

# SPORE PRINTS

BULLETIN OF THE PUGET SOUND MYCOLOGICAL SOCIETY  
Number 518

HAPPY  
NEW  
YEAR

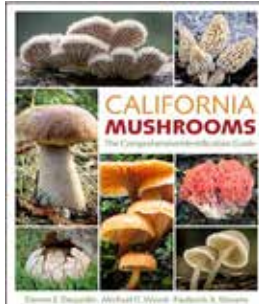


## CALIFORNIA MUSHROOMS: THE COMPREHENSIVE IDENTIFICATION GUIDE

Book Review by Debbie Viess  
Bay Area Mycological Society

When I first received my reviewer's copy of this new guide to California fungi I will admit to being impressed, but certainly not surprised. The three authors, Dennis E. Desjardin, Michael G. Wood, and Frederick A. Stevens, have been great good friends with each other for many years, and share a love for, as well as a great talent for mycology.

Professor Desjardin received his mycological training under the late Dr. Harry Thiers, and continues in his fine mycological tradition at San Francisco State University (SFSU), teaching and training students and leading annual mycology trips to the Sierra Field Station in the spring, as well as expanding our mycological efforts and knowledge to overseas. Stevens and Wood have collaborated on the fine online field guide, "The Fungi of California," for over two decades. Wood and Stevens are also fine photographers, and their photos make up the bulk of those within these pages. Primary author Desjardin is responsible for the text, written in an easily understandable and fact-filled style, one that he has honed over many years of teaching at SFSU. Other members of the California mycological community were tapped for both specialist's insight as well as photographs of fungi. The book is even better for the collaboration. All three authors are not only practicing field mycologists but also avid mushroom hunters – and as such, they bring a wealth of personal experience to their book



There are 650 species depicted by both photos and text, and 479 others are briefly described, providing an extensive but not exhaustive spectrum of interesting and common California fungi. Only those species with full descriptions are included in the keys; you will eventually come upon a mushroom that is not included here but that is a small criticism, and true of all other field guides.

Reading through my brand new volume of "California Mushrooms" (Timber Press) was like flipping through a photo album of old friends: my California fungal friends that is, in all of their mushroomy glory. The book is organized with large color photos of the mushroom right along with the text, a useful format. Concise and well-written chapters on mushroom biology and ecology, current nomenclature and taxonomy, as well as delimiting our new understanding of mushroom morphology and phylogeny precedes and enlivens the many species descriptions. There is a nice section on "How to Identify Mushrooms," from proper collecting techniques to important fungal features.

Mushroom edibility opinions in any field guide will vary from author to author and palate to palate. Some are determined by popular opinion, others by personal experience. But not all edibility information is equally valid. I was surprised to read the authors list *Boletus eastwoodiae*, a red-pored, bulbous-based bolete found in oak woodlands, as poisonous (in a brief sidebar on edible and poisonous California mushrooms) and then again as "edible with long cooking" (via hearsay). And some of these edibility claims are merely a way to say "not poisonous," but hardly worth eating. I was delighted to see Desjardin list *Amanita muscaria* as unambiguously poisonous, despite the second author's having touted its edibility after parboiling, on his popular website, Mykoweb.

*continued on page 3*

## JUDGE SENTENCES MAN FOR ILLEGAL IMPORTATION OF MATSUTAKE INTO JAPAN

Jiji Press English News Service, Dec. 10, 2015

A Japanese district court ruled that the 50-year-old second son of Ho Jong Man, head of the pro-Pyongyang General Association of Korean Residents in Japan, or Chongryon, is guilty of illegally importing matsutake mushrooms from North Korea to Japan.

Kyoto District Court sentenced Masamichi Kyo, to 20 months in prison, suspended for four years, for violating the foreign exchange law. It also gave the 70-year-old president of a Chongryon-affiliated Tokyo trading company a two-year prison sentence, suspended for four years. The company was fined 2 million yen.

According to the ruling, Kyo and the trading company chief imported about three tons of matsutake, declared to be worth about 7.6 million yen, from North Korea in September 2010 by claiming

that the mushrooms were from China. Matsutake is among items subject to an import ban under Japan's economic sanctions on North Korea. In the trial, Kyo claimed to be innocent, saying he did not know the mushrooms would be exported to Japan.

