LONG ISLAND MYCOLOGICAL CLUB

L.I. SPOREPRINT

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MUSHROOM DAY 2011

PLANTING FIELDS ARBORETUM

OCT. 23 1PM—4 PM

This annual event is a tradition of over 20 years standing, in some ways the highlight of the collecting year, and serves to introduce the public to our activities and the importance of fungi in the environment. We ask all members to pitch in and help to collect samples for exhibition and to assist in setting up the display tables.

Volunteers should arrive at 12 noon in order to have the exhibits in place and labeled by the 1 PM opening. Search your favorite spots for interesting and colorful examples for this public display and for the enjoyment of our members as well.

We particularly invite all new members, as well as those who do not often attend our forays, to join us on this special day.

INVASION OF THE DEATH CAPS

By Benjamin Wolfe, PhD

(In the previous two installments, our science advisor, Ben, described his research into the origins of mushroom mutualisms from saprophytic beginnings, and consequent loss of cellulose digesting genes with their replacement by symbiotic, mutualistic ones. In this last installment we will hear the story of how one symbiotic species developed into a deadly invader with the help of mankind.)

In the early 1900's, with the development of the California wine industry, seedlings of cork oaks were brought to California from Europe and planted along the California coast. The cork oaks would be an excellent local source of corks for bottling wines throughout California. Unbeknownst to the purveyors of these trees, their roots were colonized by the deadliest mushroom in the world - the ectomycorrhizal fungus *Amanita phalloides*, commonly known as the Death Cap mushroom. These trees would be the start of a deadly mushroom invasion throughout North America.

AMANITA PHALLOIDES

After many years of growing below ground with the cork oaks where it was originally introduced, the death cap eventually produced mushrooms whose spores were released into the air. As they traveled on the wind or were dispersed by human activity, they spread to new locations, germinated, and began a new population of this deadly fungus. After growing belowground for several years, the fungus would eventually produce mushrooms and start the whole cycle once again. During the 1960's and 1970's, mushroom hunters throughout the San Francisco Bay Area were surprised by the appearance of these Death Cap mushrooms which they had never seen in the region before. But collectors had seen photos of this mushroom in European guides, and they slowly began to piece together that this mushroom must have been introduced to North America. By the 1990's, researchers at the University of California at Berkeley observed that

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PRESIDENT'S MESSAGE

Of all the seasons, I love the fall the best. The air is fresh and cool and the leaves put on their finery before falling to the ground. It is also the time when really interesting and good mushrooms appear. The only problem is finding them in the leaves that sometimes cover them; but what fun to find them! Hen of the woods are out now under oaks. Today I found three on my way home from shopping. Leccinum is also showing up in the forests and even those sometimes hide under pine needles or poplar leaves. You have to look. I urge all of you to get out there and search -you'll be rewarded.

We have a few new members and I think this is a good time to remind people of practices that we encourage. On a foray we share big finds such as oysters, chicken or hen mushrooms. We do not ask if we can have someone else's mushrooms unless they are offered. We do not share morels although we are free to give them away. We bring non foray excesses to the next walk. We use skin spray and/or spray our clothes against ticks, mosquitoes and chiggers. We check our email every Friday evening to see if there is any change to the schedule. We always carry PAPER bags and a knife to forays and in DEC areas bring our permits.

Last but not least, forays are not the place to address controversial topics, which may be hurtful or offensive to others. I care very much about our club and want all to enjoy our outings.

As always, if there is a problem or a question about our club, kindly feel free to communicate with me. I will do whatever I can to resolve any issues.

Our annual luncheon may be delayed as Parkside is having the kitchen redone. I will keep you apprised of any changes.

Finally, I want to thank all the members who came to the picnic. We had great food and everyone enjoyed themselves. Also, please remember Mushroom Day at Planting Fields. Any help is most appreciated.

