# Obispoensis

Newsletter of the San Luis Obispo Chapter of the California Native Plant Society


February 2013

## Common Polypody or California Polypody

*Polypodium californicum*

Bonnie's drawing this time represents a fern recently found in the Los Osos Elfin Forest. The fern is the common or California polypody (*Polypodium californicum*). It was found by Al Normadin while scouting for his recently led trip in the Elfin Forest. It is a quite common and widespread fern on the Central Coast, where it is commonly found growing along edges or out of cracks in rocks. It is especially common on north facing slopes. However, I was surprised to find it reported from the Elfin Forest. This is because ferns generally require consistently available soil moisture. Since the Elfin Forest Reserve's sandy soils tend to lose their moisture and it doesn't rain for over six months, one would not expect to find many fern species here. I suspect these particular ferns are able to do so because they occur in shade near or under the pygmy oak over-story where the oaks provide shade and extra moisture. The extra moisture comes from the ability of the pygmy oaks to condense water on their leaves and twigs from the common coastal fogs. This fog drip can add over 20 inches of extra water to that which falls from the clouds. Even the extra moisture from fog drip might not be enough to support California polypody were it not for this particular fern's ability to go into an extended period of dormancy. That is, the living green leaves simply die back to the under ground stem (rhizome) and decompose during the dry months. Therefore this fern actually totally disappears from view during the rainless months of the year. This disappearance probably explains how it could be present, yet not recorded in a species list. Then when moisture returns to the soil, the buds on the rhizome produce one to several new leaves. A note about all of our native ferns, the only visible vegetative structures one can observe without digging are the leaves. Stems and roots are all below ground. California polypody appears quickly after the first rains of autumn.

Bonnie's main drawing actually shows two non-seed producing plants. The larger one, as stated above, is the common or California polypody or *Polypodium californicum*. The smaller, but more numerous is some kind of moss. I have no idea what kind. Mosses and their closely related liverworts and hornworts are usually neglected in nature books. Neither mosses nor ferns produce seeds. Seeds are complex multi-cellular reproductive structures that consist of at least three parts. These include the outer, protective seed coat whose cells contain DNA that is identical to the mother plant, a food supply (endosperm) often consisting of cells controlled by 2/3 mother and 1/3 father DNA, and an embryo whose DNA is one-half from each parent. Seeds allow land plants to disperse over a land environment. Mosses and ferns do not produce seeds, yet they too are land plants. So by what devise do they disperse over land? They use spores. Spores are simple, unicellular structures that are enclosed in a thick wall. Like seeds, spores usually are capable of a period of dormancy before they can germinate and grow. In the true plants (Kingdom Plantae, which includes mosses, ferns and seed plants) all spores contain a single set of chromosomes (haploid). In all true plants, spores are always produced in a capsule-like structure called a sporangium, each of whose cells contains two sets of chromosomes (diploid). Since the cells of the sporangium are diploid and the spores produced inside are haploid, something special must happen to at least some of the cells inside the sporangium. This special type of cell division occuring when a single diploid cell (spore mother cells) divides its chromosome number in half producing four haploid spores is meiosis. All sexual organisms do this process some time in their life cycle. The stalked sporangia in common polypody are produced in clusters on the underside of leaves. These clusters are termed sori (plural) or sorus (singular). Bonnie has drawn a portion of the underside of a leaf lobe showing several sori. A typical, single, tiny, stalked fern open sporangium is also shown. When these haploid spores germinate, the do not produce the fern plant one sees growing in nature. They produce a tiny, barely visible to the naked eye, haploid plant known as a gametophyte. This little plant, (not shown) produces the sex organs that produce either the sperm or the eggs. These gametophytes live on the soil surface where periodically there is moisture enough to create a film of water over soil and plants. The sperm then swims through this film of water to the egg. The fertilized egg grows into the typical visible fern plant that Bonnie has drawn.

