SPORE PRINTS

BULLETIN OF THE PUGET SOUND MYCOLOGICAL SOCIETY
Number 474 September 2011

2011 ANNUAL EXHIBIT

Kim Traverse

48TH ANNUAL WILD MUSHROOM SHOW
OCTOBER 15 & 16
AT THE MOUNTAINEER'S
7700 SAND POINT WAY

It's my privilege and pleasure to again serve as chair of our annual show. The Show Planning Committee has been meeting since we have selected our new venue. We're all excited because The Mountaineer's beautiful new headquarters will give us some much needed elbow room and allow us to try out some new things. And since it is quite close to the Old Navy Brig where the show has been held a number of times in the past, we hope that it will not be too hard for people to find.

But with any major change like a new location, we need to be very careful to ensure that everything goes smoothly, and we don't want a larger facility to affect the very personal touch our shows always have.

That's where you can help.

If you have never volunteered for one of the shows you can't imagine how much fun you are missing. PSMS has so many fabulous people to work with, and this is the event where we really get to share our interests and knowledge with the larger public. Two days of satisfying work and plenty of fun. And the potluck in the volunteer hospitality room is not to be missed.

We start setting up the afternoon of Friday, October 14, and mushrooms start arriving around that same time as members out foraging come by to drop off what they have found. Saturday morning we start early and finish setup while the mushrooms get sorted, identified, and arranged in the display trays. We open to the public at noon on Saturday and close for the evening at seven. It takes a few volunteers about an hour to put the mushrooms to bed for the night.

Sunday we open at ten and run until five. Tear-down is fast and furious, and we have to leave the place as clean as we found it.

One of the reasons we have such great shows is the sheer number of volunteers that come out and help. Nothing is so complicated that you can't be of help even if you have never done any of it before. The first year I volunteered, I worked a while at almost every job there was—and if I can do it, believe me, anybody can. Easy and fun—just the way we like it.

There are a great variety of jobs that need to be done—from crowd control and greeting to book sales and mushroom cleaning and pot washing for the cooking demonstrations. This year we will have sign-up capacity on our revamped website as well as sign-up sheets at the September and October meetings.

We have held Annual Exhibits every year starting in 1964, the year PSMS was founded. Forty-eight years of sharing with thousands of people the wonders of the Kingdom Fungi. A great tradition to be a part of.

ANNUAL EXHIBIT ART SHOW: A Call for Entries

Doug & Tambra Birkebak

PSMS is pleased to announce our fourth juried art exhibit as part of the 48th Annual Wild Mushroom Show. This is your invitation to join with local artists to blend your mushroom-centered passion with artistic skills in any media; entries must include a mushroom or fungal motif with enough realistic information to be identifiable to genus. Your artwork must be original and be completed within the last 3 years. Artwork will initially be judged for admittance in accordance with motif requirements, size, and number of pieces based on display space restrictions. Review full prospectus details and entry form on the PSMS website.

First place is $100 plus a one-year membership in the society; second place is $50 plus a one-year membership in the society; third place is a one-year membership.

Deadline for entries is September 15, 2011.

For further questions or assistance, e-mail Doug and Tambra at PSMSART@gmail.com.

Haiku

Ponderosas spire
Mind-sight wanders needled ground
Pine cones morph, morel

—Dory M.

Spore Prints

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PUGET SOUND MYCOLOGICAL SOCIETY

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CALENDAR

Sept. 13	Membership Meeting, 7:30 pm, CUH
Sept. 19	Board Meeting, 7:30 pm, CUH board room
Sept. 20	*Spore Prints* deadline
Sept. 22	Beginner ID Class starts
Sept. 23–25	Field Trip (see insert & website)
Oct. 1	Field Trip (see insert & website)
Oct. 8	Field Trip (see insert & website)
Oct. 11	Membership Meeting, 7:30 pm, CUH

BOARD NEWS

Denise Banaszewski

We will be selling our very old microscopes, and will offer them first to members. We plan to buy some updated microscopes at some point. We have drafted revised bylaws, which must be approved by members in order to go into effect; we will post them to our website the week following the Annual Exhibit. We'll hold a special member meeting to discuss the bylaws prior to the regular membership meeting in November. We'll vote on the bylaws at the December membership meeting. Teddy Basladynski has been working on a redesign of our website to give it an updated look. The functionality will not change, just the user interface. The Board reviewed a Ben Woo grant application from Katherine Galligan and approved funding her research (just over $1,400). We plan to hold the Board retreat (which will include more people than just current board members) in January or February 2012, the goal of which will be to determine long term goals of PSMS.

