



MycoDigest:

Close Encounters with the Puffballs of California: a Look through a Scanning Electron Microscope

Stephanie Jarvis

September 16

General Meeting Speaker



Tom Bruns

*"Forest Fire and Fungi: Losers, Winners,
and Strategies in the Postfire Environment"*

Professor Bruns joined the faculty at the University of California, Berkeley in 1989, where he studies fungal ecology and systematics, and has published over 150 scientific papers in this area. He has served as president of the Mycological Society of America, and is a current fellow of the American Association for the Advancement of Science, the California Academy of Sciences, and the Mycological Society of America. He has won teaching awards from the College of Natural Resources and the Mycological Society of America.

Bruns' talk will examine fungi and forest fires. Fire is a natural part of most western forest ecosystems, and plant strategies for surviving or recolonizing after fire are well known, yet much less is known about how fungi deal with this common disturbance. This talk will review some of the details known about how saprobic and ectomycorrhizal fungi recolonized following severe, stand-replacing fires, using examples from studies of the Mt. Vision Fire in Pt. Reyes and the more recent Rim Fire in Stanislaus National Forest and Yosemite. These examples will trace the development of molecular ecology from the crude RFLP days to the current high-throughput sequence.

This past May 2014, the monograph on the Lycoperdaceae of California was finally completed after seven years of research. Members of the gasteroid basidiomycetaceous family, Lycoperdaceae, represent a part of the Gasteromycete fungi, the stomach fungi, better known as the puffballs. A saprotrophic group, puffballs are common in temperate zones throughout the globe, with somewhat less diversity in the tropics. Although the family Lycoperdaceae has been sunk into the family Agaricaceae (Basidiomycetes), and is no longer recognized as a separate unit, here, I reference the puffballs as the Lycoperdaceae family (Monclavo et al. 2002, Hibbett et al. 2007). Overall, there are 1303 names belonging to twelve genera of the Lycoperdaceae recorded on Index Fungorum. In California, these fungi are represented by thirty-five species in seven genera: *Abstroma*, *Bovista*, *Calbovista*, *Calvatia*, *Disciseda*, *Lycoperdon*, and *Mycenastrum*. Here we will discuss the use of Scanning Electron Microscopy (SEM) to examine spore surface ornamentation for species identification purposes.

The Gasteromycete body form has evolved to withstand arid environmental conditions and to passively disperse spores from the basidia (statismosporic) over long periods of time. Being related to the Hymenomycete class of fungi (Hibbett et al. 1997), Thiers (1984) hypothesized that the evolution of the Gasteromycete body form and statismosporic release of spores was driven by a drying climate that lacked the moisture needed for ballistosporic (forcible) release of spores that occurs in the gilled fungi. Others have suggested that puffballs developed a special mechanism for spore dissemination by either utilizing the kinetic energy and weight of raindrops, or by completely falling apart and harnessing the kinetic energy of wind (Gregory 1949). There could be a possible correlation with the ornamentation of spores, giving assistance in this dispersal process. Previous studies have shown that many species within the Lycoperdaceae have advanced mechanisms for spore dispersal using drops of rain. This can be seen using ultra high-speed Schlieren cinematography (Gregory 1949, 1976). It was noted in the Gregory (1976) study that species such as *Bovista plumbea* and *Calvatia gigantea* both have a sizeable air-filled pedicel attached to the spore, aiding the spore's ejection and landing mechanisms. Further study using wind energy may help to better understand any correlation between dispersal mechanisms and spore ornamentation.



Calvatia sculpta fruit body
from Yuba Pass, California

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PRESIDENT'S POST

Hello MSSF Members,

Welcome to the start of a new MSSF season! I hope everyone had a relaxing summer while the society has been on vacation. As I'm sure many of us have been experiencing California's recent dry times, a few mushroom related anecdotes are always a nice respite from the lack of water and will be sure to whet our appetites as we anticipate a more lucrative, rain filled year. As always, if you have something to share please send it to the *Mycena News* editor before the 15th of each month. Volunteering stories is a great way to contribute to our organization and learn what our members are up to.

