

Bamboo Balls

A Tale of Fungal Feasting in the Rain Forest

By Daniel Winkler
Mushrooming.com

Working our second rainforest transect I am all excited having found three huge clusters of elegant snow-white Arched Sawgills (*Lentinus concavus*, formerly *Pleurotus concavus*), a good neotropical edible, when cooked thoroughly. We surely scored enough to offer a good taste at camp for the 20-people-strong expedition crew, most of them members of the local Trio tribe. Meanwhile Addi and Jon quickly apply their indigenous ingenuity weaving a transport basket out of palm fronds.

While watching, fascinated by their handy skills, my eye catches an orange ball, with a flat side where it attaches to a tall bamboo culm. I have never seen anything like this, very strange! I wonder, is it a fungus or a gall? The rubbery consistency seems to confirm fungal nature. Cool! There has got to be more of them! I look around and see a purple, nearly golf ball-sized oddity and two more white balls on another culm. Out comes the scalpel and reveals a gelatinous core with a puzzling structure. The jelly nature reminds me of an *Entonaema*, but its structure is clearly different. There is a weird core to this while *Entonaema* is segregated into several liquid-filled chambers.

I am pretty clueless at this point. What can I do? Let's take a bite. Hmm ... interesting, nice consistency with a bit of crunchy rind and a mild nutty tasty; quite succulent! I am reminding myself, don't swallow! Darn it, that could be something to feast on! There pops an idea. What about the bamboo fungus that some small rainforest monkeys are crazy about, and which I read about awhile ago? I don't remember any name nor do I have an idea where these "bamboo balls" should hang in the evolutionary fungal tree. And are the white, creamy yellow and purple balls different species or just different development stages?

It really frustrates me not having usable internet for weeks in the rainforest when I want answers, but luckily it lets me focus on all the fantastic fungi out there and taxonomic answers have to wait. The key is good documentation and taking samples, which is my job. I was invited by Mark Plotkin, who co-founded the international NGO Amazon Conservation Team (ACT), and by ACT Suriname, to research the local fungi with special attention to edible and medicinal fungi—anything of commercial or other value that could benefit local communities. ACT

has organized a two-week expedition mapping and cataloguing traditional landscape knowledge and potential sources of non-timber forest products, such as tree nuts and fruits, stingless bee hives, and mushrooms (my duty). The development of local forest products can provide sustainable economic alternatives to future destructive activities such as logging or mining.

The area we are researching is located along the Sipaliwini River in south Suriname within a day hike of the borders of Brazil and Guyana. So far, the lowland rainforest is well protected by the fact that there is no road or ship-accessible waterway. The only access is by expensive charter flights to remote airstrips, but now the government is building a road which will likely bring significant environmental, economic, and cultural change.



Ascopolyporus philodendri, the Purple Bamboo Ball.

Back at home in Seattle I begin researching my bamboo balls. It turns out they belong to the genus *Ascopolyporus*, erected by Giacomo Bresadola in 1897 based on collections by Alfred Möller (1860-1922). The same Möller for whom Bresadola named the ubiquitous entomo-parasitic fungus *Moelleriella* that feeds on scale insects and aphids. It grows little yellow spots over the insect on leaves in the tropics. From 1890 to 1893 Möller was researching Amazonian fungi in Brazil and published impressive reports with beautiful paintings (Möller, 1901). Later on, he became a forestry professor in Eberswalde near Berlin, founding Pilzinstitut, a fungal research center, besides developing and promoting his Dauerwald (“Perma-forest”) management strategy that argues for sustainable, biodiverse, and close to nature forest management, in clear opposition to widespread plantation forestry, which is too often based on massive biocide. Alas, he was too far ahead of his time, opposition to his visionary ideas resulted in the termination of his academic work, the Pilzinstitut was shut down, and Möller sadly died within a year of a heart attack (or more holistically, of a broken heart). Not surprisingly, over 100 years later several forests managed for all these years based on Möller’s principles are now the most biodiverse, stable and profitable forests in Germany (Bode and Hohnhorst, 2000).

Anyway, back to tropical mushrooms. Only recently it was understood (Bischof et al., 2005) that the base of the strange center of *Ascopolyporus* (Cordycipitaceae, Hypocreales, Ascomycota) is a scale insect, just as in *Moelleriella*! Who would have thunk! A tiny invertebrate on the base of the “giant” fruiting body! Many entomopathogenic fungi, as its *Cordyceps* cousins, relate in size to the insect host. Not in this case; bamboo balls are hijacking the “pipeline” drilled by the insect’s stylet, the piercing mouthpart. Furthermore, while the insect is long-killed, the fungus keeps on guzzling that bamboo juice until Goeldi’s marmosets (a small monkey, weighing less than a pound) spots his favorite food fungus and devours it.