Each cluster (sorus) contains a few score of sporangia. Let's say 60 sporangia. Each sporangium produces approximately 60 spores so a single sorus would be expected to produce 60 x 60 = 3,600 spores. Each leave produces about 20 sori, so the number of spores produced per leaf would be 72,000. Each individual fern plant produces at least 10 leaves so the number of spores per plant is now 720,000. But the California polypody is a perennial and it produces spores almost every wet year of its life. If we are conservative and say a given fern individual encounters only five wet years during it life, then during that individual's five-year life, it will produce 3,600,000 spores. How many of these spores must be successful in order to produce a stable population of fern plants? The answer is only two! What happens to the individuals that could have been produced from the other 3,599,998 spores? They die. If 3 or more are successful, the ferns population increases, if only one or none then the fern population decreases. ~ Dirk Walters, illustration by Bonnie Walters

## President's Note

I think the lilies are some of the most appreciated of flowers, and so Sean Ryan's presentation at our February meeting should be very interesting. We are scheduled for the library in Atascadero for our March meeting, which will feature a presentation slanting toward the north end of the county and points north. We are planning lots of great field trips for the late winter and early spring, and we will keep you posted.❊ David Chipping

## Conservation

I toured the burned area around Coon Creek, a result of a escaped control burn that ran through the riparian area and the southern slopes of Coon Creek, reaching close to the summit of Valencia Peak in one location. The trail was opened at the beginning of January, and revealed a hitherto concealed structure of the creek-side willows, which have large trunks running horizontally for long distances. Some re-sprouting had already started, and I am not concerned about that area. However the old growth manzanita stands along the Rattlesnake trail, and the lichen oaks are severely damaged, and there has been considerable ground disturbance from fire line construction in these areas. I am concerned that there might be an opportunistic invasion of veldt grass into this area, as a shale-loving variant is already in fast-grow mode along the trail. In an ironic note, plant specimens I had selected as my watch plants for the Phenology Project (see last newsletter) are now toast.

I attended a meeting on the North County Habitat Conservation Plan, and gave input on CNPS concerns. I also attended a meeting by the Department of Fish and Wildlife on the management of the Chimineas Ranch area, and have pointed out some problems we have seen. I also attended a meeting on invasive species held by the Morro Bay National Estuary Program. ❊ David Chipping

## Chapter Meeting

Thursday, February 7, 2013. Meet at the Veterans Hall, San Luis Obispo, 801 Grand Avenue. 7 p.m. social half-hour, 7:30 business meeting and program.

Local naturalist and CNPS member Al Normandin will host an identification workshop on Lichens before the monthly meeting on February 7 from 6:15 to 7 p.m. After a brief general introduction to lichens, we will be examining and identifying at least a dozen or so lichen samples commonly seen in the SLO area. If possible, bring a hand lens or magnifying glass for closer viewing of the samples.

"Adventures with *Fritillaria"* Sean Ryan is the program speaker for the February 7 meeting. Sean is a Master's student at San Diego State University studying the systematics *Fritillaria* (Liliaceae). His work seeks to clarify the species relationship within this charismatic group of lilies using DNA sequencing and morphological studies of current and past researchers. Sean has traveled throughout California collecting different *Fritillaria*. He will share trip photos and photos and stories from his research with *Fritillaria*.

Sean grew up in Arroyo Grande and initially studied architecture at Cal Poly, SLO before eventually receiving his undergraduate degree in biology after he was bitten by the botany bug. He taught environmental education for two years at Rancho El Chorro Outdoor School for Kids before beginning the Master's program in Evolutionary Biology at San Diego State with Mike Simpson. He is currently working to finish his Master's thesis and is also teaching botany labs at Cal Poly, SLO with Matt Ritter.

The March meeting will be at the Atascadero Library Community Room on Thursday, March 7, 6 to 10 p.m.

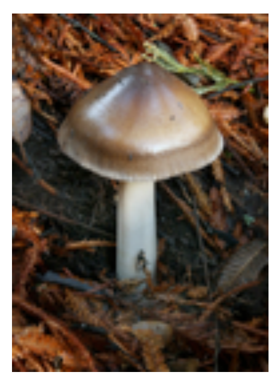
## Cambria Fungal Foray December 15, 2012

Twenty-four eager participants joined David Krause and Mark Brunschwiler Saturday morning for the CNPS's annual Cambria mushroom walk. Despite dry conditions and a scarcity of mushrooms, the group managed to find several interesting species, including the stately *Amanita pachycolea*. Additionally, the expected *Suillus* species were found in abundance, along with a variety of *Russulas*. Toward the end of the walk the group was excited to discover a magnificent fruiting of *Amanita muscaria*, whose bright red, white speckled caps made for a great photo opportunity. ~ Eric Brunschwiler

*Russula emetica*
emetic russula

*Suillus granulatus*
granulated slippery jack

*Amanita pachycolea*
western grisette



*Amanita muscaria*
fly agaric

## FIELD TRIPS

**Saturday, February 9, 9:45 a.m., Cal Poly Tree Walk.** This is an easy 2 hour stroll around the center campus to view the most diverse landscaped trees from all over the world that SLO County has to offer. Meet in front of the Kennedy Library located at N. Perimeter Road and University Drive. Library parking is free on Saturday. Rain or threat of rain cancels. If you need additional info, call leader Al Normandin at (805) 534-0462.

