ABSTRACT

VERNIA, CAROLINE SUE. Polypores of a North Carolina Piedmont Forest. (Under the direction of Richard Braham.)

Fungi play an important role in recycling woody debris in forest ecosystems. The dynamics of fungal decay of woody debris are important factors in creating animal habitat and soil organic matter as well as causing economic losses in the commercial utilization of timber resources. Polypore fungi account for approximately 70% of the fungi capable of decaying wood. On September 6, 1996 winds from Hurricane Fran downed trees throughout the Piedmont of North Carolina and provided abundant substrate for polypore development. The objectives of this research were to: 1) Survey two forested tracts, totaling 115 hectares, for the occurrence of polypore fungi; 2) Record any new fungi or host-fungi associations for North Carolina; 3) Develop a key, based on macroscopic features, to these polypores for use by non-experts. A 100% cruise of Schenck Forest and an adjacent tract of land in Wake County, North Carolina was completed. Fifty-six polypore species representing 37 genera in five families were observed. Twenty-four taxa of woody plants were recorded as substrates. Six of these fungi are new reports for North Carolina. Fourteen of the host-fungi associations are new reports for the United States. A key and individual species descriptions are presented.

POLYPORES OF A NORTH CAROLINA PIEDMONT FOREST

by

CAROLINE SUE VERNIA

A thesis submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the Degree of
Master of Science

FORESTRY

Raleigh

1999

APPROVED BY:

Chair of Advisory Committee

BIOGRAPHY

Caroline Vernia was born and raised in southeastern Michigan. Upon completion of her B.A. degree in Philosophy from Kalamazoo College, she spent a year as a Thomas J. Watson Fellow in Thailand studying the experiences of Hmong refugees from Laos. In addition to this survey of Piedmont polypores her work has included two summers assisting in the NCSU Fraser Fir task force. Currently employed as a technician in the NCSU Department of Plant Pathology, she lives with her daughter in Raleigh.

ACKNOWLEDGEMENTS

My genuine thanks and appreciation are due to many people who helped to make this project possible. The respect I have for my committee members. Dr. Richard Braham, chairman, and Dr. Barry Goldfarb of the Department of Forestry and Dr. Larry Grand of the Departments of Plant Pathology and Forestry, has ensured that this research amounted to more than just a hike through the woods. Their support, questions, comments and good humor have been most generously shared. Financial support for this study was provided the the College of Forest Resources and that College's William Slocumb work-study endowment. The Department of Plant Pathology supplied many of the necessary mycological materials, microscopes, references and herbarium supplies. A special thanks to Larry Grand for his time and encouragement; his enthusiasm and curiosity for all things fungal, and many things not, were usually infectious and always sustaining. Dr. Elizabeth Wheeler generously assisted with some wood identification. Although we have not met, the work of Dr. R.L. Gilbertson has been an inspiration and I appreciate the time he took to identify some polypore specimens. The staff of the National Fungus Collection in Beltsville, Maryland kindly allowed me to roam through their wonderful herbarium at will; giving me the truly pleasant opportunity to come face to face with some of Overholts' collections. The Tripsaver staff at D.H. Hill Library persevered in tracking down many, often obscure, references. Thanks also to Heather Hartzog who kindly drew some of the figures and to the members of the Fall 1998 Advanced Mycology class for their helpful comments on early drafts of the keys. Finally, thanks to my family, their support and understanding have been invaluable.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The role that fungi play in recycling nutrients in natural ecosystems is well recognized by many mycologists. Alexopoulos *et al.* (1996) suggest that fungi are "most important on Earth as agents of decay." Hawksworth (1991) credits decay fungi with "ensuring that we survive the death, dung and detritus of contemporaneous members of our own species as well as of other organisms." Overholts (1953) contends that without fungi "every dead branch that falls to the gound, every wind thrown trunk and every stump left by the lumberman would lie indefinitely on the forest floor and the forests would soon be so choked with dead and down materials that they would be absolutely impenetrable."

On September 6, 1996, Hurricane Fran, a weakening Class 3 hurricane (Mayfield, 1996) passed through Wake County, NC. The eye of the hurricane grazed the western edge of Raleigh as it tracked northwest from its landfall the previous day near Wilmington, NC. Wind gusts reaching 69 miles per hour uprooted trees loosely anchored in soil already saturated from intense rainfall, broke trees mid-bole and scattered branch debris. Many trees were extensively damaged by wind, tornadoes, down bursts or other falling trees.

Considerable monetary and human resources were expended to remove the woody debris from the landscape. Yet given adequate time microorganisms, primarily fungi, would have naturally recycled this debris. In fact decomposition will recycle the downed timber remaining in forested land.

While overlooked or only casually admired by many naturalists, the biodiversity of fungi is recognized by mycologists as an important area of research (Hawksworth, 1991; Rossman, 1994). Additionally, the biochemistry of some wood-decay fungi is currently being investigated as a tool in bioremediation (Davis and Burns, 1990). Identification of wood-decay fungi is of interest to homeowners, urban foresters and forest managers due to the potential damage to standing trees and hazards posed by falling branches and boles.

LITERATURE REVIEW

Classification of Polypore fungi

Taxonomy of the polypores, a non-phylogenic group of fungi with a poroid hymenophore, has been revised dramatically over the years. Linneaus placed all polypores in the genus *Boletus*, a group currently limited to poroid, fleshy, mycorrhizae-forming species (Ainsworth, 1976). Persoon delineated the order Porodermi to include all fungi with pores (Ainsworth, 1976). In the nineteenth century, Fries subdivided the order by taking an earlier name, *Polyporus*, first used by Micheli (Ainsworth, 1976), and applying it to the firm to woody poroid fungi, differentiating these from the fleshy boletes. He later recognized a total of eight genera and placed them within the family Polyporaceae. In the early twentieth century Murrill split these eight genera of the polypores into 48 genera (Murrill, 1914; 1915). Overholts (1953) reduced these 48 genera to the eight originally recognized by Fries. Subsequently, with insights gained from cultural, microscopic and interfertility studies, these taxa have been expanded to the 96 presented in Gilbertson and Ryvarden (1986, 1987). Nomenclatural change has occurred at the family level as well. Genera formerly placed in Fries' Polyporaceae are now placed in the Bondarzewiaceae, Corticiaceae, Ganodermataceae and Hymenochaetaceae. All polypores are currently classified in the phylum Basidiomycota, class Homobasidiomycetes, order Aphyllophorales (Alexopoulos *et al.*, 1996).

Polypores are distinguished from other, perhaps more familiar, fungi by having a fertile layer, the hymenium, that lines the inner walls of tubes, rather than along the sides of gills. The reproductive structure of a polypore, the basidiocarp, is typically firm, leathery or woody and persistent. Most polypores utilize some combination of cellulose, hemicellulose and lignin as a resource for growth and reproduction. Polypores account for 70% of the fungal species able to decay wood and are responsible for 90% of the wood-decay in forest ecosystems (Overholts, 1953;

Gilbertson and Ryvarden, 1986).

The functional similarities (use of wood as a resource) and similar configuration of the hymenophore upon tubes makes limitation of a study to the Polyporaceae *(sensu stricto)* somewhat awkward for field work. Because some family level distinctions are not readily apparent in the field, polypore, as understood here, refers to poroid fungi that form basidiocarps on woody substrate with a hymenium borne on the inner walls of tubes. The group of polypore fungi surveyed in this research is therefore a nontaxonomic grouping not limited to a single taxa. Members of the Polyporaceae *(sensu stricto)* with some genera in the families Bondarzewiaceae, Corticiaceae, Ganodennataceae, and Hymenochaetaceae were included here. Ginns (1997) used a similar approach to the corticoid fungi. Exclusively resupinate species in the genus *Poria* are excluded from the results. Restriction of this survey to the Polyporaceae *(sensu stricto)* would result in a guide less useful for field identification and an incomplete inventory of the poroid wood-decay community at Schenck Forest. Thus, polypores, in the broad Friesian or Overholtsian sense of the group, are the taxa included in this study. Nomenclature, however, follows the more modern treatment found in Gilbertson and Ryvarden (1986, 1987).

Polypore fungi and wood decay

Cellulose, hemicellulose and lignin are cell wall components found throughout the stems of trees, shrubs and lianas. Biochemically and physically, lignin, comprising from 10-30% of the wood tissue, is most resistant to decay. Fungi are the dominant decay organisms found in woody substrate (Overholts, 1953; Gilbertson and Ryvarden, 1986; Eriksson *et al.,* 1990).

Wood decay caused by fungi can be classified in three categories (Overholts, 1953; Manion, 1991; Eriksson e(*al., 1990):* (1) white rot or brown rot; (2) sapwood or heartwood decay; and (3) top rot, stem rot and root and butt rot

White-rot fungi decay all cell wall components: lignin, cellulose and hemicellulose. The wood becomes bleached and little residue remains in the ecosystem because all cell wall components are decomposed (Jurgensen *et al.*, 1979; Jurgensen *et al.*, 1980; Larsen *et al.*, 1980). Variations occur in the type of white-rot decay related to the rate of decay of the different wood components and the appearance of the wood as decay progresses (e.g. stringy white rot or white pocket rot).

Brown-rot fungi primarily utilize the cellulose of the cell wall (Eriksson *et al*, 1990). A cubical, brittle, brown residue, the undigested lignin, remains after this decay is complete. This residue is resistant to further decay and can persist in the ecosystem as soil organic matter (Jurgensen *et al.*, 1979; Gilbertson, 1981).

Sapwood decay is not common in living trees, possibly as a result of the higher moisture content of the outer sapwood and the presence of living cells (Rayner and Boddy, 1988). But basidiocarps of sapwood-decay fungi can sometimes form around stem wounds on living trees. Sapwood-decay fungi are important for the recycling of nutrients in dead trees and slash. Heartwood decay occurs in the central portion of the stem which contains dead cells often filled with extractives. Heartwood decay can occur in living trees. A noted heartwood decay in southern pines is caused by the white-rot fungus *Phellinus pini* (Thore) A. Ames. Heartwood-decay fungi are responsible for most damage due to decay that results in timber value loss. Brown-rot and white-rot are not correlated with sapwood or heartwood decay (Highley and Kirk, 1979).

Top-rot, stem-rot and butt-rot fungi are categorized by the location of decay in the tree. White-rot and brown-rot fungi may fall into any or all of these categories. Basidiocarps of some species can be found at any point on the tree; *Trichaptum biforme* (Fr. in Klotzsch) Ryvarden, for instance, can be found from upper branches down to the root collar. Most species, however, are competitive only at a given location on the tree.The diversity of species of wood-decay fungi in a

forest depends upon the woody species present as well as its diameter and degree of decay (Nakasone, 1996).

The ecological importance of wood decay

Decomposition is the result of the actions of a suite of organisms, including invertebrates, acting within environmental constraints (Rayner and Boddy, 1988; Ausmus, 1977). Niches created during or after decay and the end products of decay that persist in the soil are ecologically important for several reasons.

Brown-rotted woody debris improves soil quality by increasing moisture holding capacity and cation exchange capacity (Jurgenson *et al.*, 1979; Harvey *et al.*, 1980; Larsen *et al.*, 1980; Hendrickson, 1991; Jurgensen *et al.*, 1992). Decaying wood can serve as a nutrient sink, reducing leaching from the soil (Gilbertson, 1981; Abbot and Crossely, 1982). Decaying wood can also form a localized enrichment point; fungal hyphae and bacteria colonize and soften the debris allowing the entrance of other microorganisms, plant roots, invertebrates and small animals (Harmon *et al.*, 1986; Franklin *et al.*, 1987). The volume of a live tree is 10% living tissue. Once a tree falls and begins to decay, organisms colonizing the bole increase the living biomass within that volume to 35% (Franklin *et al.*, 1987). Decay residue serves as a site for growth of ectomycorrhizae-forming and nitrogen-fixing microorganisms (Jurgenson *et al.*, 1979; Harvey *et al.*, 1980; Larsen *et al.*, 1980; Hendrickson, 1991; Jurgensen *et al.*, 1992). Harvey *et al.* (1980) associate this localized enrichment with the high moisture holding capacity of brown-rotted wood relative to surrounding soils, In conifer dominated ecosystems, brown-rot soil residue can comprise 10-30% of the soil (Harvey *et al.*, 1980; Gilbertson, 1981).

During decay by both brown- and white-rot fungi, the substrate is altered and made available to a variety of animals. Nesting, perching, drumming and roosting sites for birds are formed in softened wood of snags, large stumps and heartrot cavities of living trees (Conner and

Locke, 1982; Harmon *et al.*, 1986; Maser *et al.*, 1988; Cain, 1996; Lanham and Guynn, 1996). The softened debris provides hibernation burrows for reptiles and amphibians (Whiles and Grubaugh, 1996). Insect larvae develop within the wood and are available to insect-eating animals such as black bear (Powell, 1997). Snags provide cavities for cavity-nesting mammal species such as squirrels and bats (Loeb, 1996). Insects feed on and tunnel in the fungal basidiocarps (Graves and Graves, 1966). One symbiotic association between a polypore and a wood wasp has been documented (Gilbertson, 1984). Calcium oxalates produced on fungal hyphae within the decaying debris provide calcium for small animals (Eriksson *et al.*, 1990). Large woody debris stabilizes soil and litter; preventing slope erosion and reducing sedimentation of streams. Pools and riffles, as well as nutrient sources, are established by streamside windthrow (Harmon *et al.*, 1986; Sedell *et al.*, 1988; Wallace *et al.*, 1996).

Pathological significance of wood decay

Commerical utilization of forest resources is also influenced by wood-decay fungi. Wood decay accounts for the loss of one billion board feet of timber each year (USDA, 1995). Cruschow and Trousdell (1958,1959) used scaling tables from timber sales in National Forests in North Carolina to study volume losses in old growth pine and hardwood stands. Many pines were over 65 years-old; some were over 100 years-old. Volume loss due to heartrot was 37% and 38% in two stands in the study. Pine rotations are currently significantly shorter and these losses may not apply to stands harvested between 30-40 years of age, given the direct correlation of incidence of heartrot with stand age (Hepting, 1971). Surveys of hardwoods from the same timber sale found a high variability of volume loss due to decay among tree species. *Acer rubrum* L. and *Nyssa* spp. were most damaged by heartrot with volume losses of 38% and 13%, respectively. *Liriodendron tulipifera* L. had the least volume loss due to decay at 4%

(Gruschow and Trousdell, 1958).

Jacobi *et al.*, (1980a, b) used forest inventory data from permanent plots in the Piedmont of North Carolina to determine the extent of decay in both pines and hardwoods. Their findings were dependent on the ability of survey teams to identify decayed trees which required that the standing tree show signs or symptoms of decay. Damage to living pines from heartrot occurred in 1.6% of the trees, making heartrot the fourth most common cause of damage to living pines (Jacobi *et al.*, 1980a). The impact of root and butt rot caused by *Heterobasidion annosum* (Fr.) Bref. was much less severe, with 0.007% of the surveyed trees affected. Heartrot affected 2.4% of the hardwood trees surveyed (16.9% of the sawtimber trees). Heartrot of hardwoods was second only to "poor form" as a cause of value loss in hardwood stands (Jacobi *et al.*, 1980b).

In plantations, decay losses are lower because trees are harvested at younger ages. Nonetheless, damage from thinning operations or fire produces injuries which serve as infection courts for the entrance of wood-decay fungi. In some hardwood plantations, planting has replaced coppicing, reducing the incidence of heartwood connections between the decaying stump and the coppice regeneration, thus possibly reducing the volume loss due to decay.

Wood debris also harbors pathogenic root decay fungi, such as *H. annosum*. In their work on western soil organic matter, Harvey *et al.* (1979,1980) noted that the benefits of woody debris in the soil can be nullified if the organic matter supports high inoculum levels of pathogens that could damage the trees in subsequent rotations. In these cases, debris should be burned or removed to reduce infection of subsequent stands.

Wood-decay fungi are important to foresters and landowners as potential causes of economic

loss. They are also crucial components in ecosystem nutrient cycling processes. Many researchers have surveyed the biodiversity of fungi in other North Carolina ecosystems, yet the polypore fungi of the Piedmont have never been intensively studied. Additionally, as biodiversity surveys increasingly include microorganisms (Rossman, 1994), methods enabling efficient sampling and identification of these microorganisms could be of use to future researchers. The fungal flora of the southern Appalachian region of North Carolina is recognized for its diversity (Nakasone, 1996) and has been well documented (e.g. Coker, 1946,1948; Lowe and Gilbertson, 1961; Grand *et al.*, 1975; Jung, 1987). Work continues to develop a list of the fungi found in a barrier island maritime forest (Grand, unpublished data). Yet in the Piedmont only the larger stipitate polypores have been intensively studied (Coker, 1948), and more research is needed.

Schenck Forest has a high availability of new woody debris of different species and sizes that resulted from Hurricane Fran, the remains of older debris, and a diversity of substrate species that are the result of long-term management differences at the stand level. The period following the hurricane represented an opportunity to observe the formation of a potentially robust community of wood-decay fungi.

OBJECTIVES

The objectives of my research were to: (1) conduct a systematic, descriptive survey and collection of the polypore fungi found on coarse woody debris at Schenck Forest; (2) document records for fungi not previously reported from North Carolina, if any, and any new fungus-host records for both North Carolina and the United States; and (3) develop a key, based on macroscopic features, to the polypores found at the study site.

MATERIALS AND METHODS

Study site

This study was conducted in Wake County, NC (latitude 38° 52' N; longitude 78° 47' W) on two state-owned forests: Schenck Demonstration Forest managed by the Department of Forestry, North Carolina State University, and an adjacent tract of land owned by the North Carolina Department of Corrections (Fig. 1). These sites were selected as being representative of the North Carolina Piedmont. Upland soils belong to the Cecil and Cecil-Appling series, and bottomland soils belong to the Congaree series (Cawthorne, 1970). The 108 hectare tract of Schenck Forest is divided into 31 stands including loblolly pine (*Pinus taeda* L.) plantations, natural pine stands, hardwood demonstration plantations and stands maintained as natural areas. Many stands suffered windthrow due to the high winds and saturated soil conditions that occurred during Hurricane Fran. Damage assessments reported 300 mbf of downed timber, of which 175 mbf were removed through salvage cuts (Jervis, 1997). The additional parcel of 7 hectares owned by the NC Department of Corrections contains stands of oak, hickory and beech,

Temperatures during the 1997 survey ranged from an average monthly low in December of 4.9° C to an average monthly high in July of 26.4° C. Total precipitation during the year was 103.7 cm with April the wettest month (12 cm) and August the driest month (2.6 cm). Rainfall was below average for seven months of the year (NOAA, 1997-1998).

Methods

Twenty-seven of 31 stands at Schenck Forest and two stands on Department of Corrections land were included in the survey. Omitted stands were less than 10 years-old that suffered very little damage during the hurricane. Each stand was sampled twice, once between February and June 1997 and again between September 1997 and January 1998. Two sample periods enabled

observation of species that form basidiocarps seasonally. A 100% survey of each stand was accomplished each sample period using the strip cruise method. Each strip was 20 meters wide, and adjacent strips had a common boundary. This sample design maximized the number and type of potential substrates investigated. During the survey, debris in each strip was located and examined for the polypore basidiocarps. An observation consisted of debris supporting one or more basidiocarps of a single species.

Substrate information in three categories was recorded for each observation. First, species or genus of the substrate was determined. When degradation of the wood prevented species determination, identification to genus or phylum (either hardwood or conifer) was made. Oaks were separated to the subgenus. Nomenclature of substrate species follows Radford *et al.* (1968). Second, width (either diameter of the branch or dbh of the snag) and length of the substrate was determined. These measurements were taken initially with a measuring tape and calipers, as the survey progressed these measurements were made by occular estimation. Finally, the degree of decay of the substrate was rated using a scale of 1 - 3 where: 1 = recently fallen, no bark loss, wood still firm; 2 = some to significant bark loss, wood beginning to lose structure, and softening, loss of density, initial insect infestation; 3 = wood sodden and stringy or friable for white rots, fragmented for brown rots, wood crumbly and structureless, forming, or close to forming, soil organic matter.

Observations were made in the field regarding the basidiocarp's color, texture and growth habit. The basidiocarp and, where possible, underlying decayed wood were collected. Labels were made indicating host, date, field note number, and the basidiocarp was wrapped in wax paper or placed in a kraft paper bag for later identification. Where microscopic examination was required for identification, fungal tissue was mounted in 5% KOH solution or Melzer's reagent (Hawksworth *et al.*, 1995). Overholts (1953), Grand (1985), Farr *et al.* (1989), and Gilbertson and Ryvarden (1986, 1987) were used for species identification, and as authorities for host records and

geograpnical location. Nomenclature follows Gilbertson and Ryvarden (1986, 1987). Specimens at the NCSU Mycological Herbarium and the USDA National Fungus Collection, Beltsville Maryland, were examined to verify some determinations. Additional specimens were examined and species determinations made by R.L. Gilbertson, Professor Emeritus, Department of Plant Pathology, University of Arizona. Identified specimens were dried in an herbarium dryer and labeled. Voucher collections are housed in the Mycological Herbarium, North Carolina State University. Some duplicates were sent to the University of Arizona Mycological Herbarium.

RESULTS AND DISCUSSION

From over 750 observations, 56 species polypore wood-decay fungi representing 37 genera in five of the twelve poroid families were identified from the study site (Table 1). Twenty-four woody taxa were recorded as substrates for the fungi. These host-fungus associations are presented in Table 2. A key to the polypore species, based upon macroscopic characteristics, and individual species descriptions of the polypores found in this study are presented following the conclusion.

Six species of polypores found at Schenck Forest are new records for North Carolina. New state records are indicated with an asterisk in Table 1. Fourteen of the substrate-fungus associations have not been reported previously; they are indicated with an asterisk in Table 2.