Although we've technically been off over these last few months, several mushroom related activities have taken place. Sunday July 27th, amongst the trees of Oakland's Joaquin Miller Park, was our annual Summer BBQ. I want to thank George Willis and the hospitality committee for hosting this event, as it's a great way to stay in touch during the off-season. I'd also like to thank Eric Multhaupt for helping reintroduce the Mushroom Tabernacle Choir. As the new musical component of the MSSF, they'll be sure to entertain us for many future forays and events. If you are so inclined to join the merriment, please contact Eric.

I also want to thank Tyler Taunton and Ken Litchfield for organizing an MSSF table at the San Francisco Botanical Garden Show this past August. This popular annual event provides many local nature societies valuable opportunities to teach and interact with the public. As offering free and accessible information to curious newcomers is one of the MSSF's most important missions, we appreciate both of their efforts to let people know who we are and what we're about.

The first general meeting of the season is on September 16th at the Randall Museum. Social hour begins at 7p.m., followed by the official meeting, announcements, and the speaker at 8p.m. I highly encourage you all to attend this event, as Dr. Tom Bruns, this month's speaker, will be giving a talk on fungi and forest fires. As this has been a hotly discussed issue over the past year, I have no doubt that Dr. Bruns will have a lot to share about his recent fieldwork in California's fire zones.

Lastly, I want to give a hats-off to Curt Haney, the outgoing President of the MSSF. Curt did some outstanding work leading the Society on a forward path over the past two years when he was at the helm. As he wasn't able to join us for his final presidential meeting in May, please be sure to thank him sometime for his selfless service. I look forward to continuing in his footsteps and leading the MSSF into a bright (and hopefully wetter) future.

-- David Gardella

CULINARY CORNER

Patricia George

Among those of us who love mushrooming, September brings the resumption of our meetings, our dinners, and eager anticipation for the season ahead. With the unseasonably dry weather, shrinking snowpacks, and so many areas we love in flames, we have far more reasons to wish for rain than just the appearance of fungi. More morels with more fires? Maybe, but what a terrible price to pay! Like many, though, I had a glorious time foraging for morels in Yosemite this past spring. But first, a few tidbits of mushroom lore:

Mushrooms don't just grow in forests and damp meadows. Charles Darwin told of some inhabitants of Tierra del Fuego subsisting on a giant local fungus, eaten raw. The Kalahari Desert yields a substantial truffle harvest. Even the termites who build those towering mounds in the Okavango Delta in Botswana benefit from the *Termitomyces* fungus as it breaks down wood so it can be used as food. Large fruiting bodies appear above ground and are collected for food by the locals.

Haute cuisine has always had a thing for mushrooms. Truffles were prized in ancient Babylon and at the tables of imperial Rome. In the 17th century, Pierre Francois de la Varenne, France's culinary pioneer, sang the praises of truffle ragouts, while his successor, Francois Massiolot, taught the English public about the truffle, the mousseron, and the beloved *morille* in his famous 1702 cookbook. By the 19th century, Brillat-Savarin famously described the truffle as "the very diamond of gastronomy."

As it's still early for collecting this month, and I still have plenty of dried fungi in the pantry, on page five, I'm posting one of my favorite morel recipes, courtesy of a good friend and chef, Loraine Berry.



The truffle: "the very diamond of gastronomy"

In other news, the Culinary Group's last May dinner was another triumph. Many of our guests brought appetizers that highlighted the bounty of morel season. Our menu was Caribbean inspired: goat curry (Al Carvajal Sunita Dutt, goat provided by Tom Whiteside), black-eyed peas and rice (Colliers), Yucca (Bill and Carol Hellums), collard greens (Catherine Ung), passion fruit and mango mousse (Catherine Ung), coffee (Carol Reed).

It was a memorable feast. In fact, our Culinary Group dinners are all quite memorable. Great food cooked by inspired and talented volunteer cooks, with all the help and encouragement you need. If you aren't already a member of the Group, consider joining us this season. Our first meeting is September 8, and according to tradition, will