**Saturday, February 23, 9 a.m., Wildflowers and Waterfowl Collaborative Field Trip, Lopez Lake**. This is a walk to identify native birds (mainly waterfowl) and plants of the Lopez Lake area, along the Wittenberg arm of Lopez Lake. This walk will be about 4 miles in length and have a 200 foot elevation gain. We will meet at the Mabel French Boy Scout Camp. From Arroyo Grande, follow the signs towards Lopez Lake. After crossing the damn, but just before entering Lopez Lake County Park, turn right on Hi Mountain Road and proceed 0.8 miles to the junction of Upper Lopez Canyon Road. Bear left on Canyon Road and proceed 3.6 miles to the entrance of the Boy Scout Camp, on the left (west) side of the road. Park in the parking lot, where restrooms are available. No day use fees are charged as this area is outside of the fee area. Participants should bring water, snacks, and dress in layers for the weather; a hat and sturdy shoes are advised. A pair of binoculars will come in handy for bird watching. Rain or threat of rain cancels. For more information contact Bill at (805) 459-2103 or bill.waycott@gmail.com

**Saturday, March 2, 2013, 9 a.m., Late Winter BMC Chaparral CNPS Field Trip at the La Purisima Mission.** The California Native Plant Society (CNPS)/ Lompoc Valley Botanic and Horticultural Society (LVBHS) will hold their annual winter field trip to the Burton Mesa Chaparral on the La Purisima Mission grounds Saturday the 26th. Meet at the east end of Burton Mesa Boulevard (1550 E.) in Mission Hills at 9 a.m. for a chance to see the early bloomers and interesting scenery. To reach Burton Mesa Boulevard, get to SR 1 north of Lompoc. At the signal where SR 1 turns down hill towards Lompoc, take Harris Grade Road north to Burton Mesa Boulevard, and turn right (east). For more information call Charlie Blair at 733-3189.

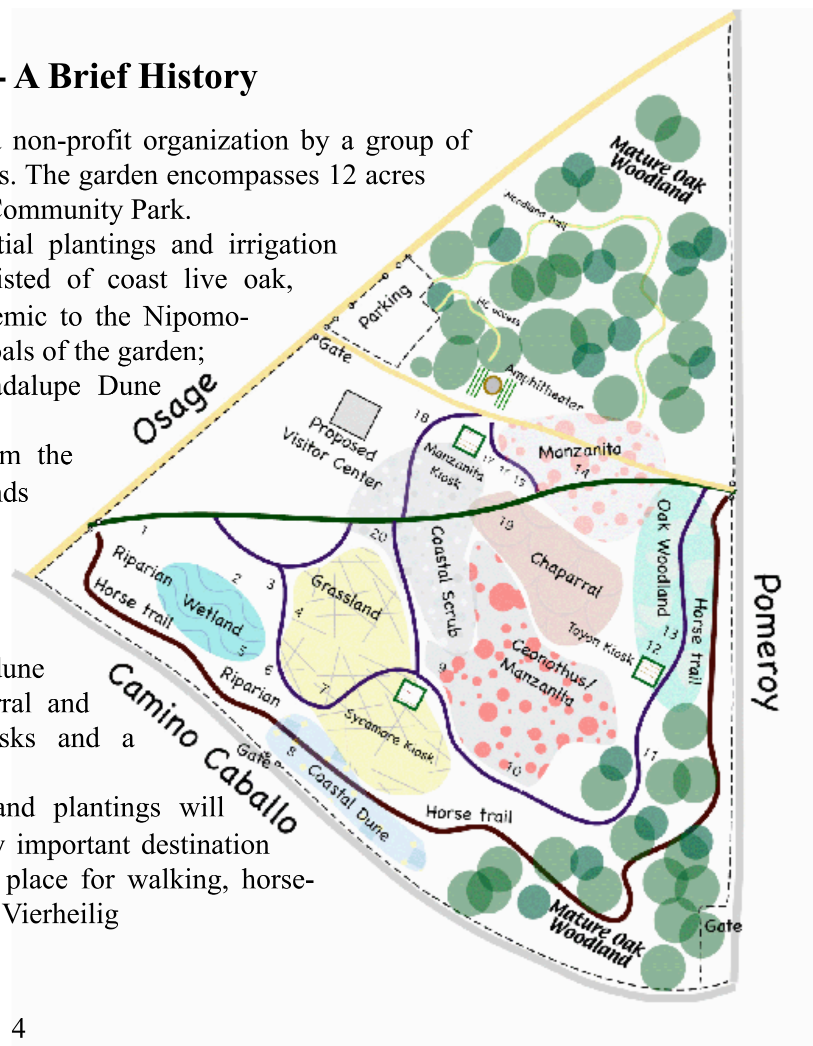
## Nipomo Native Garden - A Brief History

