

Mycena News

Mycological Society of San Francisco

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Mycodigest

Mycodigest is a section of the Mycena News devoted to the scientific review of recent mycological information

Fungal Taxonomy I: The Basal Fungi

By Peter Werner

The goal of modern taxonomy is to understand the relationships of living organisms in terms of evolutionary descent. If we say, for example, that two species are members of the same genus, then we are (or at least should be) saying that the two species are descended from a more recent common ancestor than one that they share with a species in another genus. The relationships between living organisms are understood in terms of nested clades – every time a speciation event takes place, two new clades are produced. If a species in that clade further evolves into two different species, two more clades are produced that are nested within the old clade. When a group of related clades are mapped together into a family tree-like arrangement, the tree is known as a phylogeny. The phylogeny of a particular group of organisms provides us with a diagrammatic outline of the evolutionary history of that group.

Ideally, all taxa (that is, taxonomic groupings) that are defined from such phylogenies should be monophyletic. A taxon is monophyletic when all of its members are part of the same clade, and all members of that clade are members of that taxon.

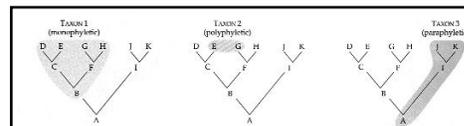


Figure 1 Examples of monophyletic, polyphyletic, and paraphyletic phylogenies. (from Campbell NA, et al. 1999. Biology. 5th ed. Menlo Park, CA: Benjamin/Cummings.)

If a subclade within the larger clade is not included in the taxon, that taxon is said to be paraphyletic. Since the phylogeny of all living organisms represents an infinitely nested series of clades, there are many instances in which taxa must be defined paraphyletically. However, a situation to be avoided is one in which a taxon is polyphyletic, that is, members of more than one single clade are grouped together in a common taxon.

Traditionally, taxa have been given Linnaean rank designations, ranging from kingdoms down to genera; however, since every speciation event produces a new clade, one rapidly runs out of Linnaean ranks to assign to them. Because of this, the concept of rank-free classification is taking hold, in which many newly discovered clades are not assigned a Linnaean rank at all. Linnaean ranks are still used, but mainly as placeholders to outline the system of biological classification.

Presently, we are in the midst of a period of great discovery and revision in our understanding of the taxonomy of all living organisms. Advances in molecular biological technique and computer-aided statistical analysis have allowed biologists to analyze genomes in much greater depth. Such analysis has confirmed many relationships that were inferred by morphological, anatomical, and physiological evidence, but has also falsified many long-held hypotheses about such relationships, and often revealed relationships that were not previously suspected.

About ten years ago, our understanding of fungal taxonomy had advanced to the point where it was understood that, based upon differences in cell structure and physiology, most of the groups that had been called “lower fungi” (cellular and plasmodial slime molds, oomycetes, hyphochytrids, etc.) were clearly not fungi at all, nor even closely

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Speaker for September
MSSF Meeting
Matthew Keirle

San Francisco State
University

Taxonomic Analyses of
Hawaiian Members of the
Coprinus cordisporus /
C. cardiasporus Complex

Matthew Keirle completed his Master of Arts degree in Systematics and Ecology this past year under the tutelage of Dr. Dennis Desjardin at San Francisco State. His research involved preparation of a monograph for the coprinoid mushrooms of the Hawaiian Islands. Matthew made two collecting expeditions to Hawaii and examined more than 150 Hawaiian collections. His thesis has been submitted for publication in *Fungal Diversity* as the eighth installment of the ongoing work “The Agaricales of the Hawaiian Islands.” Matthew will begin work towards a Ph. D. this September at the University of Chicago, where his advisor will be Dr. Greg Mueller, curator and chair of botany at the Field Museum of Natural History in Chicago.