Abundance of species of polypores fell into one of three categories in the wood-decay community (Table 3). Seven species were observed more than fifty times during the survey. They are cosmopolitan, generalist-species that form early in the decay process (Lincoff, 1981; Gilbertson and Ryvarden, 1986, 1987). *Trametes versicolor* (L.) Pilat, *Trichctplum biforme* and *Trichaptum abietinum* (J. Dicks.) Ryvarden were widespread throughout the sampling period. These species show a low-level of substrate preference, only to phyllum, and occur on both small and large diameter debris at a variety of decay stages. Basidiocarps of *T. biforme* and *T. abietinum* were occasionally observed on living trees. About 52% of the observations were made of these three species and another common polypore, *Irpex lacteus* (Fr.) Fr.

A second group of 16 polypores were observed between five and 50 occasions. They were found on a variety of substrates and appeared to be limited by the substrate size or degree

of decay. *Coltricia cinnamomea* (Pers.) Murrill was observed only on extremely decayed pine wood or stumps. Well-decayed stumps from previous logging operations before Hurricane Fran were present at the study site, although their volume is small relative to the volume of fresh debris. The occurrence of some species on this list is likely to increase as decay progresses and more woody biomass is degraded providing resources for the formation of basidiocarps.

The third abundance category included 33 species of polypores that were infrequently encountered; having been observed fewer than five times, often only once or twice. This low abundance may be explained by several reasons, not all of which apply to each species in this category. Some species may be at their northern or southern distribution limits. Although Lowe (1963) suggests that most polypore species are widespread, Nakasone (1996) contends that the Carolinas are an ecotone between tropical and boreal wood-decay fungi. For instance, *Pycnoporus cinnabarinus* (Jacq.) P. Karst. is a boreal species that is replaced by *Pycnoporus sanguineus* (L.: Fr.) Murrill in the Gulf States and the tropics. *Climacocystis borealis* (Fr.) Kotl. et Pouzar is a boreal species that reaches its southern limit in North Carolina (Gilbertson and Ryvarden, 1986).

Some species have a strong preference for a substrate that does not occur at Schenck Forest. *Ganoderma* applanatum (Pers.) Pat., for instance, recorded once in the survey, is found in abundance on old, living *Acer saccharinum* L. ornamental plantings in southwestern Michigan (Vernia, pers. obs.). Trees of this type are not present at Schenck Forest. Polypores with a host preference would not be expected to occur frequently in an environment where the preferred host is absent. Some wood-decay species require a substrate at an advanced stage of wood-decay for reproduction. Basidiocarps are formed only after the cellulose or lignin is metabolized and the fungus has amassed sufficient resources to reproduce. Alternatively, a polypore species may be limited physiologically or competitively to substrates in late stages of decay. The relative

abundance of well-decayed wood in the study site, a young, largely managed forest, is less than that found in older stands in northern climates where decay progresses at a slower rate. Ausmus (1977) in a study of the organisms present in decaying wood, suggested that basidiocarps were most likely to form 3-4 years after the tree's death. The species forming basidiocarps on well-decayed wood three years hence may result in an increase in the occurrence of species infrequently found in this survey. *Ganoderma lucidum* (W. Curt.) P. Karst., *Spongipellis delectans* (Peck) Murrill, and *Spongipellis spumeus* (J.C. Sowerby) Pat. may be examples of this situation.

Some species are inconspicuous and easily overlooked. *Coltriciella dependens* (Berk. et M.A. Curtis) Murrill represents the best example of this situation. The small dark brown basidiocarps of this species hang pendant from the inner surface of bark of well-decayed pine stumps. *Porodisculus pendens* (Schwein.) Murrill is another wood-decay fungus with a small inconspicuous basidiocarp found on small branches and young coppice stems.

These fungal abundance categories found throughout the study site also exist at the woody debris' species level. Four common tree species and the species of polypores observed on them are presented in Table 4. Each tree species has a slightly different association of polypores, but in all instances, one or two species of fungi account for the majority of observations. Four species of polypores that were found to be most abundant forest-wide were also most abundant on these different substrates. *Trichaptum abietinum* found on *Pinus taeda* is replaced on hardwoods by the closely related *Trichaptum biforme*. *Trametes versicolar* and *Irpex lacteus* are important in the decay of *Liriodendron tulipifera* and *Quercus* spp., in both red and white oak groups. All four species of fungi form small, often effused-reflexed, pilei with thin context and shallow tubes; rapidly colonizing a substrate and efficiently utilizing the resources to produce reproductive structures. In the later months of this survey, after the trees had been down for a year, the occurrence of *Trametes hirsuta* (Wulf.)Pat. and *Trametes elegans* (Spreng.) Fr. increased. These species are characterized by large, substantial basidiocarps forming with thick contextual tissue

and an extensive pore surface.

Not all woody species found at the study site were substrates for wood-decay fungi. For example, no polypore fungi were found on *Oxydendrum arboreum* (L.) DC., sourwood, although debris of that species was present. Farr *et al.*, (1989) record only two polypore species on sourwood. One of these, *Trametes versicolor,* was found at the Schenck, but not on sourwood.

No polypores were found on the shrubby genera, *Vaccinium, Elaeagnus and Myrica.* In a survey of damage caused by Hurricane Andrew, Loope *et al.* (1994) noted that damage to shrubs in Florida pinelands was mitigated by overstory trees bearing the force of the wind. Some woody shrubs were toppled at the study site. But often enough root mass persisted buried in the soil for the specimen to remain alive during the survey.

Small diameter branches and twigs form the bulk of the coarse woody debris from which observations were made (Fig. 2). The occurrence of observations on large diameter debris is inversely related to the diameter of the debris; a trend consistent with results found in studies of coarse woody debris distribution (Harmon *et al.*, 1986). The proportion of observations on wood in the 2.5 cm diameter class, however, is perhaps lower than the actual occurrence of such debris in the study site. Either the limited resources offered by small debris are inadequate for the development of a basidiocarp; moisture, and thus basidiocarp development, are limited by the high surface area to volume ratio of smaller debris; or small debris, buried in the forest litter layer, is more easily overlooked.

The range of substrate conditions under which each species of polypore was found in this survey, by host diameter and degree of decay, is presented in Table 5. Some fungal species are generalists, occurring on a variety of substrate host species and sizes while others are more limited to a specific host. The degree of decay present in the substrate appears to be the most

limiting factor; e.g., *Irpex lacteus*, while forming on a variety of hosts species at many diameters, was only found on wood in the early stages of decay.

As decay progresses over time, species may be added to this base list as organisms that are competitive on well-decayed wood or require substrate in advanced stages of decay become more predominant

Decay Associations

Of the 56 species of polypores present, nine (16%) cause brown rot. This figure is consistent with the proportion of brown-rot fungi, approximately 20%, found in the Polyporaceae (*sensu lato*) as a whole (Overholts, 1953; Gilbertson, 1981; Gilbertson and Ryvarden, 1986). Conifers provide a substrate for more brown-rot fungi (6 of 9 species; 66%) than hardwoods (4 of 9 species) in this study. Conifers are commonly associated with brown-rot fungi, yet a high number of fungi observed on conifers cause white rot (11 of 17 species; 65%). White-rot fungi were dominant on hardwoods as well (39 of 45 species; 90.7%).

The results of a χ^2 test on the distribution of fungi by decay type and host indicate a significant difference from that which would be expected from an even distribution ($p< 0.005$; Dixon and Massey, 1983; Wagner, 1992). Gilbertson (1981), in fact, contends that most brown-rot fungi occur north of 35° latitude. This study site is on the southern edge of this range. The balance between brown-rot fungi and white-rot fungi could, perhaps, be different further north. Yet, when a χ^2 test was performed on the distribution of fungi by decay type and host in this survey versus distribution reports in the literature (Gilbertson, 1981) no significant difference was found.

Fungal Associations

Coarse woody debris offers a substrate for fungal species capable of colonizing the wood and

utilizing the resources in the wood. Some species formed basidiocarps simultaneously with other fungi on a shared substrate (Table 6), indicating either coexistence through the occupation of different resource niches or occupation of different sites in the substrate.

Rayner and Boddy (1988), Blanchette and Shaw (1978) and others investigated the decay of wood by a succession of organisms. In its initial stages, this succession begins with the abundance of *Trichaptum biforme* and *Irpex lacteus,* shifting as these species are replaced by *Trametes hirsuta* or *Trametes elegans.* Thirty-two of the 59 species (54%) of polypores found in this study produced reproductive structures simultaneously with other species, indicating coexistence. Only one case involved a species of a brown-rot fungus *[Antrodia albida* (Fr.) Donk*]* occurring with a species of white-rot fungus *[Daedaliopsis confragosa* (Bolt.) J. Schrot.*].* The other brown-rot fungus, *Coltriciella dependens,* was found in association with *Coltricia cinnamomea,* a species with uncertain wood-decaying ability (Gilbertson and Ryvarden, 1986).

Liquidambar styraciflua L., substrate to the greatest number of species of polypore, was also the substrate for the greatest variety of associations. Three white-rot fungi, *D. confragosa, T. biforme* and T. *versicolor* occurred in association with the greatest variety of fungal species, all early successional fungi. *Trichaptum abietinum,* the common polypore on conifers, was not found in association with other species of polypores.

Disease occurrence

Five species of polypores that cause economic losses in forests were observed during the survey. A map showing the location of these species, *Heterobasidion annosum, Phellinus pini, Bondarzewia berkeleyi* (Fr.) Bond. et Singer, *Inonotus ludovicianus* (Pat. Murrill and *Ganoderma applanatum,* is presented (Fig. 3).

Heterobasidion annosum was found in pine stands generally over 30 years-old. The exception was its occurrence on a pine stump remaining after a harvest operation at the edge of a loblolly

pine plantation in the 1 to 10-year-old age class. This last occurrence is, perhaps, the most typical pathway for *H. annosum* to infect regeneration through the stumps and roots. *H. annosum* was also found twice on fallen boles of pines.

Phellinus pini was found in pine plantations over 50 years-old. In four of six occurrences, the basidiocarp was growing on living trees. It was also observed once on a windthrown tree which had been the upper stem of a nearby snag. The snag held seven basidiocarps of the sessile, ungulate, form of *P. pini*.

Bondarzewia berkeleyi and *Inonotus ludovicianus* were once economically important decay species that caused losses in oak (Overholts, 1953). Both fungi cause root and butt rot in large diameter trees and in coppice stems that form from an infected stump. *Bondarzewia berkeleyi* was found at the base of a large oak in an area maintained as a natural stand. *Inonotus ludovicianus* occurred in only one stand on large, well-decayed *Liquidamber styraciflua* stumps. Sweetgum is common throughout the study site, but it often occurs in stands that are periodically burned and may not reach the size or age needed for widespread infection to occur. *Ganoderma applanatum* was found only once in the study site on a wound on a coppice stem of red maple. Periodic burning of the stand containing this species supresses the hardwoods. Many of the red maple trees never reach the upper canopy layer and perhaps never develop to a size that would support the widespread occurrence of *G. applanatum*. Additionally, red maple may be less susceptible than sugar maple to infection by the fungus (Hepting, 1971).

Keys and Species Descriptions

A key to the fungi species found during the survey period was developed. This key has been designed to assist non-mycologists in identifying polypore species based on macroscopic features. All polypore keys in the monographic treatments require some

microscopic analysis; this places those without training or a microscope but with an interest or need to identify a polypore species at a disadvantage. Additionally, biodiversity survey methods have been designed to utilize the energy and enthusiasm of nonprofessionals (Rossman, 1994). Reliable keys based on macroscopic features and limited to local or regional populations of a given taxon can increase both the efficiency and accuracy of surveys. The key has been utilized with good results by a graduate level mycology class at NCSU. The survey-based key contained all species of polypores found by the students at the study site.

Conclusions

This survey found 56 species of polypores on 24 taxa of woody plants. Six of these species are new reports from North Carolina; and 14 are new host records. These new records indicate that there is a continuing need for more surveys of the fungal population of the Piedmont.

Pileus color helps distinguish species. Color keys have been developed for specialists. This key, however, uses relatively conventional color names. The surface of the pileus can be one color (**unicolorous**). When the color of the pileus varies in bands around the surface, it is **zonate**. Zonations can be multicolored or unicolorous. The **margin** of the pileus can sometimes be diagnostic, but the only aspect of the margin used in this key is color.

The body of the basidiocarp, under the pileus, from which the tubes extend is the **context**, best viewed in cross-section. Color and thickness are the primary characteristics of the context used in this key. Context thickness should be measured at a point midway between the base and the margin. The **texture** of the context, woody, leathery, friable, chalky, etc., is best determined when the basidiocarp is fresh.

Pores are the openings of the tubes on the underside of the basidiocarp. The inner surfaces of the tubes are covered by fertile tissue on which the basidia form. The basidia bear basidiospores – the primary reproductive propagules of polypores. The shape of the pore opening (Figure 5) is an important characteristic. It ranges from **lamellate** (gilled), to **daedaloid** (mazed), to **toothed** to **round** with a high degree of variability in some species. Pores can, for example, be daedaloid at the base, and become lamellate at the margin. They can also change over time being rounded when fresh but daedaloid with age.

Pore number per linear millimeter, tube length (in millimeters), pore color and tube-layer color are also used in this key. The mouths or margins of pores are used in some keys as a diagnostic character. In this key, this characteristic is provided in the species description. Pore size and shape should be measured in the middle portion of the pore surface as pores can be distorted when forming on the margin or at the base. Pore size should be measured along the width of the basidiocarp rather than radially from the base.

In some species the main body of the basidiocarp is borne on a stalk or **stipe**. In these instances the basidiocarp is said to be **stipitate**. Often the stipe of a basidiocarp has diagnostic features which include the location of the stipe (centrally or laterally attached), its color, size and pubescence.

The manner in which the basidiocarp forms on the substrate is also helpful in species determination (Figures 6-8). Four forms are most common: **resupinate, effused-reflexed, sessile** and **stipitate**. These terms represent a gradation of how the pores form on the substrate. All polypores are positively geotropic; meaning that the pore openings, when formed naturally and undisturbed, face downward. An easy way to visualize these distinctions is to consider the proportion of the pore openings that is borne under a distinct pileus surface. Resupinate species have only a very small portion of the pores formed under a distinct pileus. Effused-reflexed species have pores forming both without a pileus and under the pileus-surface. Sessile species, in contrast, have almost all the pores formed under a distinct pileus. Stipitate species have basidiocarps attached to a stipe.

An important characteristic of the basidiocarp used in this key is size (Figure 9). Width (measured in millimeters or centimeters) is used to describe the size of the basidiocarp parallel or tangential to the wood surface. Length is the size of the basidiocarp radiating or extending out perpendicularly from the surface of the wood. Thickness is the depth of the basidiocarp from the pore opening to the top of the pileus.

The texture of the basidiocarp (watery, rigid, leathery, woody, etc.) is important. It is most easily differentiated when the basidiocarp is collected in the field.

Collection and observation

The key was written so that the only material needed for identification are: a specimen; a hand lens (at least 5x); and a small metric ruler. Some basidiocarps change quite a bit as they age, are weathered or are attacked by insects. Mature and fresh specimens are easiest to identify.

Often it is more practical, due to time constraints or unfavorable conditions in the field, to collect the polypore basidiocarp for further study in a more comfortable environment. When fungi are collected in the field, observe and note the **texture** of the basidiocarp, the **substrate** (hardwood or conifer at least, or the genus if possible), and the **type of rot** (either white or brown). These features are all used in the key. Collect as much of the basidiocarp as possible and wrap it in wax paper or in a paper bag. Plastic wrapping will cause other fungi to grow on top of the specimen. Many species are food or habitat for destructive insects. If a specimen is to be saved, it should be dried to kill the insects and prevent degradation.

A description of each species found at the study site follows the keys. Species are listed alphabetically by genus. These descriptions provide a fuller characterization of each species, its pathogenicity and its role in the ecosystem. Overholts (1953) and Gilbertson and Ryvarden (1986 and 1987) also provide species descriptions which include microscopic features. References to these monographs are included in my descriptions. My descriptions are based on study site materials, often only one or two specimens. Where these measurements are not representative of the species, additional observations from the above authors are included in brackets. Species descriptions can provide additional information which will help confirm an identification.

When a particular species has a noteworthy microscopic feature, brief mention is given in the species description. Most often these features are easily found when a thin section is made and viewed under a microscope at 100-400x. Features mentioned include

hyphae, the filamentous cells of which the fungi are formed; **spores**, the sexually produced reproductive propagules of the fungi; and **chlamydospores** and **oidia**, asexually formed propagules that are often rounded and thick-walled.

DICHOTOMOUS KEYS

TO THE POROID WOOD-DECAY FUNGI FOUND AT SCHENCK FOREST

Key to the dichotomous keys:

Basidiocarp with dark context; brown, maroon, deep yellow to red; definitely not white or pallid ..... **KEY I** (page 25)

Basidiocarp with pale context; white, cream to off-white or pale hues; not deeply colored or dark ..... **KEY II** (page 29)

KEY I: Polypores with dark context: brown, maroon, deep yellow to red; not white or pallid.

1. Basidiocarp stipitate 2
1. Basidocarp resupinate, effused-reflexed, sessile to substipitate 7

2. Basidiocarp less than 3 cm in diameter 3
2. Basidiocarp greater than 3 cm in diameter 5

3. Pileus deep brown; finely pubescent, appearing glabrous; pore mouths with whitish to pale cast ..... ***Polyporus arcularius***
3. Pileus rusty- to cinnamon- to tobacco-brown; silky to wooly pubescent; pore mouths concolorous with pileus and context 4

4. Basidiocarp centrally stipitate; pileus silky tomentose ..... ***Coltricia cinnamomea***
4. Basidiocarp laterally stipitate to pendant; pileus wooly tomentose ..... ***Coltriciella dependens***

5. Pileus glabrous, often encrusted with a shiny layer of yellow, red to maroon.....
.....*Ganoderma lucidum*

5. Pileus tomentose to pubescent, tomentum may become matted with age; but neither encrusted nor shiny.....6

6. On the ground at base of coniferous trees, or rarely on the bole; pileus finely tomentose.....
.....*Phaeolus schweinitzii*

6. On wood at base, butt or roots of hardwoods; pileus matted and roughly tomentose.....
.....*Inonotus ludovicianus*

7. Basidiocarp composed of numerous individual pilei that overlap to form a large pendant cluster.....*Globifomes graveolens*

7. Individual pilei discrete, if joined then laterally fused.....8

8. Basidiocarp hard and woody when fresh or dry.....9

8. Basidiocarp leathery, spongy or supple when fresh; hardened when dry.....12

9. Pores brown; unchanged when bruised or dry.....10

9. Pores whitish to pale; darker when bruised or dry.....11

10. Basidiocarp formed of numerous perennial layers; typically more than 3 cm thick; on boles of living, or less frequently dead, conifers.....*Phellinus pini*

10. Basidiocarp formed of a single tube layer; basidiocarp less than 2 cm thick; on dead or decayed portions of hardwoods.....*Phellinus gilvus*

11. Pileus covered with a velvety, upright, maroon-brown pubescence; becomes blackened and glabrous in spots and on margin; pores not darkened where bruised ..... ***Ischnoderma resinosum***

11. Pileus finely pubescent to mostly glabrous; buff to mousy-brown; unchanged when dried pores darken brown where bruised..... ***Ganoderma applanatum***

12. Pores daedaloid or lamellate..... **13**

12. Pores rounded; occassionally elongate on effused-reflexed specimens..... **14**

13. On conifers; tubes elongate, often lamellate; pileus tomentose with glabrous zones; pileus and context, when fresh, deep rusty- cinnamon- to tobacco-brown; with bright whitish to yellow-brown pubescent margin..... ***Gloeophyllum sepiarium***

13. On hardwoods; tubes angular to daedaloid to lamellate; pileus glabrous throughout; pileus and context dull beige to light brown; zonate to azonate; margin concolorous..... ***Daedaliopsis confragosa***

14. Pileus and context bright or deep red, orange, yellow or maroon; glabrous, or finely pubescent and appearing glabrous..... **15**

14. Pileus and context grey, light to dark brown or white; pubescent, tomentose or glabrous..... **17**

15. Pileus dark brown to maroon to wine-colored; found on hardwoods and conifers in late stages of decay..... ***Nigroporus vinosus***

15. Pileus bright red, yellow to orange; found on hardwoods in early to intermediate stages of decay..... **16**

16. Pileus and context bright red to orange, sometimes with a whitish cast; semi-circular to shell-shaped; sessile on substrate; light and firm when fresh; not bending without breaking; margin concolorous with pileus or whitish.....*Pycnoporus cinnabarinus*

16. Pileus and context yellow, sometimes with a maroon to purplish cast; nodulose to shell-shaped basidiocarps; sodden and soggy when fresh; bending without breaking; margin blackens with age.....*Hapalopilus nidulans*

17. Pores deep purple, to violet, to bay; distinct from context; tubes typically less than 2 mm long; found on conifers.....*Trichaptum abietinum*

17. Pores off-white to dark tan; concolorous with context; tubes elongate, 0.3-1 cm long; found on hardwoods.....*Coriolopsis rigida*

KEY II: For polypores with context white, cream, off-white or pallid colors.

