A Survey of Los Alamos County and Bandelier National Monument for Macroscopic Fungi

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LA-UR-96-3581

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Abstract

Surveys have been conducted for macroscopic fungi within Los Alamos County and Bandelier National Monument (BNM) from 1991 to 1995. From the information gathered, we have developed a data base that provides information on species found, and the ecology and biology of each specimen collected. To date we have catalogued 1,048 specimens and identified 241 species. Fifty-one species are new to the State of New Mexico, 21 specimens are considered rare. This paper provides a preliminary listing of species found within Los Alamos County and BNM. Seventy-six percent of the specimens have been preserved and stored in a herbarium.

I. Introduction

The importance of fungi to the ecosystem is well expressed by Arnold (1992). He says, "Wild mushrooms are fascinating organisms, not only because of their tremendous variations in color and shape, but also in view of their unpredictable time of appearance, the rareness of so many species and their enormous ecological differentiation. Fungi are not only decorative, but are also essential components of our environment; without them there would be no long-term survival of the forests."

As indicated by Arnold's statement, the ecological importance of fungi is being recognized**.** Macroscopic fungi (large, visible fungi) have been found to be good indicators of environmental change. (Deka and Mishra 1981; Kinnes 1982; Wright and Tarrant 1957; Klopatek et al. 1987, Jansen 1990, Arnold 1992). In Europe, researchers have become alarmed at the disappearance of edible species such as the chanterelle. Researchers, such as Cherfas (1991), believe the disappearance is not due to over collecting but to subtle environmental impacts such as nitrogen fertilizer in farming.

To understand environmental change in the environment, we must know what species occur in an area, in which habitats they live, and the conditions of those habitats (Kosztarb1983). Some types of fungi can be indicative of certain environmental factors and may be indicators of unique or sensitive habitats. In our surveys, we encountered the rare Jemez Mountains salamander (*Plethodon neomexicanus*) in areas where we located a rare fungal species. It is important to understand the species diversity and species dependence on habitats, particularly those which support threatened, endangered, or species of concern. Understanding the fungal component of the ecosystem will help in making management decisions related to other trophic levels.

Within Los Alamos National Laboratory (LANL), the Los Alamos County, or the State of New Mexico there have been few intensive studies of the fungal flora. Indeed, diversity studies of fungi are rare in North America (Nishida 1992, Ammirati 1994). The area within Los Alamos County and Bandelier National Monument (BNM) offers a unique opportunity to study the fungal species and their diversity. LANL represents a 112-km^2 (43-mi^2) area that is remote but does have the potential for contaminants to enter the environment because of Laboratory operations. BNM experienced a large fire in 1977 and provided an area to study fire disturbance and succession. Therefore, in 1991, we began a systematic survey of LANL, Los Alamos County, and BNM for fungi. Figure 1 shows the location of Los Alamos County and BNM.

The ultimate goals for a study related to fungi are the following:

1) To understand distribution patterns within the County and Bandelier.
2) To understand the diversity of species within these environments.
3) To record any rare and unusual species of the area.
4) To begin to understand the distribution patterns and potential change of these species.
5) To begin to understand the ecology of the species within these environments.

Once this baseline information is available, the potential exists to understand the fungal species as indicators, periodicity of species, and occurrence of rare and decreasing species. This paper documents the surveys done from 1991 to 1995 and discusses a data base developed from these surveys. With this baseline information and modeling of this baseline data, we can begin to understand more about the fungal flora of the areas.

2.0 Ecological and Taxonomic Information

2.1 Ecology

Macromycetes in the vegetative state (hypha) are thin segmented microscopic filaments hidden in the soil or host. Based on their functions these fungi are divided into three main functional-ecological groups: saprotrophic, parasitic, and mycorrihizal. Approximately 50% of the macromycetes are saprotrophic and 50% are mycorrhizal. There are very few parasitic species.