EDITOR'S NOTE

Although it has now been several years since the NYS DEC altered their rules to permit picking of mushrooms (and berries) on their property, news apparently takes a very slow route in filtering down to local areas. So new members may be misled when receiving their access permits to DEC lands in Suffolk county, inasmuch as the instructional pamphlet that they receive continues to expressly forbid the collection of mushrooms. This pamphlet, apparently printed in 2009, states that "Removal of, or damage to, trees and other vegetation, including mushrooms, is prohibited". This is just plain wrong, as the revised DEC regulations state (Sec.190.8g) clearly that, "No person shall ...remove….any flower, shrub, fern, fungi or other plant, rock, etc.…**except for personal consumption**…" This is awkwardly phrased and also seems to permit the removal of anything and everything, as long as it will be used for personal consumption. Happily, DEC rangers whom we have met while collecting are familiar with the new laws, and will not hassle law abiding mushroom gatherers, while some will express interest regarding the varieties being found.

MATERIAL FOR THE WINTER, 2011 EDITION SHOULD REACH THE EDITOR BY DECEMBER 1ST

(Submissions may be forwarded by email in any format or typed.)

(All unsigned articles authored by editor.)

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THE HIDDEN LIFE OF THE PINE BARRENS

(This article by the editor was solicited by the L.I. Pine Barrens Society and will appear in the Autumn issue of their newsletter. Particularly instructive for beginners.)

Autumn has touched the Northeast, and now reaches down and transforms Long Island. Fallen leaves accumulate upon the earth, leaving barren limbs which the breeding birds have abandoned, the forests now bereft of their song, while northwest winds hurtle through the trees. Nature seems to be withdrawing to prepare for winter's siege, but under the earth, invisible life forms are gathering, preparing to emerge. The mycorrhizal fungi, those thousands of species which have partnered with trees in a mutually beneficial symbiosis, will emerge in an immense autumnal fructification of myriad forms and colors: the mushrooms of the pine barrens.

They are mostly content to live underground, where they reside as an extensive network of microscopic tendrils and filaments, often so numerous that a gram of soil can contain lengths of thousands of meters of them. This is the complete organism itself, and only when it feels the need to propagate, and conditions are right, does it form the spore producing reproductive bodies which we know as mushrooms. They can be considered the equivalent of fruits on a tree, so that removing them is not like uprooting a plant or felling a tree, but more like harvesting berries or apples. No harm is done to the living organism, which lives on to fruit again next season.

Mycorrhiza translates as fungus root, which accurately describes how the mushroom's filaments, called hyphae, envelop the roots of their chosen partner, often a pine or oak, and extend their range and area many times, in fact doing most of the labor of obtaining water and minerals, the tree's own roots serving mostly as support. In return, they receive sustenance in the form of carbon-containing sugars. This ancient partnership now includes over ninety percent of existing plants, and their complex networks permeate the forest floor, linking not only fungus to plant, but plant to plant, and fungus to fungus in what has been called the original www: the wood -wide -web. (A single fungal individual can comprise many fruiting bodies spread across an area that can be as large as 2000 acres. In Michigan one such organism (the "humungous fungus") estimated to be 1500 years old, is claimed to be the world's largest living thing.) Without this cooperative network, our forests would be much diminished, particularly in nutrient poor soils such as the pine barrens. Trees raised experimentally without a fungal partner grow at a much lower rate, and sometimes fail to survive.

So rich is this subterranean pipeline that plant thieves have developed that tap into it but offer no payment in return: the mycoheterotrophs. One species wide-spread throughout our pine barrens, the white Indian Pipe (*Monotropa uniflora)*, glimmers ghostlike in shadowy groves. Without chlorophyll to manufacture food, thievery is its only way to exist.

While some mushrooms form associations with several species of trees, others are more specialized, so that mushroomers seeking them must be able to recognize their arboreal partner. So seekers of the Orange-capped Bolete (*Leccinum aurantiacum)* a large and particularly esteemed edible, know to seek out pine or aspen stands. On the other hand, one species of pine is known to form connections with as many as thirty different mushroom species. Gourmet items such as Chanterelles, Morels and Truffles must be collected from the wild since they are mycorrhizal and cannot be cultivated in the absence of their forest friends.