Nipomo Native Garden was formed in 1993 as a non-profit organization by a group of Nipomo residents and the County Board of Supervisors. The garden encompasses 12 acres and is disconnected by a road from the main Nipomo Community Park.

With several small grants from the County, initial plantings and irrigation installation were accomplished. The plantings consisted of coast live oak, toyon, manzanitas, coffeeberry and other plants endemic to the Nipomo-Guadalupe Dunes Complex. This became one of the goals of the garden; to feature the various habitats of the Nipomo-Guadalupe Dune Complex using endemic plant species.

In early 2003, the garden received a grant from the California Department of Fish & Game utilizing funds from the Unocal Oil Spill Settlement. This allowed expansion of the plantings, infrastructure and irrigation to rapidly expand. The garden, over a period of years, added paths and a road, fencing, wetlands, riparian area, coastal sage scrub, coastal dune scrub, manzanita/ceanothus, central maritime chaparral and other habitats. Also added were information kiosks and a desperately needed parking lot.

Improvement and expansion of infrastructure and plantings will continue as the garden matures. It has become a very important destination for residents of Nipomo and surrounding areas as a place for walking, horse-riding and just sitting and observing nature. ❊ Larry Vierheilig



## CHIMINEAS PLANTING

In December CNPS members planted native plants around the ranch house at Chimineas Ecological Reserve on two different days.  All the plants are native to that area. Marti Rutherford,  Doyle, Melinda Elster, Mardi Niles, Linda and Dave Chipping and I put in a total of fourteen shrubs and perennials. The grand total is now sixty-two. These replace plants that need too much water and care. We also removed some non-native shrubs. Thanks everybody!


We transplanted a coyote brush from a too-shady place to a good sun place with more water and drainage. We made a little grouping of two California evening primrose, a Salinas milkvetch, and a scarlet bugler. Two saltbushes were planted on a dry, sunny bank (probably common saltbush; they came up from seed in a pot). A woolly morning glory got out of its pot into its new home in the ground, plus a black sage and Jones' bush mallow; and a California  matchweed and pale-leaf goldenbush, where a Jimson weed had come up on its own. We put in two more scarlet buglers, and a yarrow. A quailbush replaced another that had died. A purple sage and California buckwheat will adorn a sunny bed together. We moved some big rocks into a group and planted a dud-leya there. It will be lovely, and we can add some other rock plants some day. We made a little hill and put a big-berry manzanita on top, with rocks and a purple sage and a mountain mahogany. Another mountain mahogany went in at a front corner, and will be cut to be tall and narrow. All of our plants have anti-gopher cages, and many have wire cages on top too. So far all but one are transplants. Nearly all are mounded, for better drainage.


On each day we made an excursion afterwards.  The first was to a place called red tank, where we saw mistletoe berries and junipers and Tucker oaks overlooking canyons. The second was along Tule Road, with beautiful sky and rocks and blue oaks.

I'm expecting flowers this year, 2013, from some of the plants that were planted early last year. We already had a few in 2012.