But presiding judge Makoto Wada said his testimony is untrustworthy. The trading firm president played a leading role in the matsutake import by procuring the mushrooms in North Korea, the judge said, adding that Kyo well knew the circumstances around the matter and was in charge of administrative procedures relating to the import.

"Their behavior represented a very antisocial act undermining the Japanese government's sanctions policy against North Korea," the judge said.

The defense said it will consider filing an appeal.

Chongryon said in a statement that the ruling was unjust, ignored the truth and would fuel anti-Chongryon sentiments.

# Spore Prints

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## MEMBERSHIP MEETING

Regular meeting is 7:30 p.m., January 12, 2016 at the Center for Urban Horticulture, 3501 NE 41st Street, Seattle.

Our featured speaker is Peter McCoy, based out of Portland. A self-taught mycologist with over 14 years of accumulated study and experience, Peter is an original founder of Radical Mycology, a grassroots organization and open-source movement that teaches the skills needed to work with mushrooms and other fungi for personal, societal, and ecological resilience.



He is the author of the upcoming book, "Radical Mycology." Peter will cover some of the more obscure corners of the fungal realm from Antarctica to the bottom of the ocean and expose what we've all been missing. The result just may change the way you think about fungi and the world at large.

Would members with last names beginning with A-K please bring a snack or refreshment to share after the meeting?

## PRESIDENT'S MESSAGE

**Kim Traverse**

I'm not one to start a new year with a list of resolutions but I sometimes *do* come up with goals for the year and have even, at least occasionally, made those goals. I didn't run for president just because "someone has to do it" or to fix things that were broken since things certainly were *not* broken.

But I do have ideas for improving our operations, ways to make regular activities easier and more efficient, better ways to accomplish our mission. A little progress year by year keeps PSMS healthy.

If I had to come up with one goal I think we need to work toward, it would probably be helping interested members become better identifiers. Not everyone will want to get into that larger pool that means really paying attention to any and all of the thousands of mushrooms out there, but PSMS will always have use for those who do. It means doing field trips, ID clinics, and helping out with the occasional medical emergency.

If you think you have the interest, PSMS can certainly help you gain the knowledge and experience. Talk to Brian Luther, Danny Miller, Marian Maxwell, Steve Trudell, Adrian Lee, Josh Powell, Daniel Winkler or Wren Hudgins about what it takes and what you can expect to get out of it. Their personal stories will inspire you!

I'm always happy when members share ideas or concerns with me. Within such a large group it is easy to forget that everyone has their own perspective on what needs to get done and how to do it. An email to [president@psms.org](mailto:president@psms.org) will always get my attention.



## CALENDAR

January 12	Membership meeting
January 18	Board meeting
January 19	Feb. Spore Prints deadline

## BOARD NEWS

**Luise Asif**

New Year's greetings. The year 2016 promises to be a busy and exciting year for PSMS. We need an enthusiastic person who is interested in taking the lead for PSMS publicity and forming a Publicity Committee for the club. The 2016 Annual Show date has been changed to October 29 and 30<sup>th</sup> with setup on October 28. Erin and Brady Raymond and their Blog Committee expect to be able to roll it out March 2016. Nominations for the 2016 – 2018 term are open. Contact Marian or Donna with your nominations or your own willingness to run either at the membership meeting or through email, [pastpsmspres@yahoo.com](mailto:pastpsmspres@yahoo.com). Elections will be held in February and the new board members introduced at the Survivor's Banquet in March. The board thoroughly discussed five Ben Woo Scholarship requests. Two were approved as meeting the guidelines and clear in objective. Discussions continue on the 2016 fall Ben Woo Foray, possibly linking it with the All Sound Foray that PSMS will co-sponsor with the Kitsap Club. The board is developing a Volunteer Guild so our hard-working members who help make this club a success are recognized by the membership.

## CALIFORNIA MUSHROOMS

cont. from page 1

Author Mike Wood has had a longstanding interest in the genus *Inocybe*, and this is reflected in the abundance of *Inocybe* photos and descriptions. Dennis has built his career upon more delicate genera like *Mycena* and *Marasmius*. In collaboration with the work of his former graduate student, Brian Perry, these small and often colorful saprobic denizens of California are well represented, described and photographed.