Twenty-nine species belonging to the genera *Coprinus* and *Podaxis* (Agaricaceae) and *Coprinopsis*, *Coprinellus*, and *Parasola* (Psathyrellaceae) are reported from the Hawaiian Islands. These species represent a polyphyletic assemblage of dark-spored, saprotrophic taxa comprising the traditional genus *Coprinus* and the genus *Podaxis* that was thought to be a secotioid ally. The collections were obtained from a variety of habitats ranging from sandy

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President's Message

My history as a Mushroom Hunter

By Mark Lockaby, marklockaby@sbcglobal.net

It all started about 12 years ago when one of my friends, Bruce Mordecai, looked at me and said, "Did you know that chanterelle mushrooms grow in the hills around here?" He had the idea that one would have to look in areas that had a mix of Pine and Oak trees. That was based on what a friend had told him. From that moment on, I spent most of my spare time during the winter hunting in the hills where I lived. After what seemed like forever, I finally found what I thought were chanterelles. They were located in a small park less than one minute walking distance from my home. Another friend of mine knew a mushroom expert. I called him and asked if he would come to the park and verify my discovery. He arrived promptly with basket in hand. I had not picked any of the mushrooms so he could use the surrounding habitat to help identify them. Upon looking at them, he immediately said "Yep, these are chanterelles" as he began cleaning and placing them in his basket (this is where I first learned how much mushroom folks love to share!). After talking to me about mushrooms for a while, he suggested that I join the MSSF, where I could learn more about my newfound interest. He said that I just had to go on a foray with this big guy who just blasted his way through the brush to get at the mushrooms. He said you had to see it to believe it. The guy's name, he said, was Larry Stickney.

For a while, I was happy just looking for chanterelles with my children and a couple of friends. Then I met Jan Donaghy. He pushed me relentlessly to keep learning and hunting for all types of edible mushrooms, and it is because of Jan that I developed the skill of finding and identifying many of the popular edible mushrooms. To increase my knowledge even more, I have attended two of Dr. Dennis Desjardin's "Fungi of the Sierra Nevada" classes.

I feel honored to be elected President of the MSSF and will do my best to keep the MSSF running smoothly.

Please show up for Cleanup Day at Salt Point on September 20th. I am hopeful that our efforts in that regard will help keep the park open for collecting, or at the very least, show the folks in charge how much we care about Salt Point State Park.

Looking forward to seeing you there. Thanks.

Mark Lockaby

MSSF Discussion Group on Yahoo

The MSSF discussion group that is facilitated through Yahoo is a great way to keep in contact with other members, particularly in the summer when no meetings are held.

To join, go to the MSSF web site (www.mssf.org), click on the left link that says: Members Only, and then click on the link titled: Join the MSSF mailing list.

To get into the members only section of the web site, the user name is: mssf, and the password is: macrofungi. The "members only" section contains the current Mycena News, the MSSF roster, the library catalog, and the council minutes.

HELP WANTED:

Editor and Layout Person for the *Mycena News*

The *Mycena News* has been very lucky to have Lorrie Gallagher (Editor) and Rose Flaherty (Layout) at the helm. They have done a superb job. Unfortunately, (for MSSF) they are retired. There are a couple of people who have indicated, albeit reluctantly, that they would be willing to do it if no else steps forward. The *Mycena News* is very important to the MSSF providing vast amounts of information and insight about the wonderful world of mushrooms.

If there is anyone (or two) in the Society who would willingly and joyfully step forward, now is the time. Those folks (who shall remain anonymous for the moment) that have reluctantly agreed to help, if no one else does, would be willing to be a back up/support team. Please contact Mark Lockaby at marklockaby@sbcglobal.net or 510-412-9964, if you are willing to help. Our beloved forager (Patrick Hamilton) will share all his secret spots with you and then cook you dinner!

Many thanks to Rose Flaherty for doing the layout for this issue. Without her willingness to do so, we would have been hard pressed to have a newsletter this month. This is Mark and Jeanne's editing foray, so if there are mistakes, it's their fault!

Membership and Subscription Information

To join the MSSF and receive this newsletter, send a \$25 check, payable to MSSF (\$20 for seniors 65 and over and full time students), to MSSF Membership, Attn: Jane Collier, c/o The Randall Museum, 199 Museum Way, San Francisco, CA 94114. Please include contact information: home and/or work phone numbers and e-mail address. New and renewal memberships will be current through December of 2003. To change your mailing address, please notify Jane. MSSF members may also join or renew membership in the North American Mycological Association at a reduced rate by including with their MSSF check a separate check for \$32 payable to NAMA. Send it to Jane at the same address. For further information, e-mail Jane at jcollier@stanford.edu or call (415) 641-6068.