MEMBERSHIP MEETING

Tuesday, September 14, 2011, at 7:30 pm at the Center for Urban Horticulture, 3501 NE 40th Street, Seattle.

Brian Luther

We start our fall series of speakers with fellow PSMS member Brian Luther. His presentation is titled "A Tribute to Dr. Daniel E. Stuntz, First Scientific Advisor to PSMS."

Brian graduated with a BS in botany (with honors) from the UW where he studied under Dr. Daniel E. Stuntz and continued taking advanced courses there for two more years. He then did postgraduate work at the University of Tennessee studying mycology under Dr. Ronald H. Petersen, where he taught or helped to teach Botany, Mycology, and Biology and conducted his own research on southern Appalachian fungi.

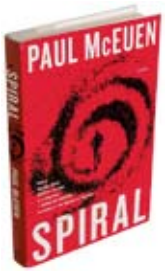
Brian and his wife Pam joined PSMS in 1971, so this year will mark their 40th year as active PSMS members! Brian has chaired the PSMS Identification Committee for almost 30 years and was honored with the Golden Mushroom Award in 1995. Retired since 2009, Brian has recently become even more involved in PSMS, including his responsibility as Field Trip Chairman. He continues to focus his research on his favorite group of fungi—the resupinates—and is involved in a long-term project documenting these fungi on Cypress Island, a Washington State DNR-protected island in the San Juan Archipelago.

In addition to mycology, his interests include collecting and studying mushroom-illustrated postage stamps (mycophilately), old postcards (mycodeltiology), and other paper illustrations of fungi (mycoephemera). He loves digital photography and constantly takes photos of fungi and plants. He also enjoys writing, hiking in summer, studying, and growing native plants, and has a big garden at Eagle Creek. He enjoys lecturing and leading nature walks on subjects ranging from native plants and fungi to intertidal beach life and oyster shucking. In early 2011 Brian and Pam received the Washington State Parks Volunteer of the Year Award. He also worked with Apple programmers in 2009 and 2010 as the mycologist for one of the first mushroom ID apps available for iPads and iPhones called *idMushroom*, an introductory-level program.

BOOK REVIEW

Maggie Iadanza

MushRumors, Ore. Myco. Soc., July/Aug. 2011



Spiral, a new science fiction novel, is a frighteningly plausible account of the role that fungi could play in a terrorist-type attack. There is so much for mycophiles to enjoy about this novel. The author, Paul McEuen, is a physicist in nanoscience research at Cornell. The story involves tiny, scalpel-footed robots, some no bigger than mustard seeds created by Liam Connor, a renowned mycologist who uses these "microcrawlers" to tend his 400,000-specimen fungus farm in the Cornell Plant Pathology Herbarium, fondly known as the Gardens of Decay. Liam was teaching microcrawlers to create ethanol fuel for themselves by, for instance, breaking down old credit cards. He envisioned the crawlers as instruments of good, not micro-electro-mechanical devices with a bad attitude.

What makes this novel so intriguing is not only the impeccable science but that the fungus is not just the bit player that you find in the typical murder-by-mushroom mystery. From the first moment that Liam Connor identifies the mycotoxin poisoning as "maybe *Claviceps purpurea*. Ergot. Or one of the species of *Fusarium*," you suspect that the novel will be challenging. (The poison turns out to be *Fusarium spirale*, a mold that infects corn and cereal substrates.) There is a discussion of "the maximum temperature a fungal spore can take and still be viable," that species of *Fusarium* could live inside the guts of migratory fowl," and that the feathers of birds are ideal for carrying spores. Maggie, Liam's daughter, creates fungal art on a log using *Aspergillus* as living paint.

The story was a little lightweight but the science was detailed and accurate. The future it portends for fungi in combination with nano- and information technology, as well as micro- and synthetic biology, is both intriguing and troubling.

"HOTLIPS" FUNGUS WINS SPECIES NAMING COMPETITION

Patrick Barkham

guardian.co.uk, July 20, 2011

A 12-year-old girl has beaten more than 5,000 entrants to win a competition to invent the best new moniker for 10 endangered and overlooked species lacking a common name.

*Hotlips (*Octospora humosa)

A lurid orange fungus, previously only known by its rather forgettable scientific nomenclature, *Octospora humosa*, was named "hotlips" by Rachael Blackman from Swindon, perfectly capturing the appearance of the moss-dwelling member of a group of fungi called Discomycetes, or "discos."

"They looked a bit like lips and I thought the name suited it really well because of the bright orange colour," said Rachael. "It's exciting to know it will always be called hotlips."