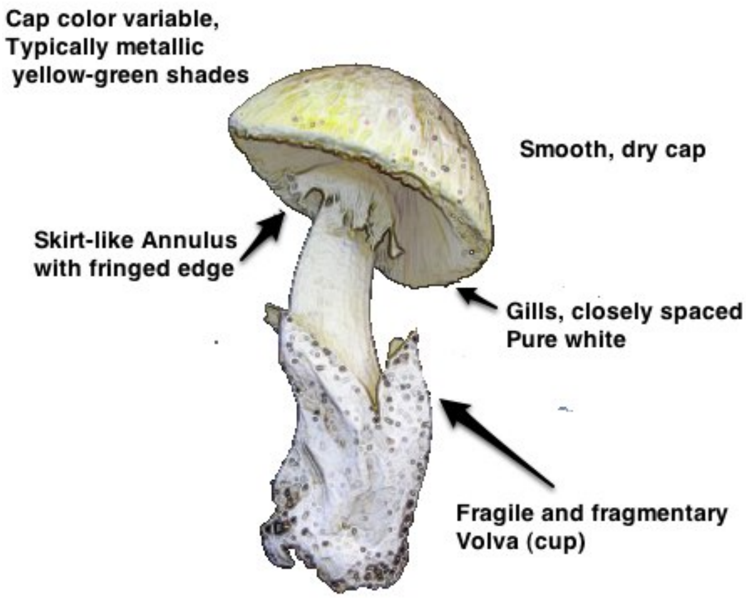
~ George Butterworth

*Obispoensis* is published October through June except January.  Items for submittal to *Obispoensis* should be sent to rhotaliing@charter.net.  The deadline is the 10th of each month.  Botanical articles, news items, illustrations, photos, events and tidbits are welcome!    Visit the websites:  **www.cnps.org** & **www.cnpsslo.org**

# Why is the Death Cap Deadly?

by John Chesnut

On New Year's Day I visited a favorite, and normally productive, chanterelle patch outside San Luis Obispo to discover an enormous fruiting of the dangerously toxic death cap mushroom (*Amanita phalloides*).




My culinary disappointment was tempered by my growing fascination with the question, "Why are mushrooms deadly poisonous?" Proximally, the answer is direct: because they contain a peptide, alpha-amanitin which halts RNA transcription in the cell nucleus. In broader context, the question should be rephrased, "What ecological advantage and evolutionary fitness does the presence of this toxin contribute?"

*Amanita phalloides* is a newcomer to California. It is known to be a native of Europe, and its first verified collection in California dates to 1938. Anecdotally, its introduction is ascribed to an accidental arrival on the roots of cork oak trees. It is now known from Southern California to British Columbia. A similar introduction (on the roots of Italian chestnuts?) affects the East Coast.

Death cap is an ectomycorrhizal symbiont. This means it forms connections on the root-tips of forest trees; in California, its typical (but not exclusive) partner is coast live oak. Unlike many symbionts which are highly host specific, death cap is promiscuous in its associations as it spreads worldwide. It is now present in South Africa, Australia and most other similar climes.

Ectomycorrhizal (EC) fungi collect major nutrients, nitrogen and phosphorous, and exchange these with the host tree for sugars. Delicate hyphal strands extend outward from the root tip mass into the surrounding soil and mulch. EC also allows efficient active transfer of macronutrients, micronutrients, and soil water to the tree. The chronic phosphorous limitation in serpentine soils makes the EC symbiosis especially important for local forest types on this soil. Studies in Norway discovered up to 50% of a birch tree's sugar is exchanged at the root tips with EC symbionts. Other studies describe how a mushroom, *Laccaria bicolor*, lures springtail insects (*Folsoma candida*) into traps, consumes them, and transfers the nitrogen obtained to its host tree.

Trees form non-exclusive associations with many fungi. Studies at Pt. Reyes show more than 15 taxa of EC fungi present at the root tips of coast live oak from a single grove. Most of the live oak symbionts are not deadly or even dangerous, and include the sought after chanterelles.

It is an entirely open research question as to whether the recent invasion of *Amanita phalloides* into the California oak forest is supplanting native fungi. Studies (in Bishop pine) have shown that EC fungi partition their habitat niches very precisely, allowing multiple fungi to coexist in close proximity. I have visited the particular chanterelle patch since the 1970's without noticing the *Aman5.0ita*, so the 2012 fruiting might possibly represent a replacement of one symbiont for another, or just be a fortuitous fruiting of an established co-dominant. The "competitive exclusion principle" argues that if these organisms are competing within the same precise niche, the most successful will replace all others.

The deadly toxin of *Amanita's* is alpha-amanitin. This is a heat-stable cyclic peptide that interferes with the transcription function of RNA in the nucleus of cells of virtually all organisms. Humans, dogs, rabbits, and guinea pigs are equally poisoned. The toxic crisis is caused by irreversible liver or kidney damage, as the molecule concentrates in those organs. More expansively: organisms other than bacteria are affected by alpha-amanitin. Insects, worms, flowering plants, and even viroids (infectious single strands of RNA) that cause "mad cow" and disease in plants cannot replicate when treated with amanitin.

Amanitin is a large, very stable molecule ($C_{39}H_{54}N_{10}O_{14}S$) so it represents a significant metabolic cost to the fungus to create. Several, widely unrelated, taxa of gilled mushrooms possess amanitin toxin, so its synthesis has been separately evolved several times in fungi –supporting the assumption this represents an important competitive innovation for the species. Fortunately, amanitin is too large to cross the blood/brain barrier, so even victims with irreversible liver and kidney damage due to mushroom poisoning are not affected mentally.