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Desert Truffles Galor

By John Feeny, reprinted by permission from Saudi Aramco World

There is nothing quite like a truffle to stir up an air of mystery. It's in their nature. Theophrastus, a pupil of Aristotle's, referred to truffles in 500 BC as "a natural phenomenon of great complexity, one of the strangest plants, without root, stem, fiber, branch, bud, leaf, or flower." They grow completely out of sight, below the surface of the soil, and no one can predict exactly where they will grow, or when. All of them grow wild: No one has ever managed to grow them under cultivation, despite continuing efforts. And the treasured desert truffle of the Middle East, it is widely believed, is spawned by lightning and a clap of thunder. But don't let this put you off. If a basket of desert truffles should come your way, you should know that they make delicious eating. Wrinkled and gnarled when dug up, and slightly perfumed, they look for all the world like bruised, lobed potatoes, wizened walnuts or dried prunes. Their appearance is of course deceptive—part of the mystique.

Brown, black, creamy white, sometimes pink, there are more than 30 varieties, all members of the *Terfezia* or *Tirmania* genera, cousins of the white, fragrant truffles (*Tuber* spp.) of Piedmont, Alba and Umbria and the "black pearls of Perigord" that grow around the roots of European oak and hazelnut trees.

If you can only find them, desert truffles lie in wait in arid areas all around the Mediterranean, especially along the North African coast from Morocco to Egypt and farther east across the great desert plain from Damascus in Syria to Basra in Iraq. In all this vast region of the earth, you will find few, if any, surface signs to show you where the truffles are hiding—yet in all these regions, people gather truffles for food.



Truffles go by different names in different places. In Morocco they are called *terfez*—probably the source of the Latin botanical name. In Egypt the Bedouin in the Western Desert call them *terfas*. The Kuwaitis call them *fagga*, the Saudis *faq'*, and in Syria they are known by their classical Arabic name, *kamaa*. Iraqis call them *kamma*, *kima* or *chima*, depending



If only you can find them: From Morocco to the Arabian Peninsula, truffles' surface signs are subtle at best. A careful eye can spot the hint of a hump in the sand, or the symbiotic grasses. Then, move quickly: Exposed to light and air, desert truffles pass their peak in about 96 hours.

on local dialects and in Oman they are either *faqab* or *zubaydi*. In the Eastern Province of Saudi Arabia, where they are found mainly between Nu'ayriyah and Qaysumah, and also near Safaniya, local names are also used, and two varieties are best-known: *Khalasi* are oval with a black skin and a pinkish-ivory interior, and have a nut-like flavor that many think makes them the very best. However, after years of enjoying many varieties of Saudi truffles, I favor the second major type, the cream-colored *zubaydi*, which is usually more expensive, but which offers a more delicate flavor.

Usually no more than a few centimeters across, but occasionally the size of a fist, desert truffles are light in the hand, typically weighing from 30 to 300 grams (1-10 oz). A Bedouin truffle-gatherer told me, "The number and size of the truffles are influenced by the force of thunderclaps." And in fact, there is a connection, for the rains must be just right during October and November to start the truffles germinating. Too much rain at the wrong time can rot the truffle spores. Then the weather must remain dry during January, followed by a light shower or two in the spring to bring on the truffles in February and March. Altogether, researchers have found, as little as 200 to 250 millimeters of rain (8-10") can produce a good crop, and when there is less, experienced truffle-gatherers know to look preferentially in hollows and other places that may dry out more slowly.

They also know to look for certain plants that are symbionts of the desert truffle, especially shrubs of the *Helianthemum* genus—relatives of the common rock rose cultivars of North America. Desert truffles are often found nearby. Fungal filaments of the truffle penetrate the roots of the other plant—sometimes reaching as far as 40 centimeters (15") to do so—and obtain nourishment from it; in return, researchers speculate, the truffle produces a substance that

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The Foragers' Report

By Patrick Hamilton, MYCOCHEF@aol.com

This is the time of year when some of you have already revealed to me that certain summertime cemeteries continue to produce those fairy rings which seem to dance on graves. Others have pointed the way to "pinetrells" hiding under the fog drip-wetted Bishop pine duff above the sea cliffs at Salt Point. Market foragers have told of corn smut beginning to show up at the farmer's stalls.

A friend living in New Mexico is now (August 13) sending messages of many boletes being picked in the high mountains north of Sante Fe. Edible *Agaricus* species should be coming up in the Sunset and near Sea Ranch. A young and juicy sulfur shelf was taken from a dead Red fir near Rockbound Pass, at 7,500', in the Sierras by your reporter and a friend relatively new to mushrooming.