If plants have friends among the fungi, they also have foes. These numerous disease causing parasites, mostly microfungi, attack and infiltrate many flowering plants by their invasive hyphae, digesting their substance and thereby nourishing themselves. The larger bracket fungi, some several feet across, which are seen attached to the trunks of living trees, are all parasites, some so virulent as to cause the rot and destruction of millions of dollars of valuable timber. Others are relatively benign, not causing the immediate demise of their host but merely draining some of its resources. Some digest only the dead hardwood at a tree's core, hollowing it out but leaving the living layers intact, so that it becomes more supple and better able to withstand storm winds.

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Hidden Pine Barren Life ***(Continued from page 3)***

The third category of fungi are the decomposers, also known as saprotrophs, which live by digesting the organic remains of plants, and are the primary recyclers in forest ecosystems, able to break down stubborn substances such as cellulose which bacteria cannot. They are indispensible in their role of returning these nutrients to the soil. This type of mushroom is easily cultivated, grown on straw and dung, and includes the familiar white button, the portobello, and others found on supermarket shelves.

Mushrooms have been a food source for humanity for millennia, extolled by the ancient Romans and depicted in Egyptian hieroglyphs. Edible mushrooms are found in all three of the categories (saprotrophs, parasites and symbiotes) mentioned above, with neither one of these being superior in quality. The largest, however, are the parasites, shelf mushrooms such as *Leitiporous sulfurous* (Chicken Mushroom) and *Grifola frondosa (*Hen of the Woods) which can weigh many pounds and are avidly sought by mushroomers. Contrary to persistent old wives' tales, there exists no rule of thumb (such as a silver coin turning black upon cooking) to identify edible and poisonous species. Neither can we turn to the example of animals to learn what is edible, since, for example, squirrels, which are immune to the toxins of deadly Amanita species, can be seen happily munching them. One must learn to identify precisely the species of mushroom in hand in order to know whether it is edible or not, much as a birder can tell a Blue Jay from a Bluebird. The great majority of species, not having been subjected to the trial and error of human sampling over the centuries, are simply of unknown edibility, although we may make educated guesses regarding particular families or groups.

Worldwide, about 20,000 species of macrofungi have been identified, although estimates of existing populations are much higher. On Long Island, the Long Island Mycological Club has compiled a checklist of about 900 species, with more being added each year. On a good day in autumn, more than 70 species can be found, ranging from edible orange Milkcaps that exude white latex to delicate, fragrant Black Trumpets; deadly, gleaming white Destroying Angels and golden, apricot scented Chanterelles. The beauty, variety and unpredictability of this kingdom are very compelling, and attract more and more natural history buffs as well as natural food lovers. To access the checklist of LI mushrooms or to learn more, visit our website at limyco.org.

■ **IF YOU GO DOWN IN THE WOODS TODAY….**

A new tick-borne disease, discovered in Japan in 1995, and carried by deer ticks, which also cause Lyme Disease, has been demonstrated to occur in the Northeast USA, according to a study by Yale researchers reported September 20, 2011 in the NY Times. Caused by the spirochete bacterium *Borrelia miyamoti,* it has been found in 2% of northeastern deer ticks, and is estimated to infect about 3,000 Americans yearly. However, the diagnostic test for it developed in Russia is not yet available in the USA, so it is not known whether any Americans have actually fallen ill. It causes higher fever than Lyme Disease, sometimes recurrent, and can be cured by a course of antibiotics. The researchers suggest that doctors should consider this possibility when Lyme tests are negative.