Okay, I admit, I am dramatizing here. There is no *Callimico goeldii* population



A young *Ascopolyporus polychrous*, the ones that tasted nutty with a touch of sweetness.

in Suriname; they are denizens of the western Amazon basin. In Suriname their closest relative is the Red-handed tamarin (*Saguinus midas*), who hasn’t been caught red-handed feasting on bamboo balls (*Ascopolyporus polychrous* & *polyporoides*) or Wood Ears (*Auricularia auricula* and *A. delicata*) as Goeldi’s monkey love to do.

This fungal feeding has spawned interesting research. Although at least 22 primates are documented feeding on fungi (Hanson et al., 2003), there are no other primates known (possibly except

some readers of FUNGI) that spend as much time feeding on fungi as Goeldi’s marmosets. It has been calculated (Hanson et al., 2006) that they spend 29% of their annual feeding time on mycophagy. During the dry season it is up to 63%. Therefore, the researchers, who might not have tasted bamboo balls themselves, argue that mushrooms are a “fall back” food, since there are few other foods available such as fruits. Anyway, expressed in weight, Goeldi’s marmosets average an annual fungal intake of about 6.1 kg per monkey. Should I try to



Mature *Ascopolyporus polychrous* on a bamboo culm. The little dark spots on the rind are the openings (ostioles) of the perithecia in which spores are produced. The cross-section shows them well developed on the lower side.

match the mushroom feasting of the tiny marmoset, based on my weight, I would need to eat 3 tons of fresh mushrooms per year! Sorry, but that sounds at best like serious constipation if not organ failure within a few weeks!

As I learned from the Trios men I had the privilege to search the rain forests with, fungi are also a “fall-back” food for them. Most Trios on the expedition are supported by ACT whether as forest rangers—a budding initiative to help natives to control their forest resources—or in other functions, to achieve the biocultural conservation goals set by the community in partnership with ACT. Needless to say, they are all expert naturalists that still sustain themselves from the forest, though there is also some manioc cultivation. However, the pride of a Trio man is bringing home some tasty game or big fish, which is getting harder and harder since missionaries initiated settling of formerly migratory clans into big villages that now offer medical stations, schools, churches, piped water supply, limited electricity, and even cell towers as well as airstrips.



Sliced open mature fruiting body of *Moelleriella gaertneriana*.

The improved living standard and centralization has seriously reduced wildlife around villages and using the canoe for travel up or downstream requires a lot of expensive gas, which

must be flown in. Still, for these Trio men, mushrooms are “loser” food—bringing such food home from the hunt reveals that they were not successful.

Trio woman might collect mushrooms,



Typical big clusters of the Arched Sawgill (*Lentinus concavus*) growing out of a fallen tree.

but modernity has undermined this forage activity as expressed in common statements like “My grandmother used to pick something like this, but I am not sure if this is an edible mushroom.” So, it turned out that none of the Trio men had ever eaten the Arched Sawgill, which is enjoyed by the Yanomamis and other Amazon peoples. An earlier attempt failed to have our crew’s cook, Mateo, fry up Hairy Tropical Goblets (*Cookeina tricholoma*), an easily recognized and, in the Guianas, commonly-eaten bright red cup fungus. He just ignored the crop I had brought, and they went quickly bad in the tropical humid heat. That taught me to take initiative to get any mushroom cooked. Luckily expedition leader Dr. Bruce Hoffman, the *Lianas in the Guianas Guide* guy, a mycophile himself, started out by washing them and removing the leathery tough stems. We took turns stirring the load in the wok. It must have been half an hour later that all the water was evaporated, and they were fried well enough over the fire to be shared. Now, while a few of the Trio men were curious and forthcoming to taste, others had to be encouraged to try. However, the feedback we got was appreciation and surprise at how tasty and similar to chicken they tasted. And, as usual, I was a bit nervous feeding a big group a mushroom in the middle of nowhere I had only eaten a few times before. However, during the night I did not hear any unusual commotion in our camp (that consisted of a cluster of hammocks strung under tarps in the forest). The next morning, Kamanija, one of the several shamans who help in plant identification and are crucial to project success, told me that he dreamed of his ancestors and did ask them about mushrooms and the ancestors replied to him “Mushrooms are medicine!”

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Addi and Jon with their baskets for *Lentinus concavus*.