms

The red mushrooms
With white spots
Appeared under the pine tree.
I was raised in the city
What do I know about mushrooms?
So in case they were poisonous
I got a shovel and tossed them into the trash
Hoping the fairies could forgive me
For taking away their shade.

—Connie Webb

MUSHROOM BREAD PUDDING **Anne Rosenzweig**

The New York Times Magazine, Nov.14, 1993

Ingredients

1 loaf *Brioche* or *Challah*
1 lb (4 cups) sliced *Mushrooms* (see “Selecting Mushrooms”)
1¼ cups *Heavy Cream*
Pepper to taste
1 TBs minced *Garlic*
4 *Eggs*
¾ tsp + ¾ tsp *Salt*
1¼ cups *Stock* (see “Stock”)
2 TBs *Unsalted Butter*
¼ cup minced *Shallots*
1 cup *Milk*
Butter for the pan and foil
½ TBs chopped *Fresh Thyme*

Selecting Mushrooms

If possible, use half strong flavored mushrooms and half bland mushrooms. Strong flavored mushrooms include fresh shiitake, revived dried shiitake, revived dried *Boletus edulis*, and mature *Agaricus bisporus* (crimini or portobella). Bland mushrooms include button mushrooms (*A. bisporus*), *Sparassis radicata,* and chanterelles.

Stock

Use a rich turkey, chicken, or veal stock. Alternately, reduce the liquid that is left over after soaking dry shiitake or *B. edulis* and use that.

Preparation

Slice the bread ¾" thick, remove the crusts, and toast the slices on both sides. Reduce the stock by half over medium heat. Add cream. Simmer until mixture is reduced to 1½ cups. Whisk milk, eggs, and ¾ tsp of the salt together. Whisk in the reduced stock mixture and set aside. Melt butter, add the shallots, garlic, and thyme and sauté over medium heat until softened (5 min). Add mushrooms and cook until wilted (10 min). Season with pepper and the remaining ¾ tsp of salt. Butter the bottom of an 8½ × 4½ × 2½" loaf pan. (Alternately, to ensure neat removal of the finished product, line the loaf pan with aluminum foil and butter the foil.) Line the bottom of the loaf pan with a layer of bread slices. Top with half of the mushroom mixture. Repeat the layers and top with a third bread layer. Pour the egg mixture over the bread. Cover the pan with plastic wrap and refrigerate overnight. Press the bread down into the liquid. Cover with buttered foil and put in a roasting pan. Pour boiling water halfway up sides of loaf pan. Bake at 350ºF for 1½ hours. Uncover &continue baking ½ hour until set and top is puffed and browned. (Total baking time is about 2 hours.) Serve warm or reheat pan in hot water.

Wishing you the very best in this New Year!

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

RETURN SERVICE REQUESTED

Non-Profit Org.
U.S. POSTAGE
PAID
SEATTLE, WA
PERMIT NO. 6545