State Historic Fungal Survey, Bear Springs, Fall 2009
Mt. Hood National Forest

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submitted by
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Introduction

In the fall of 2009, we surveyed for five State Historic fungal species and all federally listed Sensitive and Strategic fungal species (USFS/BLM 2009), in the Bear Springs area on the southeast slope of Mt. Hood, Mt. Hood National Forest, Wasco County, Oregon (Township 5 south, Range 10 east, Sections 22, 23, 26, and 27). The five State Historic species included two mushrooms, *Lyophyllum gracile* and *Psathyrella subcaespitosa*, and three truffles, *Rhizopogon brunneifibrillosus*, *R. oswaldii*, and *R. quercicola*. All of these taxa were collected in the Bear Springs area in October of the years 1946, 1947, and 1964. Three of them (*L. gracile*, *P. subcaespitosa*, and *R. brunneifibrillosus*) have not been documented in any other locations.

Methods

The surveys occurred during the time thought to be most likely to produce the target fungi, particularly in late October when several of the target taxa had been historically collected. The surveys were performed by the contractor, Matt Trappe, Ph.D., and Kimberly Kittredge of Northwest Mycological Consultants, on October 24-27 and November 7-10. The "controlled intuitive" survey method (Claridge et al 2000) was used, in which experienced mycologists look for fungi in probable or target microhabitats, such as near large coarse woody debris or under chinquapins. Particular attention was paid to campgrounds, trails, and riparian areas. Campgrounds are often hotspots of fungal diversity (Trappe et al 2009); trailsides are typical habitat for *Lyophyllum* (Arora 1986); riparian areas provide moist soil conditions and were cited as the type locality for *Rhizopogon brunneifibrillosus* (Smith & Zeller 1966).

Two of the target taxa, *L. gracile* and *R. oswaldii*, had historically been collected on Mt. Wilson Road. Mt. Wilson Road is now several miles inside the Warm Springs Indian Reservation as a consequence of a 1972 boundary adjustment, correcting an erroneous survey from 1871. We did not examine this area because our instructions were to survey "outside of the Warm Springs Reservation lands." It is an area that would be very interesting to visit, given tribal permission.

On our first survey visit we focused on the Bear Springs campground, the environs of the Bear Springs Work Center, the forest north Hwy. 216 around Bear Springs, and the McCubbins Gulch and Clear Creek campgrounds. We used truffle rakes to seek any and all hypogeous fungi, simultaneously scanning for potential target mushrooms. When a potential target species was located, the specimen was photographed, the site monumented with three 24" lengths of pink flagging tape and a pink pinflag (Fig. 1), a GPS reading was acquired, and careful field notes were taken. Specimens were dried on the evening of their collection using a food dehydrator, and labeled for microscopic examination. A map is provided in appendix 1.

On our second survey visit we focused extensively on the area north of Hwy. 216, from Bear Springs campground to McCubbins Gulch road, an area of approximately 160 acres. We revisited the Bear Springs campground, and surveyed the area east of the Bear Springs Work Center, south of Hwy. 216.

All potential target species were dried on a food dehydrator and brought back to Corvallis for microscopic examination. Spore measurements and specific reactions to chemical reagents were noted and documented, and collections were curated for accession to the OSC herbarium at Oregon State University.

Fig. 1. Target site monumenting #33905

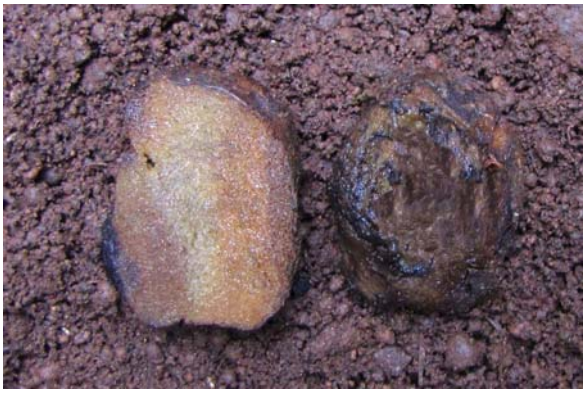

Fig. 2. *Rhizopogon brunneifibrillosus* #33905

Results

We collected and identified a total of 21 specimens of hypogeous fungi (Table 1). Sixteen of these were field identified as potential target species (thought likely to be in the genus *Rhizopogon*), and were vouchered and monumented. *Rhizopogon*s are fairly distinctive due to their relatively thin peridium and spongy olive-gray to brown gleba, however microscopic examination of the spores and peridial structure is necessary to identify them to species level. Several collections field identified as possible *Rhizopogon*s turned out to be in the sister genus *Truncocolumella* upon microscopic examination. Truffles collected that were obviously not *Rhizopogon*s were not vouchered and monumented, but are listed in Table 1. Images of selected non-target truffles are presented in Figs. 3-8