Author Fred Stevens has long had a fascination with the genus *Agaricus*, and is in fact our acknowledged expert in this group here in California. Many interesting and little known *Agaricus* species are described and illustrated in "California Mushrooms." Surprisingly, many had Latin *nom. provs.* taken from Rick Kerrigan's still unpublished work on North American *Agaricus*. This is a bit unorthodox, but will certainly give this section a leg-up over other identification guides, once these names are actually published and come into usage.

Puffballs are another group of special interest to Stevens, and this section was no doubt also helped by his collaboration with Stephanie Jarvis, who recently obtained her master's degree in Desjardin's lab. At the start of the puffball section, there is an iconic photograph of the "Methuselah Puffball Ring" of *Calvatia pachyderma* at Knowland Park in Oakland. This remarkable and fungally historic structure is more than 100 years old and is sadly threatened by an Oakland Zoo expansion.

I found it particularly useful to have the new Latin names for various genera of inky caps finally spelled out in print; up until this book, we have had to write the new names of these species in the margins of our old field guides! As most of you know, the genus *Coprinus*, typified by *Coprinus comatus*, was broken up into several new genera, once we realized that the group was polyphyletic. Our commonly encountered California inky caps can now be found in *Coprinopsis*, *Coprinellus* and *Parasola*, with only the shaggy mane, *C. comatus* and a few other species remaining in *Coprinus*.

Mushroom novices, looking to put names to their fungal finds, can begin with a simple pictorial key to mushroom body shapes. This then takes you to keys for various genera. The keys are simple to use, but have the same drawbacks as any other key, if you have either an unusual form or an undescribed mushroom. Considering that over 3,000 species of fungi are estimated to grow in California, that leaves you with the potential for quite a few unsolved mysteries!

Mushroom taxonomy and nomenclature are constantly evolving, and one must eventually just send one's book to the printer. Missing the cut were the many new species of *Butyriboletus* or butter boletes, like the former *Boletus* now *Butyriboletus regius* and *B. abietinus* (now *Bu. abietinus*). Also no longer an accepted North American (NA) species is *Lactarius deliciosus*, the former NA varieties of which have been elevated to species level. *Lactarius deliciosus* "varieties" (aka cryptic species) are discussed in the *L. deliciosus* comments.

continued on page 5

## ECOLOGICAL ROLES OF FUNGI - A REFRESHER

Ron Post

You may want to know all about this subject if you're interested in fungi and you are made of organic matter, because some fungi are just waiting to digest you. It's as if the mushroom is the chef, and you or your deliciously available organics (skin or hair or whatever else you are made of) become the juicy piece of meat. No cooking required!

The mushroom produces the spices, aka the enzymes, to help the digestive process along. This is called decomposition. Sounds musical, eh? As the melody plays, if the fungus is not eating you it can find plenty of other things to chew on: leaves, trees, decaying wood, paper, insects, cheese and just about all the other organic matter available. And it doesn't even need a stomach!



Dave Poling artwork

Fungi is the kingdom of gastronomy gone wild. And there are, of course, many different kinds of chefs and cuisines. Some scientists classify the ecological role of fungi using the following method: as saprotroph, necrotroph or biotroph. Does it decompose dead organic matter? Does it digest and kill live things? Is it mutualistic or parasitic?

Many fungi are not decomposer-chefs (saprotrophs) but symbiotic partners with other life (biotrophic.) These are called by various names. Mycorrhizza is a good term but bulky and well ... Greek. I prefer the simpler term partner. It's a bit more romantic and it accurately describes the unseen fungi residing in the roots of most plants. Partner fungi get nutrients such as sugars from the plants, and the partner-plants get a number of benefits, including more water and nutrients and some protection from disease. It's that simple!