1. Basidiocarp stipitate to substipitate or pendant.....2

1. Basidiocarp sessile, effused-reflexed or resupinate.....14

2. Pilei numerous, from a central stipe or joined stipes; forming a rounded cluster.....3

2. Basidiocarp single, from a central or lateral stipe; possibly growing in groups but not in a common mass.....6

3. Pores 4-7 per mm; pore surface and pileus rapidly blackening with age or when bruised.....***Meripilus giganteus***

3. Pores 1-4 per mm; pore surface and pileus remaining largely unchanged with age or bruising.....4

4. Pileus white to cream; taste bitter with age; typically 2-3 pilei forming from a single stipe.....***Bondarzewia berkeleyi***

4. Pileus grey to brown to light orange; taste not unpleasant; pilei from a central mass.....5

5. Pileus grey to brown with bronze patches; pores white to cream, unchanged when dry or with age; basidiocarp emerging from ground or root collar.....***Grifola frondosa***

6. Pileus orange to salmon; pores bright lemon yellow, palled when dry or with age; basidiocarp emerging from ground, stem or root collar.....***Laetiporus sulphureus***

6. Stipe base black and glabrous.....7

6. Stipe concolorous with context or pileus; glabrous to finely pubescent.....8

7. Pores 5-7 per mm; tubes 2 mm long; basidiocarp 4-20 cm broad; pileus dark brown to reddish-brown; on logs or stumps.....***Polyporus badius*** (see *P. elegans*)

7. Pores 4-5 per mm; tubes 1-3 mm long; basidiocarp 1.5-7 cm broad; pileus tan to sandy-brown; on small twigs or branches.....***Polyporus elegans***

8. Stipe poorly developed, or basidiocarp substipitate with pileus as a lateral extension of the stipe, or stipe a cup-like structure; pores round.....**9**

8. Stipe well-defined; pores angular.....**13**

9. Basidiocarp less than 5 cm in diameter; on branch debris or small coppice stems.....**10**

9. Basidiocarps more than 5 cm in diameter; on stumps or large boles of living or dead trees.....**11**

10. Basidiocarp minute; typically less than 5 mm in diameter; pendant from a laterally attached, much-reduced stipe; 6-10 pores per mm; often covered by a thin layer of mycelium; pileus pinkish to cream colored.....***Porodisculus pendulus***

10. Basidiocarp 0.5-1 cm in diameter; stipe present as a sterile cup-like structure at the base of the basidiocarp; 2-4 pores per mm; not covered with a mycelial layer; pileus light brown, often zonate; becoming white with age.....***Trametes conchifer***

11. Pileus pale pink to brown to yellowish; pores becoming daedaloid; margin exuding reddish drops when fresh.....***Abortiporus biennis***

11. Pileus white to grey; pores rounded; fresh margin dry.....**12**

12. Pores 1-4 per mm; margin concolorous with pileus and unchanged on drying.....
.....***Boudarzewia berkeleyi***

12. Pores 4-7 per mm; margin becoming olive to brownish green in a glabrous
band on drying, or with age.....***Fomitopsis spraguei***

13. Pores hexagonal to diamond-shaped; regular; pileus bright cream to reddish-brown;
tomentose when fresh; on large debris; forming singly or in masses....***Polyporus alveolaris***

13. Pores angular; irregular; pileus dull dark brown; finely pubescent to glabrous;
forming small solitary or paired basidiocarps.....***Polyporus arcularius***

14. Basidiocarp mostly resupinate; majority of pores not under a pileus surface; or
basidiocarp less than 1 cm thick 15

14. Basidiocarp mostly 28

15. Pores concolorous with context to slightly darker; openings toothed or elongate.....16

15. Pores color different from context; openings even and round.....24

16. Pores irregular and angular or daedaloid.....17

16. Pores regular and round or distinctly toothed.....22

17. Tube length highly variable in the same basidiocarp; knotty in cross section; often
nodulose; texture chalky.....***Abortiporus biennis***

17. Tube length consistent throughout basidiocarp; distinct layers of pileus, context
and tubes; texture spongy, fleshy or leathery.....18

18. Basidiocarp fleshy, fragile and watery when fresh; mostly resupinate; pores daedaloid, often shallow.....***Schizopora paradoxa***

18. Basidiocarp coriaceous to leathery when fresh; effused-reflexed pores daedaloid to angular; shallow only at the margin.....**19**

19. Pileus azonate; finely tomentose to glabrous, drying friable.....***Tyromyces fissilis***

19. Pileus zonate; hirsute to tomentose to finely pubescent; drying rigid.....**20**

20. Pores 3-5 per mm; pileus rusty-brown; pores brown.....***Antrodia serialis***

20. Pores 0.5-3 per mm; pileus and pores white to straw-colored to light brown.....**21**

21. Pores 1-3 per mm; pore surface white to pallid when fresh; pileus lightly pubescent; common on hardwoods.....***Antrodia albida***

21. Pores 0.5-2 per mm; pore surface and pileus beige to straw-colored; pileus hirsute to tomentose; drying glabrous; more common on conifers.....

.....see: ***Antrodia sinuosa*** and ***Antrodia heteromorpha***

22. Pileus and context pale to light brown; pores toothed to rounded; context more than 1 mm thick; tubes longer than 2 mm.....***Coriolopsis rigida***

22. Pileus and context white to greyish white; pores toothed or rounded; context less than 1 mm thick; tubes less than 2-3 mm long.....**23**

23. Pores round; tubes less than 1 mm long; pileus less than 0.5 cm long; white, azonate; finely, pubescent.....***Chaetiporellus latitans***

23. Pores toothed; tubes 1-3 mm long; pileus variable in length, 0.5-1 cm long; grey to white; zonate; cottony pubescent.....***Irpex lacteus***

24. Tube layer different color from context; tubes smoky grey, brown, black, orange to maroon.....**25**

24. Color difference between context and tubes limited to pore surface; pores reddish, purple or violet.....**27**

25. Tube layer smoky grey to black in color; similar in texture to, and not separating easily from the context.....***Bjerkandera adusta***

25. Tube layer purple, yellow to orange; gelatinous in texture; separating easily from the context.....**26**

26. Pileus cream; azonate; pores yellow to gold; slightly irridescent.....***Skeletocutis nivea***

26. Pileus white to beige; azonate to faintly zonate; pores deep yellow-orange to maroon.....***Gloeoporus dichrous***

27. Host a hardwood; pores cream, violet to lavender especially at the margins when fresh; pileus 0.5-4 cm long.....***Trichaptum biforme***

27. Host a conifer; pores bright purple to lavender or violet when fresh; brown to rusty on drying; colored across pore surface; pileus under 1 cm long;.....

.....***Trichaptum abietinum***

28. Surface of pileus red, orange, pinkish-brown; glabrous or finely tomentose; azonate.....**29**

28. Surface of pileus white to cream, to light grey to light brown; tomentose to finely pubescent; azonate to zonate.....**30**

29. Pileus brown to salmon-pink; basidiocarps often lumpy or in nodulose masses; at the base of coniferous trees and stumps.....***Heterobasidion annosum***

29. Pileus deep brown to maroon; with rough upright pubescence and black sulcate spots; basidiocarp semi-circular and well-formed; on hardwoods.....***Ischnoderma resinosum***

30. Host a conifer **31**

30. Host a hardwood.....**36**

31. Pileus azonate; white to cream; pore surface white.....**32**

31. Pileus zonate; grey to beige; pore surface white, lavender, purple, when fresh; occassionally rusty brown when dry.....**35**

32. Pileus finely pubescent; taste bitter.....***Oligoporus stipticus***

32. Pileus glabrous or pubescent; taste not bitter.....**33**

33. Pileus cream to pale brown; pileus often bluish when fresh; with an upright pubescence; margin reddish- to rusty-brown; glabrous in contrast to rest of pileus....***Oligoporus caesius***

33. Pileus milky white, not appearing bluish when fresh; glabrous to finely pubescent; margin concolorous with pileus.....**34**

34. Pores 3-6 per mm; basidiocarp less than 1 cm thick.....***Dichomitus squalens***

34. Pores 1-3 per mm; basidiocarp to 2 cm thick.....***Climacocystis borealis***

35. Basidiocarps usually in clusters; often effused-reflexed; less than 1 cm long.....

.....***Trichaptum abietinum***

35. Basidiocarps single or in groups of individually sessile pilei; more than 1 cm long.....

.....***Trametes villosa***

36. Pore surface irregular; pores lamellate, toothed, daedaloid or hexagonal.....**37**

36. Pore surface even; pores round to deadaloid **41**

37. Basidiocarp more than 5 mm thick; pores daedaloid to lamellate.....**38**

37. Basidiocarp less than 5 mm thick; pores toothed to daedaloid **40**

38. Basidiocarp nodulose to pileate; reddening where bruised; chalky when fresh; drying friable Pores rounded to daedaloid.....***Abortiporus biennis***

38. Basidiocarp pileate, semi-circular; unchanged on bruising; coriaceous when fresh; rigid on drying; pores daedaloid to lamellate.....**39**

39. Pores daedaloid at base; occassionally lamellate at margin; white to brown; pileus brown; azonate or zonate; glabrous.....***Daedaliopsis confragosa***

39. Pores lamellate throughout; pore surface white to cream; pileus yellow, brown, grey; zonate; hirsute.....***Leuzites betulina***

40. Pore surface white to cream; tubes 1-5 mm long; pileus less than 1 cm long; cottony pubescent.....***Irpex lacteus***

40. Pore surface grey; tubes 0.5-4 mm long; pileus over 1 cm long; hirsute.....***Cerrena unicolor***

41. Basidiocarp nodulose; often appearing poorly formed; tube layer shallow.....**42**

41. Basidiocarp shell-shaped to semi-circular; occassionally laterally joined, but distinct.....**43**

42. Basidiocarp pendant, under 5 mm long and broad; pink to cream; rigid; pores well developed but often obscured by a milky white layer of mycelia; tubes less than 1 mm long.....***Porodisculus pendulus***

42. Basidiocarp sessile, often nodulous; over 5 mm long; white; spongy when fresh; tubes less than 1 mm long; tubes poorly developed.....***Perenniporia compacta***

43. Context less than 5 mm thick.....**44**

43. Context more than 5 mm thick.....**51**

44. Pileus finely pubescent and appearing glabrous or glabrous; margin changing when bruised or dry.....**45**

44. Pileus pubescent, tomentose or hirsute; margin occassionally darker but unchanged when bruised or dry.....**46**

45. Pileus white; turning olive-green to greenish-brown when bruised; substipitate to sessile.....*Fomitopsis spraguei*

45. Pileus white with a milky cast; turning blackish with age or on bruising; sessile.....*Dichomitus squalens*

46. Tomentum upright and fine; pileus azonate; margin a glabrous band contrasting with pileus; margin reddish to rusty-brown.....*Oligoporus caesius*

46. Tomentum silky, velvety or hirsute; pileus zonate or azonate; margin similar to pileus, not contrasting **47**

47. Pileus white, cream to light brown; finely pubescent; azonate or with unicolorous zones.....**48**

47. Pileus brown, grey or multicolored; velvety hirsute to silky pubscent; zonate.....**49**

48. Pileus silky tomentose, visible under a hand lens; white; pore surface white to light brown; often arising from a sterile cup-like structure at base.....*Trametes conchifer*

48. Pileus velvety pubescent; tan to brown; when zonate with unicolorous zones.....*Trametes pubescens*

49. Pileus with sharply contrasting, multi-colored zones; pore surface regular; pores white to cream.....*Trametes versicolor*

49. Pileus with similarly colored zonations; pore surface irregular; pores brown, to purple to rusty tan.....**50**

50. Pileus roughly to silky tomentose; straw colored; pores brown to tan; pores round.....***Trametes cervina***

50. Pileus finely pubescent; grey to brown; pores cream with a violet cast on margin and when fresh; pores becoming toothed.....***Trichaptum biforme***

51. Context fleshy, spongy, to sodden when fresh; drying rigid; tube layer distinct from context.....**52**

51. Context cottony fibrous when fresh; drying same; tube layer largely continuous with context.....**53**

52. Pores irregular; pore surface uneven; 1-2 pores per mm.....***Spongipellis delectans***

52. Pores regular and rounded; pore surface even; 4-6 pores per mm.....***Spongipellis spumeus***

53. Pileus zonate with unicolorous zones; very hirsute; pore surface even; pores rounded.....***Trametes hirsuta***

53. Pileus azonate; usually white, mousy-brown to grey; margin darkening on drying; finely pubescent to glabrous; pore surface dull white; pores irregular, rounded to daedaloid.....***Trametes elegans***

1. **Abortiporus biennis** (Bull.: Fr.) Sing.
Synomym: *Polyporus biennis* Bull.: Fr.

Overholts (1953): page 224; Gilbertson and Ryvarden (1986): page 85

Basidiocarp: Annual; sessile, occasionally laterally stipitate, substipitate or effused-reflexed; often noduose or laterally fused; spongy to chalky and sodden when fresh; rapidy drying to friable; 1-15 x 1-5 x 1.5 cm. **Pileus**: When present, initially white to cream; drying pinkish-brown to beige or dull yellow; azonate; finely, matted, pubsecent; margin darker pink to beige (although reported to be lighter to white), fimbriate; when moist and fresh, margin exuding droplets of reddish liquid. **Context**: Often poorly developed, in nodulose forms a thin layer interwoven among a maze of thin tubes; white to cream; drying pale yellow to pink; 1-8 mm thick; fibrous to chalky; friable when dried. **Pores**: Round to daedaloid; 1-3 per mm; surface light beige to pink; reddening upon bruising; tube mouths finely serrate; tubes highly variable in length; up to 6 mm long; concolorous with context. **Stipe**: Absent or present; beige; tomentose; up to 5 cm. long and 1.5 cm in diameter.

Type of decay: White rot of dead trees.

Substrate: *Liriodendron tulipifera* (yellow-poplar); *Quercus* spp. (oak).

Comments: This was one of the first species to appear on large debris (Yellow-poplar, 40 feet long, 12 inches dbh) downed by Hurricane Fran. I found it both in the effused- reflexed nodulose and stipitate forms which are quite dissimilar. Nodulose basidiocarps have pore openings covering all basidiocarp surfaces, lacking any particular orientation, and can occur alongside pileate basidiocarps. For some authors, the nodulose form is a variety, *Polyporus biennis* var. *distortus* (Schw.) Graff (Bondartsev, 1971; Gilbertson and Ryvarden, 1986). Its co-occurrence with var. *biennis*, I think, questions varietal recognition. Bondartsev (1971) also suggests that the nodulose form is often an undeveloped pileate or stipitate form. I noted that nodulose basidiocarps observed over the course of three to four weeks on the substrate failed to develop into pileate basidiocarps.

Diagnostic characteristics that are diagnostic include spongy nodulose basidiocarps occurring alongside pileate basidiocarps; basidiocarp tissue which quickly dries and becomes friable when removed from the wood; reddening of the pore surface when scratched or injured; and the daedaloid tube layer evident in cross-section. The texture of the basidiocarp when broken is distinctly chalky or talc-like.

This species quickly degrades to frass due to insect infestation. Its coloration and texture change rapidly during drying.

Microscopic characteristics are particularly interesting, although not necessary for identification. A thin section of a basidiocarp at 100-400x shows tissue that often seems to be composed more of spores than of hyphae; a situation highly unusual for the Polyporaceae, in which spores are frequently difficult to locate. These structures are in fact chlamydospores, asexual reproductive spores formed from hyphae rather than on basidia. Long hyphal extensions called gloeocystidia also occur within the hymenium. These are comparable to normal cystidia occasionally found in many wood decay polypores, but greatly elongated and often inflated.

ANTRODIA

Like a few other genera in this survey the species of *Antrodia* are macroscopically very similar and often differentiated only on the basis of spore shape and size and substrate. Because pore size, pileus coloration and tomentum intergrade among species, without microscopic examination, specific identification can be problematic; although determination to the genus level is relatively simple. All *Antrodia* species cause a cubical brown rot in dead wood. None are recognized as pathogens. Overholts (1953) notes that mycelial mats can form within the cracks of the decaying wood.

2. Antrodia albida (Fr.) Donk
Synonym: *Trametes sepium* Berk.

Overholts (1953): page 136; Gilbertson and Ryvarden (1986): page 122

Basidiocarp: Annual; effused-reflexed; applanate to ungulate; in clusters of individual pilei, or laterally fused; leathery and flexible when fresh; rigid on drying; 1-3 x 1-2 x 0.5 - 2 cm. **Pileus:** Hirsute to finely pubescent when fresh; glabrous when dry, with the dried tomentum forming radial striations; azonate; straw, tan, off-white to light brown; darker on margin; margin entire or appearing fimbriate. **Context:** White to tan; 3-4 mm thick; roughly or stringy fibrous (as opposed to cottony fibrous found in some species of *Trametes*); **Pores:** Mouths round and entire; becoming elongated, angular or dentate at base or where effused; irregular to daedaloid toward base; 1-3 pores per mm; surface white when fresh; drying yellowish-brown; tubes 2-5 [- 15] mm long; walls thinning with age.

Type of decay: A cubical brown rot of dead trees.

Substrate: *Carya glabra* var. *odorata* (red hickory); *Juniperus virginiana* (eastern redcedar).

Comments: This species most commonly occurs on angiosperms, although it has been noted causing decay in *Juniperus* branches (Gilbertson and Ryvarden, 1986). It can be distinguished from other *Antrodia* species by the substrate type, white coloration of the fresh pore surface, and the variable pore surface that can progressively exhibit all pore forms from round to daedaloid to lamellate, often in the same specimen.

Bondartsev (1971) places this species in the genus *Coriolus*, a genus not recognized by Gilbertson and Ryvarden (1986), although it is commonly cited in European research. He also notes that Lloyd (1898) contended that *A. albida* was simply a form of *A. heteromorpha* that found on hardwoods.

3. **Antrodia heteromorpha** (Fr.) Donk.
Synonym: *Trametes heteromorpha* (Fr.) Bres.

Overholts (1953): page 141; Gilbertson and Ryvarden (1986): page 132

Basidiocarp: Annual; effused-reflexed, often resupinate on underside of downed logs; individual pilei laterally fused or dimidiate; leathery to corky and flexible when fresh; bends double without breaking; rigid on drying; 1-6 x 0.5-1.5 [-3] x 0.3-1 cm thick. **Pileus:** Off-white to cream to light brown; sometimes with darker bands in zones; occasionally drying with radial striations; hirsute; drying glabrous. **Context:** Off-white, cream to beige; soft; 1-3 mm thick. **Pores:** Round to angular; often irregular and daedaloid; 0.5-1 pore per mm; pore surface uneven; light brown; tube mouths finely dentate to entire; tubes 3 [- 10] mm long.

Type of decay: Cubical brown rot of dead trees.

Substrate: *Pinus taeda* (loblolly pine); *Quercus alba* (white oak).

Comments: *Antrodia* species, as mentioned above, can be difficult to distinguish. When found on conifers, it's usual substrate, *A. heteromorpha* can be distinguished from *A. sinuosa* by a slightly less hirsute pileus and slightly larger pores. The degree of hirusteness and pore size are often only subtley different and positive identification is best made microscopically; the spores of *A. heteromorpha* are broadly elliptic while those of *A. sinuosa* are narrow and allantoid. *A. heteromorpha* is less frequently found on hardwoods than *A. sinuosa* or *A. albida*. It can be distinguished from *A. albida* which is common on hardwoods by its larger pores and darker pore surface, darker context, and slightly darker pileus when fresh.

4. Antrodia serialis (Fr.) Donk
Synonym: *Trametes serialis* Fries

Overholts (1953): page 138; Gilbertson and Ryvarden (1986): page 141

Basidiocarp: Annual, although in some cases the pore surface persists and an additional layer is formed the second year; mostly resupinate or decurrent on substrate; sometimes effused-reflexed with the pileus forming in a long laterally fused ridge; friable and soft when fresh; drying brittle; 3-4 x 0.4-1 x 0.5 cm. **Pileus:** small; poorly developed; light brown to yellowish brown; azonate, but rugose in zones giving an appearance of zonations; margin fimbriate and closely decurved or adpressed against the pore surface. **Context:** Friable to corky; thin and poorly developed; light tan; paler than either pileus or pores; 1-3 mm thick. **Pores:** Round to daedaloid; pores 3 - 5 per mm, just visible to the naked eye; surface greyish brown to light tan; irregular, tubes 2-3 [-5] mm long; walls entire and thick; tube mouths entire; pores often fusing when compacted together or breaking and separating forming a cracked surface.

Type of decay: Cubical brown rot of dead wood.

Substrate: Unidentified hardwood

Comments: This is not a particularly common species at Schenck Forest. It was found in a mostly resupinate condition with only a small pileus formed at the margin. The small pore size and dark pileus distinguished this species from others in the genus. The texture, especially when dry, is crusty and friable; more fragile than species of *Trametes*. The basidiocarp is bulkier than the thin specimens of *Coriolopsis rigida* found at Schenck Forest.

According to Overholts (1953) this species is most often found on gymosperms; only occassionally occurring on hardwoods. It also causes decay of structural timbers. Overholts (1953) notes that *A. serialis* can often be confused with *Heterobasidion annosum*. *H. annosum* has a more uniformly colored pileus and finely textured tometum that does not become rugose. *H. annosum* can also form in a more globose or nodulose fashion than *A. serialis*, the pileus of which, when present, is shelf-like.

5. Antrodia sinuosa (Fr.) Karst.
Synonym: *Polyporus sinuosus* Fr.

Gilbertson and Ryvarden (1986): page 143

Basidiocarp: Annual; effused-reflexed to resupinate; laterally fused or clustered; can form large aggregates; coriaceous to leathery when fresh; drying rigid. **Pileus:** Dimidiate; yellowish to straw colored or off-white; hirsute to tomentose when fresh; drying glabrous; rugose to striate; margin darker than tomentum, fimbriate, sterile. **Context:** Light tan to off-white; lighter than tubes; fibrous; 2-4 mm thick. **Pores:** Deadaloid to toothed; 1-2 pores per mm; extremely elongated when formed along substrate surface; light brown to straw colored; lighter at margin where tube layer is less developed; mouths dentate to fimbriate; tubes 2-5 mm long.
Type of decay: Brown rot of dead trees.
Substrate: *Juniperus virginiana* (eastern redcedar); *Pinus taeda* (loblolly pine).
Comments: Macroscopically, *A. sinuosa* is similar to *A. heteromorpha*. The two species, both of which occur on coniferous wood, are best distinguished by spore characteristics. The spores of *A. sinuousa* are very thin and crescent shaped while those of *A. heteromorpha* are broad and ellipsoid. When fresh, both species exhibit a tomentose pileus and can form in large clusters.