"It's very simple, it's very apt and it's the kind of thing that people will remember, which cuts to the heart of the competition," said Pete Brotherton, head of biodiversity at Natural England and one of a judging panel including *Guardian* columnist George Monbiot and Liz Holden of the British Mycologists Society.

A NEW FIND: FUNGI THAT CAN SURVIVE 100°C

www.indianexpress.com, July 17, 2011

(Bangalore) - Studying 25 samples of leaf litter fungi—microorganisms that degrade fallen leaves—from the Nilgiris, Western Ghats, researchers have found that spores of nine survived 100 degrees Celsius (212ºF).

Among these, the spores of *Chaetomella raphigera* and *Phoma* species survived a two-hour incubation in a drying oven at 110ºC, and those of the *Bartalinia* species survived exposure to 115ºC (239ºF) for two hours.

The team was led by T S Suryanarayanan, Director of the Vivekananda Institute of Tropical Mycology (VINSTROM), Ramakrishna Mission Vidyapith, Chennai.

The fungi are among the most heat-resistant eukaryotes (organisms with a membrane-bound nucleus) on record, he said. They have been named "Agni's Fungi" after the Hindu god of fire.

GREEN BURIAL PROJECT DEVELOPING CORPSE-EATING MUSHROOMS

Paul Ridden

various sources, July 29, 2011

Spore-laden burial suit.

As part of the Infinity Burial Project aimed at getting people to accept and embrace their own mortality, visual artist Jae Rhim Lee is training mushrooms to decompose human tissue.

Lee is experimenting with two kinds of common mushrooms (shiitake and oyster mushrooms) that can be adapted to grow on the artist's own collected hair, nails and skin. She's built a tarpaulin-covered mobile laboratory to cultivate and fine-tune the tissue-digesting fungi, and has also developed a prototype of a spore-laden body suit that the dearly departed would be wrapped in while the mushrooms do their work. This would be used in conjunction with a special spore-slurry embalming cocktail to break down the body's organic matter and clean out the accumulated toxins, producing a nutrient-rich compost.

Special make-up based on the spore slurry is also being considered that will quickly break down and assist the decomposition process.

The project is aiming toward the development of a natural burial system which will facilitate decomposition of the body, remediate accumulated body toxins, and deliver nutrients to plants in the surrounding area.

A group called the Decompiculture Society has been formed to support the project. The group is made up of such people as green burial providers, health-care workers, and curious individuals.

FUNGI DISCOVERED IN DISHWASHERS

Mel Borup Chandler

www.ksl.com, Aug. 15, 2011

Researchers took samples from the rubber seals of home dishwashers in 101 communities. The majority of the samples came from Europe via researchers at the University of Ljubljana in Slovenia. The study later expanded to include samples from North and South America, Israel, South Africa, Far East Asia, and Australia. Four of the six U.S. samples, which all tested positive for fungi, came from California and two from Utah.

In the study, 62 percent of the dishwashers tested positive for the fungus genus *Aspergilla*, and 56 percent tested positive for *Exophiala*, a bacterium that colonizes the lungs of people with cystic fibrosis or compromised immune systems, usually in hospitals and health care institutions. Other fungi identified were *Candida*, *Magnusiomyces*, *Fusarium*, *Penicillium*, and *Rhodotorula*, which were reported only occasionally. However, the black yeasts *Exophiala dermatitidis* and *Exophiala phaeomuriformis* were frequently isolated. In some cases more than one fungus was identified in the same place or nearby.

The intent of the study was not "to scare people with dangerous fungi in your household," said G. S. de Hoog, one of the principle researchers and a professor at universities in Amsterdam, Beijing, and Guangzhou. "These fungi occur worldwide and apparently are very common. They occur in Salt Lake City just as anywhere else. But there is no danger at all for normal individuals; the number of infections is very small, even in the immunocompromised.

RESUPINATE FUNGUS OF THE MONTH: The *Athelia epiphylla* complex ©Brian Luther

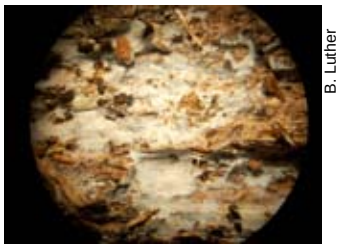
The genus *Athelia* is characterized by a basidiocarp with a very thin, usually white, easily removable pellicle, or skin (pellicular) and by a characteristic candelabra-like, or open airy branching arrangement of the hymenial and subhymenial hyphae, often with right angles forming in the subhymenial area.* This loose openness is due to fewer, widely spaced hyphae and a restricted number of primordial basidial cells which, unlike in most resupinates, form only in terminal clusters (Eriksson & Ryvarden, 1973, p. 96). Clamp connections may be present or absent. Other identiying characteristics are short basidia, smooth, inamyoid spores, and the absence of rhizomorphs (Eriksson & Ryvarden, 1973).