Well - it's really a bit complex. Fungi are extremely important to the forests in our temperate zone. Forests rely on mycorrhizal mushrooms to help them thrive. There is evidence that these fungi are completely necessary for forests to regenerate: studies in alpine areas show that trees will not colonize land where glaciers have receded unless mycorrhizal fungi are present. Other studies show that conifer trees, especially those within the group Pinaceae, will not be healthy unless accompanied by fungal partnerships. Timber companies learned this fact long ago and so they inoculate the roots of their soft-wood seedlings with fungi before planting.

It is also thought that when plants first evolved on land they were only able to do so with the help of fungal partnerships. Lichens, a mutualistic association between fungi and algae and/or bacteria, are thought to be one of the most ancient land-dwelling life forms. Fungi are in a league of their own, and they even compete with each other. For more information on competition, succession and how fungi invade or co-exist with trees, you can watch Professor Lynne Boddy's online Vimio. Of course, wild animals and insects are happy to spread the spores of both the partner fungi and harmful ones into new areas. Eating the fruited mushroom or just walking through mushroom habitat will do the trick. You and I help this process along when we pick mature mushrooms and transport them. Spores get around.

## TOP BANANA MONOCROP ONCE AGAIN THREATENED BY FUNGAL PATHOGEN

Ottawa Citizen

In the mid 1900s, the most popular banana in the world - a sweet, creamy variety called Gros Michel grown in Latin America - all but disappeared. At the time, it was the only banana in the world that could be exported. But a fungus, Panama Disease, which first appeared in Australia in the late 1800s, changed that after jumping continents. The damage was so great and swift that in a matter of only a few decades the Gros Michel nearly went extinct.

Now, half a century later, a new strain of the disease is threatening the existence of the Cavendish, the banana that replaced the Gros Michel as the world's top banana export, representing 99 per cent of the market. And there is no known way to stop it or even contain it.

That's the troubling conclusion of a new study published in the journal PLOS Pathogens, which confirmed something many agricultural scientists have feared to be true: that dying banana plants in various parts of the world are suffering from the same exact thing, Tropical Race 4, a more potent mutation of Panama Disease.

Specifically, the researchers warn that the strain, which first began wreaking havoc in Southeast Asia some 50 years ago and has more recently spread to other parts of Asia, Africa, the Middle East and Australia, will eventually make its way to Latin America, where the vast majority of the world's exported bananas are still grown. They say, it's not a question of whether Tropical Race 4 will infiltrate the mother ship of global banana production; it's a matter of when.

The reason the original disease and its latest permutation are so threatening to bananas is largely a result of the way in which we have cultivated the fruit. While dozens of different varieties are grown around the world, often close to one another, commercially produced bananas are all the same because they are effectively clones of each other.

This helps companies like Dole and Chiquita control for consistency and produce massive amounts of bananas on the cheap without having to deal with imperfections, but it also makes their bananas vulnerable to attacks from disease. When you get rid of variety entirely, you risk exposing a crop to something it can neither cope with nor evolve to defend itself against. The virtual extinction of the Gros Michel is an apt example. When the first strain of Panama Disease appeared in Latin America, there was nothing to stop it. This is how journalist Gwynn Guilford, who chronicled the hopeless sequence in a piece for Quartz last year, put it: "By 1960, 77 years after it had appeared, Panama disease had wiped the Gros Michel out of every export plantation on the face of the planet." The latest strain is likely to put the risks of monoculture on display once more. And while scientists might find or breed a better banana in the meantime, it could be only a matter of decades before the most popular banana on the planet once again disappears.



## CHEFS SUCH AS MARY BERRY BLAMED FOR RISE IN ILLEGAL MUSHROOMING

The Daily Telegraph

Television cooks such as Mary Berry, the Great British Bake Off judge, have been blamed for a sharp rise in illegal mushroom foraging at the Royal Parks in London.

Some 80 people have received police warnings for picking fungi in Richmond Park and Bushy Park, with two prosecutions in the past year, according to Pc Paul Barber, of the Metropolitan Police. Foraging in the Royal Parks, which have more than 400 species of fungus, many of them endangered, is banned. "We've noticed a steady rise in mushroom foraging which could be attributed to celebrity chefs' endorsement," Pc Barber said. "In some cases, we have caught individuals with enough mushrooms to fill a small dustbin."