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MycoDigest continued

Looking at the spore surface under a Scanning Electron Microscope has proven helpful in better understanding and identifying these fungi. The spore ornamentation within the Lycoperdaceae is taxonomically important. When comparing SEM images of different species of puffballs, the characteristics become clearly defined. As discussed in Bates (2004), the terminology used to describe spore ornamentation was originally developed with the use of a compound light microscope (LM). Using the traditional terminology in collaboration with the use of SEM has made it possible to clarify and revise the ornamentation of these species. Much of the detail seen in SEM is not visible with a LM. However, with careful observation and a trained eye, using KOH mounts (potassium hydroxide dilute solution), it is still possible to correctly identify puffball species combining a light microscope with macromorphology. There are eight types of spore ornamentation described here: smooth, asperulate, asperate, verruculose, verrucose, echinulate, echinate, and pitted. These were determined using mature spores, with typical SEM dry prep and mounting, at 7,000–20,000x magnification. Descriptions of these ornamentation types and puffball species are listed below:

Smooth spores are those that lack ornamentation and have a smooth surface under both LM and SEM. Under SEM, they often have a flaking, peeling, or a slightly vein-like structure on their surface. Magnifications between 7,000–20,000x clearly show spores with a smooth surface, even among any flakiness that may be present. Two species of puffballs in California have smooth spores: *Calvatia pachyderma*, and *Disciseda brandegeei*.

Asperulate spores have a seemingly smooth surface under compound light microscopy. SEM magnification at 7,000x or greater exhibits an ornamentation of minute globose bumps and ridges scattered over an otherwise smooth surface. This is also described as delicately asperate. There are two species of puffballs in California with asperulate spores: *Disciseda atra* and *Disciseda levispora*.

Asperate spores have a slight coarseness that can be seen under light microscopy using KOH in wet mounts and close observation. These spores may still appear smooth to an untrained eye; however, under closer investigation, they are roughened with projections or bumps. Eight species of puffballs in California have asperate spores: *Bovista aestivalis*, *Bovista plumbea*, *Calvatia booniana*, *Disciseda cervina*, *Disciseda luteola*, *Lycoperdon lloydianum*, *Lycoperdon pratense*, and *Lycoperdon pyriforme*.

Verruculose spores have a medium coarseness with large and densely packed clusters of verrucae that can be seen with a light microscope using KOH wet mounts. The verrucae are globose to irregular in shape and may be flattened or appressed at the apex. An untrained eye using a LM and KOH mounts will be able to see small verrucae on spores. Eight species in California have verruculose type of ornamentation: *Bovista sierraensis*, *Bovista pila*, *Calbovista subsculpta*, *Disciseda candida*, *Disciseda uplandii*, *Lycoperdon nigrescens*, *Lycoperdon umbrinum*, and *Lycoperdon utrifforme*.

Verrucose spores have small round processes or warts called verrucae, which are larger and more robust than those found in verruculose ornamentation. They are typically globose to irregular in shape, column-like, and very densely clustered on the spore surface. Three species in California have verrucose ornamentation: *Calvatia lloydii*, *Lycoperdon dermoxanthum*, and *Lycoperdon molle*.

Echinulate spores have a composition of sharply pointed spines, or diminutive pyramidal warts, called echinae. These protrude from the spore, sometimes fusing at the tips, making larger assemblages of pointed spines. The six California species with this type of ornamentation include *Bovista californica*, *Calvatia sculpta*, *Lycoperdon curtisii*, *Lycoperdon perlatum*, *Lycoperdon subcretaceum*, and *Lycoperdon vernimontanum*.

Echinate spores have large, dense clusters of echinae, some so much that the surface is concealed, even from SEM imaging. Mounting these spores in KOH under LM creates a halo-like effect, where a bubble forms around the spore, emphasizing the ornamentation. The four species in California with echinate ornamentation include *Calvatia fragilis*, *Calvatia fumosa*, and *Disciseda johnstonii*, *Disciseda subterranea*.

Pitted spore ornamentation is rare in fungi. As the spores swell and mature, the surface area expands, tearing open the tissue layers to create gaps or pits into the surface of the spore. The pits on these spores can be round, to hexagonal, or irregular in shape. The two species of puffballs in California with pitted spore ornamentation include *Mycenastrum corium* and *Abstoma townei*.



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To subscribe, renew, or make address changes, please contact Stephanie Wright: Membership@MSSF.org

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CULTIVATION QUARTERS

Ken Litchfield

On August 8-10, the MSSF's Cultivation Committee and Far West Fungi Farm in Moss Landing, Monterey County, hosted the first annual Far West Fungi Cultivation Mycology in honor of the farm field trip's 20th anniversary.