■**CURBING MALARIA WITH A FUNGUS:** For years, researchers have been attempting to kill malaria-carrying mosquitoes with fungi. In a novel departure, researchers at the Univ. of Maryland have engineered the fungus *Metarhizium anisopliae* to attack the malaria parasite itself as it dwells within the mosquito. So although the *Anophales* mosquito is not killed, it becomes incapable of transmitting disease. Approval for field testing is expected soon. (Science 25 February 2011:Vol. 331 no.6020 pp. 1074-77)

■ **HIDDEN FUNGI:** Not in plain sight, but apparently ubiquitous, these flagellated microfungi, measuring from 3-5 micrometers, have been found worldwide in soil, freshwater, and aquatic sediments by scientists at the Univ. of Exeter, UK. They are called "cryptomycota", and DNA sequencing places them in a basal (primitive) position among the fungi, and apparently the oldest currently known. They have been called a "missing link" marking the point of divergence between fungi and other forms of life. However, they lack a chitinous cell wall, the hallmark of almost all other fungi, and their closest relation is *Rozella,* formerly a member of the Protista. These facts make the characterization of these organisms as fungi somewhat controversial, and more studies are sure to follow. (Nature,V.374, June 9, 2011)

(*Compiled by editor from indicated sources.)*

FORAY RESULTS SUMMARY

JUNE 25, PLANTING FIELDS: 25 species was about par for this date, with some early Amanitas, a huge amount of *Collybia dysodes*, and a notably large outcropping of Wood Ear, *Auricularia auricula.* Also prevalent were grass lovers such as *Panaeolus foenisecci* and *Conocybe lactea*, along with Inocybe intricata.

July 2, Muttontown North: Conditions were drying out, and only a meager 15 species were collected, including the Summer Bolete, *Boletus reticulatus,* but mostly worm ridden. Three species of Russula included the recently described *R. parvovirescens,* confirmed microscopically.

Auricularia auricula

Boletus reticulatus

July 9- July 30 was dry and hot, with all forays cancelled. Due to regional forays none were scheduled for August 6 & 13.

August 20, Prosser & Cathedral Pines: With improving conditions, a very successful foray, with a total of 57 species, with little overlap despite the close proximity of the sites. There were 4 species of Boletes, including the rare *Boletus lignicola,* a pine stump associate, and new to our list. Another new species was *Laccaria bicolor,* with lovely lilac tinted base. Edibles were few and included *Boletus rubropunctus*, some Suillus, and *Fistulina hepatica.*

August 27, Blydenburgh CP: Continuing rains helped produce a satisfying 64 species, with 15 species of Boletus, many edible, including *B. ornitapes,* for once not bitter; and two *Leccinum, albellum* and *rugosiceps.* One new species, *Thelephora vialis.*

Thelephora vialis

September 3, Muttontown N: A respectable 36 species, again with some edible Boletes and two previously unlisted species, *Callistosporium luteo-olivaceum* and *Phellodon confluens.*

September 10, Brookhaven SP: This new site was productive, although attendance was disappointingly low. West enders should be more adventurous and head east once in a while-you're missing a lot! Results were good, with 50 species found, including 3 Chanterelles, 5 Boletes, 5 Lactarius, 6 Amanita, 9 Russula and 2 early Tricholoma. *Ramaria formosa* was plentiful, and 1.5 lbs were sent to Univ. of CT reasearchers for bioactive compounds.

Ramaria formosa

September 17, Bethpage SP: Everyone had a lot of fun collecting 64 species and then attending our annual picnic. (See below.) There were good amounts of desirable edibles (on ground and table) such as *Lactarius corrugis, Craterellus fallax, Lepiota americana, Macrolepiota procera,* and *Cantherellus cinnabarinus.* Previously unrecorded were *Cortinarius lilacinus* and *C. cylindripes.* One less than pristine specimen seemed to be the yellow capped *Boletus ochraceoluteus,* but that will require further cogitation as it is reported only from Kissimmee, Florida

Picnickers & Harvest

Peggy, a welcoming committee of one.

Invasion of Death Caps *(Cont'd from page 1)*

the death cap was migrating from highly disturbed urban habitats and beginning to invade native forests. As of 2010, the introduced range of the death cap on the West Coast extends from Vancouver Island south to Los Angeles. In many of the native forests where the death cap is now found on the West Coast, it is incredibly abundant compared to native mushrooms, and is considered an invasive species with possible threats to native mushroom diversity.