An evolutionary entomologist working in New York State, John Jaenike, has discovered four species of mushroom flies in the genus *Drosophila* that lay eggs in the gills of fruiting *Amanita phalloides*. The fruit fly taxa are related to ones that inhabit rotting skunk cabbage, but in New England have recently transferred to the recently introduced *Amanita* fruitings.

Jaenike discovered that *Amanita phalloides* is toxic to the damaging parasitic nematodes *Howardula* that reproduce in the stomach of fruit flies. The toxicity of the death cap to the parasitic nematodes results in much greater egg-laying (fecundity) by the fruit flies. The fruit flies are affected by the toxic amanitin, especially the males, but the poison is more than offset by the increase in reproduction.

Janike also discovered that most other insects using mushrooms as egg laying sites (craneflies and forest gnats) shun use of the *Amanita* (due to its toxicity). Fruiting mushrooms are a scarce and erratically scattered resource for reproduction and larval feeding. Fruiting mushrooms are fully and completely consumed by mushroom gnat larvae, and Jaenike postulates fierce competition for insect breeding sites. Jaenike has published several papers describing the *Amanita-Drosophila-Howardula* food web. Mushroom flies secured a niche free of competition by exchanging an evolved tolerance to sub-lethal poisoning for escape from nematode parasitism. The increased fitness leads to greater egg-laying ability, and has provided the evolutionary inertia for this recent adaptation.

Nematodes are significant pests of commercial mushroom production, epidemic infestation can result in the loss of the growing beds. The oyster mushroom, *Pleurotus osteraceus*, traps and consumes nematodes in noose-like knots of hyphal tissue.

So why are *Amanita* so poisonous? It is an unlikely deterrence to vertebrate predation of the fruiting caps, as the effect is slow-acting (36-72 hours before the toxic crisis in humans) and the toxin is not concentrated in the cap. Evidence supports the hypothesis that the fitness obtained from synthesizing the toxin is secured within the hyphal network. Perhaps toxic *Amanita* obtain nitrogen from poisoned nematodes, or protect themselves (and their symbiont hosts) from plant parasitic nematode predation. Perhaps the toxin suppresses the growth of competing fungal webs. It seems clear the toxic effect of death cap is intrinsic to its invasive success worldwide.

<u>Sources:</u>

Jaenike, J., "Parasite Pressure and the Evolution of Amanitin Tolerance in Drosophila," *Evolution*,Vol. 39, No. 6 (Nov., 1985), pp. 1295-1301.

Jaenike, J. and T J. C. Anderson, "Dynamics of Host-Parasite Interactions: The Drosophila-Howardula System," *Oikos* Vol. 64, No. 3 (Sep., 1992), pp. 533-540. http://web.uvic.ca/~stevep/pdfs/AmNat_02.pdf

Pringle, Anne, and Else Vellinga, "Last chance to know? Using literature to explore the biogeography and invasion biology of the death cap mushroom *Amanita phalloides."* http://www.msi.harvard.edu/downloads/teacherworkshop/Readings/Ben_Papers%20_TWS/Pringle%20and%20Vellinga%202006.pdf

Pringle, Anne, Rachel I. Adams, Hugh B. Cross, and Thomas D. Bruns, "The ectomycorrhizal fungus *Amanita phalloides* was introduced and is expanding its range on the west coast of North America," *Molecular Ecology* (2009). http://arnarb.harvard.edu/faculty/pringle/pubs/Pringle_MolEcol_2009.pdf

Wolfe, Benjamin E., Franck Richard, Hugh B. Cross, and Anne Pringle, "Distribution and abundance of the introduced ectomycorrhizal fungus *Amanita phalloides* in North America," *New Phytologist* (2009). http://www.oeb.harvard.edu/faculty/pringle/documents/Wolfe_Ap_Distribution.pdf

Wieland, Theodor and H. Faulstich. Amatoxins, Phallotoxins, Phallolysin, and Antamanide: The biologically Active Components of Poisonous *Amanita Mushrooms.* http://informahealthcare.com/doi/pdf/10.3109/10409237809149870

Horton, Thomas R., and Thomas D. Bruns, "The molecular revolution in ectomycorrhizal ecology: peeking into the black-box," *Molecular Ecology* (2001)10, 1855–1871. http://www.cnr.berkeley.edu/brunslab/papers/

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