Every spring and fall over the past ten years, the MSSF has sponsored a Sunday field trip to the

60,000 square ft. farm. Over this period, the event has grown from around 30 folks to over 150 attendees. This trip begins with a tour of the farm and its production houses, followed by a potluck BBQ (where our hosts grill a variety of organic mushrooms for us to sample first-hand). Last, we get the chance to raid the recycle pile for once-harvested mushroom blocks (that still have plenty of life left) to make garden beds for our backyards, community gardens, and local schools throughout the Bay Area.

This year's event began with an in-depth tour of the farm and a hands-on class about the techniques and applications of mushroom cultivation, led by John and Toby Garrone, owners of the farm, and their son Kyle, the farm manager. Mycology attendees and a crew of Bay Area Radical Mycology volunteers then got to design and build their own mushroom garden beds using the spent mushroom block compost and freshly picked, but still viable, mushroom blocks fresh from the fruiting halls. This allowed visitors to learn how to incorporate recycled blocks into their own home gardens.

But this wasn't all. We then got the chance to enjoy presentations by a diverse group of myco-experts, ranging from artist Phil Ross of Mycoworks, Julie Cabral, the Global Environmental Health & Safety Manager of Autodesk, and Ray and Patti Lanier, urban gardeners of Mushroom Maestros. We were also treated to hands-on demos about everything from log plugging to spawn burritos to pinatas. (More about these in future articles.) Cooking agar jars were presented at the Mycochatauqua demonstration area. And we had a talk in the corn fields on how to grow corn and huitlacoche mushrooms.

Participants camped on the farmgrounds and cooked on the farm facilities, making for a fun and collaborative atmosphere. We also made time for a hike to the beach, foraging for wild plants along the way, and relaxed in the hot tub on Saturday night. We were very pleased with the results of our first Mycology, and are already planning for next time.

2014 MOREL FORAY RECAP

Curt Haney

The MSSF led two morel forays this past spring: the last weekend of April and the first weekend of May. Our base camp was the Pines Campground in the Stanislaus National Forest. We had originally planned to lead approved scientific collection forays into the Rim Fire burn zone. Two weeks before the first foray, Norm Andresen, Eric Multhaupt, Enrique Sanchez and I accompanied Dr. Tom Bruns and Else Vellinga from the University of California, Berkeley into the Rim Fire burn zone to assist with their collections and scout the area for our MSSF members. A week later, however, our plans changed when government officials told us only five people would be allowed into the burn zone on each foray and no mushrooms could be collected for consumption.

Each weekend, members split into groups and carpoled to stay discreet, as we did not want anyone arrested or ticketed for being in the burn zone's closed areas. Inside Yosemite, it was



The morel motherlode: all in a day's work

legal to collect up to one pint of berries, nuts, and mushrooms for personal consumption. Some members were stopped and questioned by Yosemite Park rangers, who were not always aware of their own regulations, allowing us to pick up to a quart of mushrooms per person. (The following weekend, however, there was a sign, forbidding mushroom picking, at the park entrance.) By this time, they had been overrun by commercial pickers, members of other societies, and the general public, all looking for morels.

While more mushrooms were collected on the first weekend than the second, everyone found plenty of morels, and we held a bonfire and potluck each Saturday night.

I want to thank all of those previously mentioned, plus Roy Coto, Don Hughes, David Gardella, David Campbell, Mark Lockaby, Ken Litchfield, Henry Shaw, and Brennan Wenck. I especially want to thank Norm Andresen, Enrique Sanchez, and Eric Multhaupt for helping me make these forays fun and productive for our members. I am looking forward to next year's forays, possibly back in the Rim Fire burn zone, or possibly in new burn zones due to this extremely dry year and the current drought conditions.

I hope to see you in the forest, or at a future MSSF event!

Culinary Corner continued

be potluck-style.

Time for me to pack for the Telluride Mushroom Festival, where I hope to bring home some great recipes and stories to share next month. See you in the woods, or at our next dinner!