Soon after word spread that the Death Cap was invading the West Coast, curious mushroom hunters on the East Coast also began noticing an unfamiliar mushroom popping up in their parks and yards. Father James Wolfe, a mushroom hunter in Rochester New York, first noticed it in a park outside of Rochester in 1970, where numerous exotic trees from around the world had been planted. Following these initial discoveries in upstate New York, collectors in New Jersey and Pennsylvania also reported this strange *Amanita* species for the first time. Since then, this species has been reported throughout the Northeastern United States, and now extends from the coast of Maine to Maryland. In contrast to the West Coast where this mushroom is incredibly abundant and invades native forests, on the East Coast of North America, it seems to live only in urban parks and planted forests. On the West Coast, it is a successful invasive species, while on the East Coast, it is limited to certain areas, and is spreading less rapidly.

What is fascinating about the invasion of North America by the Death Cap is that this human-mediated mushroom migration is a large-scale accidental experiment. It's an experiment that can be used to understand how symbiosis constrains the biology of these mushroom mutualisms. Given that *Amanita* species have lost some of the pathways to be free-living and are dependent on their hosts for carbon, we predicted that the invasion of the Death Cap in North America would be controlled in large part by the trees that provide nutrients to this fungus; also that it would form partnerships with trees that are closely related to the trees that it associated with in Europe. Many symbiotic associations show signs of this choosiness, known as host-specificity, where a large number of potential hosts are available for making partnerships, but only a few species of hosts actually form associations with a symbiont. Host-specificity can be a result of coevolution between the host and symbiont over long evolutionary time scales, or can be due to something about the ecology of a particular habitat that makes one host more suitable than another. While host-specificity has been described from hundreds of symbiotic associations, the role that this exclusivity plays in controlling the distributions of symbiosis is unknown. As the death cap spread across North America, it had to make new partnerships, often with species it never encountered. This provided us with the perfect opportunity to test how host-specificity shapes the ecology of a mutualism.

To quantify the change in host preferences during the invasion of the death cap, I collected data on trees associated with the death cap in Europe and compared these to the trees that were hosts in North America. Because the Death Cap catches the attention of mushroom hunters, there are many specimens stored in herbaria around the world. Field notes collected with these mushrooms were used to determine what tree was growing in close proximity to the mushroom. I also weighed each mushroom to determine the biomass; since the mushroom obtains all of its carbon from its tree host, the amount of carbon available will determine how large the mushroom can grow. Any shifts in the amount of carbon provided by trees in North America should lead to changes in the size of mushrooms.

Data from over 465 specimens from Europe and North America showed a striking pattern of new relationships and partner swapping during the invasion of North America. In its native range in Europe, the death cap most frequently associates with oak trees. As this fungus has invaded North America, two very different patterns of preferences for particular types of trees have emerged. On the East Coast, where this fungus is a limited intruder, it associates almost entirely with pines, which are rarely hosts of this fungus in Europe. On the West Coast, it associates almost exclusively with one species of oak, the coast live oak (*Quercus agrifolia*), mirroring host associations in Europe. In California the range of the Death Cap mirrors that of its host, the coast live oak; this exclusivity has limited its invasion solely to areas where its host grows.

Another pattern emerged from the data on mushroom biomass that suggests that something very different is happening as the Death Cap invades California. Mushrooms in California were ***twice*** the size of mushrooms on either the East Coast or in Europe. Forming partnerships with oaks in California seems to be providing ample benefits for the Death Cap mushroom, and may explain its success in California, but not on the East Coast. Perhaps the Death Cap invasion in California is an example of a mutualism run amok. The massive mush-

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Invasion of Death Caps *(Cont'd from page 6)*

rooms in California might indicate that the Death Cap is taking more from its live oak hosts than it is giving back in return. If this is the case, the Death Cap may have switched from functioning as a friend with benefits in its native range, to a friend with costs in its introduced range.