This species is not previously recorded from North Carolina.

6. Bjerkandera adusta (Willd.:Fr.) Karst.
Synonym: *Polyporus adustus* Willd.: Fr.

Overholts (1953): page 364; Gilbertson and Ryvarden (1986): page 165

Basidiocarp: Annual; resupinate, effused-reflexed or sessile; sometimes forming imbricate clusters; frequently laterally fused; soft and flexible; often sodden when fresh; firm when dry; 1-10 x 1-4 x to 1 cm. **Pileus:** Finely pubescent to tomentose; pubescence often more evident after drying or when viewed with a hand lens; azonate, although sometimes discolored grey patches appear as the basidiocarp ages; margin thin and entire; usually sterile; wavy. **Context:** Light

cream to yellowish; fibrous; azonate; soft and spongy when fresh and dried; 1-5 mm thick. **Pores:** Light grey to black; surface concolorus with pileus and context toward the margin so that the margin appears as a distinct whitish band; 6-8 pores per mm; sometimes enlarged toward the base of the basiodiocarp; walls thin; mouths round and entire; pores congealing and cracking with age and upon drying; tubes 1-3 mm long.

Type of decay: White rot of dead trees and dead branches on living trees.

Substrate: *Quercus alba* (white oak); *Carpinus caroliniana* (musclewood); *Fagus grandifolia* (beech); *Liriodendron tulipifera* (yellow-poplar).

Comments: This species is widespead at Schenck Forest. The light brown to cream pileus and the grey pore surface distinguish *B. adusta* from other polypores with a colored pore surface. It is particularly prolific on *Carpinus caroliniana* especially on trees overhanging the banks of Richland creek, forming a resupinate mass that extended down the bole of standing snags or near a branch wound on living trees.

B. fumosus (Pers.:Fr.) Karst., a closely related species, is less widespread than *B. adusta,* has 2-5 pores per mm and a thin black line that separates the context from the tube layer (Gilbertson and Ryvarden 1986).

7. Bondarzewia berkeleyi (Fr.) Bond. et Sing.
Synonym: *Polyporus berkeleyi* Fr.
Family: Bondarzewiaceae

Overholts (1953): page 238; Gilbertson and Ryvarden (1986): page 171

Basidiocarp: Annual; laterally stipitate; often in clusters; fleshy and firm when fresh; rigid on drying; pileus 4-9 [-15-25] cm in diameter x 0.4-1.5 [-3] cm thick. **Pileus:** White to cream; yellowish to light brown on drying; glabrous; azonate; smooth; margin thick, entire, sterile and decurved on drying. **Context:** Concolorous with pileus and pore surface; satiny on drying; leathery; 0.4-0.8 [- 3] cm thick. **Pores:** Round to elongate and toothed on stipe; 0.5-2 pores per

mm; tubes shallow, to 1 mm deep, shrinking considerably on drying; walls firm; pore mouths entire; decurrent on stipe. **Stipe:** Lateral; concolorous with the rest of the basidiocarp; 2-5 cm long; to 1 cm thick; spathulate rather than cylindrical.

Type of decay: White rot in the heartwood and roots of living hardwoods.

Substrate: *Quercus* sp. (red oak group)

Comments: Gilbertson and Ryvarden (1986) note that this species is commonly found on oak and chestnut but has also been reported on other hardwood species. The basidiocarp forms at the base of living, old, large trees. The large, stipitate, white to cream basidiocarps are diagnostic. Other stipitate species found at Schenck Forest had either a deep brown context or pigmented pilei.

The stipe grows from an underground sclerotium (Bondartsev, 1971; Gilbertson and Ryvarden, 1986) produced from mycelium parasitic on tree roots and capable of spreading to adjacent susceptible species.

The spore walls of *B. berkeleyi* are ornamented with echinulations or teeth and amyloid, in Meltzer's reagent. *Bondarzewia* is only one of three genera of polypores with amyloid spores, a feature leading some mycologists to place *Bondarzewia* in its own family, the Bondarzewiaceae. Gilbertson and Ryvarden (1986) limit this family to the type genus, while Stalpers (1996) includes four other genera, two of which are poroid and suggests that this family is closely related to the agaric genus *Russula.*

The specimen found at the Schenck was fresh and producing spores. It was, however, covered with a *Penicillium* mycoparasite and is not in the Herbarium collection

8. Cerrena unicolor (Bull.: Fr.) Murr.
Synonym: *Daedalea unicolor* Bull.: Fr.

Overholts (1953): page 125; Gilbertson and Ryvarden (1986): page 197

Basidiocarp: Annual; sessile; leathery when fresh; firm when dry; 5 [- 8] x 2.5 [- 6] x 0.1-0.3 cm. **Pileus:** Noticeably velvety hirsute; glabrous bands giving the appearance of unicolorous zonations; white to grey; tomentum often with a greenish cast due to algal growth; margin thin, entire, sometimes undulating or lobed; usually sterile in a narrow band 1-3 mm wide. **Context:** Off-white to cream; fibrous; thin, 1 [- 3] mm or less. **Pores:** Round to entirely daedaloid; 2-3 [- 4] pores per mm; surface off-white to light brown to grey; tubes 2 mm [- 1 cm] long; tube mouths becoming toothed; walls thick, pale at base (closest to the context) noticeably darkener toward the mouth.

Type of decay: White rot of dead hardwoods.

Substrate: *Liriodendron tulipifera* (yellow-poplar)

Comments: The common name for this fungus, the Moss Maze Polypore (Lincoff, 1981), refers both to the characteristic green cast to the pileus due to the rapid development of algae and the daedaloid, or maze-like, pore surface. The velvety pileus distinguishes *C. unicolor* from *Daedaliopsis confragosa*, a polypore with a similar pore surface but with a glabrous pileus. When the pores grade into brown and tan *C. unicolor* can be confused with faded *Trichaptum biforme*, which also turns green with algal growth. *T. biforme*, however, has round to toothed, not daedaloid, pores and a less tomentose pileus. *Trametes versicolor*, also common on hardwoods, has a multicolored zonate pileus and yellowish regularly round pores.

Gilbertson and Ryvarden (1986) report much larger dimensions and a dark zone in the context which they describe as duplex. These features were not seen in samples from Schenck Forest. Overholts (1953) reports that this fungus can be parasitic and is associated with canker formation in *Acer*.

This polypore has a well-documented relationship with wood-feeding insects (Gilbertson, 1984). Many wood-decay fungi in families other than the Polyporaceae live in close association, in some cases symbiosis, with termintes and beetles. *C. unicolor* is the only member of the Polyporaceae that has a symbiotic relationship; in this case with a wood wasp (*Tremex columba* L.) (Gilbertson, 1984; Gilbertson and Ryvarden, 1986) Oidia, asexual reproductive structures, of the fungus are borne in mycetangia on the insect and deposited during oviposition into the wood substrate (in this case beech). The oidia germinate and develop into mycelium. While not clearly established, many researchers think that the wood-wasp larvae ingest the hyphal nutrients by secreting saliva which digests the hyphae. The wasps then reingest the saliva which now contains nutrients from the fungus (Gilbertson 1984).

9. Chaetoporellus latitans (Bourd. et Galz.) Bond. et Sing.
Synonym: *Poria latitans* Bourd. et Galz.

Lowe (1966): page 72; Gilbertson and Ryvarden (1986): page 198

Basidiocarp: Annual; resupinate; laterally fused and pileus developing as a slightly revolute margin of the largely resupinate basidiocarp; 3-10 x 1-3 x 1-3 [- 5] mm. **Pileus:** White to tan; drying white to cream to tan; glabrous; azonate; margin entire. **Context:** White; less than 1 mm thick. **Pores:** Round; some tubes disappearing or elongating with age and on drying, giving the pore surface a net-like appearance; mouths entire, thin, becoming dentate with age; 0.5 - 5 pores per mm; tubes 1-2 [- 5] mm long.

Type of decay: White rot of conifers and hardwoods.

Substrate: *Cornus florida* (flowering dogwood), *Pinus taeda* (loblolly pine).

Comments: The resupinate condition in which this fungus is typically found is reflected in its previous classification in the genus *Poria*. The basidiocarp consists mostly of pores with a poorly developed, thin context. The color, size and habit of the basidiocarp could lead to mistaking this species for *Irpex lacteus*, which is, however, not often found on coniferous substrates, the most

common substrate for *C. latitans* species. The pores of *C. latitans* are, when well formed, smaller and rounder than those of *I. lacteus*. *C. latitans* forms a very short but widely confluent basidiocarp that dries to a cream color. *I. lacteus*, in contrast, will often form small individual pilei in addition to the wide confluent portion of the basidiocarp. The basidiocarp of *C. latitans* is slightly smaller, lighter in color and with more round or net-like pores compared to *Schizopora paradoxa*. Gilbertson and Ryvarden (1986) suggest that members of this genus are closely related to certain toothed genera in the family Corticiaceae.

10. Climacocystis borealis (Fr.) Kott. et Pouz.
Synonym: *Polyporus borealis* Fr.

Overholts (1953): page 312; Gilbertson and Ryvarden (1986): page 201

Basidiocarp: Annual; sessile; thick and fleshy when fresh; drying firm; forming singly or in imbricate clusters; [2] - 5.5 x [1.5]-5 x [1] - 2 cm. **Pileus:** White to grey to off-white or cream; azonate; slightly tomentose; becoming glabrous and algae-covered with age; radially striate to tuberculate at base; margin uneven to even, sterile, thin, entire, but frimbriate when dry or old. **Context:** Cottony fibrous; white; azonate; soft both when fresh and dried; 0.5-1.5 cm thick. **Pores:** Round; 2-3 pores per mm; surface white; tubes 2-5 mm long; mouths often elongated; walls thick. **Type of decay:** White rot butt rot in living conifers and white rot in dead trees.

Substrate: *Pinus taeda* (loblolly pine)

Comments: This species is very similar to a roughened *Tametes elegans*, which most often occurs on hardwoods. *Dichomitus squalens*, which also causes a white rot of conifers, has smaller pores (3-6 per mm on *D. squalens* vs. 1-3 per mm on *C. borealis*) and a thinner context. Microscopically, *C. borealis* lacks the dendridically branched contextual hyphae found in *D. squalens*, although both have distinctive cystidioles, sterile hyphal structures that project from the hymenium.

11. Coltricia cinnamomea (Pers.) Murr.
Synonym: *Polyporus cinnamomeus* Pers.

Overholts (1953): page 386; Gilbertson and Ryvarden(1986): page 203

Basidiocarp: Annual; centrally stipitate; often with two or three pilei fused together; 1-5 cm in diameter; 1 -3 mm thick. **Pileus:** Circular, centrally depressed; flexible when fresh, drying rigid; cinnamon- to tobacco-brown; blackening on drying; tomentose with silky striations, most notable in fresh specimens, less apparent in aged specimens; occasionally zonate; margin, thin and finely serrate. **Context:** Less than 1 mm thick; cinnamon- to tobacco-brown; fibrous. **Pores:** Round to daedaloid; 2-3 per mm; cinnamon- to tobacco-brown; tubes 0.5-3 mm long; mouths thin and fimbriate; not decurrent on stipe. **Stipe:** 1-4 cm. long; 1-3 mm in diameter; finely pubescent to velvety; concolorous with pileus; centrally attached.

Type of decay: A terrestrial species not reported to cause wood decay (Coker 1946; Overholts 1953; Gilbertson and Ryvarden, 1986).

Substrate: *Pinus taeda* (loblolly pine); *Juniperus virginiana* (eastern redcedar).

Comments: At Schenck Forest, I most often found this species on well-decayed *Pinus taeda* stumps, growing on wood well-decayed and softened with cubical brown rot, but still intact. It also occurred on the upper surface of decorticated loblolly logs, on degraded fiber collected in a cavity of a loblolly and on the inner-surface wood of a cavity at the root collar of *Juniperus virginiana* (eastern redcedar). Overholts (1953) reports that this species occurs on banks and paths and Gilbertson and Ryvarden (1986) characterize it as a terrestrial species that utilizes soil organic matter.

Coker (1946) likens the pileus tomentum to the silky texture seen on a moth's wing. He collected this species extensively in the mountains of western North Carolina; finding it on the ground in hardwood and coniferous forests, but only once on a "very rotted pine." It is possible that the lack of a well-developed organic horizon at Schenck Forest, and a different moisture regime in the Piedmont, explain the variations in substrate for this species.

A larger, but similar, species, *Coltricia perennis* (Fr.) Murr. (syn.: *Polyporus perennis* Fr.), is reported to occur in similar habitats in North Carolina, but was not found at Schenck Forest. *C. perennis* can reach 11 cm. in diameter, but Overholts (1953) reports that the basidiocarp lacks the silky tomentum of *C. cinnamomea* and is sometimes found on charred ground, a substrate upon which *C. cinnamomea* is not reported.

12. Coltriciella dependens (Berk. et Curt.) Murr.
Synonym: *Polyporus dependens* Berk. et Curt.

Overholts (1953): page 396; Gilbertson and Ryvarden (1986): page 210

Basidiocarp: Annual; laterally stipitate and pendant; occurring in masses or clusters; stipe enlarging into a cup or vase-like structure with the tubes borne on the inner surface of the cup; 0.5 - 2 cm in diameter. **Pileus:** Umber- to cinnamon-brown; covered with a wooly pubescence giving the basidiocarp a fluffy or fuzzy appearance. **Context:** Umber- to cinnamon-brown; finely fibrous; less than 1 mm thick. **Pores:** Round; 2-3 pores per mm; tubes 2-8 mm long. **Stipe:** Often poorly developed; less than 1 cm long; 1-2 mm in diameter; covered with pubescence similar to that of the pileus.

Type of decay: Subsists on soil or well-decayed organic matter; not reported to be a wood-decay fungus.

Substrate: *Pinus taeda* (loblolly pine).

Comments: Both Overholts (1953) and Coker (1946) liken well developed basidiocarps to minute wasps nests and comment on its apparent rarity. Overholts noted only twelve collections, possibly because this species is limited to the inner bark layers of decaying stumps. Clusters of basidiocarps occur together in varying stages of development with some having well-developed pores and those beginning to form appearing as wooly patches of mycelium. Coker (1946) notes the species occurs pendant on the external surfaces of a variety of substrates. It has also been

reported on *Castanea* (chestnut), *Juniperus* (cedar), *Liriodendron tulipifera* (yellow-poplar) and *Quercus* spp.

13. Coriolopsis rigida (Berk. et Mont.) Murr.
Synonym: *Trametes rigida* Berk. et Mont.

Overholts (1953): page 149; Gilbertson and Ryvarden (1986): page 218

Basidiocarp: Annual; effused-reflexed over a broad area of the substrate; pileus a narrow, usually small, shelf; laterally fused; fragile to coriaceous when fresh; drying friable; 0.3 - 15 x 0.2 - 4 x 0.2-0.4 cm. **Pileus:** Light tan, cinnamon to orangish-brown; zonate with fine dark lines forming across the pileus; finely tomentose; margin fertile, fragile, often paler than the rest of the pileus and finely scalloped to fimbriate. **Context:** Less than 1 mm thick. **Pores:** Surface variable across the same specimen; poorly developed and warty when found on the underside of the substrate; or elongated as the hymenophore curves up the substrate; 2-4 pores per mm; cinnamon- to orangish-brown; tubes <1 - 4 mm long; mouths dentate; walls fragile.

Type of decay: White rot of dead and living trees.

Substrate: *Acer rubrum* (red maple) and *Quercus alba* (white oak).

Comments: This species has not been reported before in North Carolina, but according to Gilbertson and Ryvarden (1986) it is very common on hardwoods in the southeast. Closely related to *Trametes*, the coloration of the hyphae give the basidiocarp a brown pigmented appearance; the hyphae of *Trametes* are colorless. The pores are smaller than those of similarly effused-reflexed *Antrodia*.

14. Daedaliopsis confragosa (Bolt.: Fr.) Schroet.
Synonym: *Daedalea confragosa* Bolt.: Fr.

Overholts (1953): page 120; Gilbertson and Ryvarden (1986): page 226.

Basidiocarp: Annual; sessile; shell-shaped; sometimes forming in imbricate clusters or laterally fused; firm and leathery when fresh; drying rigid; [2-] 3-15 x [1-] 2-8 x 0.5-1.5 cm. **Pileus:** Off-white, light brown, tobacco-brown, woody- or deep chocolate brown; glabrous; zonate to azonate; radially striate; sometimes tuberculate; margin very thin, wavy, usually darker than the pileus surface. **Context:** Off-white to light brown to tobacco-brown; fibrous; soft when fresh and dried; 0.2-0.5 mm thick. **Pores:** Highly variable in shape, color and thickness; round, daedaloid to lamellate often all variations occur on the same basidiocarp; 1-3 pores per mm; pore surface cream to off-white to tan, light brown, deep chocolate brown; yellowing with age; tubes 1-5 [- 20] mm long; tube mouths thin to thick; fimbriate.

Type of decay: White rot of dead hardwoods.

Substate: *Betulanigra* (river birch); *Cornus florida* (flowering dogwood); *Fagus grandifolia* (beech); *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Prunus serotina* (black cherry); *Quercus alba* (white oak); *Quercus* spp. (red oak group); *Ulmus* sp. (elm)

Comments: When the pore surface is daedaloid to lamellate, *D. confragosa* is easily identifiable; being the only brownish daedaloid species on hardwoods found during the survey. When fresh the pore surface is lighter with more round pores which thin and become daedaloid with age. Basidiocarp size appears associated with the size of the substrate; numerous large specimens form on fallen boles while smaller specimens, borne singly or fused in pairs, form on smaller branches and twigs.

Gilbertson and Ryvarden (1986) report that *D. confragosa* is also found on conifers. *Daedalea quercina* Fr., not found in this survey, is macroscopically very similar to *D.confragosa.* The two are distinguished by the larger size and more woody texture of *D. quercina* which has pores that are more daedaloid and tube walls that are white and approach 1mm in thickness.

15. Dichomitus squalens (Karst.) Reid.
Synonym: *Polyporus anceps* Pk.

Overholts (1953): page 279; Gilbertson and Ryvarden (1986): page 238

Basidiocarp: Annual; sessile to effused-reflexed; laterally fused; fragile and soft when fresh; firm when dry; 2-4 x 0.5-1.5 x 0.5-1 cm. **Pileus:** Chalky white; yellowing with age; finely tomentose to glabrous; often with small guttations or depressions on the surface; margin thick, entire, often recurved and sterile; yellow with age. **Context:** White; azonate; corky; drying very firm; to 0.5 cm thick. **Pores:** Irregular; round and entire, daedaloid when fused; 3-6 pores per mm; concolorous with context; tubes elongate and toothed when forming along substrate; mouths entire; walls thick.

Type of decay: White pocket rot on conifers.

Substrate: *Pinus taeda* (loblolly pine).

Comments: *Dichomitus squalens* can be distinguished from other white rot fungi found on conifers by microscopic features such as hyphae of the context that are distinctively branched and elongated. Macroscopically the small pore size and a soft, very white, pileus that becomes yellow and guttate with age, separate it from *Tyromyces chioneus* and *Climacocystis borealis*. All three species are similar, however, and positive identification requires an examination of microscopic features.

In North Carolina, none of these three species are pathogens causing significant economic loss in pines. In forests of the eastern U.S., *D. squalens* causes decay in slash and downed stems. In the western U.S., however, this species is responsible for considerable economic loss in living Ponderosa pine, causing red heart (Gilbertson and Ryvarden, 1986).

This species has not been reported previously in North Carolina, although it is reported from other eastern states.

16. Fomitopsis spraguei (Berk. et Curt.) Gilbn. et Ryv.
Synonym: *Polyporus spraguei* Berk. et Curt.

Overholts (1953):page 224; Gilbertson and Ryvarden (1986): page 284

Basidiocarp: Annual; substipitate to sessile; leathery when fresh; drying rigid; 3-7 [-9] x 3-5 [-7.5] x 0.5-1.5 [-4] cm. **Pileus:** Bone-white to off-white when fresh; drying darker brown when bruised; glabrous, forming a distinct, leathery layer over context; roughened with scattered tubercules; margin thin, entire, drying a distinctive yellowish brown to olive green. **Context:** White to bone- white to off-white when fresh; darkening where touched or upon dyring; 2-5 mm thick. **Pores:** Regular; fine and round; elongated when growing along the substrate; 4-5 pores per mm; surface bone white to off-white; becoming yellowish and gelatinous-appearing where touched and on drying; pores tubes 2-7 mm long; decurrent along substipitate portion of basidiocarp.

Type of decay: Cubical brown rot on dead and living hardwoods.

Substrate: *Liquidambar styraciflua* (sweetgum).

Comments: This species is separable from other similar species, by the rapid change of the margin from white to a drab olive-green. The pore layer contrasts the context. The dried geltinous texture, yellowing pore surface and the darkening margin are diagnostic. Some of the stipitate cluster species are similar in form, but the pileus surface of both *Meripilus gigantea* and *Grifola frondosa* is much more grey and the pore layer more homogenous with the context.