Saprophytic fungi are involved in the decomposition of dead organic matter, including leaf litter, wood, dung, and dead sporocarps of other fungi. The fungi are one of the few groups of organisms with effective enzyme systems for the breakdown of lignin, one of the main components of plant material.

Parasitic fungi species feed on living tissues of plants and animals including other fungi. They attack weakened hosts, mainly trees and other vascular plants, often killing them.

The mycorrhiza fungi participate in a beneficial symbiotic relationship with trees. This mutualist relationship is an intimate union between the fungal hyphae and the feeding rootlets of the tree. Many trees and bushes are obligatory ectomycorrhizal, (Arnolds 1992), including in our area willow (*Salix* spp.), juniper (*Juniperus* spp.), cottonwood (*Populus* spp.), pines (*Pinus* spp.), spruce (*Picea* spp.), Douglas fir (*Pseudotsuga* spp.), white fir (*Abies* spp.), Oak (*Quercus* spp.), and Birch (*Betula* spp.). It has been estimated that there are roughly 1,000 kg (2,200 lb) of hyphae per acre in an average forest.

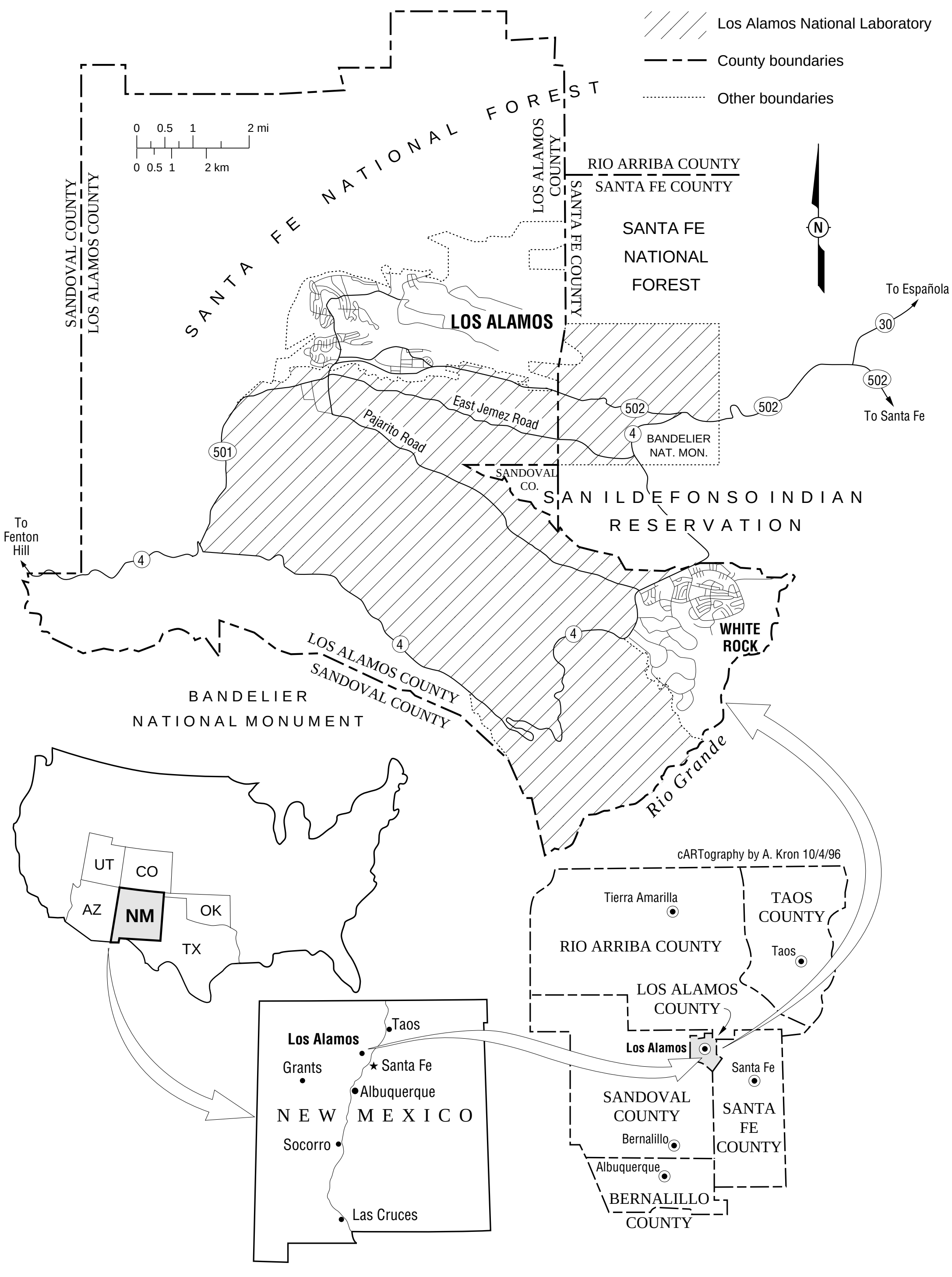

Figure 1. Locations of Los Alamos County and Bandelier National Monument.

2.2. Taxonomic Information

The taxonomy of fungi is complicated and we are not providing a full description in this paper but have outlined the various taxonomic levels in Figure 2. Some common representatives of this taxonomic hierarchy are in Table 1.

3.0 Methods

3.1 Collection Techniques

Specimens were taken from Los Alamos County in north-central New Mexico and the adjacent BNM. On LANL, emphasis was placed on areas where other botanical surveys were being conducted and in forest areas burned by fires, particularly the 1977 La Mesa fire. Because fungal fruiting depends heavily on soil moisture and atmospheric humidity, which, in Los Alamos, is dependent on altitude, we searched in areas at different elevations and within different vegetative zones from 1700 m to 2900 m (5500 ft to 9500 ft).

