

MYCOLOGICAL NEWS

A North American Flora for Mushroom-Forming Fungi

A small cadre of mushroom collectors assembled July-August 2009 for 12 days at the University of Tennessee Biology Field Station located just east of Gatlinburg, Tennessee. Situated near the Greenbrier entrance to the Great Smoky Mountains National Park, our primary goals were to produce field photographs of mushrooms and allied fungi from “the Park”, some of which are poorly represented in North American field guides, contribute to the diversity of the region, and become better acquainted with our eastern North American flora. The group collected mostly in mixed mesophytic forests with Eastern Hemlock seemingly omnipresent (but noticeably defoliated by insect damage) and made several trips beyond 5000 feet elevation to collect in the Fir-Spruce-Birch zone. The team was warned that this particular time of year is warmest and wettest, and that we would be showered with the charismatic mega-mushrooms (boletes, amanitas, chanterelles). However, this was hardly the case. All in all our crew of Joshua

Birkebak, John Lennie, Michael Pilkington, Steve Trudell, Else Vellinga, Aaron Wolfenbarger, Mike Wood, and myself amassed 647 collections that represent 410 morphological species, primarily fleshy basidiomycetes. Of these, *Lactarius*, *Entoloma* sensu lato, and *Cortinarius* were particularly diverse and represented by 20+ species each. At least ten species of *Ramaria*, *Inocybe*, *Boletus*, *Hygrocybe*, *Marasmius*, and *Mycena* were also collected. Undoubtedly, more collections and species could have been made had *Russula* been more conspicuous and had the complete team been able to get in and out of Cades Cove, where heavy rainfall and washed-out roads deterred us.

Diversity of macrofungi in the Smokies is fairly staggering. Consider that 3012 names have been applied to species from the Park, collections of which are curated at the University of Tennessee Fungus Herbarium. Not surprisingly, some collections from our trip could not be identified owing to a mixture of lack of taxonomic expertise, potential taxonomic novelties, and lack of literature. Of the potential taxonomic novelties, several deserve mention. One includes a salmon and yellow colored *Lepiota* with a sea-shell pink spore deposit, a *Tricholomopsis*-like species unknown by any of us, and a medium-sized white tricholomatoid fungus with distinctive cheilocystidia and pleurocystidia and inamyloid spores. Not mentioned are the species with which we are intimately aware, armed with molecular findings, which are currently misunderstood under European names but represent autonomous taxa that have yet to be described.



Fig. 1. *Gloeocantharellus purpurascens* (photo by Mike Wood) has yet to be illustrated in color in any North American field guide. It was fruiting abundantly and frequently in the Park at mid-elevations in mixed mesophytic forests dominated by hardwoods and, seemingly, poison ivy.

As any seasoned collector knows, a fungus taxonomist virtually needs a truck to cart around issues of *Mycotaxon*, *Mycologia*, *Persoonia*, the antiquated fungus portion of the *North American Flora*, various works by North American taxonomists, field guides, and so on to get a strong handle on agaric taxonomy. Fortunately, many of these items required for mushroom identification can be located online, but many treatments are still only available in printed form.

What is needed is a centralized and updated version of the out-of-date North American Flora (NAF) published by the New York Botanical Garden, an outstanding resource from the early 1900s that provided dichotomous keys and descriptions to mushrooms from North America, including Central America and the Caribbean. This effort was largely led by one of our most interesting North American taxonomic personalities, William Alphonso Murrill, but would not have been possible without contributions by others such as Gertrude S. Burlingham, Leigh H. Pennington, Calvin H. Kauffman, Lee O. Overholts, and John H. Barnhart. Remarkably, it has been over 100 years since North American taxonomists have had a single comprehensive floristic treatment of mushrooms from North America. And the longer the wait to update the job, the more difficult it will be.