Conservation experts fear that fragile ecosystems that provide food for wildlife are being damaged. Berry revealed earlier this year on her show, Mary Berry's Absolute Favourites, that she has been a keen mushroom hunter since childhood.

## NEWLY DISCOVERED MARINE FUNGI, A UNIQUE BRANCH ON THE TREE OF LIFE, MAY HAVE EVOLVED ON LAND

Science Daily Nov. 18, 2015

Researchers from the University of Exeter have discovered several new species of marine fungi inhabiting previously undescribed branches of the tree of life. Little is known about the fungi in the world's oceans. This study revealed that many marine fungi are very different from those found on land. The research, published in *Proceedings of the Royal Society B*, used large-scale DNA sequencing to describe the diversity of fungal microbes in a wide range of marine environments. The study found a lower diversity and abundance of fungi in marine environments, suggesting that the majority of evolutionary diversification of fungi occurred on the land not in the sea.

Professor Thomas Richards from Biosciences at the University of Exeter said: "Compared to their land-based counterparts, little is known about the diversity and function of fungi in the oceans. We identified more than seventy marine fungi and in doing so we discovered several previously undescribed groups that are so genetically different from others we know of that they must represent highly unique branches on the tree of life."

Samples of marine fungi were taken from near the shore in six European locations across Bulgaria, Norway, Spain, Italy and France. Their genetic code was then mapped to understand how closely related they were to each other and to terrestrial fungi. The results reveal the diversity and abundance of fungi in marine environments. They also help to build understanding of the evolution of these important microbes and shed light on how frequently fungi have transitioned from marine to terrestrial environments in the past. The researchers believe that further sampling of fungi from different marine habitats, including those living on animals and algae, will reveal still more undiscovered species and help us understand fungi in the marine environment.

## CALIFORNIA MUSHROOMS

cont. from page 3

Not surprisingly, the key to *Mycena* species is extensive and excellent, using easily perceived characters like color and the presence or absence of latex and fruiting substrate, and whether the mushrooms have marginate (colored) gill edges. Budding mycologists need to carry a hand-lens!

*Psilocybe*, an ever popular genus here in California and especially in the Bay Area, are given short shrift, with only *P. cyanescens* described and two other woodchip-dwelling *Psilocybe* sp. mentioned. No word on those famous cow-pie pasture fruiters, *Psilocybe semilanceata*, so commonly collected in Humboldt County, the senior author's boyhood home.

Amanitas are given a rather cursory treatment, with much incomplete information and even incorrect information. Since amanitas contain some of the most important of our California mushrooms relative to public health, these omissions are perplexing. The introduced *Amanita phalloides*, a mushroom that kills unwary foragers on a regular basis, and which is the only known instance of an invasive mycorrhizal mushroom in North America, has expanded its host trees from live oak and cork oak to both tan oak and pine, and now occurs in places here in California where it never grew before, including the wildly popular mushroom hunting grounds of Salt Point State Park on the Sonoma Coast. This information has been available for years, and should have been included in this book.

Although a *Cortinarius* expert recently published a new name for a familiar spring species of amanita, *Amanita vernicoccora*, or the Spring Coccora, that didn't mean that we should throw out all of the rest of our knowledge of this species, obtained over many decades. Although Bojantchev perhaps has only found it with black oak in the Sierra, many others have found it with pine in the Sierras, and a variety of hardwoods coastally. It is also commonly found with a white cap, not merely a yellow one. None of this information was included. I was glad to see that Desjardin acknowledged that the range for *vernicoccora* extended out of California and up into the Pacific Northwest.

"California Mushrooms" claims that our Sierran *Amanita aprica* is not the same as the *A. aprica* first named from the Pacific Northwest, but that is not in fact true. They are both DNA identical, and both have a similar range of colors, from bright day-glo yellow to orange. Color morphs of amanitas like the commonly encountered white phase *Amanita velosa* and yellow-capped *Amanita augusta* and white *Amanita muscaria*, as well as pure white forms of *A. vernicoccora* were left unmentioned. The fall coccora, *Amanita calyptroderma*, a popular edible species here, also has many color morphs, including a dark brown and a metallic copper and very rarely, white. None of these colors are mentioned.