F. spraguei shares a similar habit with *Inonotus ludovicianus;* inhabiting both living and dead hardwoods. Both were found at Schenck Forest on well decayed, large diameter sweetgum stumps. Gilbertson and Ryvarden (1986) note that it is also frequently found on oak and chestnut.

17. Ganoderma applanatum (Pers.) Pat.
Synonym: *Fomes applanatus* Pers.
Family: Ganodermataceae

Overholts (1953): page 98; Gilbertson and Ryvarden (1986): page 291

Basidiocarp: Annual or perennial; firm and woody when fresh and dried; substipitate, sessile or effused-reflexed; 3-6.5 x1-4 x 0.5-2 cm. **Pileus:** Surface covered by thin very fine tomentum; fawn brown to deeper tobacco to chocolate brown; azonate; smooth; margin very thick, entire, sterile, often lighter than pileus surface. **Context:** Firm to woody; dark chocolate brown in distinct contrast to pore surface and pileus; fibrous; azonate; sometimes with white mycelial threads at base; 1-3 cm thick. **Pores:** Round and entire; 4-6 pores per mm; surface white to cream when fresh; darkening when bruised; tubes 0.1 - 1 cm long; decurrent on effused or substipitate portion of basidiocarp.

Type of decay: White rot of living and dead hardwoods.

Substrate: *Acer rubrum* (red maple).

Comments: This species is called the Artist Conk (Lincoff, 1981) since a nail or pen knife can easily engrave a picture or message on the easily bruising pore surface.

Ganoderma lucidum, also found at Schenck Forest has a bright red to maroon pileus with a varnished appearance, but is very similar in its dark brown woody context and white pore surface. The pilueus of *Ischnoderma resinosum,* another large woody polypore found on hardwoods, is deeper brown and velutinate when fresh.

18. Ganoderma lucidum (W. Curt.: Fr.) Karst.
Synonym: *Polyporus lucidus* (Leys ex. Fr.)
Family: Ganodermataceae

Overholts (1953): page 208; Gilbertson and Ryvarden (1986): page 299

Basidiocarp: Annual or perennial; laterally stipitate; substipitate or sessile; firm and tough when fresh; drying woody and rigid; 5-10 x 3-6 x 1-3 cm. **Pileus:** When fresh, covered with a yellow, orange, red to deep maroon glistening crust; turning brown to reddish brown on drying or with age; glabrous; azonate, but often with colors grading from deep red at base or center of pileus to yellow or cream at the margin; smooth or tuberculate and roughened. **Context:** Chocolate brown; fibrous; firm; 0.3-1.5 cm thick, gradually thinning as pore surface develops and expands; often pockmarked with insect burrows. **Pores:** Regular, round, entire; 3-5 pores per mm; surface white when fresh; becoming brown on drying or with age; tubes 0.5 - 1 cm long; forming in annual layers; pores not decurrent on stipe. **Stipe:** When present, covered with crust similar in color and varnished texture to that found on pileus; 0.8 - 1.5 cm in diameter; 1-3 cm long.

Type of decay: White rot of living and dead hardwoods.

Substrate: *Liquidambar styraciflua* (sweetgum).

Comments: The varnished and brighly colored pileus and hardwood host are diagnostic for this species. A very similar species, *G. tsugae* Murr., occurs on hemlock and is commonly called the hemlock varnish shelf (Lincoff, 1981). *G. lucidum* is also known as ling chi and is used in Chinese herbal medicine (Lincoff, 1981).

This polypore commonly grows on stumps or large diameter debris and is also reported on living trees (Overholts, 1953; Gilbertson and Ryvarden, 1986).

Some authorities (Overholts, 1953) consider the stipitate form of this fungus to be a distinct species, *G. curtisii* Berk.

19. Globifomes graveolens (Schw.) Murr.
Synonym: *Polyporus graveolens* (Schw.) Fr.

Overholts (1953): page 419; Gilbertson and Ryvarden (1986): page 307

Basidiocarp: Annual; sessile, formed of multiple pilei in an overlapping cluster that resembles a bunch of grapes; individual pilei 1 x 1 x 0.5 cm; grouping variable in size, up to 8 x 8 x 15 cm. **Pileus:** Individual pilei fused and imbricate in a hanging cluster rather than an upright rosette as is common in some imbricate species; surface glabrous; when fresh light to dark brown, developing a grey to black crust with age; zonate; margin darker in brown forms, whitish in black or grey specimens; margin entire, thick sterile, recurved, lightly tomentose; entire pileus with undulating ridges and wavy margin; 1 - 4 x 1 - 1.5 x 0.2 - 0.4 cm. **Context:** Cinnamon- to tobacco-brown; fibrous; to 1 mm thick; distinct from both pileus and tube layer. **Pores:** Regular and round; 3-4 pores per mm; surface deep chestnut brown with a whitish cast; tubes 0.5 - 1.5 mm long; thick-walled; mouths entire.

Type of decay: White rot in living and dead hardwoods.

Substrate: *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar).

Comments: The morphology of *G. graveolens* basidiocarps is distinctive and unique. Its distinctive form, and not unpleasant odor, provide the common name, Sweet Knot (Lincoff, 1981). Lincoff contends that it was used by early settlers as an air freshener.

Basidiocarps of *G. graveolens* occur at different heights on the boles of large trees. Trees can be found bearing a number of basidiocarps of this species, although single specimens are more common. Gilbertson and Ryvarden (1986) note that the distribution of *G. graveolens* is limited to the eastern and midwestern United States. *Globifomes* is a monotypic genus.

20. Gloeophyllum sepiarium (Fr.) Karst.
Synonym: *Lenzites saepiaria* (Wulf. ex Fr.) Fr.

Overholts (1953): page 111; Gilbertson and Ryvarden (1986): page 320

Basidiocarp: Annual; sessile to, less frequently, effused-reflexed; shell-shaped to circular; often laterally fused; sometimes in imbricate clusters especially on branch stubs; leathery and pliable when fresh; drying rigid; 1 - 3 x 1- 2 x 0.2 - 0.5 cm. **Pileus:** Rich rusty- to cinnamon- to tobacco-brown; hirsute; zonate, with zones either of sharply contrasting colors or more concolorous; margin thin; sterile; entire to fimbriate with age; often distinctly lighter than the rest of the pileus. **Context:** Thin; concolorous with pileus surface; orange- to cinnamon- to tobacco-brown; fibrous; 1 - 3 mm thick. **Pores:** Lamellate at base; more or less daedaloid toward margin; 1 - 2 pores per mm; orange- to cinnamon- to tobacco-brown when fresh; drying deeper chocolate-brown; surface with a whitish cast when fresh; tubes 1 - 5 mm long.

Type of decay: Brown rot of conifers.

Substrate: *Pinus taeda* (loblolly pine); *Juniperus virginiana* (eastern redcedar)

Comments: The lamellate pore surface, coniferous substrate, and deep brown coloration serve to distinguish this from other species of polypores at Schenck Forest. *G. sepiarium* has more widely spaced pores or lamellae and a brighter brown hirsute pileus than *G. trabeum* (Fr.) Murr., a species found both on wood in service and hardwoods, but not found in this survey.

G. sepiarium was found in confluent masses between bark plates of loblolly pine and emerging from the cracks in well-decayed eastern redcedar slash that had fallen before the hurricane. This is one of the few species found on the highly decay resistant eastern redcedar and has also been noted on atlantic whitecedar (*Chamaecyparis thyoides*) in the Coastal Plain (Gilbertson and Ryvarden, 1986).

Occasionally a specimen is found with a well developed, upright, base, the primordium (States, 1972), a transition between the hyphae of the substrate and those of the reproductive

structure. The hyphae of this species initially are clear; turning yellow to brown when exposed to low humidity and increased light (States, 1972).

The white cast of the hymenial layer is formed when the fresh and sporulating basidia, which are hyaline, develop in sharp contrast to the deeply pigmented hyphae of the tube layer.

21. Gloeoporus dichrous (Fr.) Bres.
Synonym: *Polyporus dichrous* Fr.
Family: Corticiaceae

Overholts (1953): page 361; Gilbertson and Ryvarden (1986): page 328

Basidiocarp: Annual; effused-reflexed to resupinate; very seldom sessile; laterally fused or forming in vertically imbricate clusters; often covering extensive portions of the substrate; sodden to rubbery when fresh; firm when dry; 0.6 - 6 x 0.5 - 1 x 0.1 - 0.2 cm. **Pileus:** White to cream to greyish-white; azonate; very finely pubescent; margin thin, entire, sterile, often with a reddish-brown band followed by a fine thin whitish edge. **Context:** White to cream; fibrous and soft both when fresh and after drying; 1 - 5 mm thick. **Pores:** Round to irregular; often fused; 5 - 8 pores per mm; maroon to orange-red to purplish to cream; rusty to purple-brown on drying; with a waxy or chalky cast and a gelatinous texture; easily separable from context; tubes to 1 mm long.

Type of decay: White rot of dead hardwoods and conifers.

Substrate: *Acer rubrum* (red maple); *Carpinus caroliniana* (musclewood); *Cornus florida* (flowering dogwood); *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Pinus taeda* (loblolly pine); *Prunus serotina* (black cherry); *Quercus alba* (white oak); *Quercus* spp. (red oak group); *Ulmus rubra* (slippery elm).

Comments: When found on conifers pay attention to the pore surface to avoid confusion with some *Merulius* species. *G. dichrous* forms distinct and well-delineated pores, while *Merulius* has a

folded and wrinkled hymenophore. *G. dichrous*, however, is placed in the Corticiaceae because the basidia are borne on all surfaces of the tubes, not just within the inner walls.

22. Grifola frondosa (Dicks.: Fr.) S.F. Gray
Synonym: *Polyporus frondosus* Dicks.: Fr.

Overholts (1953): page 246; Gilbertson and Ryvarden (1986): page 332

Basidiocarp: Annual; stipitate to substipitate; numerous pilei emerging from a branched central stipe; leathery and flexible when fresh; drying firm; 8 x 4 x 5 cm. **Pileus:** Grey, off white to buff; sometimes with a bronze or brownish cast; azonate; margin thin and entire; individual pilei 2 - 5 x 3 - 5 x 0.5 cm; not darkening noticeably where brused or handled. **Context:** Thin, cream to off-white; drying yellowish and gelatinous; 1 - 5 mm thick. **Pores:** Round to angular; very irregular in size; sometimes unevently developed with much of the pore surface remaining smooth; 1 - 4 pores per mm; surface cream to off-white; unchanged on drying; tubes shallow, <1 mm long; inconsistently decurrent on stipe; walls thick and entire. **Stipe:** When present, flattened; concolorous with the pore surface; greyish brown at base; mostly sterile.

Type of decay: White rot of living hardwoods.

Substrate: *Acer rubrum* (red maple).

Comments: Commonly called hen of the woods, *G. frondosa* is a highly desired edible species that can grow quite large; up to 40 cm across and 100 pounds (Lincoff, 1981; Gilbertson and Ryvarden, 1986). In form, it is very similar to *Laetiporus sulphureus* and *Meripilus giganteus*. The pilei of *L, sulphureus* are typically more red, orange or pink and the pore surface and pileus of *M. giganteus* darken rapidly when bruised or dried.

23. Hapalopilus nidulans (Fr.) Karst.
Synonym: *Polyporus nidulans* Fr.

Overholts (1953): page 398; Gilbertson and Ryvarden (1986): page 338

Basidiocarp: Annual; sessile; dimidiate to nodulose; soft and spongy sodden when fresh; very lightweight and firm on drying; 2-6 [- 12] x 1 - 3 [- 8] x 0.5 -2 [- 4] cm. **Pileus:** Glabrous; sulcate; radially ridged or pruniose; muddy yellow to dull brick red to brownish maroon; when yellow, darkening on bruising; azonate; smooth; margin entire; blackening in older specimens. **Context:** Chalky to fibrous; concolorous with pileus surface; 0.2 - 0.5 [- 4] cm thick. **Pores:** Round; 1 - 4 pores per mm; continuous with context but with a whitish cast when dried; tubes 0.2 - 0.6 [- 1] cm long; walls brittle and degrading with age to form irregular gaps or cracks on the pore surface; mouths thin, entire, dentate.

Type of decay: White rot of the sapwood of living and dead hardwoods.

Substrate: *Liriodendron tulipifera* (yellow-poplar); *Quercus alba* (white oak); *Quercus* sp. (red oak group).

Comments: The color of this species, even though it varies from muddy yellow through maroon is quite distinctive and, along with a spongy texture when fresh, makes *H. nidulans* an easily identified species. The color does not approach the bright orange-red of *Pycnoporus cinnabarinus*. The tubes are slighly lighter than the context due to white cystidioles, minute in the hymenial layer (Gilbertson and Ryvarden, 1986). All species in this genus have a red to violet purple reaction to KOH. It occurred on larger windthrown branch debris or dead tree boles in some of the more moist bottomland stands.

Bondartsev (1971) indicates that initial infection occurs only in dead or diseased branches, but the mycelium can then spread to healthy branches and damage the entire tree.

24. Heterobasidion annosum (Fr.) Bref.
Synonym: *Fomes annosus* (Fr.) Cooke

Overholts (1953): page 40; Gilbertson and Ryvarden (1986): page 343

Basidiocarp: Annual to perennial; effused-reflexed to sessile; nodulose to shell-shaped; often laterally fused; soft and spongy when fresh; drying firm; 1-5 [-9] x 1-2 [- 15]x 1-2 [- 5] cm. **Pileus:** Dimidiate to an irregular agglomeration of tuberculate nodules; finely tomentose; salmon pink to rusty or seal brown; red to brown on bruising or drying; tomentum forming a distinct layer; often convoluted and recurving in and out of the context and pore surface; margin thick, entire, cream to off-white, sterile. **Context:** Off-white to cream; fibrous; soft and cottony when dried; distinct from tomentum; 0.5 - 1 cm thick; **Pores:** Irregular; round to daedaloid; 1-3 pores per mm; tubes 1-4 mm long; mouths entire; becoming toothed when tubes are elongated; walls thick.
Type of decay: White root and butt rot of living and dead conifers.
Substrate: *Pinus taeda* (loblolly pine); *Pinus echinata* (shortleaf pine).
Comments: *H. annosum* is the pathogen that causes Annosum root rot in many pines. It can be a problem in young plantations where the fungus newly cut stumps and spreads through roots to infect young trees (Hepting, 1971; French, 1993). In a 1973-1974 survey (Jacobi *et al.*, 1980a) Annosum root rot accounted for loss in 0.007% of the trees in the over 5,000 study plots surveyed in North Carolina. The authors suggest, however, that symptoms of the disease and signs of the fungus' presence are often difficult to identify and that the total number of infected trees may have been higher.

Basidiocarps of *H. annosum* can be found on the sides or surface of cut stumps or on the ground at the root collar. Basidiocarps were also found on large windthrown trees. Basidiocarps can be difficult to locate when they are formed at the root collar as they are often buried under soil and accumulated needles. *H. annosum* was found in five pine plantations at Schenck Forest (see Figure 3).

25. Inonotus ludovicianus (Pat.) Murr.
Synonym: *Polyporus ludovicianus* (Pat.) Sacc. et Trott.

Overholts (1953): page 414; Gilbertson and Ryvarden (1986): page 380

Basidiocarp: Annual; stipitate to substipitate; basidiocarps often, but not exclusively, occurring in large clusters that can encircle a tree at ground level; more commonly in clusters 15-50 cm broad. **Pileus:** Individual pilei up to 10 x 5-10 x 2-3 cm; semicircular to kidney-shaped; often depressed where the stipe joins the pileus; deep orange-brown to rusty-brown; purplish-brown to black on aging; rough tomentose with the tomentum often agglutinizing or matting to form clumps of upright fibers; tomentum most developed at margins; weathering to glabrous with a thin, easily flaked crust. **Context:** Dark rusty-brown, similar to pileus surface; initially fibrous and satiny; when weathered the context is friable; readily breaking into large cubical fragments; 0.5-1.5 [- 2] cm thick. **Pores:** Round; 2-3 pores per mm; greyish brown to dark brown; tubes 1.0-1.5 cm long; thin walled; easily separable from context and from each other. **Stipe:** Often poorly developed or rudimentary; central to lateral; concolorus to pileus; tubes decurrent.
Type of decay: White pocket rot in the butts and roots of living and dead hardwoods.
Substrate: *Liquidambar styraciflua* (sweetgum).
Comments: This species is limited to the southeastern states and causes a pocket rot in both the butts and roots of trees. It also causes a decay in living oaks and blackgum. Overolts (1953) considered this to be one of the most important heart-rot fungi of the southeastern United States. Basidiocarps can be found on the ground, attached to roots, at the base of the bole or on stumps. One specimen at Schenck Forest encircled the base of a large living sweet gum tree with clusters extending out 60 cm beyond the root collar.

This species sporulates profusely. When fresh (early August in this survey) all surfaces of the basidiocarp and surrounding wood and litter will be blanketed in a deep yellow spore

layer. *I. ludovicianus* is also distinctive as it ages with a weathered cluster of basidiocarps resembling in texture, color and shape a lump of coal.

A related species, *Inonotus hispidus* (Bull.:Fr.) Karst. occurs on oak in North Carolina but forms on the bole, rather than at the root collar, of infectected treees. This species can be differentiated from *Phaeolus schwienitzii* by its clustered or massed pilei and the hardwood substrate.

26. Irpex lacteus (Fr.:Fr.) Fr.
Synonym: *Polyporus tulipifera* (Schw.) Overholts

Overholts (1953): page 329; Gilbertson and Ryvarden (1986): page 404

Basidiocarp: Annual; resupinate to effused-reflexed; very seldom sessile; coriaceous and firm when fresh; rigid when dry; when effused-reflexed the pore surface can cover extensive portions of the undersurface of the substrate. **Pileus:** White to grey to cream; glabrous to tomentose; azonate or with very indistinct zonations; margin thin, fimbriate or finely serrate; dark brown to grey; often forming on the substrate at divergent angles; 1 x 0.5-1 x 0.1-0.5 cm; **Context:** Less than 1 mm thick; often not apparent with pores arising directly from the pileus or mycelium; white to cream. **Pores:** Angular and irregular; becoming toothed, especially on elongated tubes; 1-2 pores per mm; white to grey to cream; drying light-brown; tubes to 3 mm long; often very shallow; walls thick to thin; mouths becoming jagged.

Type of decay: White rot of dead hardwoods.

Substrate: *Acer rubrum* (red maple); *Cornus florida* (flowering dogwood); *Gleditsia triacanthos* (honey locust); *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Paulownia tomentosa* (princess tree); *Prunus serotina* (black cherry).

Comments: *I. lacteus*, a decayer on slash, is found on numerous sizes and species of hardwoods early in the decay process. As Overholt's synonym indicates, this species is often associated with, but not limited to, yellow-poplar.

I. lacteus most often occurs in the resupinate to effused-reflexed form. When the pilei are large, it can be confused with a small, aged specimen of *Trichaptum biforme*. The pileus of *I. lacteus* is, however, more glabrous, less zonate and in general smaller. The tube mouths of *I. lacteus* are unquestionably toothed in contrast to *T. biforme*. Specimens examined from Schenck Forest are not as densely pubescent as Gilbertson and Ryvarden (1986) claim is typical for this species.

Irpex is a monotypic genus.

27. Ischnoderma resinosum (Fr.) Karst.
Synonym: *Polyporus resinosus* Fr.

Overholts (1953): page 301; Gilbertson and Ryvarden (1986): page 406

Basidiocarp: Annual; sessile; semi-circular; spongy and soft when fresh; rigid and friable when dry; 4-11 x 2-6 x 0.5-1 cm. **Pileus:** Deep chestnut to mahogany brown to maroon; gradually lightening toward margin; finely to velvety tomentose; glabrous and sulcate in patches upon drying; tomentum forming a distinct layer over context; margin very thin, fimbriate and fragile; margin light tan when fresh, blackening on drying. **Context:** Light brown to beige; fibrous; granular with the consistency of an eraser when dry; 0.5-2 cm thick. **Pores:** Round and regular; 3-5 pores per mm; surface concolorous with context; tubes <1 mm [- 10 mm] long; walls thick; tube mouths entire; quickly browning where bruised.

Type of decay: White rot of dead hardwoods.

Substrate: *Ulmus* sp. (elm).

Comments: The dark brown velvety tomentum and the pale context are characteristic. Overholts (1953) aptly describes the glabrous sulcate spots that form as the basidiocarp ages as "metallic black;" similarly colored patches develop on the margin.

This species was collected once at Schenck Forest from a large uprooted elm with the basidiocarp forming on the lower end of the bole on water-saturated wood.

28. Laetiporous sulphureus (Bull.: Fr.) Murr.
Synonym: *Polyporus sulphureus* Bull.: Fr.

Overholts (1953): page 243; Gilbertson and Ryvarden (1986): page 423

Basidiocarp: Annual; stipitate with numerous pilei arising from a single central or lateral stipe to substipitate to sessile; firm and coriaceous when fresh; drying rigid; 4-15 [-40] x 4-12 x 0.5-1 [-2] cm. **Pileus:** Individual pilei flabelliform to dimidiate; finely pubescent to glabrous; bright orange to faded apricot or peach colored, occasionally cream to off-white; color confined to pileus surface; faintly zonate; margin thin and recurved on drying. **Context:** Cream to off-white; fibrous when fesh; drying friable; azonate; 0.5-1.5 [-2] cm thick. **Pores:** Round and regular; 3-4 pores per mm; surface off-white to cream to bright yellow; tubes 1-2 mm long; mouths fimbriate; tube layer distinct from context.

Type of decay: Brown cubical rot of living and dead hardwoods and conifers.

Substrate:I *Quercus* sp. (oak).