Morels and Chicken in a Bourbon Cardamom Sauce

- 3 T. butter
- 8 boneless chicken thighs
- 3 T. chopped shallots
- 1 clove garlic, chopped
- 1 cup chicken stock
- ½ ounce dried morels, soaked in 1 cup water, then drained, keeping the soaking liquid and straining to remove grit or sand.
- 1/2 cup bourbon
- 1 1/2 T. cardamom seeds, husks discarded
- 1 cup heavy cream or half-and-half
- 1 t. salt
- 1 t. pepper

In an ungreased heavy skillet, heat the cardamom seeds briefly to release the flavor. Set aside. Sauté the chicken thighs in the butter until brown. Set aside. Sauté the shallots and garlic, taking care not to brown them and then add the morels sautéing them for a few minutes. Add the chicken stock, the morel water (not the gritty bits, of course) and the bourbon to the pan along with the chicken and cardamom seeds. Cover and simmer for 15 minutes. Remove the chicken and keep warm. Add the cream to the pan and reduce the liquid by one third. You should have about 1 ½ cups of sauce.

Add the salt and pepper. Add the chicken and serve. Serves 8.

HOSPITALITY COMMITTEE SHOUT-OUTS TO MSSF GUEST CHEFS



Enrique and Miki Lemieux's pizzas were universal crowd-pleasers

The Hospitality Committee has two shout-outs for outstanding appetizers from April and May 2014. In April, guest chef Enrique Sanchez, ably encouraged and supported by his wife, sous-chef Mickey Sanchez, provided an array of pizzas with lion's mane and shiitake mushrooms, plus a pesto sauce and a marinara sauce. In May, guest chefs Julia Cabral and Trina Lynn provided a mushroom medley soup with tamari and herbs, a savory mushroom quiche with thyme and gruyere, and, in an innovative sweet treat finale, mushroom meringue with candy cap chocolate gills. Much appreciated! More to come in 2014 - 2015.



Julie Cabral and Trina Lynn stole the show with a candy-cap mushroom meringue

YOU TOO can be a guest chef at a hospitality function at some point of your choosing in the future. Just email one of your Hospitality co-chairs:

Eric: mullew@comcast.net

George: gwillis2@mac.com

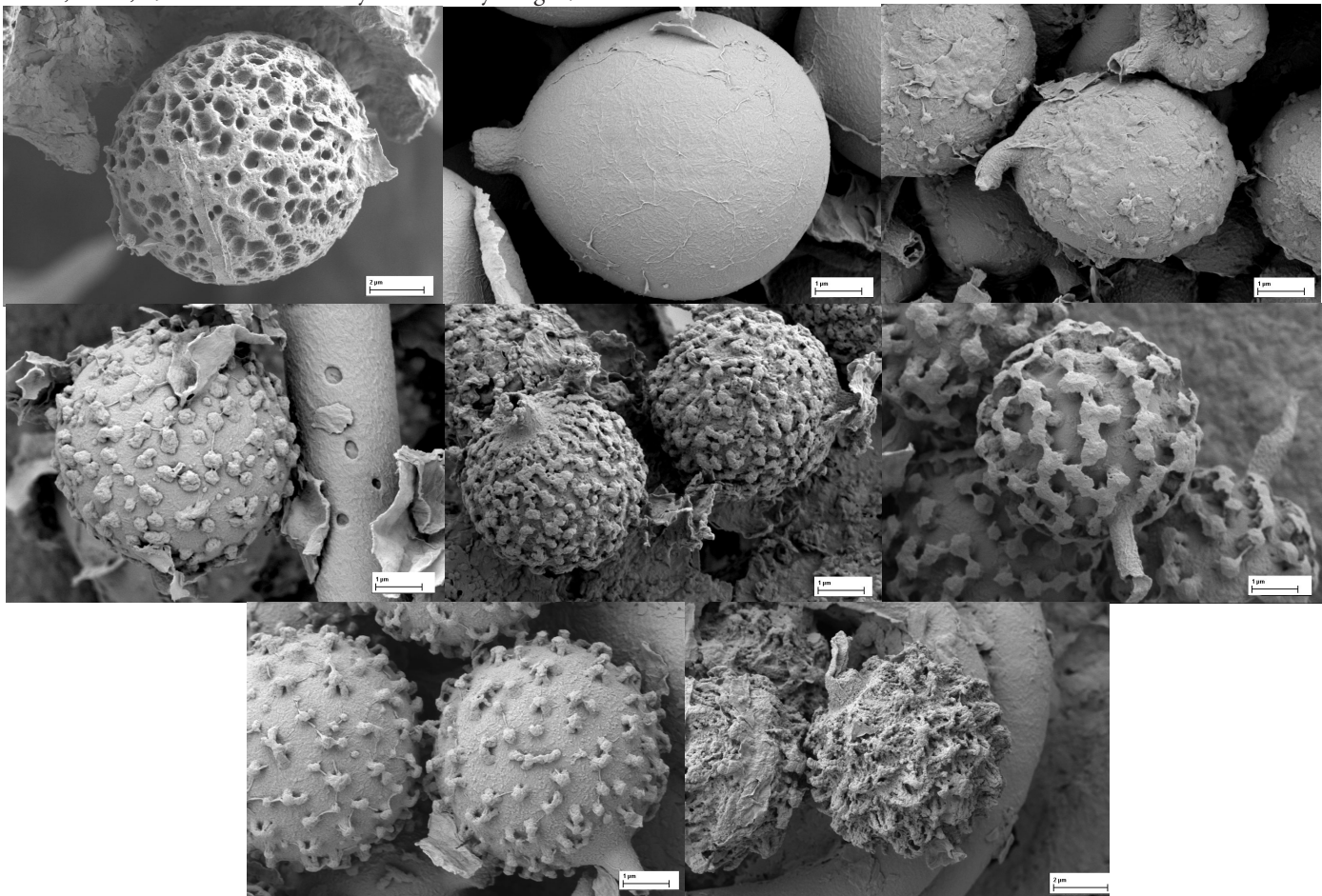
to let us know of your interest.