*Amanita protecta*, one of our endemic grisettes, has apparently been found by Fred Stevens under pine; most collectors find it under live oak, and there has even been recent documentation of it growing in pure stands of willow. Why not gather data from more than one source, and present the broader perspective? As to its edibility, yes, it is not poisonous (no grisettes are) but it frankly tastes awful. I have eaten it but have no desire to repeat the

experience. Claims are made that the European species *Amanita vaginata*, one of many barely distinguishable grisettes, occurs here in California, which is highly unlikely, and disputed by most amanita experts. We have plenty of unnamed grisette species in California; what we call "*vaginata*" is one of them.

I was puzzled by the authors' selection of *Morchella* species. There is no question that recent North American morel names have been confusing, owing to practically simultaneous publications from France and the United States. But if so, why use as your few illustrated species morels that simply cannot be told apart in hand, and ignore the few good and recognizable species that we do have here, like *M. snyderi* and *M. tomentosa*? The new name for our widespread North American blonde morel is not *esculentoides* but *M. americana*. *Morchella rufobrunnea*, the wood chip morel, is not a "blonde morel," nor representative of the *esculenta* clade, although it is pale. The book contains a photo of *M. americana* by Hugh Smith, mislabeled as *rufobrunnea*. But none of this is easy. It might have been helpful if the authors had consulted with Michael Beug, who wrote a recent fine book on the "Ascomycete Fungi of North America," and spent many long hours untangling morel names, although even his up to date research and name conclusions have been modified with new genetic data presented in a recent Mycologia paper, a collaboration between North American and French mycologists and geneticists. If you are confused by the new NA morel names, you are not alone. But Latin names are not important in the fry pan. Like Desjardin stated at a recent talk, acknowledging the difficulties of sorting out these new names: regardless of Latin name, all morels are edible!

These issues aside, on the whole I like this book very much. It will serve as an excellent in-home reference, or perhaps a back-at-camp reference, but certainly not an in-the-field guide proper. Weighing in at four and a half pounds, this extensive and colorful treatment of California mushrooms makes David Arora's "Mushrooms Demystified" feel like a featherweight! It will certainly prove to be a useful volume for any library, and especially for western mushroom hunters and identifiers. Nice job, fellas.

(This review was adapted from the BAMS newsletter with permission of the author. A longer version first appeared in *Mushroom, The Journal of Wild Mushrooming*, Issue 113, Vol.31, No.2-3, Spring-Summer 2015.)

## SERVING ON THE PSMS BOARD OF TRUSTEES IS FUN, EDUCATIONAL AND REWARDING

At PSMS we look forward each January to another year of good mushrooming and fun, especially the Survivor's Banquet in March, when results of the election are announced. A few forward thinkers in PSMS are looking for people to embark on a journey of learning and growth, aka service on the board of trustees. Requirements for serving on the board are enthusiasm for mushrooms and mushroomers and the willingness to help PSMS grow by serving its membership and the public. The election is coming up. If you are interested in running for the board or would like more information, contact (soon) Marian Maxwell or any member of the election committee. Serving on the board is fun, rewarding, and educational and requires no heavy lifting (usually).



# Royal harvest of urban mushrooms



*Agaricus augustus, the Prince, growing in a North Seattle park, 2015*

From July of last year through October, *A. augustus* grew (almost every week) in landscaped ground near my P-patch in a small area of about 30 square-feet. Each specimen shown here had the telltale odor of sweet almond and other characteristic signs such as small brown patches on the underside of the thick annulus. I first picked the Prince near the UW campus more than a quarter-century ago. Among the larger, brown-spored mushrooms growing in urban environments (during summer) the Prince is one that every beginner should aspire to learn. (It is also worth noting that the genus *Agaricus* can be efficient at taking up heavy metal contaminants.) A good starting point for identifying mushrooms of this genus is the Pacific Northwest Key Council identification key (online) and also see David Arora's "All That the Rain Promises and More," which has a good treatment of West Coast *Agaricus* species. - R. Post

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## MAKE HISTORY: VOTE FOR THE TRUSTEES OF YOUR CHOICE IN 2016

The February issue of Spore Prints should reach you a little earlier than usual, because it serves as our annual ELECTION NOTICE. You will find in that issue your official PSMS ballot(s) and instructions for voting for your chosen candidates.