Careful examination of each collection of *Rhizopogon* revealed that only one possibly fit the description of a target taxon, *Rhizopogon brunneifibrillosus* (see discussion). This collection (Trappe #33905; Fig. 2) had spores that fit the size range of *R. brunneifibrillosus* and extensive examination found no trace of green reaction by the peridium to KOH (5% aqueous potassium hydroxide) on a microscope slide mount. This specimen was collected under a small ponderosa pine tree among white fir, Douglas-fir, and snowbrush (Fig. 1), about 50 m north of Hwy. 216 and 50 m west of Spring Drive (UTM 10T 616616.65 E, 4996850.15 N, elev. 3176'). Five other collections were very similar to *R. brunneifibrillosus* but had peridial staining characteristics that clearly identified them as the commonly occurring *R. villosulus*.

We did not observe any sporocarps of the target genus *Psathyrella*, however we did find several fruitings of *Lyophyllum decastes*. *Lyophyllum decastes* is a very common mushroom, and easily distinguishable from the target *Lyophyllum gracile* by its substantially larger stature (the stem of *L. gracilis* is 3.5-5 mm thick [Clémençon & Smith 1983]; that of *L. decastes* is 1.5-2 cm thick [Arora 1986]). We did flag several populations of *L. decastes*, most of which were along the shoulder of the gravel road paralleling Hwy. 216 about 300 m to the north. Table 2 provides a complete species list of the observed epigeous taxa.

Table 1. Truffles collected.

Trappe #	Hypogeous Species
n/a	*Gautieria monticola*
n/a	*Hysterangium crassirhachis*
n/a	*Leucogaster citrinum*
n/a	*Melanogaster tuberiformis*
33905	*Rhizopogon brunneifibrillosus*
33906	*Rhizopogon occidentalis*
33911	*Rhizopogon parksii*
33915	*Rhizopogon ponderosus*
33903	*Rhizopogon salebrosus*
33900	*Rhizopogon villosulus*
33907	*Rhizopogon villosulus*
33908	*Rhizopogon villosulus*
33909	*Rhizopogon villosulus*
33916	*Rhizopogon villosulus*
33913	*Rhizopogon vinicolor*
33901	*Rhizopogon vulgaris*
33904	*Rhizopogon vulgaris*
n/a	*Truncocolumella citrina*
33902	*Truncocolumella citrina*
33904	*Truncocolumella citrina*
33910	*Truncocolumella citrina*

Table 2. Mushrooms observed.

Epigeous Species
Albatrellis ellisii
Amanita silvicola
Amanita smithiana
Boletus smithii
Cantharellus subalbidus
Collybia oregonense
Cortinarius cf. laniger
Cortinarius cf. traganus
Cryptoporus volvatus
Fomitopsis pinicola
Galerina angustifolia
Geastrum saccatum
Gomphidius oregonensis
Gomphus floccosus
Guepiniopsis alpina
Hericium abietis
Hypholoma fasciculare
Inocybe geophyllum
Laetiporus sulphureus
Lyophyllum decastes
Morchella angusticeps
Mycena aurantiomarginata
Mycena capillaris
Mycena monticola
Phaeolus schweinitzii
Pholiota malicola
Ramaria rasilispora
Ramaria rubrievanescens
Russula cf. emetica
Russula cf. integra
Sparassis crispa
Spathularia flavida
Tricholoma cheilolamnium
Tricholoma vaccinum
Tricholoma virgatum

Discussion

According to members of a Hawkwatch survey crew who has visited the area annually, this year did not seem to produce as many mushrooms as last year. Interannual variability as a function of weather is normal, and this year's patterns may have been unfavorably affected by a weak El Nino condition. The Bear Springs area has a remarkable diversity of ectomycorrhizal tree species (Douglas-fir, white fir, ponderosa pine, and shrub chinquapin are widespread; larch, Engelmann spruce, willow, aspen, and cottonwood occur in localized populations) in a variety of age classes, as well as an abundance of large well-decayed (class IV-V) coarse woody debris. In a normal year, these conditions should be favorable to a great variety and abundance of fungal sporocarps, however we did not observe the diversity of fungi we expected. Additionally, *Piloderma fallax*, a bright yellow soil fungus very commonly found near coarse woody debris (Smith et al 2000), was only observed about a dozen times. In our experience this is very unusual, given the rich habitat.