As a prelude to revise the NAF, consider the issues at hand. For example, the genus *Lyophyllum* P. Karst. is characterized by

Continued on following page

siderophilous granules in the basidia, white spores with cyanophilous, non-amyloid walls, with a cutis as pileipellis, and the presence of clamp connections. Many species stain black. Most are poorly known in North America, and only a few species are widespread and common (*L. decastes* and *L. connatum*). In the field these species stand out often because of their caespitose habit, the smooth, slightly greasy pileus, and the firmness of their fruitbodies. Some species are consumed for food such as the Chicken Fried Mushroom (*L. decastes*). Their ecology is not clear, but some are mycorrhizal. The species are rather non-descript and have not bathed in a tub of attention, although Clémenton in Switzerland has studied the genus extensively, mostly in Europe, but he has also described North American species, and phylogenetic research on the genus and its allies has also been carried out by Valerie Hofstetter and colleagues.

In 1916 Murrill treated *Lyophyllum* as a synonym of *Gymnopus* in NAF, but there do not appear to be any species keyed out and described that fit the modern concept of the genus. However, 35 species of *Lyophyllum* have been described or reported from North America since this time. There are no keys to all species, no distribution data on species, and molecular comparisons between European and North America representatives of the same species have not been made. Field guides mention only a few species and illustrate even less. GenBank has data for 14 species of *Lyophyllum*, three of which are conservatively positioned in *Tephroclype*, one species only known from Japan, and two collections of *L. connatum* and an undetermined species from North America.

The pronounced gap concerning our knowledge of North American *Lyophyllum* is hardly an exception. As another example, the genus *Melanoleuca* Pat. is likewise composed of showy mushrooms, some of which are encountered in wood chips. *Melanoleuca* is a rather small group of saprotrophic white-spored species with notched lamellae and spores with amyloid warts. The species boundaries and the interpretation of the literature have posed many problems, resulting in around 80 species described in Europe, where a lively tradition of “Melanoleucology” exists. Murrill (1913-1949) treated the genus in a much wider sense, including species of the ectomycorrhizal genus *Tricholoma*. In most of his publications of new species he immediately transferred all to the genus *Tricholoma* as well. Murrill alone described 93 *Melanoleuca* species and gave descriptions of 119 species in total in the NAF (including five unique to tropical North America, and 30 Pacific Coast species).



Fig. 2. The 2009 collecting crew at the UT Biology Field Station. Pictured from bottom left in counter-clockwise fashion are Mike Wood, Steve Trudell, Martin Ryberg, Joshua Birkebak, Else Vellinga, John Lennie, and Michael Pilkington. Not pictured are Aaron Wolfenbarger and Brandon Matheny.

After Murrill’s death in 1957 nobody investigated the genus in North America until 1977 when Gillman & Miller published on boreal, arctic, and alpine species, a paper in which four species were described as new for North America. In total 10 species were keyed out and described in detail, including one from Switzerland. *Melanoleuca alboflavida*, a species of eastern North America, is the only species from the NAF also treated in the Gillman & Miller publication. Not surprisingly, *Melanoleuca* is step-motherly treated in guide books where descriptions and illustrations are few. There is no insight into the number of species in North America, nor their identity, and there are no keys to the 17 species recognized for the USA so far. Distribution and ecology of the species are mostly unknown. There are no combined molecular-phylogenetic/morphologic-taxonomic treatments of the genus, nor is its position within the *Agaricales* sufficiently elucidated. *Melanoleuca verrucipes*, relatively well represented in Genbank, is a relative newcomer in North America growing on wood chips and nutrient enriched soil. It is common in the Bay area of California and in Seattle but not listed in Arora as of 1986.

As our intensive collecting efforts in the Park and these two examples illustrate, taxonomic mycology and attempts to complete the Tree of Life face significant challenges. These problems will be mitigated by efforts to revitalize a North American Flora for mushroom-forming fungi. Many more intensive collecting trips like the one held this summer in the Park are necessary to work towards this goal.

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