Remember to return your marked ballot postmarked no later than February 28, 2016. Winners for each open position plus any alternates who wish to serve will be named at the Survivor's Banquet in March.

The election committee has worked hard to present a slate of excellent, capable and enthusiastic candidates. Their pictures and brief statements will

appear in the pages of the February issue of Spore Prints along with the paper ballot. Instructions on voting methods are included.

Board members serve two-year terms and alternates are named in case of withdrawals during any board member's term. Feel free to contact a present or past PSMS board member with questions.

This year's election committee is chaired by Immediate Past President Marian Maxwell. Marian can be reached by email: [pastpsmspres@yahoo.com](mailto:pastpsmspres@yahoo.com), or by phone at 425-235-8557.

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## OUT OF THE PAST

Dec. 2, 1995

To: Agnes Sieger  
From: Joy Spurr

Enjoyed reading about the mushroom found in amber, which is a fossil resin of vegetable origin, probably a tree resin in this case. There is a fossilized *Coprinus* species at the Burke Museum. It was found in volcanic ash and lava in southern Idaho and documents the existence of mushrooms in that part of the world over 60 million years ago. I have a photo of it in my slide show "Introduction to Mushrooms."

Sixty million years go back to the time when the Rocky Mountains were forming, and possibly the Cascades were just starting to form. This is a fairly well-preserved specimen that easily shows it belongs to the *Coprinus* group. Maybe our members would like to know about this. I don't know if the specimen is on display. Most likely it is still in one of the basement storage cabinets.

Joy

*Editor's note:* Joy was a charter member of PSMS. Fossil fungi are extremely rare. Letter reprinted from SP issue No. 318.

# ANTIFUNGAL TREATMENT *IN SITU* ERADICATES SOME OF MALLORCA'S TADPOLE INFECTIONS

Biology Letters Nov. 18, 2015

Emerging infections are on the increase, incurring extraordinary economic and health costs and globally degrading our natural capital. In response, several efforts to eradicate animal pathogens are under way, however with few successes. Research on livestock pathogens predominates and provides insight as to how pure wildlife pathogens may be combated for host conservation purposes.

Delivery of an efficient and practical intervention is a cornerstone of any scheme to eliminate infectious diseases, and the direct application of antimicrobials to infected hosts or immunization can be used effectively to control pathogen replication within a host and to reduce the likelihood of transmission to susceptible individuals.

However, for these types of interventions to be effective, control of environmental reservoirs of (re)infection must also be achieved. Local control of pathogens through the use of environmental chemical treatments has been effectively used to disinfect areas where environmental transmission of parasites can occur, but the impact of chemical treatment on transmission and maintenance of infection in concert with antimicrobial treatments has rarely been examined.

Amphibian chytridiomycosis, a disease predominantly caused by the aquatic chytrid fungus *Batrachochytrium dendrobatidis* (*Bd*) has driven population declines, local extirpations and species extinctions across five continents. The pathogen is an extreme generalist, infecting over 700 amphibian species (<http://www.bd-maps.net>).

Strategies developed to ameliorate the impacts of chytridiomycosis are predominantly geared towards disease-free maintenance of captive assurance colonies, and multiple methods have been developed to treat captive amphibians against infection with *Bd*; however, most attempts at immunization have failed.

The remaining approaches that hold promise for *in situ* control include bioaugmentation with bacteria, direct application of antifungal drugs and environmental application of anti-*Bd* chemicals. Although not without promise, research on the application of bioaugmentation so far describes complex interactions between host, beneficial bacteria, the broader microbiota and pathogen that are strongly dependent upon environmental context and amphibian community structure.

We chose to explore direct application of antifungal drugs to infected hosts and environmental application of chemicals as strategies to eliminate *Bd* from a simple, single host system.

## Abstract

Here, we report the outcome of a five-year effort to eliminate infection with *Batrachochytrium dendrobatidis* affecting an island system with a single amphibian host. Our initial efforts to eliminate infection in the larval reservoir using a direct application of an antifungal were successful *ex situ* but infection returned to previous levels when tadpoles with cleared infections were returned to their natal sites. We subsequently combined antifungal treatment of tadpoles with environmental chemical disinfection.