While the invasion of the Death Cap in North America has presented an unparalleled opportunity to explore the science of mutualism, it has also had tragic consequences. Almost every year, on both the East and West Coasts of North America, someone will pick and eat the Death Cap. Just half of a cap of the mushroom is enough to fatally poison an adult. After eating the mushroom, which is said to be quite delicious, the victim will begin to experience severe stomach pain. Two to three days later, things seem to return to normal as symptoms fade, but in the meantime the liver of the victim is dissolving. Toxins from the Death Cap stop the activity of RNA polymerase II, an enzyme that is necessary in cells for production of proteins. Without a liver transplant the victim will die. In 2009 two women from Newton, Massachusetts were poisoned by the Death Cap that they had cooked and eaten. Fortunately, medical professionals intervened early enough to stop major damage to these two women. But many others have fallen, and will fall victim to this invasive mushroom mutualism.

EPILOGUE

In 2009 my research took me to a desolate rural part of Eastern Texas, where on a steamy summer night in 2009 I lay awake on an uncomfortable couch in an unfamiliar trailer home. The air was heavy with the unrelenting heat and the intoxicating smell of Amanitas drying in a food dehydrator, the standard method of preserving them for future study. This organic aroma, hovering somewhere between a sweet earthiness and a putrid stench, had become all too familiar to me over the past six years of PhD research, and my mind drifted to thinking of the genus Amanita and this wild place it had led me to, the spider and snake infested Big Thicket of Eastern Texas.

In these environs, my host David Lewis and I had spent the day searching, and in an antiquated graveyard, under a gnarly Post Oak, a cluster of milk chocolate colored mushrooms displayed themselves alongside an unmarked gravestone from the late 1800's: *Amanita westii,* a species that has been collected only three or four times in the entire world. It was astonishing to me that I was the fourth or fifth person in the entire world to ever knowingly observe this species in the wild. Mushrooms from this particular population of *Amanita westii* may never be noticed again, but the fungus will keep forming a webby network belowground, intermingled with the memorials to East Texas locals.

AMANITA WESTII

As I finally drifted to the edge of sleep, my mind continued to spin images of Amanita, a group of species so much older than our own, and the lessons we might learn from them. For millions of years Amanita, along with thousands of other species of mycorrhizal fungi, has sewn together the underbelly of the forests of the world, providing incredible benefits to its hosts, and creating habitat for millions of others, including ourselves. But to make this partnership work, Amanita has had to make sacrifices and let go of old habits, such as the decomposition of cellulose. Clearly these sacrifices have paid off, as the amazing diversity and dynamic partnerships of this genus have demonstrated.

Perhaps the next time Amanita pops up in your world, whether as a character in a video game, the poisonous weapon of choice in a murder mystery, or under a tree in your backyard, you'll be reminded of what we've learned from Amanita.

.

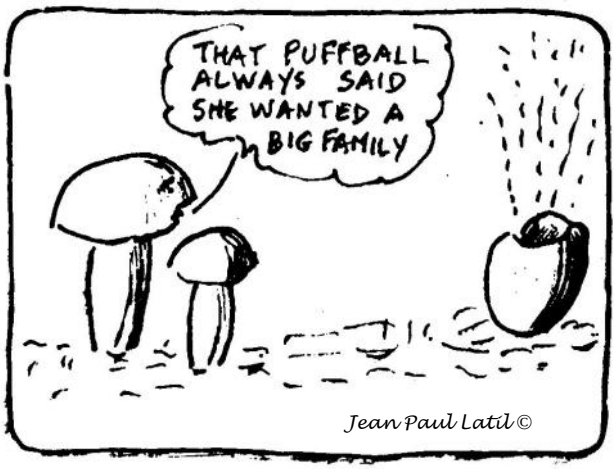
WELCOME NEW MEMBERS

XIAOTONG & YUMING GONG

MICHAEL & DONNA JONES

ERIK LONGABARDI

JOSE ZAPATA



IN THIS ISSUE

An early morning walk is a blessing for the whole day…

Henry David Thoreau

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