Microscopically, the genus is easy to observe because the tissue in the fruiting bodies is so open that slide mounts readily show all features. Thin sections or other special micro-techniques needed for viewing typical, more dense fruiting bodies are not required.

Description of Collection

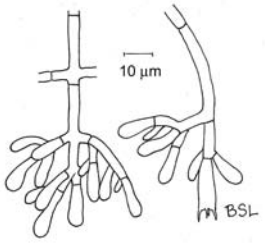
Athelia epiphylla Pers. (complex)
Brian S. Luther coll. # 2010-34-9.
On soft, well rotted Western Hemlock (*Tsuga heterophylla*) wood, in mixed conifer/hardwood forest, Discovery Park, Magnolia, Seattle, King Co., Washington. March 4, 2010.

***Basidiocarp*:** Resupinate, white, drying creamy-white, forming small to large patches, very thin, and pellicular, soft, cottony and easily removed from the substrate; margin diffuse, thin, and byssoid (finely cottony). (Refer to photomicrograph.)

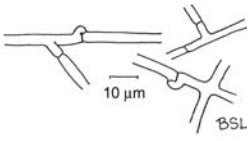


Athelia epiphylla,
7.5X view under dissecting microscope.

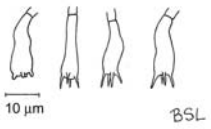
***Microstructures*:** *Hyphal system* monomitic, the hyphae loosely interwoven; hymenial hyphae 2–5 µm wide, hyaline, thin-walled, without clamp connections (simple septate), and sometimes having crystalline incrustations; subhymenial and subicular hyphae similar, except slightly thicker walled and having clamps on some of the septa. *Cystidia* none. *Basidia* 14–21 × 5–6.5 µm, clavate, hyaline, thin walled, without a basal clamp connection, borne in clusters on terminal or lateral hyphal branches; sterigmata four, up to 5 µm long. *Basidiospores* 5–6 × 3–3.5 µm, ellipsoid, hyaline, smooth, thin walled, and inamyloid; often seen in clumps of two or more. (Refer to line drawings.)



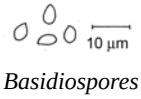
Hymenial and subhymenial hyphae showing candelabra formation of basidia.



Hyphae



Basidia



Basidiospores

*The term athelioid is in reference to this genus and means that a fungus forms a thin, detachable membrane-like basidiocarp (Hansen & Knudsen, 1997).

Comments

Athelia epiphylla spores range widely in size and shape, and this (and other characteristics) was used by Julich (1972) to segregate a number of new species from this complex. For a discussion of this complex and its segregates refer to Eriksson & Ryvarden (1973), who provide eight pages of line drawings showing the degree of variation seen in this species complex (pp. 114–121). Treatments of *Athelia epiphylla* and the genus *Athelia* are also given by Eriksson (1958), Christiansen (1960), Lindsey & Gilbertson (1978), and Julich & Stalpers (1980).

The basidiospores of my collection measure on the low end of the range for the *Athelia epiphylla* complex, matching more closely those of *A. decipiens*. However, that species lacks clamped hyphae, and the collection reported here has frequent clamps on the subicular hyphae. Eriksson & Ryvarden (1973, p. 111), however, mention that some clamps were seen in collections identified as *A. decipiens* by Julich. In their description of *A. decipiens* Bernicchia & Gorjón (2010) state that "all hyphae with simple-septa." The complexity of the variability never seems to end.

I usually find *Athelia epiphylla* on conifer wood, but it is also known to occur on hardwoods as well as on a great variety of other forest debris such as duff and old leaves. This species is also known to grow on post timber harvest Subalpine Fir (*Abies lasiocarpa*) foliage, specifically under snow (psychrophilic conditions) in winter (Larsen et al., 1981).

Oberwinkler (1970) found that *A. epiphylla* can parasitize unicellular green algae, and thus it is considered a lichenicolous fungus. The USDA website http://plants.usda.gov/java/profile?symbol=ATEP treats this fungus as a lichen. I have never personally found this species associated with algal growth.