The fungal fruiting season runs normally from May through October, with most of the fruiting occurring in the rainy season from July through September. Most of our collections were made from July through September.

We established collection locations in BNM, LANL, and the Santa Fe National Forest, all within the Los Alamos County. Collections were made within several Laboratory Technical Areas (TA) including TA-0, 3, 18, 67, and in burn sites in BNM near the Juniper Campground, park headquarters, and parts of the 1977 La Mesa fire at Burnt Mesa, Apache Springs Road area, and the Dome Road intersection.

A collection site was defined as roughly a 100-m (330-ft) circle (unless a definite habitat change exists within). We attempted to informally scan each site several times during the season. The use of the term “collection” or “item” in this report refers to either a single fungal fruit or to a group of identical fruits from a gregarious stand of fungi. Universal Transverse Mercator (UTM) coordinates were determined for each site.

3.2 Identification

A first taxonomic identification was made from personal knowledge, reference to various field guides (see Appendix A), and suggestions from experts at forays. A number of species are only identifiable by microscopic study.

3.3 Voucher Preservation and Herbarium

A serious attempt was made to preserve and store voucher specimens for all species found. A herbarium system was designed. Each new specimen was spore printed, given preliminary identifications, dried as soon as possible, and put into storage. Seventy-six percent of all specimens were stored.