Comments: *L. sulphureus* is an edible species that is characterized by large imbricate clusters of orange basidiocarps. It occurs both at the base and on the bole of living and dead hardwoods with oaks, in both the red and white subgroups, common hosts. In the wstern U.S. *L. sulphureus* occurs more often on conifers (Gilbertson and Ryvarden, 1986). This species was not found in this survey.

29. Lenzites betulina (Fr.) Fr.

Overholts (1953): page 108; Gilbertson and Ryvarden (1986): page 425

Basidiocarp: Annual; sessile to slightly effused-reflexed; dimidiate to semi-circular; often laterally fused; firm and fleshy when fresh; drying rigid; 2-10 x 1-4 x 1-2 cm. **Pileus:** Hirsute with glaborus bands; zonate with contrasting zones or zonate with unicolorous zonations formed by glabrous bands; buff to grey to light brown; when fresh often with an orange margin; when old, often covered with a greenish tinge from algal growth; margin entire, thin, hirsute, often darker than pileus. **Context:** Thin and indistinct; less than 5 mm thick; fibrous; buff to off-white. **Pores:** Lamellate throughout; cream to ivory to straw colored; lamellae thin; continuous to base; edges toothed and fimbriate; becoming wavy and undulating on drying; up to 1 cm long.

Type of decay: White rot of dead hardwoods.

Substrate: *Acer rubrum* (red maple); *Betula nigra* (river birch); *Carpinus caroliniana* (musclewood); *Fagus grandifolia* (beech); *Liquidambar styraciflua* (sweetgum); *Lonicera japonica* (honeysuckle); *Quercus alba* (white oak); *Quercus* sp. (red oak group).

Comments: *L. betulina* looks like a gilled fungus. The persistent basidiocarp, firm texture, and hirsute pileus are very similar to that found in some *Trametes* species. Early in the development of the basidiocarp, the lamellae can be thick and appear daedaloid as in *Trametes hirusta.* The lamellate "pores" are diagnostic and the orange tomentum of fresh species is not found in other species.

This is a common species on debris of various sizes, although the basidiocarps are more fully developed when forming on large substrates. *L. betulina* is the only species of this genus in North America (Gilbertson and Ryvarden, 1986).

30. Meripilus giganteus (Fr.) Karst.
Synonym: *Polyporus giganteus* Pers. ex Fr.

Overholts (1953): page 242; Gilbertson and Ryvarden (1987): page 442

Basidiocarp: Annual; stipitate to substipitate; potentially forming large, low-growing clusters of individual pilei emanating from a single central stipe; 20+ x 30 x 15 cm. **Pileus:** Satiny pubescent with tomentum aligned out toward the margin; light brown to ivory white to pale grey; margin concolorous with pileus when fresh; rapidly darkening to black on drying or where bruised; radially striate and tuberculate toward base; individual pilei 6 x 9 x 0.3-1 cm. **Context:** Off-white to bone-white; unchanged on drying; fibrous with the contextural hyphae thick and long and aligned in a parallel fashion; firm when fresh; drying tough; to 0.5 cm thick. **Pores:** Round; irregular in size; 2-5 pores per mm; off-white, cream to bone-white when fresh; drying straw colored, light brown to tan; blackening where bruised; distinct from context; cracking ansd separable when dry pore surface elongated and dentate along the stipe and toward the base of the basidiocarp. **Stipe:** Flattened elongation of pileus; buff to greyish brown; formed of satiny fibrous contextual tissue; numerous pilei arising from single, unbranched stipe.

Type of decay: White heart and butt rot of living trees.

Substrate: *Fagus grandifolia* (beech).

Comments: The unbranched single stipe and rapidly darkening margin and pore surface distinguish this species from others which form large stipitate clusters. The blackening occurs almost immediately after the basidiocarp is collected and drying darkens it even further. The contexutal tissue, formed of long hyphae aligned parallel to one another is also more distinct than similar species. The context cannot be torn against or perpendicular to the alignment, but it is easily shredded when torn with the alignment when fresh or dry.

The habit of this species is at the root collar or on top of large well-decayed stumps.

Larsen and Lombard (1988) contend that *M. giganteus* is limited to Europe. Based on a variety of microscopic characteristics, primarily spore size differences, these authors have named the North American species *Meripilus sumstinei* Larsen et Lombard.

31. Nigroporus vinosus (Berk.) Murr.
Synonym: *Polyporus vinosus* Berk.

Overholts (1953): page 400; Gilbertson and Ryvarden (1987): page 454

Basidiocarp: Annual, but often persisting; substipitate to sessile; pinkish resupinate mycelium occasionally developing on substrate; flabelliform to semicircular; leathery when fresh; firm and rigid when dry; 2-9 x 1.5-5 x 0.5 cm. **Pileus:** Deep maroon to dark brown to blackened; glabrous; striate in circumferential sulcations; margin thin, entire, sterile, slightly darker than the pore surface. **Context:** Pinkish-brown to maroon or dark brown to purple when fresh; coriaceous; firm when fresh and dried; up to 0.5 cm thick. **Pores:** Round and regular; 4-6 pores per mm; dark brown, maroon to black; distinct from context; surface appearing velvety; tubes to 0.5 cm long; mouths round, regular, entire.

Type of decay: White rot of dead hardwoods and conifers.

Substrate: *Liquidambar styraciflua* (sweetgum); *Pinus taeda* (loblolly pine).

Comments: The deep coloration throughout the thin basidiocarp and glabrous surface distinguish this species from other species with dark contextual tissue. The context, when fresh, can be quite pinkish, a color not often seen in other polypores.

This species was most often found on well-decayed substrates, softenend snags and pine stumps fragmented with sodden or friable wood. Often it occcurs on the same material as *C. cinnamomea*, another species common on well-decayed debris. *N. vinosus* was not found on windthrow only on stumps or snags with roots still in the ground.

32. Oligoporus caesius (Schrad.: Fr.) Gilbn. et Ryv.
Synonym: *Polyporus caesius* Schrad. ex Fr.

Overholts (1953): page 292; Gilbertson and Ryvarden (1987): page 465

Basidiocarp: Annual; sessile; umbonate; coriaceous when fresh; drying rigid; 1[- 5] x 0.5 [- 6] x 0.3 [- 1.5] cm. **Pileus:** Small; umbonate; cream to light beige; hirsute with a short, upright tomentum; margin glabrous and satiny when fresh, dark red to rusty brown, in sharp contrast to pileus, entire, thin, sterile. **Context:** Thin; < 1 mm thick; cream to light beige; coriaceous when fresh; drying firm. **Pores:** Irregular in size; round to daedaloid with age; 2-4 pores per mm; yellowish brown to straw colored; darker than pileus tomentum and context.walls thick; tubes to 2 mm long; mouths entire.

Type of decay: White rot of dead hardwood and conifers.

Substrate: *Pinus taeda* (loblolly pine).

Comments: The very fine upright pubsecence and the distinct, contrasting, thin and glabrous margin distinguish this species from other small, thin-context, species. Gilbertson and Ryvarden (1987) and Overholts (1953) state that this species can develop a unique blue color when fresh that doesn't persist on dried specimens. This collection was made when the basidiocarps were just beginning to form and there was no sign of blue color. The margin is the most distinctive feature that I note in this species.

The one collection from Schenck Forest was made in early April 1997 from a loblolly pine that had been felled and bucked in March 1996, prior to the hurricane. No other polypores had yet formed on this year-old debris, and only 4-5 diminuitive basidiocarps of *O. caesius* were present.

33. Oligoporus fragilis (Fr.) Gilbn. et Ryv.
Synonym: *Polyporus fragilis* Fr.

Overholts (1953): page 274; Gilbertson and Ryvarden (1987): page 467

Basidiocarp: Annual; often watery to sodden and occassionally highly fragrant; laterally confluent; dimidate to effused-reflexed; 2 [-6] x [1 -] 3 [- 10] X [0.3 -] 1 [- 1.5] cm. **Pileus**: white, rapidly changing to dull brown to brownish red or chestnut; lightly tomentose but the tomentum often obscured in wet specimens; azonate; margin thin and entire; black on drying. **Context**: markedly distinct from tube layer, 1 [2-12] mm thick; starting white, rapidly becoming brown to reddish brown upon drying or bruising; azonate. **Pores**: Slightly daedaloid; 1-3 [-4] per mm; smaller toward the margin and elongating especially on effused-reflexed specimens, toward the base; tubes1-6 (-8) mm long; mouths becoming toothed.

Type of decay: Brown rot of conifers.

Substrate: *Pinus taeda* (loblolly pine).

Comments: This species, aptly named by Fries, is the most ephemeral of the polypores collected at Schenck Forest. *Oligoporus fragilis* rapidly deteriorates and observations of color, size and texture are best made in the field or very soon after collecting. Bondartsev (1971) in discussing the darker chestnut color that can develop, noted that the pigments of particularly dark and damp specimens readily bleed into paper in which the specimen is wrapped. The specimen examined from Schenck Forest was sodden even though other polypores on the same tree were relatively dry and conditions in the forest at that time were dry; indicating that its moist condition can be diagnostic of the species.

The uniformly thin and distinct context, watery and fragrant condition and rapid color change easily differentiate *O. fragilis* from *D. squalens* the other small, white polypore found on pines in this survey. The fragile texture and azonate pileus separate it from both *Trichaptum abietinum* and *T. villosa*.

This species is widely distributed, but reportedly of uncommon occurrence, especially in southern pine forests. It was found occurring with *Nigroporus vinosus* and *Heterobasidion annosum*.

34. Oligoporus stipticus (Pers.: Fr.) Gilbn. et Ryv.
Synonym: *Polyporus immitis* Pk.

Overholts (1953): page 288; Gilbertson and Ryvarden (1987): page 485

Basidiocarp: Annual; sessile; broadly attached; soft when fresh; soft when dry; nodulose to semicircular; borne singly on the substrate; 2 x 1 x 0.5 cm. **Pileus:** Round; white to cream; drying yellow; finely tomentose; margin sulcate, entire, recurved. **Context:** White; firm; coriaceous when fresh; punky when dry; slightly fibrous; to 0.5 cm thick. **Pores:** Round, regular, although some tubes extend slightly longer than others creating an uneven surface; 2-4 [- 5] pores per mm; continuous with context; surface white, drying cream to off-white; tubes 1-3 mm long; elongated when effused on substrate.

Type of decay: Borwn rot of conifers.

Substrate: *Pinus taeda* (loblolly pine).

Comments: The description above is based on a single collection made on a windthrown loblolly pine. The context texture is diffferent, more chalky and firm, than some of the other white species found on pine. The fine upright tomentum is unique but microscopic features are required to separate it from other *Oligoporus* species, *Climacosystis borealis* or *Dichomitus squalens*. If the decay type can be determined from the substrate, *C. borealis* and *D. squalens*, which cause white rot, can be eliminated.

Not a common species at Schenck Forest, this species has not been reported previously from North Carolina.

35. Perenniporia compacta (Overh.) Gilbn. et Ryv.
Synonym: *Polyporus compactus* Overh.

Overholts (1953): page 306; Gilbertson and Ryvarden (1987): page 513

Basidiocarp: Annual; dimidiate to nodulose; often laterally fused; soft to corky when fresh; firm and rigid when dry; 1-2 x 1.5 x 0.2-0.5 cm. **Pileus:** White to cream; drying grey to blackish; finely pubescent; becoming glabrous; azonate; sulcate; margin thin, entire, sterile; darkening on drying. **Context:** White; remaining so when dried; corky when fresh; firm when dry; 0.3-0.5 cm thick. **Pores:** Regular and round; 2-3 [- 4] pores per mm; surface white; becoming grey to black or cream when dry; tubes very shallow; 1-2 mm long; walls thick; mouths entire.

Type of decay: White rot of hardwoods.

Substrate: *Liquidambar styraciflua* (sweetgum); *Quercus* sp. (red oak group).

Comments: *P. compacta* is a nondescript, fairly uncommon species found on hardwoods. The blackening basidiocarp, appearing dingy rather than deeply pigmented, is suggestive, although not highly diagnostic, of *P. compacta.* The nodulose basidiocarp, regular round pores and shallow tubes are also somewhat unique. The best diagnostic feature for this species are the microscopic chlamydospores; vegetative reproductive structures with thickened walls, formed in the hymenial layer.

The species is commonly cultured off decaying oak wood (Gilbertson and Ryvarden, 1987) without basidiocarps. They also report that basidiocarps of this species are often amorphous and poorly developed. A similar situation is found in *Abortiporus biennis,* which also forms chlamydospores.

P. compacta has not been reported previously from North Carolina.

36. Phaeolus schweinitzii (Fr.) Pat.
Synonym: *Polyporus schweinitzii* Fr.

Overholts (1953): page 395; Gilbertson and Ryvarden (1987): page 539

Basidiocarp: Perennial; laterally to centrally stipitate to substipitate; 8-15 [- 25] cm in diameter; 1-5 cm thick. **Pileus:** Finely pubescent; yellow to rusty orange, cinnamon to tobacco brown when fresh; deep chestnut brown with age; margin often lighter than the pileus; thick, undulate, sterile. **Context:** Fibrous; firm, cinnamon brown; to 5 cm thick. **Pores:** Round and irregular in size; 0.5 - 3 pores per mm; surface sulphur yellow to cinnamon borwn; distinct from context; tubes unevenly developedl <1-3 [- 5] mm long; mouths fimbriate.

Type of decay: Brown cubical rot of the heartwood of living conifers.

Substrate: *Pinus taeda* (loblolly pine).

Comments: The brightly colored, pubescent basidiocarp, and location at the base of living conifers are diagnostic of this species. *P. schweinitzii* was not found in this survey.

37. Phellinus gilvus (Schw.) Pat.
Synonym: *Polyporus gilvus* (Schw.) Fr.

Overholts (1953): page 401; Gilbertson and Ryvarden (1987): page 571

Basidiocarp: Annual to perennial; sessile to effused-reflexed; often forming in laterally fused clusters or broadly attached imbricate masses; hard and firm when fresh and when dry; 1-6 x 1-4 x 0.3-1 cm. **Pileus:** Tobacco- to cinnamon-brown; finely pubescent; rapidly becoming glabrous and crusty; zonate in alternating broad and thin bands of light and dark brown; radially striate to sulcate; margin thin, fertile, finely serrate, often undulate or scalloped, remaining pubescent longer than the pileus surface, when fresh, a bright yellowish-brown, contrasting strongly with the rest of the pileus; older basidiocarps can have clumps of moss at the base. **Context:** Fibrous; bright yellowish-brown to tobacco-brown; contrasting with the pileus and pore surface; retaining

the color through drying, darker with age and weathering; fibers radiating from the point of attachment. **Pores:** Round and regular; surface fine and smooth; 6-8 pores per mm; dark chocolate- to tobacco- to cinnamon-brown; tubes to 0.3 cm long; mouths entire; tube walls thick. **Type of decay:** White rot of dead and living hardwoods.

Substrate: *Betula nigra* (river birch); *Carpinus caroliniana* (musclewood); *Carya glabra* var. *glabra* (red hickory); *Carya* sp. (hickory); *Cornus florida* (flowering dogwood); *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Prunus serotina* (black cherry); *Quercus alba* (white oak); *Quercus* sp. (red oak group).

Comments: One of the more common species at Schenck Forest, both on windthrow from Hurricane Fran and on older debris. It is one of the few brown-context species of small to moderate size that is found on hardwoods. The context, even when dry, is a deep golden brown that also appears on the margins of fresh specimens, but, unfortunately, does not persist after drying. Pore development is very regular giving the pore surface a velvety appearance. The small pores are not easily visible with the naked eye.

P. gilvus develops on medium to large stem debris, rarely on debris under 7.5 cm in diameter. On living trees it appears around stem wounds. It forms in masses of basidiocarps, rarely is a single specimen found.

The genus *Phellinus* is characterized by highly pigmented basidiocarps, hyphae and spores. *Phellinus* species are also distinguished by forming setae, sharp, sterile hyphae that project in the hymenial layer.

38. Phellinus pini (Thorne ex. Fries) A. Ames
Synonym: *Fomes pini* (Thore ex. Fries) Karst.

Overholts (1953): page 76; Gilbertson and Ryvarden (1987): page 592

Basidiocarp: Perennial; applanate to slightly convex; sometimes ungulate; hard and woody; firmly attached to the bole of the tree; 3-10 x 2-10 x 5 cm. **Pileus:** Composed of the edges of

annual pore layers which are often appressed creating a roughened rugose surface; deep brown to black; glabrous; cracked or rimose; old basidiocarps frequently covered with moss. **Context:** Deep brown; each annual layer to 5 mm thick; hard and woody; annual layers remain distinct. **Pores:** Angular to daedaloid; forming annual layers with only the current year's pores visible at any given time; 2-5 pores per mm; tubes 2-6 mm long.

Type of decay: White pocket rot of the heartwood of living and dead conifers.

Substrate: *Pinus taeda* (loblolly pine); *Pinus echinata* (shortleaf pine).

Comments: *Phellinus pini* is a major cause of timber loss in coniferous forests and occurs throughout North America and Europe. It causes heartrot of coniferous trees which Overholts (1953) contends accounts for losses that exceed those from all other funig. Due shorter rotations for pines and fire control, this statement may not reflect the current situation. *P. pini* was, in fact, one of the early wood decay fungi investigated by Robert Hartig in the 1870s (Blanchette, 1980; Eriksson *et al.*, 1990).

The infection court for *P. pini* is dead branches that are large enough to have developed heartwood. The fungus is typically not a problem until the trees are about 60 years old (Hepting, 1971; Blanchette, 1980; Burns and Honkkala, 1990; French, 1993). The fungus can extend from the dead heartwood material of a tree into the living sapwood is both a parasitic and saprophytic fungus (French, 1993). Decay columns in the tree can extend, in advanced stages of decay, to ten feet up or down from a visible basidiocarp (French, 1993).

A resupinate form of the fungus is known as *Phellinus pini* var. *abietis* (Karst.) Overh. *P. pini* was found as a resupinate specimen in one collection, but as the substrate was the upper bole of a snag and the standing portion of the snag contained numerous basidiocarps of the fungus, the growth form in this instance was considered to be caused by the orientation on the flat substrate.

P. pini has been thought to be an important factor in managment for the red-cockaded woodpecker (Jackson *et al.*, 1979). The bird requires nesting trees that are old enough to be infected with *P. pini* for cavity formation. The relationship between the wood-decay and the bird's ability to excavate a nesting cavity not clear. Conner and Locke (1982) did not find conclusive evidence that *P. pini* was always present in excavated trees.

39. Polyporus alveolaris (DC.: Fr.) Bond. et Sing.
Synonym: *Favolus alveolaris* DC.: Fr.) Quel.

Overholts (1953): page 156; Gilbertson and Ryvarden (1987): page 645

Basidiocarp: Annual; laterally or centrally stipitate to substipitate; semicircular; borne singly or in clusters; soft and watery to spongy when fresh; drying firm and rigid; 0.5-6 cm in diameter; 0.1-0.5 cm thick. **Pileus:** Cream to golden to rusty brown when fresh; often with reddish tints; finely pubescent to tomentose when fresh; drying glabrous with scaly striations; margin thin, entire, drying undulate; azonate; with depression in pileus at stipe connection. **Context:** Thin; white to off-white; drying unchanged; fibrous with short unorganized fibers; drying cottony; 1-3 mm thick. **Pores:** Irregular; angular, most often hexagonal; elongated toward stipe and smaller at the margin; 1-2 pores per mm; 3 pores per mm at the margin; tubes 1-5 mm long; walls thick; mouths entire; not decurrent on stipe. **Stipe:** Pubsecent; yellow to cream; short and stubby; often no more than a narrow attachment of basidiocarp to substrate; up to 5 mm in diameter; up to 1 cm long.

Type of decay: White rot of dead hardwoods.

Substrate: *Carya* sp. (hickory); *Quercus alba* (white oak).

Comments: The hexagonal pores and the reddish tint to the pileus make this a distinctive and beautiful species. It was found on debris of various sizes, from small twigs under 2.5 cm in diameter to a larger white oak branch, 7.5 cm in diameter. On the larger substrate it formed

numerous imbricate masses of basidiocarps, each over 20 cm in diameter. It was not found on the stem and appears to be saprophytic on slash.

40. Polyporus arcularius (Batsch.) Fr.

Overholts (1953): page 271; Gilbertson and Ryvarden (1987): page 646

Basidiocarp: Annual; centrally stipitate; fleshy and fragile when fresh; rigid and fragile when dry; 0.5 cm in diameter; 0.2-0.3 cm thick. **Pileus:** Dark, chocolate-brown; dull; centrally depressed at stipe; finely pubescent to glaborus when dry; margin thin and entire; wavy when dried. **Context:** Dark to light brown; very thin; < 1 mm thick. **Pores:** Daedaloid, irregular and angular, almost hexagonal; 2-3 pores per mm; light cast to the pore surface; tubes < 1 mm long; walls thin and undulate. **Stipe:** Dark brown; concolorous with pileus; slender; 2-3 mm in diameter; up to 1 cm long.

Type of decay: White rot of dead hardwoods and conifers.

Substrate: *Juniperus virginiana* (eastern redcedar); *Quercus alba* (white oak).

Comments: This species is characterized by fragile, dark-brown basidiocarps with minute angular pores. It is much smaller and more fragile than the lighter toned *P. alveolaris*. The other stipitate, small, polypores are characterized either by a highly pubescent pileus (*C. cinnamomea*) or a distinctive black zone at the base of the stipe (*P. elegans*).