Ginns & Lefebvre (1993) list 20 species of *Athelia* (and two varieties) for North America, and Ginns (1998) says there are 21. Ginns & Worrall (1999) provide a key to the species of *Athelia* known from Alaska and the Yukon Territory, but *Athelia epiphylla* is not included. Apparently it does not occur in that region.

Ginns & Lefebvre (1993) document the following four species from Washington State: *Athelia arachnoidea* var. arachnoidea, *A. decipiens*, *A. rolfsii*, and *A. salicum*. It appears that my collection is the first reported from Washington State.

Similar Genera

Other genera that look similar include *Confertobasidium* (as treated by Julich (1972) and Eriksson & Ryvarden (1973)), which is athelioid but has dark brown pigmented basal hyphae and rhizomorphs. Although it superficially resembles *Athelia*, it is in an entirely different order and family and thus totally unrelated (Larsson, 2007). There is also a problem with the type specimen designated for that genus, and Bernicchia & Gorjón (2010) do not recognize it. *Athelopsis* differs by having distinctly "stalked" basidia (Bernicchia & Gorjón, 2010), a more dense arrangement of basidia, and a more highly colored basidiocarp. *Amphinema* is also similar, but has characteristic hyphoid cystidia. *Byssocorticium* has byssoid basidiocarps which are normally bluish as well as thick-walled spores. *Leptosporomyces* is very similar, but usually has smaller spores, always has clamped hyphae, and can have dark colored basal hyphae. *Fibulomyces* is another segregate of *Athelia* proposed by Julich (1972) and treated by Eriksson & Ryvarden (1975) and Breitenbach & Kranzlin (1986), but its delimitation is seriously in question and the genus is not recognized by Bernicchia & Gorjón (2010). Larsson (2007) has shown that

some of these genera are polyphyletic (i.e., derived from different ancestral stocks). It appears that an exhaustive DNA comparison of all these taxa is necessary to sort them out.

A DNA study by Larsson (2007) places *Athelia* in the Family Atheliaceae in the Order Atheliales.

Classification Hierarchy (partly based on Hibbett, 2006)

Kingdom Mycota
Division Basidiomycota
Subdivision Agaricomycotina
Class Agaricomycetes
Subclass Agaricomycetidae
Order Atheliales
Family Atheliaceae
Genus *Athelia*
Species *epiphylla*

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MARVELOUS DESTROYERS: THE FUNGUS-FARMING BEETLES

Brandon Keim

www.wired.com/wiredscience, July 27, 2011

Ecological catastrophes are unfortunate. But they can be utterly fascinating, too.

Witness the spread of so-called bark and ambrosia beetles, a collection of 7000 species whose expansion beyond their native ranges threatens trees around the world.

It's not the beetles' fault, of course. They've simply happened upon a brilliant life strategy: Rather than eating bark, which tends to be full of toxins produced by trees to discourage predation, they eat a fungus that eats bark. It's one of the animal kingdom's greatest and most unappreciated symbioses.

"You know how famous leafcutter ants are because they grow fungus? Those groups evolved this just once. In the bark beetles, there are at least 11 independent emergences," said biologist Jiri Hulcr of North Carolina State University. "Go into the rain forest in South America, and you see the power and diversity of these fungus farmers. You'll barely see a tree without sawdust falling off. That's the fungus farmers at work, drilling through the trees and planting their fungus gardens."

Jiri Hulcr

A granulated ambrosia beetle inside a tree. The white surface is fungus. To the right are eggs.

Every group of bark and ambrosia beetles has its own unique collection of fungi, carried in specialized pockets on their bodies, in their armpits, and on their backs and in their mouths, always ready to be seeded. "Chop a beetle's head off, grind it up, spread it on agar and you will see the most marvelous organisms growing from it," Hulcr said. "Those are the fungal symbionts. And they are virtually unknown."

The number of people studying the beetles could be counted on two hands, said Hulcr, who reviewed what's known about them in a paper published July 13 in *Proceedings of the Royal Society B*. That's not particularly surprising. Little incentive has existed to study the creatures, which for all their diversity were traditionally united by a habit of feeding on dead rather than living trees. They were important, but also innocuous and relatively inconspicuous.

Leafcutter ants are famous for farming fungus. That ability arose just once in ants. In beetles, it evolved 11 separate times.

All that changed when bark and ambrosia beetles started making long-distance trips from the locales in which they evolved.

cont. on page 6

Fungus Farming Beetles, *cont. from page 5*

The first known incidence of a bark beetle attacking living trees involved a species called *Scolytus multistriatus* and its fungal symbionts *Ophiostoma ulmi* and *Ophiostoma novo-ulmi*. They're better known as the timber-import-riding agents of Dutch elm disease, which in a few mid-20th century decades almost completely eradicated the majestic trees from North America and Europe.