For those of you whose second (third, or even first) mushroom hunting season will be this one start writing on a calendar or etching on your brain just when you see or hear about species of interest to you. On the Internet in our discussion group or in the pages of this newsletter much good stuff will be written that can give you a real jumpstart into learning about these things that fascinate us.

And you new comers should also privately tell your *Forager* reporter about secret spots of yours—places that only you formerly knew of and that made you incredibly happy and proud, and that now you share with me, split 50/50, mine and, oh yeah, yours. It is the perk and reward for writing this column and is a tradition of the society.

Okay, I made that up. What really happens in this column (supposed to happen?) is that you readers do find mushrooms and that you do inform me and I put that information in the column for all to see; but I never, never, reveal exactly where your spots are. Unless, of course, you are like Larry Stickney and want to tell in joyful voice where every patch is on this planet. I don't say nothin'.

Foragers have been able to keep their secret spots secret and still communicate a little—just enough info to allow others to get the idea that certain mushrooms are fruiting now in this or that area—and with some perseverance and the old get up and go those others too might find some.

So tell me, please, what else is going on out there.

That's all for now folks.

For the most current Calendar information, call the MSSF hotline at 415-759-0495 or check the MSSF web site at:

www.mssf.org

Cultivation Corner

By Ken Litchfield, © 2003, klitchfield@randallmuseum.org

We have had some wonderful seminars during the summer with Norm Andresen, Kelly Ivors, and Phil Ross. Everybody knows Norm, all round mushroomer and resident Malcreant (sic). Kelly has her doctorate in mushroom cultivation, presented our second seminar on Basic lab techniques and Media 101, and has been helping us with recommendations for better running of the lab. Phil Ross is an artist in biological media who grew the weird and exotic reishis on display at the Fungus Fair a of couple years ago. He presented the hydrogen peroxide technique of media preparation. Our core group has been growing to include Mark Lockaby, Dan Long, and the Colliers as all round go-getters, Chris Melville and Rick Vandiver as lab fans, and Sherri Scott and Peter, new participants coming all the way down from Chico and video taping the seminars. Cultivators Don Simone and David Sarasua have also been attending and contributing.

We would like you to join us for more seminars in September and October, maybe November, when the rainy season and foray activities start again. We will also be having cultivation activities during the year, like assisting the Fungus Fair and Mushroom Day displays and putting on the Garden show. If you would like to join us in any of these activities, contact me at 415-863-7618 or klitchfield@randallmuseum.org.

WWW voting on Vernacular Names for Mushrooms (phase 1 - *Amanita*)

The MSA-NAMA Joint Commission on Common Mushroom Names for North America has set up an experimental web site to gather information on preferences for common or vernacular names for mushrooms in North America. Go to <http://www.mushroomnames.org> where you will Automatically be directed to another site that explains the project. During this test phase (lasting several months) the genus *Amanita* will be posted along with common names thus far used in a number of books. Visitors to the site should register and then submit their preferences for mushroom names. A certain amount of redundancy is built in presently because resolving the taxonomic problems scientifically proved to be more difficult than expected even for a well-known genus. Therefore, all original names have been left as is. Visit the site again in the future to see if another group of names is posted. *Amanita* will be posted for several weeks. Please spread the word to anyone interested. The results will not be binding but will be used to guide the Commission members with preliminary list.

Chairperson: Scott Redhead

Members: Lorelei Norvell, Judy Roger, Tom Volk, Walt Sundberg, George Riner, Carol Dreiling

Web Design: Jennifer Wilkinson

Desert Truffles Galor

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inhibits competing plants.

Provided all the circumstances are right, the truffles are ready to be plucked from the sand—if you know where to look. And if the truffles themselves are shyly hidden, the truffle-gatherers of Egypt's Western Desert and Saudi Arabia's Eastern Province are downright secretive. Information on where truffles might be found is kept in the dark, under the surface, *sub rosa*—just like the truffles themselves.