41. Polyporus elegans Bull.: Fr.

Overholts (1953): page 263; Gilbertson and Ryvarden (1987): page 659

Basidiocarp: Annual; laterally stipitate; 0.5-2.5 cm in diameter; to 0.5 cm thick. **Pileus:** Rusty brown to buff to light tan; darker brown at the margin; round, shell-shaped to flabelliforme; glabrous to finely pubescent; margin deep rusty brown, entire, slightly recurved on drying. **Context:** Buff to light tan to off-white; darkening with age or drying; finely fibrous with hyphae

forming short wooly strands; <1 mm to 2 mm thick. **Pores:** Regular and round; 4-6 pores per mm; white when fresh; concolorous with context on drying; tubes 1-3 mm long; mouths entire; walls thick; partially decurrent on stipe. **Stipe:** 1-4 mm in diameter; to 2 cm long; distinct black band on lower one-half to two-thirds; often with a round protrubance at point of attachment.

Type of decay: White rot of dead hardwoods.

Substrate: *Cornus florida* (flowering dogwood); *Liriodendron tulipifera* (yellow-poplar).

Comments: The blackened stipe base and round pores distinguish this species from most other stipitate polypores. Another stipitate species, *P. badius* (Pers.: S.F. Gray) Schw., not found in this survey also has a blackened stipe base and tawny pileus but it is large (up to 15 cm in diameter).

P. elegans is often difficult to find as it commonly forms just a single basidiocarp on branch debris that is fallen from the tree and buried in litter. It was very frequently found on small diameter (<2.5 cm) debris.

42. Porodisculus pendulus (Schw.) Murr.
Synonym: *Polyporus pocula* (Schw.) Berk. et Curt.

Overholts (1953): page 267; Gilbertson and Ryvarden (1987): page 679

Basidiocarp: Annual; laterally substipitate; pendant from substrate; minute; forming numerous single well-spaced basidiocarps; fragile and soft when fresh; more rigid but still fragile and friable when dry; 0.1-0.3 x 0.1-0.2 x < 0.1 cm. **Pileus:** Pinkish to cream; drying grey; finely pubescent to glabrous; drying with a thin crystalline crust; azonate; margin entire, slightly recurved; slightly darker than the pileus. **Context:** <1 mm thick; fleshy to coriaceous when fresh; friable to chalky when dry. **Pores:** 8-10 pores per mm; light brown to pale grey to tan; transluscent or with a waxy cast; pore surface covered by a thin chalky layer when fresh and dried; tubes <1 mm long.

Type of decay: White rot of dead hardwoods.

the pileus of *P. sanguineus* appears as if seared with a hot iron while that of *P. cinnabarinus* develops a rough guttate texture.

44. Schizopora paradoxa (Fr.) Donk.
Synonym: *Poria versipora* (Pers.) Rom.

Lowe (1966): page 63; Gilbertson and Ryvarden (1987): page 707

Basidiocarp: Annual; largely resupinate; laterally fused; spongy and soft when fresh; firm when dry; rapidly disintegrating due to and other fungi; can extend for considerable lengths along substrate; 20+ x 2 x 0.2-0.3 cm. **Pileus:** Laterally fused; finely tomentose; drying glabrous; azonate to zonate; radially striate; margin thin, sterile, dark brown, wavy to fimbriate. **Context:** Tan to light brown; fibrous with the hyphae aligned parallel so that the context, especially when dry, can be pulled apart in only one direction; azonate; 0.2-1.5 cm thick. **Pores:** Very irregular; usually large and angular in shape and outline, but not clearly hydnoid or daedaloid; 1-3 pores per mm; surface concolorus with context at margin, deepening to dark brown at the base; tubes 1-2 mm long in resupinate sections; 5 mm deep in well developed portions of the basidiocarp; walls very thin; tube mouth fimbriate.

Type of decay: White rot of dead hardwoods.

Substrate: *Quercus alba* (white oak).

Comments: This species often forms a resupinate basidiocarp on the undersides of larger branch debris which explains its previous placement in the genus *Poria*. The pores are large and gaping and Gilbertson and Ryvarden (1987) note that pores forming toward the margin are so shallow as to seem "net-like." *S. paradoxa* is reported to occur on twenty-two hardwood and six conifer genera (Farr *et al.*, 1989), but was only found on oak at Schenck Forest. It is a saprophytic species that decays dead hardwood debris and slash

S. paradoxa can be mistaken for an *Antrodia* or *Coriolopsis*. The context is more fibrous with marked parallel arrangement than these genera. Microscopically, it is unique among the polypores for having bulbous swellings on the tips of the hyphae that form the tramal tissue.

S. paradoxa is also host to insects which quickly turn the basidiocarp to frass. Specimens also serve as substrate for a *Trichoderma* species and bore perithecia protruding from the tube walls.

45. Skeletocutis nivea (Jungh.) Keller
Synonym: *Polyporus semipileatus* Pk.

Overholts (1953): page 295; Gilbertson and Ryvarden (1987): page 717

Basidiocarp: Annual; resupinate to effused-reflexed; soft and spongy when fresh; drying rigid; laterally fused; 1-7 x 1 x 0.1-0.3 cm. **Pileus:** Chalky white to cream; finely pubescent; azonate; margin darker brown, entire; recurving slightly on drying; pileus a thin shelfing of the edge of the basidiocarp. **Context:** White; fibrous and soft; drying unchanged in texture and color; azonate; 0.1-0.2 [to 0.5] cm thick. **Pores:** Regular and round; 6-8 pores per mm; not visible to the naked eye; surface cream to golden-yellow with a glistening sheen; distinct from the context; tubes 1 [to 2] mm long; mouths thin and entire; often cracking or separating with age;.

Type of decay: White rot of dead hardwoods.

Substrate: *Prunus serotina* (black cherry).

Comments: This genus is characterized by the minute pores, a pigmented pore surface and resupinate form. The basidiocarp has a fragile appearance and is not as thick as *Gloeoporus dichrous* a species that also has a much deeper pigmentation to the pore surface. This species is found primarily on hardwoods although many other members of the genus are noteworthy for causing decay in *Picea* species in boreal forests.

46. Spongipellis delectans (Pk.) Murr.
Synonym: *Polyporus delectans* Pk.

Overholts (1953): page 320; Gilbertson and Ryvarden (1987): page 723

Basidiocarp: Annual; effused reflexed, less often sessile; laterally fused to single; spongy and sodden when fresh; drying rigid; 3-5 x 1-2 x 0.5-1. **Pileus:** White, bone-white to cream; glabrous; semicircular to dimidiate; undulate; margin thin, fertile, drying recurvedand darkened. **Context:** Soggy and soft when fresh; drying fibrous and firm; off-white to white, cream or bone-white; azonate; 0.5 [to 2] cm thick. **Pores:** Irregular, round; 1-2 pores per mm; white, off-white to yellowish-brown; distinct from context; drying gelatinous and fragile; congealing and fragmenting with age; tubes to 0.5 cm long; mouths irregular, fimbriliate, toothed; walls thin. **Type of decay:** White rot of dead and living hardwoods.

Substrate: *Acer rubrum* (red maple).

Comments: *Spongipellis* species are characterized by sodden to soggy basidiocarps that are spongy when fresh. The tube layer is distinctly gelatinous when dried. This species can be differentiated from *S. spumeus* by the very irregular toothed tubes and larger pores. The pore surface in *S. spumeus* is even and regular.

This species has not been reported previously in North Carolina.

47. Spongipellis spumeus (Sow.:Fr.) Pat.
Synonym: *Polyporus spumeus* Sow.:Fr.

Overholts (1953): page 318; Gilbertson and Ryvarden (1987): page 726

Basidiocarp: Annual; sessile to effused-reflexed; sodden and spongy when fresh; firm and brittle when dry; 5 x 3.5 x 1.5 cm. **Pileus:** Yellowish-white to cream; finely pubescent to tomentose; azonate; margin thin, fertile, entire, recurved when dry.**Context:** Spongy and soft when fresh; firm to coriaceous when dry; white; azonate; 0.4-0.6 cm thick. **Pores:** 4-6 pores per mm; surface

yellowish and gelatinous when dry; individual pores filamentous; surface cracked and irregular when dry, otherwise tubes very fine and even; 3-6 mm long; .mouths round finely dentate; walls thin.

Type of decay: White rot of dead hardwoods.

Substrate: *Acer rubrum* (red maple).

Comments: This species is very similar to *S. delectans*. The pores of *S. spumeus* are very fine and form an even pore surface in contrast to those of *S. delectans* which tend to develop an irregular pore surface.

This species has not previously been reported from North Carolina.

48. Trametes cervina (Schw.) Bres.
Synonym: *Polyporus biforme* Fr. *(sensu* Overholts)

Overholts (1953): page 328; Gilbertson and Ryvarden (1987): page 735

Basidiocarp: Annual; sessile; laterally confluent; coriaceous when fresh; drying firm; 2-5 [- 21] x 1-1.5 [-5] x 0.2-0.5 [1.5] cm. **Pileus:** Finely pubescent to radially striate; light brown to straw colored; zonate in zones of varying thickness; margin thin; recurved on drying. **Context:** Thin; <1 mm thick; light brown to straw colored; fibrous; azonate. **Pores:** Angular and irregular; 1-2 pores per mm; surface drying cinnamon to reddish brown; tubes 1-5 mm long; mouths fimbriate; walls rapidly breaking giving the tubes a toothlike appearance.

Type of decay: White rot of hardwoods.

Substrate: *Quercus* sp. (red oak group).

49. Trametes conchifer (Schw.: Fr.) Pil.
Synonym: *Polyporus conchifer* Schw.: Fr.

Overholts (1953): page 350; Gilbertson and Ryvarden (1987): page 739

Basidiocarp: Annual; substipitate to sessile; frequently arising from a sterile cup-like structure at the base; circular; coriaceous when fresh; drying brittle; 0.5-2 [- 5] cm in diameter; 0.1-0.3 cm thick. **Pileus:** White or zonate with contrasting white and dark brown zones circling a central or lateral depression; inconspicuously pubescent to glabrous; margin thin, entire, sterile, and slightly darker than the pileus and pore surface. **Context:** Thin; <0.1 cm thick; fibrous; white. **Pores:** Round to irregularly circular; 2-4 pores per mm; surface white to cream to rusy-brown; usually white at the base even on drying; tubes 0.1-0.3 mm long; often variable across the pore surface; mouths thin, becoming finely dentate.

Type of decay: White rot of the sapwood in dead hardwood branches.

Substrate: *Ulmus alata* (winged elm); *Ulmus* sp. (elm).

Comments: The specific epithet *conchifer* is derived from the Latin *concha* meaning "mussell shell," with *conchifer* meaning "shell-bearing"; referring to the shape of the basidiocarp and the sterile cup at the base of the pileus. The small size, shell-shape and, when present, the cup-like structure at the base are all diagnostic. This species reportedly prefers elm branches as a substrate (Overholts, 1967; Lincoff, 1981; Gilbertson and Ryvarden, 1987). While not all host branches could be identified as elm, the species was always found near elms, or in one case *Celtis*. It is a decayer of small branches; not found at Schenck Forest on material over 5 cm in diameter. The all-white, azonate form is more common at Schenck Forest.

Brodie (1951) suggests that the sterile structures at the base of the basidiocarp contain oidia, asexually produced propagules, which are disseminated by rain drops.

50. Trametes elegans (Spreng.: Fr.) Fr.
Synonym: *Daedalea ambigua* Berk.

Overholts (1953): page 126; Gilbertson and Ryvarden (1987): page 743

Basidiocarp: Annual; sessile to slightly effused-reflexed; occasionally laterally fused; broadly attached; semicircular; applanate to ungulate; rigid when fresh and dry; 2-10 [- 35] x 1-4 [- 20] x 0.5-3 cm. **Pileus:** White to offwhite to yellowish-white when fresh and dried; occassionally with greyish-brown zones on margin; sulcate zonations; pubescent to glabrous; small tubercular swellings on the upper surface; margin thick, dark, entire. **Context:** Extremely dense and cottony fibrous; drying hard; white to off-white; 0.5-1.5 cm thick; difficult to bend or break. **Pores:** Variable in size and shape; regular and round to oval to daedaloid; 1-3 pores per mm; surface white, drying yellowish to cream; tubes 2-4 mm long; walls thick; mouths entire.

Type of decay: White rot of dead hardwoods.

Substrate: *Acer rubrum* (red maple); *Fagus grandifolia* (beech); *Liquidambar sytraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Quercus alba* (white oak); *Quercus* sp. (red oak group).

Comments: The substantial, finely pubescent basidiocarp with an irregular to daedaloid pore surface are characteristic of this species. The texture is similar to *T. hirsuta* which has consistently regular round and small pores, and a thicker tomentum. Often the basidiocarp forms as a lumpy, nodulose, helmet shaped mass with an overall grey pubsecence.

T. elegans and *T. hirsuta* begin forming in substantial numbers on dead wood about nine months to a year after the trees have fallen or been cut. It is most common on larger substrates (+ 12 cm in diameter) and on stumps in salvage cuts.

51. Trametes hirsuta (Wulf.: Fr.) Pil.
Synonym: *Polyporus hirsutus* Wulf.: Fr.

Overholts (1953): page 345; Gilbertson and Ryvarden (1987): page 745

Basidiocarp: Annual; sessile; arising from a rounded lateral base; often laterally fused; semiciruclar; coriaceous to soft and flexible when fresh; firm when dry; 3-7 x 2-5 x 0.5-2 cm thick. **Pileus:** Semicircular; appearing substipitate when circular; light grey, cream, light rusty brown to deep chocolate brown; zonate with contrasting zones; hirsute with a marked upright pubescence often alternating with finer more adpressed tomentum; light tones toward the base; deeper coloration on margin; margin thin, entire, sterile, hirsute. **Context:** White cottony fibrous context zonate by texture rather than color; 0.1-1.5 cm thick. **Pores:** Regular and round; 2-4 pores per mm; cream to off-white; shimmering; tubes to 3 mm long; becoming elongated and toothed toward the base of the pieleus; walls thin; mouths toothed.

Type of decay: White rot of dead hardwoods.

Substrate: *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Quercus alba* (white oak); *Quercus* sp. (red oak group).

Comments: In size and appearance of the pileus, this species most resembles *Lenzites betulina* and *T. elegans,* although the pores of *T. hirsuta* are fine and regularly round and lamellate in *L. betulina.* The context and basidiocarp are slightly thinner those those of *T. elegans.* The zonations are broader, less contrasting and with fewer glabrous bands than those of *T. versicolor.*

T. hirsuta forms a large basidiocarp and, as was the case with *T. elegans,* forms most abundantly after the substrate has been down for about a year. It tends to form on large substrate with basidiocarps that have formed on small substrate being smaller and poorly developed. Both of these species are frequently infested with insects.

52. Trametes pubescens (Schum.: Fr.) Pil.
Synonym: *Polyporus pubescens* Schum.: Fr.

Overholts (1953): page 346; Gilbertson and Ryvarden (1987): page 755

Basidiocarp: Annual; sessile; broadly attached; often laterally fused or forming small clusters; leathery to fleshy when fresh; drying rigid and tough; 1-2 x 1-4 x 0.1-0.5 cm. **Pileus:** White to cream to yellowish or light brown; zonate with unicolorous zones; velvety pubescent with glabrous bands and satiny margin; margin thin, fimbriate to entire. **Context:** White, drying cream; fibrous; 0.1-0.2 cm thick. **Pores:** Round; 3-6 pores per mm; surface white to cream; glistening; tubes 0.5-2 mm long; mouths becoming elongated and fimbrilate.

Type of decay: White rot of dead hardwoods.

Substrate: *Liriodendron tulipifera* (yellow-poplar); *Quercus* sp. (red oak group).

Comments: *T. pubescens* is difficult to distinguish from pale forms of *T. versicolor*. *T. pubescens* tends to be lighter colored with the zonations consistently pale to unicolorous. It has 3-5 pores per mm whereas *T. versicolor* has 4-6 pores per mm. The context of *T. versicolor* is separated from the pileus surface by a fine black line, a characteristic not found in *T. pubescens*. Microscopically the two species are virtually identical. In our region, *T. hirusta* is usually thicker than either *T. pubescens* or *T. versicolor*. *T. versicolor*, at Schenck Forest, is the most abundant of the species and, is distinguished by zonations of highly contrasting colors.

Numerous authors (Bondaretsev, 1971; Rayner and Boddy, 1988; Gilbertson and Ryvarden, 1987) place these species of similar *Trametes* (including *T. hirsuta, T. pubescens* and *T. versicolor*) in a complex of intergrading species, although interfertility has not been demonstrated. In European countries this is referred to as the *Coriolus* complex of fungi.

Murrill (1914) contends that *T. pubescens* is more northern in distribution, although it has been reported (Gilbertson and Ryvarden, 1987) as far south as Georgia.

53. Trametes versicolor (L.:Fr.) Pil.
Synonym: *Polyporus versicolor* L.:Fr.

Overholts (1953): page 342; Gilbertson and Ryvarden (1987): page 761

Basidiocarp: Annual; sessile; broadly to narrowly attached; individual basidiocarps laterally fused or nested forming a rosette or cluster; 1-3 x 1-4 x 0.1-0.5cm thick. **Pileus:** Multicolored zonations widely variable from black, deep blue, grey, tan, rusty-brown to maroon; velvety pubescent bands separated by dark, glabrous, bands; margin thin, fimbriate to entire; often satiny. **Context:** White to cream; sometimes drying to beige; fibrous; 0.5-2 mm thick. **Pores:** Round; 4-6 pores per mm; pore surface white to cream to yellowish; with a sheen; tubes to 5 mm long; mouths becoming fimbriate.

Type of decay: White rot of dead hardwoods.

Substrate: *Acer rubrum* (red maple); *Betula nigra* (river birch); *Carpinus caroliniana* (musclewood); *Cercis canadensis* (redbud); *Cornus florida* (flowering dogwood); *Cupressus arizonica* (arizona cypress); *Fagus grandifolia* (beech); *Fraxinus* sp. (ash); *Ligustrum sinense* (privet); *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Prunus serotina* (black cherry); *Quercus alba* (white oak); *Quercus* sp. (red oak group).

Comments: *T. versicolor* is one of the most abundant of the wood-decay fungi found at Schenck Forest. It is rare on living trees, unlike *Trichaptum biforme* which is similar in size and shape and texture, but which often occurs around stem wounds of living trees. Bondaretsev (1971), however, cites European authorities who contend that *T. versicolor* is a serious pathogen in deciduous forests. *T. versicolor* basidiocarps form on substrates of all sizes from small and was alsois found on roots of windthrown trees and stumps.

The multicolored basidiocarps are diagnostic and confusion usually only results from distinguishing very light colored forms of this species from normal forms of *T. pubescens*. Rayner and Boddy (1988) contend that color variation is due to environmental influences during

basidiocarp formation. Sharply contrasting basidiocarps can develop in close proximity to one another on the same tree, but whether they are different strains or the same strain forming basidiocarps under different environmental conditions not known.

T. versicolor has been frequently used in laboratory studies of the properties of white rot and the enzyme activities that degrade of lignin. It has also been used to study the capacity of white rot fungi to degrade industrial pulping residues (Davis and Burns, 1990) and polycarbonated biphenols. A synonym, which frequently appears in the literature and is widely used in Europe, is *Coriolus versicolor* (Gilbertson and Ryvarden, 1987).

54. Trametes villosa (Fr.) Kreisel
Synonym: *Polyporus pinsitus* Fr.

Overholts (1953): page 326; Gilbertson and Ryvarden (1987): page 763

Basidiocarp: Annual, sessile, flabelliform; tough and coriaceous when fresh; drying rigid; 2-4 [-7] x 2-3 x 0.1-0.5 cm. **Pileus:** Finely pubescent with light brown glabrous bands; zonate to azonate; off-white to grey with a green algal growth on the surface; margin thin; undulate and fimbriate. **Context:** Thin; <0.5 mm thick; fibrous; cream to light brown. **Pores:** Irregular and toothed; 1-2 pores per mm; surface light brown; tubes to 2 mm long; walls rapidly deteriorating and hymenophore becoming toothed.

Type of decay: White rot of conifers and hardwoods.

Substrate: *Pinus taeda* (loblolly pine).

Comments: *T. villosa* closely resembles *Trichaptum biforme*. The pores of *T. villosa* are more elongate and tooth-like and lack the purple hue of *T. biforme*. This species is a southeastern species in the U.S., extending into the tropcis. It was the only *Trametes* species found in this survey on pine.

55. Trichaptum abietinum (Dicks.: Fr.) Ryv.
Synonym: *Polyporus abietinus* Dicks.: Fr.

Overholts (1967): page 333; Gilbertson and Ryvarden (1987): page 768

Basidiocarp: Annual; sessile to effused-reflexed; often laterally fused or imbricate in closely packed clusters; tiny; dimidiate; soft and flexible when fresh; drying rigid and recurved; 0.5-1 x 0.5-1 x 0.1-0.2 cm. **Pileus:** White to grey to light tan; zonate; hiruste with a cottonly upright pubescence; with darker, glabrous zones; margin thin, hirsute. **Context:** Very thin; <1 mm thick; appearing as a dark line separating the pileus from the tubes; dark brown to light tan to off white; fibrous to coriaceous; drying rigid to friable. **Pores:** Round to irregular to, less frequently, daedaloid and toothed; 2-3 pores per mm; surface, when fresh, deep purple, drying brown to maroon to rust-brown; tubes shallow, to 1 mm long; walls thick; mouths entire; becoming elongated and toothed with age.

Type of decay: White pocket rot of conifers.

Substrate: *Pinus echinata* (shortleaf pine); *Pinus taeda* (loblolly pine).

Comments: The dimidiate, cottony-hirsute basidiocarp, deep purple to brownish pore surface and the coniferous substrate are all diagnostic. The substrate and uniformly light pileus distinguish this from *Trichaptum biforme*. The pileus and the decidedly poroid hymenial layer distinguish this species from some of the deeply pigmented Merulioid wood-decay fungi that also occur on pine.