Since then has come the redbay beetle, an east Asian native first found in Georgia in 2005. It has a taste for trees of the *Lauracae* family, of which avocado is one. If redbay reaches avocado-farming regions, the damage will be immense. Another tree-killing beetle is afflicting poplar plantations in South America and Europe. Another has caused Mango Sudden Death Syndrome. A fungus that apparently jumped to a native beetle is responsible for a disease that's killing off oak trees in Japan.

These are likely the tip of the iceberg. Many invasions are just now being identified, and haven't yet been described in scientific literature. Nobody knows why the beetles are suddenly attacking living trees, but Hulcr suspects it's simply an unfortunate coincidence, an evolutionary mismatch in which beetles are confused by the odor of unfamiliar trees. They think living trees are actually dead. Then the trees, unaccustomed to such attack, have either no immune defense or an exaggerated one. Like humans exposed to an unfamiliar bug, they overreact and destroy themselves.

What can be done? Not much, said Hulcr. Even if, as appears to be the case, only a miniscule fraction of foreign beetles end up causing damage, that's enough. After all, as those 7,000 species of bark and ambrosia beetles are transported around the world, there are nearly unlimited opportunities for mismatch. According to pest surveys of shipping containers at U.S. ports-of-entry, bark beetles account for 58 percent of all intercepted insects. Stopping them is practically impossible, and just a single beetle can be enough to spawn an invasion.

"Another amazing feature of these beetles is their amazing reproductive strategies," Hulcr said. Females are often capable of self-fertilization, producing fresh generations of offspring in the absence of a mate. They don't even need to bother with sons, but may have only daughters, which thanks to their rich fungal diets are ready to reproduce themselves in less than two weeks.

On the subject of fungi, Hulcr is eloquent. "They smell like white fruit. They look like puffy clouds. Sometimes they look like brown sludge. They often taste like mushrooms. So no wonder the beetles like them," he said. Asked whether he'd tasted the fungus himself, Hulcr said yes. "Wouldn't it be fascinating to grow beetle symbiotic fungus on a large scale, so we could turn wood into fruit? There are so many opportunities. This is one of the most amazing systems out there. This is so cool and it's so unexplored."

ALASKA'S ORANGE GOO IS FUNGUS, SOME MYSTERY STILL REMAINS

IBTimes Staff Reporter

International Business Times, August 21, 2011

A mysterious orange goo found on the shore of a remote Alaska village earlier this month has been identified as fungal spores.

The National Oceanic and Atmospheric Administration issued a news release on Thursday stating that the orange goo is consistent with spores from a fungus that causes rust, a plant-only disease that leaves a rust-like appearance on leaves and stems.

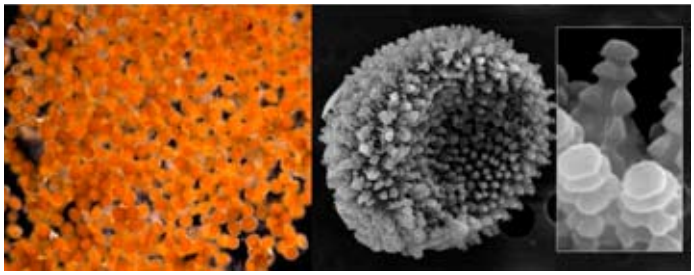
Whether the spore is among the 7,800 known species of rust fungi is still unknown, NOAA said.

"The spores are unlike others we and our network of specialists have examined," said Steve Morton, a research oceanographer with the Charleston lab, in a news release. "However, many rust fungi of the Arctic tundra have yet to be identified."

The goo was found at the edge of Kivalina, an Inupiat Eskimo community at the tip of a barrier reef on Alaska's northwest coast. It quickly disappeared, but many of the 347 residents in the village are still worried whether there will be any long-term effects. That there is still some mystery to the identified fungus, may do little to ease those worries.

City administrator Janet Mitchell has said those fears will only intensify with the latest analysis, as it didn't include toxicity tests, according to the *Washington Post*. Mitchell is also worried about the community's dwindling reserves in village water tanks that will need to be topped off, the paper added.

"We are going have more concern from the public," she said. "If I'm concerned, then there will be others with concerns."



NOAA

Left: Spores of the orange substance as seen last week. Center: A single "uredo"-spore examined up-close by a scanning electron microscope. Right: Detail of its unusual spines.