But you might get a few hints, along the lines of “Where the desert rag-rug flower grows,” or instructions that the best times of day to go in search of truffles are at the bewitching hours of sunrise or sunset, when any slight rise in the sand casts a shadow that indicates a truffle might be hiding nearly a hand's breadth below. Perhaps it is best left to those who know the trade well, for you can get desert truffles at many markets throughout the Middle East, if you inquire and learn when to go. Even before searching or buying, you ought to know what kind of taste you are in for. European truffles, prized for their intoxicating aroma, can impart a delicate flavor to terrines of foie gras, poultry, scrambled eggs and soufflés. The truffles of the desert are not so strongly flavored, but as they grow much more prolifically than their European cousins, they can be used in much greater volume. I once enjoyed, in a humble restaurant in Damascus, a whole plateful of raw, sliced black desert truffles as a salad, dressed in olive oil and lemon. Now where, in all of Europe, could you enjoy such a thing? It would cost a king's ransom. With the desert truffle, however, even people of relatively modest means can splurge on a kilo or two to make a Cream of Desert Truffle Soup—a gourmet's delight if ever there was one.

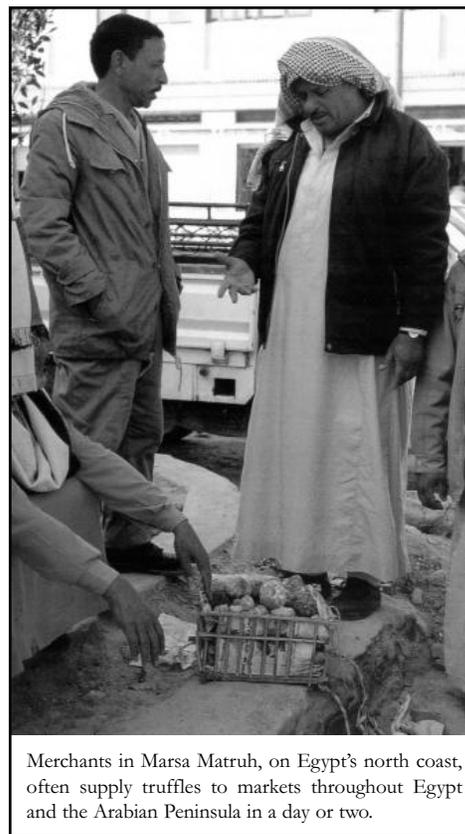
Relished by the rich and famous from the earliest times, desert fungi were served to the pharaoh, papyrus writings tell us. Three thousand years later, the tables of the Fatimid caliphs in Cairo were graced with truffles gathered from the nearby Muqattam Hills. In 1835, the English historian Edward Lane noted that “truffles were sold in such quantities in Cairo's souks that far from being choice dainties they had become cheap and common.”

But alas, desert truffles have long since been swept off Muqattam by urban sprawl, and today few Egyptians have ever even heard of them. A search in the Egyptian Agricultural Museum's library failed to turn up a single reference to *Terfezia*, let alone *terfas*.

But Khamis 'Abd Allah Briek belongs to a Bedouin family in Marsa Matruh, a town on the Mediterranean coast and a center for truffle-gathering in Egypt. He remembers when his father taught him how to hunt for them: “At the same time as hunting for birds and gazelle, we would gather a basket of *terfas* and roast them in the ashes of our nightly coffee fire.” He is also quick to point out that truffle-gathering in Egypt (and Libya) is not without peril: Large areas of the coastal desert were mined in World War II and more than one truffle-gatherer has been injured in an encounter with unexploded ordnance. More recently in Kuwait, some aspect of the 1990-1991 Gulf War seems to have ruined many truffle-gathering areas, and there have been reports of Kuwaitis crossing the border to try their luck in

truffling areas of Saudi Arabia.

Once found and brought to the surface, desert truffles have two enemies, sunlight and humidity, and the only way to deal with these is speed. Four to five days out of the sand, truffles are past their peak. You cannot keep them in plastic bags, nor can you store them in the refrigerator. They just don't like either one. Keep you truffles in a deeply shaded room, and blow a current of cool air over them, say the truffle merchants of Marsa Matruh.



Merchants in Marsa Matruh, on Egypt's north coast, often supply truffles to markets throughout Egypt and the Arabian Peninsula in a day or two.

Headed for Marsa Matruh in his half-ton truck, a modern Bedouin truffle merchant, having braved the terrors of decades-old land mines, will generally alert the truffle merchants of his imminent arrival by mobile phone. Until he calls, no one will have had any idea when to expect truffles in the market, but once word is received, excitement grows. “The truffles are coming!”

Within 20 minutes of their late-afternoon arrival, the precious crates are quickly transferred and whisked off to Cairo. At dawn the next morning, the truffles are in air cargo holds, and by that afternoon they are being hawked in markets in Abu Dhabi, Doha, Kuwait and Riyadh, in time for them to be on dinner tables just 24 hours after their arrival in Marsa Matruh.