Mycodigest continued

For more details on methods used in this study, and a taxonomic key with descriptions of puffball fungi from California, please visit the website: www.NapaValleyFungi.com.

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From left to right: Spore types: [1.] Pitted, *Mycenastrum corium* with SEM at 7,000x (scale: 2 μ m) [2.] Smooth, *Disciseda brandegeei* with SEM at 7,000x (Scale: 2 μ m) [3.] Asperulate, *Disciseda atra* with SEM at 12,000x (Scale: 1 μ m) [4.] Asperate, *Disciseda luteola* with SEM at 12,000x (Scale: 1 μ m) [5.] Verruculose, *Bovista pila* with SEM at 12,000 (scale: 1 μ m) [6.] Verrucose with truncate verrucae, *Lycoperdon molle* with SEM at 12,000x (scale: 1 μ m) [7.] Echinulate, *Lycoperdon vernimontanum* with SEM at 12,000x (scale: 1 μ m) [8.] Echinulate, *Disciseda subterranea* with SEM at 7,000 (scale: 1 μ m)

**About the Author:**

Stephanie Jarvis recently graduated from San Francisco State University, where she worked with Dr. Dennis Desjardin. Owner of *Napa Valley Fungi*, Stephanie consults on hazelnut orchards inoculated with Perigord truffles (*Tuber melanosporum*) and growing oyster mushrooms (*Pleurotus ostreatus*) for restaurants in the Napa Valley. To learn more about her work and her company, visit her website, www.NapaValleyFungi.com.

UPCOMING MSSF MENDOCINO WOODLANDS FORAY: FOOD - FORAYS - FUN

NOVEMBER 14-16, 2014

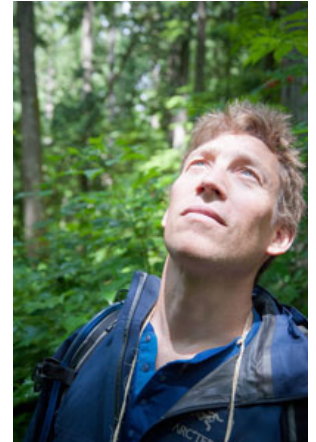
Deep in the Mendocino woodlands, MSSF members, friends, and family will gather once again this November for our annual north coast autumn fungal rite. Keeping with the “3- F’s:” Food, Forays, and Fun, this year, we will hold eight guided mushroom forays, a Saturday afternoon appetizer cooking demonstration, legendary dinners courtesy of chef Deb Dawson, and a legendary raffle, with bigger prizes than ever!