FUNGUS CAN BREAK DOWN PLASTICS

Kristen McCrae

CNN, August 4, 2011

When it comes to plastic pollution, our society has asked everyone—scientists, environmentalists, and the government— to clean up the mess we've made. Through recycling initiatives, plastic-bag bans and fees, and alternatives to plastics altogether, we still haven't come close to solving the problem…perhaps until now.

The solution might have been discovered with a fungus in a laboratory Petri dish.

Pria Anand was a student in Yale University's class of 2010 whose passion for the environment made her want to make a difference. Anand wanted to find out if there was something in nature that could decompose plastic. She began experimenting with dozens of species of fungi from the Amazon, but she graduated before she could finish her work.

Jonathan Russell took over for Anand but soon he was beginning to think maybe it just wasn't possible. One day, as he casually walked into the lab he says his eyes locked on the Petri dish containing his experiment: the plastic was gone. He'd found what they'd been looking for.

The Yale students had discovered that *Pestalotiopsis microspora* fungus can break down plastic. It's a species of fungi that can be

found in many regions of the world and can decompose polyurethane, a common plastic that is used to make things like insulation, synthetic fibers, plastic for electronics, and sealants.

The fungus was 10 days old when the experiment started and in only a matter of days, he says, it had significantly decomposed about a quart size amount of the plastic.

The study found that several species of fungi were able to at least partially decompose polyurethane, but this one was the only fungus able to do it in water without oxygen, one of the most challenging environmental conditions.

Scott Strobel, the Yale biochemistry professor who instructed Anand and Russell during these experiments, says because of this discovery, the future looks promising for all types of plastic pollution. He says fungi's potential to break down man-made materials could be endless, along with its possibilities in medicine and other fields of science.

However, Russell warns that this is not the ultimate solution to solving plastic pollution. "I don't want it to be broadcast as the cure-all to pollution, but it's a modest step towards a very important goal," he says.

The full study will be published in the September issue of the *Journal of Applied and Environmental Microbiology*.

Dr. Ming Tien, a biochemist at Penn State University, says he experimented in the past with using fungi for decomposition. He points out "the question of whether these microbes can be used in the future is an engineering challenge. It's a big leap to go from the test tube to the field."

Back in Strobel's classroom, one of his students is working to find an organism that biodegrades Styrofoam. Strobel says the current crop of students is interested in seeking out more solutions like these and that they'll continue to make discoveries like Russell.

Today, Russell is working on his Ph.D. in molecular biology at Harvard. He's encouraged that other students are taking an interest in environmental solutions.

"Growing up in a world where pollution is going to be a big issue in the future, coming up with creative ways to tackle it, gets me excited," Russell says. "I only hope that more people will take this on and get interested in it in the future."

WARNING; KILLER FUNGI COULD RUN AMOK AGAIN

Michael Marshall

New Scientist, August 19, 2011

During Earth's biggest mass extinction 250 million years ago, usually tame soil fungi ran amok, decimating most of the world's trees. A repeat coup is possible, if climate change weakens trees too much.

The Permian extinction saw 95 percent of species wiped out, dwarfing the K/T extinction that ended the dinosaurs' reign. According to Mark Sephton of Imperial College London, a knock-on effect of the vast volcanic eruptions that triggered the extinction was a global fungal plague.

Sephton has long been intrigued by a mysterious layer of fossilized strands in rocks that formed at the end of the Permian epoch. "You can find it all round the globe," he says, "and you don't see it anywhere else in the geological record." The strands were first thought to be opportunistic fungi that feasted on plants after they died, although some researchers thought they were algae, which couldn't have eaten the trees (*Palynology*, DOI: 10.2113/0260035).

To settle the question, Sephton teamed up with Henk Visscher of Utrecht University in the Netherlands and Cindy Looy of the University of California, Berkeley. They found that the strands looked just like a group of modern fungi called *Rhizoctonia*, implying a fungal takeover took place.

Rhizoctonia lurk in soils, waiting to attack plants whose immune systems are weakened. Sephton thinks their Permian counterparts attacked and killed trees, which would have been weakened by heat stress, drought, and acidification due to the volcanic eruptions (*Geology*, DOI: 10.1130/g32178.1).

Fungi's role in the Permian extinction is a warning, says Sephton. Climate change and other human activities are stressing plants around the world, potentially putting them at risk. "Dramatic changes can occur when you stress an ecosystem too far," he says.

But it's not clear that fungi could once again run amok, says Steven Running of the University of Montana in Missoula. Most modern plant pathogens can only attack one genus, or even species, limiting the damage they can do, he says.

The closest modern-day analogue is the heavily polluted Black Triangle in eastern Europe. Acidification from Soviet-era industry killed or damaged all the trees, which were then set upon by fungi.