Part of the mystique of truffles is, of course, their often extravagant cost. On a recent television food program, chef Antonino Carlucci of London's Neal Street Restaurant looked at the diamond-and-gold brooch on his hostess's blouse and estimated, “Your brooch, Madame, is worth less than my truffles.” In London, in 1993, a kilogram (2.2 lb) of the “black pearls of Perigord” sold wholesale for \$1450. The same year, in Bologna, Italian truffles fetched \$2200 a kilo. Those, however, were forest truffles of the *Tuber* genus; *Terfezia* truffles sold last year in Riyadh for \$80 to \$105 a kilo, and in recent years have reached no higher than \$270. This year, however, from Morocco to the Gulf, it has been an exceptional, unprecedented season for desert truffles and, market forces being what they are, they were selling in Riyadh for a mere 100 riyals (\$26.75) a kilo.

Filmmaker, writer and photographer John Feeney, a native of New Zealand, has seen many a truffle season during the nearly four decades he has lived in Cairo.

Crème de Truffe du Désert

For this recipe you'll need not only a basket of white desert truffles, but also a female camel. If the camel isn't handy, substitute whole milk or, even better, light cream.

Ingredients

- 9 or 10 medium-sized white desert truffles, very fresh
- 4 cups whole milk or light cream
- 1 small onion, peeled and roughly chopped
- 4 more cups whole milk or light cream
- 1 tablespoon unsalted butter
- 2 tablespoons white all-purpose flour
- 1 beef bouillon cube
- ½ tablespoon granulated sugar
- ¼ teaspoon cayenne pepper
- Salt and freshly ground white pepper
- ¼ tablespoon unsalted butter
- ¾ cup light cream



Instructions

1. Immerse the truffles in cold water for 10 minutes. Throw out the water and loose sand and cover them with water again. Repeat. Gently massage each truffle under running water with your fingers, then scrub them gently with a vegetable or mushroom brush and rinse. Scrub and rinse again. Now, some will tell you never to peel a truffle and to take out the remaining specks of sand with a fine-pointed knife. Nonsense! Much of the sand is *invisible*, so there is only one way to get rid of it. Peel the truffles very finely — but don't throw away the peelings: They are very rich in flavor and add a deft light-brown tinge to the soup. Barely cover the peelings with milk (quantity not included above) and simmer for 10 minutes. Let them stand so that some, if not all, of the remaining fine sand sinks to the bottom. Cool. Gently pour off the milk, leaving the sand behind. Discard the peelings and set aside the milk they were cooked in.
2. Roughly chop all but two of the peeled truffles. Put the onion and garlic in the first four cups of milk and bring it to a boil. Boil for five minutes, then add the chopped truffles. Simmer gently for another three minutes, no longer. Purée the mixture in a blender or a moulinette (food mill), and set it aside.
3. Then make a white roux. Use a heavy-bottomed saucepan and a heat diffuser between pot and burner. Heat the remaining four cups of milk very hot (but do not boil) and hold it at temperature. Melt one tablespoon of the butter; when it starts to froth, turn down the heat, stir in the flour and keep stirring until the butter absorbs all the flour and becomes a thick paste. Without delay, pour in the very hot milk, half a cup at a time. Keep stirring without pause until a smooth, creamy, thick sauce is achieved. If there are lumps, keep stirring until the bubbling sauce is smooth. Let it simmer very gently for another 10 minutes.
4. Slowly stir in the puréed truffle mixture until it is absorbed into the sauce. Drop in the bouillon cube and the sugar. Add salt and white and cayenne pepper. Gently, so as not to raise any remaining sand from the bottom, stir in the milk the skins were boiled in. Stir in the three-quarters of a cup of cream and the quarter



tablespoon of butter for finishing. If the soup seems too thick, dilute with a little more milk.

5. At the very last moment before serving, so as to obtain the maximum truffle flavor, take the two peeled truffles you have set aside and grate them, using a rasp or the finest part of a kitchen grater, directly into the soup. Keep the soup hot, with the lid on, in a double boiler, and do not let it boil again.
6. If the truffles were fresh, the soup should possess a delicate truffle flavor and a most luxurious texture. If you have been lucky enough to find one or two truffles with a pink interior, it will have a seductive pink tinge. It is especially good served with warm cheese-straw pastries.
7. Kept in a sealed jar, the finished soup will keep its truffle flavor for several days.