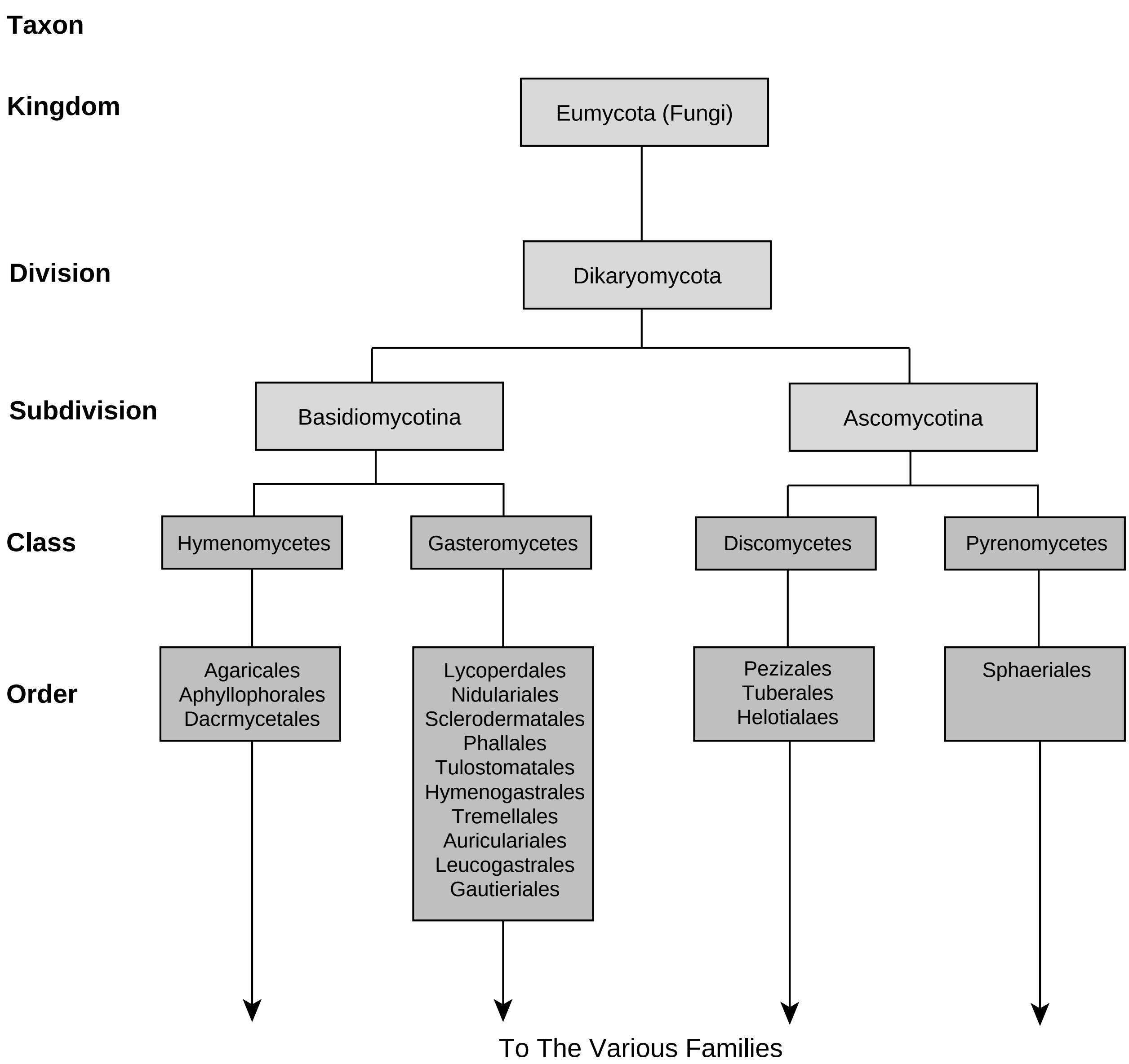

Figure 2. An outline of the various taxonomic levels of fungi.

Table 1. Common representatives of the taxonomic hierarchy for the macroscopic fungi.

Agaricales	**Aphyllophorales**	**Gasteromycetes**	**Pezizales**
Boletes	Polypores	Puffballs	Morels
Gilled fungi	Corals	Bird’s nest	False morels
	Chantrelles	Stinkhorns	Cups
	Spinny fungi	False puffballs	Truffles
		Stalked puffballs	
		False truffles	

3.4 Computer Data Base

The computer data base, FoxBASE+/MAC was chosen for versatility and compatibility with other data bases. There is a data base record for each specimen studied. Computer data base field codes are explained in Appendix A.