On Friday evening, Mike Wood and Fred Stevens will join Dr. Dennis Desjardin of the San Francisco State University Biology Department in a discussion of their forthcoming new book, *The Mushrooms of California*. Our Saturday evening keynote speaker will be the well-known writer and educator, Langdon Cook. His latest book, *The Mushroom Hunters: On the Trail of an Underground America*, which beautifully illustrates how foraging and consuming wild foods can revitalize our relationship with the natural world, won the 2014 Pacific Northwest Book Award. (Both books will be available for purchase at camp.)

All on-site meals and lodging (Friday night through Sunday lunch, alcohol is BYOB) are included in the \$220 dollar per person member rate; \$170 for children 5-12 years (accompanied by a paid adult).

Visit the website for registration information: See mms.mssf.org/members/evreg_view.php to register. Please register online if you can, but use the registration form below if you cannot register online. The schedule will be posted and sent to registered participants in October. For additional queries, please e-mail Stephanie Wright at lioness.chef@gmail.com (510) 654-6279 or Curt Haney at MendoDirector@mssf.org (415)-640-6233.

Do not wait to sign up! Over the last three years, Mendocino Camp has filled up within two weeks. Foray sign-up selections will be on the MSSF website during the registration process, or by when I receive your mailed registration. Foray selection choices will be first come first serve. More information can be found at www.MendocinoWoodlands.org.



Langdon Cook: writer, educator, and this fall's keynote speaker

Mendocino Fall Foray Registration Form

Name: _____
 Address: _____
 City: _____ State: _____ Zip: _____
 Phone: (____) _____ E-mail: _____

MSSF Member registration: (MEMBERS ONLY - NO GUESTS)

Adult (on site lodging) # _____ @ \$220.00 ea. _____
 Children (on site lodging) # _____ @ \$170.00 ea. _____
 (Ages 5-12)
 Children (on site lodging) # _____ @ Free
 (Under 5)

Total: _____

Payment Options:

Check (preferred): Please mail check with printed form to MSSF: 150 Sadowa Street, San Francisco, CA 94112

Credit Card: VISA _____ Mastercard _____ Card _____ Exp _____ 3 digit code on back _____

Please list all attendee's names and Mycological Club affiliation for badges:

Name	Club
#1 _____	_____
#2 _____	_____

_____ Please check if you are a senior or handicapped (for lodging preference)

_____ Please note number of vegetarians, if any, in your party.

Please list any food allergies or special requests:

Mycological Society of San Francisco
c/o The Randall Museum
199 Museum Way
San Francisco, CA 94114



"A World of Wonder at Your Feet"

Sept. 2014, vol. 66:01

MSSF Calendar September 2014

Sunday, September 7, MSSF Council Meeting

Monday, September 8, 7:00 p.m. - Culinary Group Dinner

Hall of Flowers, County Fair Building
Golden Gate Pk., 9th & Lincoln, S.F.

Pre-registration required for attendance. See calendar section at www.mssf.org. Email culinary@mssf.org to volunteer.

Tuesday, September 16, 7:30 p.m. MSSF General Meeting

Randall Museum, 199 Museum Way, San Francisco.

7 p.m. - Mushroom identification and refreshments.

8 p.m. - Speaker: Tom Bruns

Monday, October 6, 7:00 p.m. - Culinary Group Dinner

Tuesday, October 21, 7:30 p.m. MSSF General Meeting

Randall Museum, 199 Museum Way, San Francisco.

7 p.m. - Mushroom identification and refreshments.

8 p.m. - Speaker: Katrina Blair

MSSF Volunteers Needed

Join the Council leadership, learn the inner workings of the MSSF and help make decisions that shape the future of the society. Do your part by contributing your time to this 100% volunteer organization!

To learn more about all council and committee positions, go to: www.mssf.org members-only area, file archives, council member position descriptions. Or email president@mssf.org.

Wanted: *Mycena News* layout assistant. Familiarity with Adobe InDesign a plus. Contact president@mssf.org for details.

Officers and councilors for the 2014-2015 term:

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Vice President:	Brennan Wenck
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Secretary:	Eric Multhaup
Councilors: (1 year term)	Tyler Taunton
(2 year term)	Jackie Shay and Joe Soeller

Check the MSSF online calendar at:
<http://www.mssf.org/calendar/index.php>
for full details, latest updates
and schedule changes.

Submit to *Mycena News*! The submission deadline
for the October 2014 issue is September 15th.
Send all articles, calendar items and other information
to: mycenanews@mssf.org