Coastal Cleanup Day at Salt Point State Park Saturday, September 20, 2003

9a.m. to noon

California Coastal Cleanup day is the premier volunteer event focused on the marine environment in the country. Each year, more than 40,000 volunteers turn out to over 400 cleanup sites statewide to conduct what has been hailed by the Guinness Book of Records as “the largest garbage collection”. I hope to see everyone who collects at this park, participating in this event. This will be a joint event between the MSSF and SOMA

Where:

Woodside parking lot at Salt Point State Park

Time:

9:00 to noon Saturday September 20, 2003

Contact: Mark Lockaby

Marklockaby@sbcglobal.net

510-412-9964

Fungal Taxonomy

Continued from page 1

related to fungi. The exception were the chytrids, which were thought to be a basal line in the Kingdom Fungi, having diverged from all other fungi very early in fungal evolution and retaining many of the "primitive" characteristics of the fungal ancestor.

It was also understood that fungi were more closely related to ani-

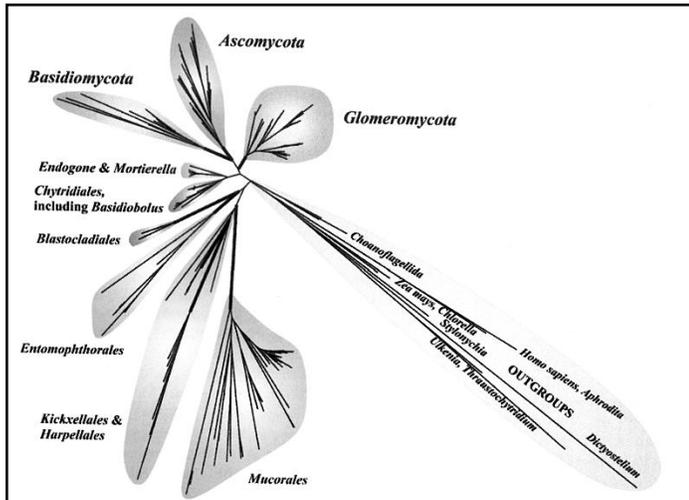


Figure 2: Phylogeny showing the major clades of the Kingdom Fungi. The group marked "OUTGROUPS" are non-fungi, and show the point where the phylogeny is rooted. (from Schüßler A, et al. 2001. *Mycological Research* 105(12):1413-1421.)

mals than they were to plants, algae, or any of the "lower fungi" (other than chytrids). The common ancestor of animals and fungi was thought to be a flagellate with similarities to the chytrids and the choanoflagellates (a group with great similarities to the hypothesized animal ancestor).

While recent findings have confirmed or refined many of these hypotheses, there have also been some surprising revisions. Most notably, it has been demonstrated that the Zygomycota are not a real monophyletic group, but instead represent a polyphyletic assemblage of parts of at least four different lineages, including a lineage that does not belong to the Kingdom Fungi at all.

Amoebidium, a trichomycete that grows in the guts of arthropods, has recently been found to belong to a group called the Mesomycetozoa, which are close relatives of the choanoflagellates. The mesomycetozoans and choanoflagellates together form a clade that diverged from the animal line at a point in animal evolution when the ancestors of animals had not yet strongly differentiated from the ancestors of fungi. It is very likely that further analysis will reveal many other trichomycetes to be mesomycetozoans rather than fungi.

The majority of taxa that were once classified as Zygomycota have been found to belong to a lineage consisting of the core zygomycetes plus the Blastocladales, which used to be classified as chytrids. This clade occupies the basal position in the phylogeny of fungi, with molecular evidence showing that it diverged from the rest of the fungi at a very early point in fungal evolution. The next most basal clade consists of the chytrids (sans the Blastocladales), plus several genera of former zygomycetes, including *Endogone*. (*Endogone* are an unusual group in that they are the only fungal taxon

outside of the basidiomycetes and ascomycetes whose members are capable of forming ectomycorrhizae with plants.)

This new understanding of the basal phylogeny of fungi throws much of our prior understanding of fungal evolution into disarray. When the chytrids were thought to be the most basal clade in the fungi, the evolution of a predominantly hyphal fungal morphology from a zoosporic one was thought to have taken place only once. It now seems that this evolutionary event took place at least three times, or perhaps there may have been several shifts back and forth between predominantly zoosporic life histories and predominantly hyphal ones.