Of the three target *Rhizopogon*s, *R. oswaldii* is distinctive due to its relatively large spores (7.5-9 x 3-3.5µm). None of the *Rhizopogon*s we collected were close to this taxon. The other two *Rhizopogon*s, R. *brunneifibrillosus* and *R. quercicola*, are in the Villosuli group (Smith and Zeller 1966), which is typified by the presence of darkly pigmented hyphae in the peridium and an obligate mycorrhizal association with Douglas-fir (Molina & Trappe 1994). Both *R. brunneifibrillosus* and *R. quercicola* are very closely related to the common *R. villosulus*, and are distinguished from *R. villosulus* primarily by the lack of an olive-green staining reaction of peridial tissue in a KOH. They are distinguished from one another by the spore size (*R. brunneifibrillosus* spores 7.0-8.5 x 2.0-2.2µm, *R. quercicola* spores 5.5-7.0 x 2.2-2.5µm). For context, *R. villosulus* spores are 6.0-8.0 x 2.0-2.5µm. It is noteworthy that *R. quercicola* (*quercicola* meaning "oak-loving") is almost certainly an obligate symbiont with Douglas-fir. Although the type collection was described as "under chinquapin oak", there is little doubt that Douglas-fir was nearby.

All of these *Rhizopogon*s were described by Dr. Alexander H. Smith, well before the advent of molecular (DNA) analysis. Dr. Smith's contributions to the field of fungal taxonomy were enormous; he described far more species of North American fungi than anyone else, and his contributions to advancing our understanding of fungal taxonomy cannot be overstated. However, recent molecular work has indicated that Dr. Smith occasionally described ontogenic stages of one species as separate taxa (young vs. mature specimens can look quite different). In other cases the morphological traits he used to separate taxa did not have an evolutionary basis, but were rather cosmetic differences between two individuals in the same species. Indeed, in the introduction to his monograph on *Rhizopogon* (Smith & Zeller 1966) he writes "(These) concepts…need testing by other workers to see if they stand the test of objectivity… The shortest road to the evaluation of a new set of characters is to set up a classification based on them and then let your colleagues try to find fault with it."

Molecular researchers have only begun to scratch the surface of Dr. Smith's enormous body of work, and in most cases his observations and intuition into species relationships have been astoundingly accurate (Grubisha et al 2002), considering the tools at his disposal. However, there are documented cases where he erroneously assigned several names to what later turned out to be a single species (Bidartondo & Bruns 2002).

The *Rhizopogon villosulus* species complex may be one of these cases (Martín et al 1998, Trappe 2005). The key trait of an olive-green staining reaction of peridial tissue characterizing *R. villosulus* sensu stricto is not pervasive throughout the peridium, but rather is patchy. One must take many sections of tissue to ensure it is observed, if present. Specimen age may also be a factor; in his description of *R. villosulus*, Smith notes a young specimen that was "unreactive in KOH."

Due to the very small number of collections in herbaria identified as *R. brunneifibrillosus* or *R. quercicola*, these taxa have yet been studied by molecular methods in relation to *R. villosulus* or other taxa within the Villosuli group. The differences between *R. villosulus*, *R. brunneifibrillosus*, and *R. quercicola* are so subtle and minute (e.g. spore dimensions, peridial reactions to KOH) that it is entirely possible that this complex actually is only one variable species, and the search for *R. brunneifibrillosus* or *R. quercicola*, while with the best of intentions, may possibly be a search for taxa that do not truly exist. Only a detailed molecular study of the Villosuli group can determine this with certainty.

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Fig 3. *Rhizopogon vulgaris* #33901

Fig. 4. *Rhizopogon salebrosus* #33903

Fig. 5. *Rhizopogon occidentalis* #33906

Fig. 6. *Rhizopogon villosulus* #33909

Fig. 7. *Truncocolumella citrina* #33910

Fig. 8. *Rhizopogon parksii* #33911

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On the cover: *Amanita silvicola*; Bear Springs Work Center west entry looking northeast across Hwy. 216; Large coarse woody debris in the forest north of Hwy. 216.

Appendix 1. Map of surveyed areas. Black circles indicate areas surveyed on the first visit, red circles indicate areas surveyed on the second visit. Blue indicates site of target species.