The master data base is labeled 27FnABC: where 27 is the current version number, Fn = fungi, ABC for complete alphabetized list. The lists are

1. Long form of 27FnABC: holds most of the fields (31 fields).
2. Short form of 27 FnABC: concise complete list (11 fields).
3. Short form 27FnNum: sorted by accession number (ncode) (11 fields).
4. Species list 27FnSpList: one type entry for each species identified plus 6 entries with a known genus, but unknown species: thus the list also acts as a genus list (10 fields).
5. Species sort by order 27FnSpOrder (9 fields). Note dominance of the Hymenomycetes.

This data base has been completed and alphabetically sorted by genus, species, date, and accession number. The “short form” stands alone as a concise list of the most useful fields. The “long form” adds 20 additional fields to form a “complete list.”

4.0 Results

The main data base was sorted both by the long form (31 fields) and the short form (11 fields). We have included the printout of the short form in Appendix B, C, and D. Information in the long form can be accessed through the data base, which will be established as a linkage to the Geographic Information System software ARC/INFO.

4.1 Summary Information from the Complete Data Base

We sorted the data base alphabetically by specimen and by accession number (27FnABC and 27FnNum). Table 2 shows the results of the information in the data base.

Table 2: Results of the surveys and collections completed in the main data base.

Number of Specimens	Item
1,048	Total number of records.
188	Total number of specimens whose species taxon could not be identified.
28	Total number of unknown families.
796	Total number of voucher specimens.
11	Microscopic studies.
79	Total number of specimens new to the New Mexico Mycological Society list.
82%	Total percent of specimens identified to species.
96%	Total percent of specimens identified to genus.
21	Number of specimens judged rare.
169	Number of specimens judged uncommon.
649	Number of specimens judged common.
39	Number of specimens judged abundant.

4.2 Summary Information When Data Base is Sorted by Species

We sorted the data base by each species being represented. This meant that specimens of the same species were lumped together, as a "type." Table 3 shows the information related to species.

The resulting data base field codes and species lists are found in the appendices. Table 4 represents the various printouts that are found in the appendices.

Table 3: Data base information sorted by species.

Number of Species	Comment
241	Identified species.
227	Of the total identifications, 227 were considered “reliable” (see discussion in Appendix A).
6	Species were judged rare.
51	Species are new to the New Mexico Mycological Society.
211	Species are of the Subdivision Basidiomycotina.
25	Species were of the Subdivision Ascomycotina.
9	Species were slime molds.

Table 4: Information found in appendices.

Appendix A
- Field Abbreviations for Los Alamos Fungi Data base
- Location and Elevation Code for Los Alamos Fungi Data base
- Identification Reliability Code for Los Alamos Fungi Data base
- Mycorrhizal Host and Immediate Habitat Code for the Los Alamos Data base
- Zone Code for the Los Alamos Fungi Data base
- Reference Codes for the Los Alamos Fungi Data base
- Collector/Identifier Codes for Los Alamos Fungi Data base
- Habitat Codes for Los Alamos Fungi Data base
- Occurrence Code for the Los Alamos Fungi Data base
- Growth Habit Code for Los Alamos Fungi Data base
- Edibility Code for Los Alamos Fungi Data base

Appendix B
- Los Alamos/Bandelier Fungi Survey—Species List

Appendix C
- Los Alamos/Bandelier Fungi Survey—Species List sorted by Order

Appendix D
- Los Alamos/Bandelier Fungi Survey—New to the New Mexico Mycology Lists

5.0 Conclusion

The efforts to collect, identify, and develop a data base for the macroscopic fungi of Los Alamos County has provided a listing of over 241 species, 51 that are considered new to New Mexico and 6 species that are considered rare. Additional work must be done on identification of unknown specimens. Completion of the data base invites study of the patterns of diversity, ecological systems with other living systems, and time and spatial fluctuations.

6.0 Acknowledgments

These surveys were sponsored by the Ecology Group (ESH-20) at LANL and the natural resurces group at BNM. We would like to express our thanks to Craig Allen at BNM and Teralene Foxx at LANL for their support.

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