Infection at four of the five pools where infection had previously been recorded was eradicated, and remained so for two years post-application.

## Material and methods

Biannual surveys at five permanent ponds were undertaken from 2008 and are ongoing. We sampled Mallorcan midwife toad (*Alytes muletensis*) tadpoles, as terrestrial stages are rarely captured as they take refuge in inaccessible locations. Tadpoles of this and other *Alytes* sp. are recognized as reservoirs of infection.

To sample, we swabbed tadpole mouthparts following established protocols. All ponds affected by chytridiomycosis on the island were included in the study and none were left as untreated controls owing to conservation requirements. However, chemical disinfection efforts at Torrent de Ferrerets preceded those at Cócó de sa Bova, affording us the opportunity to compare across sites.

Swabs were processed according to standard extraction and quantitative PCR (qPCR) methods in duplicate and run against negative controls and positive controls (0.1, 1, 10 and 100 zoospore genomic equivalents, GE).

For antifungal treatments, tadpoles were collected and transported in plastic bottles containing pond water. We used air pumps and tubes with aeration stones to ensure tadpole survival during the outward hikes. Tadpoles were then transported to the laboratory and kept in several cooled, glass aquaria.

All tadpoles were bathed daily for seven days in aged tapwater containing 1.0 mg l<sup>-1</sup> itraconazole (Sporanox, Janssen-Cilag Inc.) and returned to aquaria after each treatment. Aquaria water was replaced every day during the seven-day treatment.

After treatment, tadpoles were returned to the collection sites by helicopter, either immediately if ponds were not drained or after ponds were refilled by autumn rain. In these cases, subsets of 40 tadpoles from each aquarium were swab-sampled 15 days post-treatment. Environmental disinfection was done using Virkon S (DuPont Inc.) at 1% final concentration and a single application applied ad libitum to the environment. The disinfectant was liberally applied to all rock, gravel, crevice and vegetated areas that surrounded the immediate environs of each breeding site.



*A Mallorcan midwife toad with eggs*

*Editor's note:* Full text of this research article may be acquired for payment at <<http://rsbl.royalsocietypublishing.org/content/11/11/20150874.full>>

## Finnish Funnel Chanterelle Pie (pie with an underrated mushroom)

South Vancouver Island  
Mycological Society website

### Ingredients

8 oz. Craterellus tubaeformis  
1 large onion  
1/2 t. salt  
1/2 t. ground white pepper  
dash of ground clove  
dash of nutmeg  
3 T. butter  
1 lb. puff pastry, thawed  
6 oz. grated Emmental cheese  
8 oz. sour cream  
2 eggs, beaten

### Methods/steps

Thaw the pastry sheet at room temperature. Line the bottom and edges of a greased pie tin with the pastry. Chop the onion and fresh mushrooms finely. Melt the butter in a saucepan over medium heat, add the onions, mushrooms and seasonings, and allow to simmer until the water is evaporated. Let it cool a bit. Mix with the grated Emmental cheese, sour cream and eggs. Spread the mushroom-onion mixture over the pastry and then pour the cheese-sour cream-egg mixture over it. Bake the pie at 375 degrees F for approximately 30 minutes. Serves 4-6.



### In Memoriam TRK



*When we hunted mushrooms, the winter flew away  
Like a fledgling meadowlark as upward it wheels  
Along green valleys where it will live an age.*

*Light plays with the omens of spring, turning  
Weeds into tall flowers, hopes into ready meals.  
When we hunt mushrooms the winter flies away*

*Leading us up roads into full summer, and so  
What if the fading blue-eyed grass steals  
Away the green valleys of spring living their age?*

*There are always latecomers for spring morels  
And buggy favorites, king and queen boletales.  
We hunted mushrooms and the winter fell away.*

*How glad we are to tread across the snow  
To see lady-slipper orchids and glacier lilies  
In long valleys where they have lived an age,*

*How warm the sun as we face the waning light,  
Troubles parted from our hearts as we drink our ales.  
Hunting mushrooms as winter flies away  
In the ancient valleys, we will live an age.*

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