THE PATAGONIAN FUNGUS THAT HELPED US BREW LAGER

Discover Magazine, August 27, 2011

Every time you drink a pint of lager, you owe a debt to a small fungus that lives in the beech forests of Patagonia. This previously undescribed species—*Saccharomyces eubayanus*—merged with a close relative to create a hybrid whose fermenting abilities produce all of today's lagers. Without it, our pints would have a much darker complexion.

Ask someone to think of a domesticated species and they'll probably think of something like a dog, cat, cow, or horse. But domesticated fungi are just as close to our hearts or, at least, our livers. The yeast, *Saccharomyces cerevisiase*, has been used to bake bread and ferment wine or ales for centuries. But it's only partially involved in lagers.

Lager is fermented at a lower temperature than either ale or wine, and the fungus for the job is a cold-tolerant species called *S. pastorianus*. It has never been found in the wild, and its genes tell us why. It has four of each chromosome, and appears to be a fusion of two different yeast species. One of these is *S.cerevisiae*, but the identity of the second partner has been a long-running mystery. Until now, the best guess was yet another species of cold-tolerant yeast called *S. bayanus*. But like *S. pastorianus*, *S. bayanus* has never been found in the wild.

Now, Argentinian scientist Diego Libkind thinks he has tracked down the real species that merged with *S. cerevisiae* to help us brew

cont. on page 8

Lager Yeast, *cont. from page 7*

our lagers. And he has found it in a most unexpected place—Patagonia, the southernmost tip of South America.

Libkind has been trying to catalogue the *Saccharomyces* yeasts around the world. In the northern half of the world, these fungi are found on oak trees, and in the southern half, beeches play the same ecological role as oaks. So Libkind's fungal quest took him to the beech forests of Argentina's Lanin and Nahuel Huapi National Parks. Almost all the yeasts there could tolerate cold temperatures, since the average temperature is a chilly 8 degrees Celsius.

Libkind's found 123 samples of such cold-tolerant yeasts, which belonged to two different species. They lived on different trees and couldn't cross-breed successfully. By sequencing their entire genomes, Libkind found that one of them was virtually identical to *S. uvarum*, a species associated with wine and cider. The other, however, was a 99.5 percent match for the mystery half of *S. pastorianus*. Here, in the cold forests of Patagonia, he had found the missing wild ancestor of the lager yeast. He named it *S. eubayanus.*

But how did *S. eubayanus* make its way from Patagonian forests to European breweries? "Well, quite frankly, we don't know!" says Jose Paulo Sampaio, who led the study. Certainly, there's no trace of the species in Europe, whose forests have already been thoroughly searched for yeast species. "For the time being the most reasonable hypothesis is that it migrated from South America to European breweries and that that travel could have been caused by human trade some centuries ago."

That raises a slight timing problem. Lager-brewing in its current form began in 15th century Bavaria, and would have predated any serious transatlantic trade. Sampaio says, "The first lager beers might have been made with other yeasts and the arrival of *S. eubayanus* might have occurred somewhere between the 15th and 19th centuries." Somewhere between those centuries, this species fused with *S .cerevisiase*, creating *S .pastorianus*, which thrived in the environments created by brewers.

Since that merger, the genes of *S. eubayanus* have changed in small but important ways. For example, they have incorporated an *S. cerevisiase* gene that allows the fungus to feed off maltose, one of the most common sugars found in the liquids of the brewing process.

Meanwhile, *S. bayanus*—the strain previously thought to be *S. pastorianus*'s ancestor—has a much more complicated history. Rather than being a maker of hybrids, it's a hybrid itself. Around two-thirds of its genome comes from *S. uvarum*, a third comes from the newly identified *S. eubayanus*, and a smattering from *S. cerevisiase*. This complicated ancestry explains why *S. bayanus* has never been found in the wild. Like *S. pastorianus*, it's a result of early genetic engineering—an artificial fungus that only exists where humans brew booze.

MUSHROOM MISSIONARIES

On Tuesday, August 16, Hildegard Hendrickson was the main speaker for the bi-monthly meeting of PLANT AMNESTY. Her topic was "Mushrooms Fruiting Over A Year."

MONDAY ID CLINICS AT CUH

The popular Monday Mushroom Identification Clinics will resume on Monday, September 19, from 4 pm to 7 pm in the glass atrium at the CUH.

A chanterelle pushing up the duff,
For me, does not pop up enough,
I'd just, rather simply ask it,
To pop into my foray basket.

—Boris Subbotin

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