The remaining segregate clade of the zygomycetes consists of the VA mycorrhizal fungi and their relatives, a group that has recently been designated as the Phylum Glomeromycota. This group was found to be a basal member of the same clade as the Ascomycota and Basidiomycota. All glomeromycetes are either VA mycorrhizal-formers or live in mutualistic relationships with cyanobacteria. Interestingly, it appears that the diversification of the glomeromycetes roughly correlates with the time when plants are thought to have first colonized land, lending weight to the idea that these fungi played a role in this colonization.

So far, I have yet to discuss how the present revolution in fungal taxonomy has affected our understanding of the ascomycetes and basidiomycetes that we are so familiar with. This will be the topic of my next article.

Further reading:

Cavalier-Smith T. 2001. What are Fungi? In: McLaughlin DJ, McLaughlin EG, and Lemke PA, eds. *The Mycota*. Volume VII, Systematics and Evolution. Berlin: Springer. Part A, p 3-37.

Judd WS, Campbell CS, Kellogg, EA, Stevens PF, and MJ Donohue. 2002. *Plant Systematics: A Phylogenetic Approach*. 2nd ed. Sunderland, MA: Sinauer Associates. Chapter 2, Methods and principles of biological systematics; p 13-39.

Mendoza L, Taylor JW, and Ajello L. 2002. The Class Mesomycetozoa: a heterogeneous group of microorganisms at the animal-fungal boundary. *Annual Review of Microbiology* 56:315-344. (Available at: <http://plantbio.berkeley.edu/~taylor/ftp/mendoza2002.pdf>)

Schüßler A, Schwarzott D, and Walker C. 2001. A new fungal phylum, the Glomeromycota: phylogeny and evolution. *Mycological Research* 105(12):1413-1421.

Matthew Keirle

Continued from page 1

soils to wood chip piles, lawns and pastures, ungulate dung, herbaceous debris, and fallen logs in alien and native mesic forests. *Coprinopsis urticicola* var. *hawaiiensis* is described as new, *Coprinus candidolanatus* is transferred to *Coprinopsis*, and two additional species are provisionally described in *Coprinopsis*. Multiple specimens representing the *Coprinus cordisporus* complex were analyzed using morphological and (DNA) ITS sequence data sets to investigate relationships within the group.

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MSSF Calendar, September, 2003

Monday, September 8, Culinary Group's Kickoff Potluck Dinner: 7:00 p.m. Hall of Flowers, Golden Gate Park, San Francisco; no reservations required for potluck dinner. For information contact Alvaro Carvajal at 415-695-0466 or alvaro.carvajal@att.net; or Bill Hellums at 415-255-4950

Tuesday, September 16, MSSF General Meeting: Randall Museum, doors open at 7:00 p.m., lecture starts at 8:00 p.m. Matthew Keirle will speak about Coprinoid fungi of Hawaii.

Saturday, September 20, Coastal Cleanup Day at Salt Point State Park: 9:00 a.m. - noon. See write up for more information or contact Mark Lockaby at: marklockaby@sbcglobal.net or 510-412-9964

Saturday through Sunday, October 11-12, Yuba Pass Foray: Depends on weather conditions. Contact leaders for location and time. Norm Andresen at: n.andresen@comcast.net or 510-278-8998 Herman Brown at: herman@fungi-zette.com or 530-284-6241

Saturday, November 1, Santa Cruz Foray: Location and time to be determined by leaders. Limited group size. Contact Tina & Thomas Keller at tinakeller@covad.net or 408-879-0939

Saturday, November 8, Beginners Mushroom Walk in Marin County: Location and time to be determined by leader. Contact Terry Sullivan by email at biologyhikes@aol.com

Friday through Sunday, November 14-16, Annual Mendocino Foray: Weekend foray will include meals and lodging. Arrangements currently being made by foray coordinator. More information to be listed in the next newsletter.

Saturday and Sunday, November 22-23, Annual Salt Point Foray: Meet at 10:00 a.m. at Woodside Campground. This is a "just show up" event. Participants are responsible for their own campsite/lodging. Potluck feast on Saturday night of picked edibles. Foray Leaders: David and Jeanne Campbell, yogidog@comcast.net or 415-457-7662

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