This species is common, forming early in the process of decay, while the bark is intact. Often the basidiocarps form in cracks between the plates of bark. As in *T. biforme*, *T. abietinum* rarely is found as a single basidiocarp. The tiny pilei commonly form clusters when emerging at branch stubs.

T. abietinum is also, although less frequently, found on living trees.

56. Trichaptum biforme (Fr. in Kl.) Ryv.
Synonym: *Polyporus pargamenus* Fr.

Overholts (1953): page 336; Gilbertson and Ryvarden (1987): page 770

Basidiocarp: Annual; effused-reflexed to sessile; coriaceous when fresh; firm but pliable when dry; usually forming in masses on the substrate; very rarely singly; dimidiate to flabelliforme; variable in size; 1-5 x 1-5 x 0.1-0.3 cm. **Pileus:** Grey, tan, light-brown, off-white to cream; sometimes with a few darker striations and zonations; zonate; finely pubescent; margin thin, sterile, very fimbriate, often slightly darker than the pileus; entire pileus frequently covered with green algal growth. **Context:** Very thin; <1 mm thick; off-white to tan; fibrous. **Pores:** 1-3 pores per mm; surface buff to tan; when fresh with a pale violet or lavender hue that does not persist on drying; drying brown, rusty brown to off white; tubes 0.5-3 mm long; mouths irregular to angular; becoming toothed and fragmented as the basidiocarp ages.

Type of decay: White rot of dead and living hardwoods.

Substrate: *Acer rubrum* (red maple); *Betula nigra* (river birch); *Carpinus caroliniana* (musclewood); *Liquidambar styraciflua* (sweetgum); *Liriodendron tulipifera* (yellow-poplar); *Prunus serotina* (black cherry); *Quercus alba* (white oak); *Quercus* sp. (red oak group); *Ulmus* sp. (elm); *Vitis* sp. (grape).

Comments: *T. biforme* is a common species on debris of all sizes, although it is not found as frequently as *T. versicolor* or *I. lacteus*. on small debris. The formation of the pore layer is strongly influenced by gravity. Often a reoriented pileus supports numerous tiny pilei forming on the margin perpendicular to the original basidiocarp.

Small basidiocarps of *T. biforme* can be easily confused with *I. lacteus* while large basidiocarps sometimes resemble *T. versicolor*. *T. biforme* is usually not as effused-reflexed as *I. lacteus* which almost always has a large portion of the pore surface resupinate. The pileus of *T. biforme* also tends to be darker and more zonate than *I. lacteus*. In comparison with *T. versicolor*, the zonations of *T. biforme* contrast less sharply, the tomentum is less well-developed, and the

pore surface is more irregular and toothed. Basidiocarps of *T. biforme* are slightly thinner and softer than those found the in the genus *Trametes*. The purplish tint to the pore surface, when present, and the hardwood substrate are diagnostic. The pore surface of *T. abietinum* is deep purple; a color that persists longer than the pale violet found in *T. biforme*. *T. abietinum* also occurs only on conifers.

57. Tyromyces chioneus (Fr.) Karst.
Synonym: *Polyporus albellus* Peck.

Overholts (1953): page 299; Gilbertson and Ryvarden (1987): pgae 785

Basidiocarp: Annual; sessile to confluent clusters from a common point; ungulate or nodulose and rounded; fragile and soft when fresh; drying firm and rigid and noticeably lighter in weight; 2-3 x 1.5-2 x 0.4-0.7 cm. **Pileus:** Chalky white when fresh; yellow to gold to rusy brown on drying; glabrous but with a satiny sheen; margin darker than pileus, entire, sterile, sharply recurved on drying. **Context:** White; unchanged on drying; tightly fibrous; firm when dry; to 0.5 cm thick. **Pores:** Round to irregular; 2-4 pores per mm; surface yellow, drying with a sheen; very even; tubes to 5 mm long; continuous with context;.tube layer sometimes cracking; walls thin; mouths dentate.

Type of decay: White rot of dead hardwoods and conifers.

Substrate: *Liquidambar styraciflua* (sweetgum); *Pinus taeda* (loblolly pine).

Comments: This species is more common on hardwoods than on conifers and was not found frequently in this survey. The basidiocarp dries to deep yellow in contrast to the *Oligoporus* species also found on conifers. Its tubes are more gelatinous than those *Dichomitus squalens*. Macroscopically, most of the species with white basidiocarps that cause a white rot of conifers look very similar. Gilbertson and Ryvarden (1987) note that *T. chioneus* develops, when dried, a

thin straw-colored pellicle, or covering, on the pileus surface a characteristic not found in *D. squalens*.

58. Tyromyces fissilis (Berk. et Curt.) Donk.
Synonym: *Polyporus fissilis* Berk.et Curt.

Overholts (1953): page 321; Gilbertson and Ryvarden (1987): page 787

Basidiocarp: Annual; effused-reflexed, resupinate, sessile; laterally and vertically fused into a mass; broadly attached; soft and sodden when fresh; rigid when dry; 3-6 x 0.5-2 x0.5-1.5 cm. **Pileus:** White to cream when fresh; drying yellow; finely pubescent; drying glabrous; sulcate and warted; margin darkening to deep brown on drying; becoming recurved. **Context:** White; drying unchanged to brownish; sometimes with brown streaks through the context tissue; distinct from tube layer; fibrous to firm; to 0.5 cm thick. **Pores:** Round to angular; irregular in size and shape; 4-6 pores per mm; off- white to cream; drying pale lemon yellow to golden yellow; friable when dried; surface uneven with sulcations and partially formed pilei in places; tube length variable to 0.5 cm; walls dissolving with age.

Type of decay: White rot of dead hardwoods.

Substrate: Unidentified hardwood debris.

Comments: This species closely resembles *Abortiporus biennis* in texture when dry. The pores are, however, more finely divided and toothed. The basidiocarp, although amorphous in places, is better developed than the nodulose form of *A. biennis*.

Table 1. Polypore fungi found at Schenck Forest and adjacent Department of Corrections land, Wake County, NC.

Family	Species[a]	Synonym[b]
Bondarzewiaceae		
	Bondarzewia berkeleyi (Fr.) Bond. et Sing.	*Polyporus berkeleyi* Fr.
Corticiaceae		
	Gloeoporus dichrous (Fr.) Bres.	*Polyporus dichrous* Fr.
	Schizopora paradoxa (Fr.) Donk.**	*Poria versipora* (Pers.) Rom.
Ganodermataceae		
	Ganoderma applanatum (Pers.) Pat.	*Fomes applanatus* Pers.
	Ganoderma lucidum (W. Curt.:Fr.) Karst.	*Polyporus lucidus* W. Curt.: Fr.
Hymenochaetaceae		
	Coltricia cinnamomea (Pers.) Murr.	*Polyporus cinnamomeus* Pers.
	Coltriciella dependens (Berk. et Curt.) Murr.	*Polyporus dependens* Berk. et Curt.
	Inonotus ludovicianus (Pat.) Murr.	*Polyporus ludovicianus* (Pat.) Sacc. et Trott.
	Phellinusgilvus (Schw.) Pat	*Polyporus gilvus* (Schw.) Fr.
	Phellinus pini (Thore.: Fr.) A. Ames	*Fomes pini* (Thore.: Fr.) Karst.
Polyporaceae		
	Abortiporus biennis (Bull.:Fr.) Sing.	*Polyporus biennis* Bull.:Fr.
	Antrodia albida (Fr.) Donk.	*Trametes sepium* Berk.
	Antrodia heteromorpha (Fr.) Donk.	*Trametes heteromorpha* Fr.
	Antrodia serialis (Fr.) Donk.**	*Trametes serialis* Fr.
	Antrodia sinuosa (Fr.) Karst.	*Polyporus sinuosus* Fr.
	Bjerkandera adusta (Willd.:Fr.)Karst.	*Polyporus adustus* Willd.: Fr.
	Cerrena unicolor (Bull.:Fr.) Murr.	*Daedlea unicolor* Bull.:Fr.
	Chaetoporellus latitans (Bourd. et Galz.) Bond. et Sing.	*Poria latitans* Bourd. et Galz.
	Climacocystis borealis (Fr.) Kotl. et Pouz.	*Polyporus borealis* Fr.
	Coriolopsis rigida (Berk. et Mont.) Murr.**	*Trametes rigida* Berk. et Mont.
	Daedaliopsis confragosa (Bolg.:Fr.) Schroet.	*Daedalea confragosa* Bolt.: Fr.
	Dichomitus squalens (Karst.) Reid. **	*Polyporus anceps* Pk.

Table 1 (continued)

Fomitopsis spraguei (Berk. et Curt.) Gilbn. et Ryv.	*Polyporus spraguei* Berk. Curt.
Globifomes graveolens (Schw.) Murr.	*Polyporus graveolens* (Schw.) Fr.
Gloeophyllum sepiarium (Fr.) Karst.	*Lenzites sepiaria* (Wulf.:Fr.) Fr.
Grifola frondosa (Dicks.:Fr.) S.F.Gray	*Polyporus frondosus* Dicks.:Fr.
Hapalopilus nidulans (Fr.) Karst.	*Polyporus nidulans* Fr.
Heterobasidion annosum (Fr.) Bref.	*Fomes annosus* (Fr.) Cooke
Irpex lacteus (Fr.:Fr.) Fr.	*Polyporus tulipifera* (Schw.) Overholts
Ischnoderma resinosa (Fr.) Karst.	*Polyporus resinosus* Fr.
Laetiporus sulphureus (Bull.:Fr.) Murr. *	*Polyporus sulphureus* Bull.:Fr.
Lenzites betulina (Fr.) Fr.	
Meripilus giganteus (Fr.) Karst.	*Polyporus giganteus* Pers.: Fr.
Nigroporus vinosus (Beck.) Murr.	*Polyporus vinosus* Murr.
Oligoporus caesius (Schrad.:Fr.) Gilbn. et Ryv.	*Polyporus caesius* Schrad.: Fr.
Oligoporus fragilis (Fr.) Gilbn. et Ryv.	*Polyporus fragilis* Fr.
Oligoporus stipticus (Pers.: Fr.) Gilbn. et Ryv.**	*Polyporus immitis* Pk.
Perenniporia compacta (Overh.) Gilbn. et Ryv.	*Polyporus compactus* Overh.
Phaeolus schweinitzii (Fr.) Pat.*	*Polyporus schweinitzii* Fr.
Polyporus alveolaris (DE.:Fr.) Bond. et Sing.	*Favolus alveolaris* (DC.: Fr.) Quel.
Polyporus arcularius Batsch.:Fr.	
Polyporus elegans Bull.:Fr.	
Porodisculus pendulus (Schw.) Murr.	*Polyporus pocula* (Schw.) Berk et Curt.
Pycnoporus cinnarbarinus (Jacq.:Fr.) Karst.	*Polyporus cinnabarinus* Jacq.:Fr.
Skeletocutis nivea (Jungh.) Keller	*Polyporus semipileatus* Pk.
Spongipellis delectans (Pk.) Murr.**	*Polyporus delectans* Pk.
Spongipellis spumeus (Sow.: Fr.) Pat.**	*Polyporus spumeus* Sow.:Fr.
Trametes cervina (Schw.) Bres.	*Polyporus biforme* (*sensu* Overholts)
Trametes conchifer (Schw.:Fr.) Pil.**	*Polyporus conchifer* Schw.:Fr.
Trametes elegans (Spreng.:Fr.) Fr.	*Daedalea ambigua* Berk.
Trametes hirsuta (Wulf.:Fr.) Pil.	*Polyporus hirsutus* Wulf.:Fr.
Trametes pubescens (Schum.:Fr.) Pil.	*Polyporus pubescens* Schum.:Fr.
Trametes versicolor (L.:Fr.) Pil.	*Polyporus versicolor* L.: Fr.
Trametes villosa (Fr.) Dreisel	*Polyporus pinsitus* Fr.
Trichaptum abietinum (Dicks.:Fr.) Ryv.	*Polyporus abietinus* Dicks.:Fr.

Table 1 (continued)

Trichaptum biforme (Fr.: Kl.) Ryv.	*Polyporus pargamenus* Fr.
Tyromyces chioneus (Fr.) Karst.	*Polyporus albellus* Peck.
Tyromyces fissilis (Berk. et Curt.) Donk	*Polyporus fissilis* Berk. et Curt.

[a] Species nomenclature based on Gilbertson and Ryvarden (1986; 1987).
[b] Synonym nomenclature based on Overholts (1953).
* species which are in the North Carolina State Mycological Herbarium from Schenck Forest, but which were not found during this survey.
** species which have not been reported previously from North Carolina.

Table 2. Woody plant taxa, with associated polypore species, observed from February, 1997 to February 1998. Schenck Forest and adjacent Department of Corrections land, Wake County, NC.

Host	Polypore species
Acer rubrum L. (red maple)	*Coriolopsis rigida* *Daedaliopsis confragosa* *Ganoderma applanatum* *Gloeoporus dichrous* *Grifola frondosa* *Lenzites betulina* *Trichaptum biforme* *Skeletocutis nivea* *Irpex lactrus* *Trametes versicolor* *Pycnoporus cinnabarinus*
Betula nigra L. (river birch)	*Daedaliopsis confragosa* *Trichaptum biforme* *Trametes versicolor* *Phellinus gilvus*
Carpinus caroliniana Walter (musclewood)	*Bjerkandera adusta* *Gloeoporus dichrous* *Lenzites betulina* *Phellinus gilvus* *Trametes versicolor* *Trichaptum biforme*
Carya **spp.** (hickory)	*Antrodia albida* *Phellinus gilvus* *Hapalopilus nidulans*
Cercis canadensis L. (redbud)	*Trametes versicolor*
Cornus florida L. (flowering dogwood)	*Chaetiporellis latitans* *Gloeoporus dichrous* *Irpex lacteus* *Phellinus gilvus* *Polyporus elegans* *Trametes versicolor*
Cupressus arizonica Greene (Arizona cypress)	*Trametes versicolor*
Fagus grandifolia Ehrhart. (beech)	*Bjerkandera adusta* *Daedaliopsis confragosa* *Meripilus giganteus* *Trametes elegans* *Trametes hirsuta* *Trametes versicolor*

Table 2 (continued)

Fraxinus spp. (ash)	*Trametes versicolor*
Juniperus virginiana L. (eastern redcedar)	*Antrodia sinuosa*
	Gloeophyllum sepiarium
	Coltricia cinnamomea
	Polyporus arcularius
Ligustrum sinense Lour. (privet)	*Trametes versicolor*
Liquidambar styraciflua L. (sweetgum)	*Daedaliopsis confragosa*
	Fomitopsis spraguei
	Ganoderma lucidum
	Globifomes graveolens
	Gloeoporus dichrous
	Inonotus ludovicianus
	Irpex lacteus
	Lenzites betulina
	Nigroporus vinosus
	Phellinus gilvus
	Polyporus alveolaris
	Porodisculus pendens
	Schizopora paradoxa
	Trametes elegans
	Trametes hirsuta
	Trametes pubescens
	Trametes versicolor
	Trichaptum biforme
	Tyromyces chioneus
Liriodendron tulipifera L. (yellow-poplar)	*Abortiporus biennis*
	Antrodia albida
	Bjerkandera adusta
	Cerrena unicolor
	Daedaliopsis confragosa
	Globifomes graveolens
	Gloeoporus dichrous
	Haplopilus nidulans
	Irpex lacteus
	Lenzites betulina
	Phellinus gilvus
	Polyporus alveolaris
	Polyporus elegans
	Pycnoporus cinnabarinus
	Trametes elegans
	Trametes hirsuta
	Trametes pubescens
	Trametes versicolor
	Trichaptum biforme
Lonicera japonica Thunberg (honeysuckle)	*Lenzites betulina*

Table 2 (continued)

Paulownia tomentosa (Thunberg) Steudel (princess tree)	*Irpex lacteus*
Pinus echinata Miller (shortleaf pine)	*Heterobasidion annosum* *Phellinus pini* *Trichaptum abietinum*
Pinus taeda L. (loblolly pine)	*Antrodia heteromorpha* *Chaetoporellis latitans* *Coltricia cinnamomea* *Coltriciella dependens* *Heterobasidion annosum* *Gloeophyllum sepiarium* *Gloeoporus dichrous* *Heterobasidion annosum* *Nigroporus vinosus* *Oligoporus caesius* *Oligoporus fragilis* *Oligoporus stipticus* *Trichaptum abietinum* *Tyromyces chioneus*
Prunus serotina Ehrhart. (black cherry)	*Daedaliopsis confragosa* *Gloeoporus dichrous* *Irpex lacteus* *Phellinus gilvus* *Trichaptum biforme* *Spongipellis delectans* *Trametes pubescens* *Trametes versicolor* *Trichaptum biforme*
Quercus alba L. (white oak)	*Bjerkandera adusta* *Coriolopsis rigida* *Daedaliopsis confragosa* *Gloeoporus dichrous* *Hapalopilus nidulans* *Lenzites betulina* *Polyporus alveolaris* *Polyporus elegans* *Phellinus gilvus* *Schizopora paradoxa* *Trametes elegans* *Trametes hirusta* *Trametes versicolor* *Trichaptum biforme*

Table 2 (continued)

***Quercus* spp.** (red oak group)	*Antrodia heteromorpha* *Bondarzewia berkeleyi* *Daedaliopsis confragosa* *Gloeoporus dichrous* *Lenzites betulina* *Meripilus giganteus* *Phellinus gilvus* *Polyporus alveolaris* *Schizopora paradoxa* *Trametes cervina* *Trametes elegans* *Trametes hirsuta* *Trametes versicolor* *Trichaptum biforme*
***Ulmus* spp.** (elm)	*Daedaliopsis confragosa* *Gloeoporus dichrous* *Ischnoderma resinosum* *Trametes conchifer*
***Vitis* spp.**	*Irpex lacteus* *Trichaptum biforme*

Table 3. Polypore species by frequency of observation from February 1997 through January 1998 at Schenck Forest and adjacent Department of Corrections land, Wake County, NC.

Common (> 50 observations)	Present, not abundant (5 - 50 observations)	Infrequent (< 5 observations)
Bjerkandera adusta	*Abortiporus biennis*	*Antrodia albida*
Daedaliopsis confragosa	*Cerrena unicolor*	*Antrodia heteromorpha*
Irpex lacteus	*Coltricia cinnamomea*	*Antrodia serialis*
Lenzites betulina	*Globifomes graveolens*	*Antrodia sinuosa*
Trametes versicolor	*Gloeophyllum sepiarium*	*Bondarzewia berkeleyi*
Trichaptum biforme	*Gloeoporus dichrous*	*Chaetoporellis latitans*
Trichaptum abietinum	*Hapalopilus nidulans*	*Climacocystis borealis*
	Heterobasidion annosum	*Coltriciella dependens*
	Nigroporus vinosus	*Coriolopsis rigida*
	Phellinus gilvus	*Dichomitous squalens*
	Phellinus pini	*Fomitopsis spraguei*
	Polyporus alveolaris	*Ganoderma applanatum*
	Polyporus elegans	*Ganoderma lucidum*
	Trametes conchifer	*Grifola frondosa*
	Trametes elegans	*Inonotus ludovicianus*
	Trametes hirsuta	*Ischnoderma resinosa*
		Meripilus giganteus
		Oligoporus caesius
		Oligoporus fragilis
		Oligoporus stipticus
		Perreniporia compacta
		Polyporus arcularius
		Porodisculus pendulus
		Pycnoporus cinnabarinus
		Schizopora paradoxa
		Skeletocutea nivea
		Spongipellis delectans
		Spongipellis spumeus
		Trametes cervina
		Trametes pubenscens
		Trametes villosa
		Tyromyces chioneus
		Tyromyces fissilis

Table 4. Wood- decay species abundance on four host species during observations made from February to June 1997 at Schenck Forest and adjacent Department of Corrections land. Percentages are of total observations per host species during this period.

	Acer rubrum		*Liquidambar styraciflua*		*Liriodendron tulipifera*		*Pinus taeda*	
Fungus species	# observed	%	# observed	%	# observed	%	# observed	%
Abortiporus biennis	--	--	--	--	1	1.8	--	--
Antrodia albida	--	--	--	--	1	1.8	--	--
Antrodia heteromorpha	--	--	--	--	--	--	1	0.5
Bjerkandera adusta	--	--	--	--	6	10.5	--	--
Cerrena unicolor	--	--	--	--	1	1.8	--	--
Chaetiporellis latitans	--	--	--	--	--	--	1	0.5
Coltricia cinnamomea	--	--	--	--	--	--	24	11.2
Coltriciella dependens	--	--	--	--	--	--	1	0.5
Coriolopsis rigida	1	2.9	--	--	--	--	--	--
Daedaleopsis confragosa	--	--	30	20.7	7	12.3	--	--
Fomitopsis spraguei	--	--	1	0.7	--	--	--	--
Ganoderma applanatum	1	2.9	--	--	--	--	--	--
Ganoderma lucidum	--	--	3	2.1	--	--	--	--
Globifomes graveolens	--	--	4	2.8	1	1.8	--	--
Gloeoporus dichrous	2	5.9	6	4.1	8	14.0	2	0.9
Gloeophyllum sepiarium	--	--	--	--	--	--	7	3.2
Grifola frondosa	1	2.9	--	--	--	--	--	--
Hapalopilus nidulans	--	--	--	--	1	1.8	--	--
Heterobasidion annosum	--	--	--	--	--	--	6	2.8
Inonotus ludovicianus	--	--	2	1.4	--	--	--	--
Irpex lacteus	1	2.9	13	9	12	21.0	--	--
Lenzites betulina	3	8.8	6	4.1	1	1.8	--	--
Nigroporus vinosus	--	--	3	2.1	--	--	7	3.2
Oligoporus caesius	--	--	--	--	--	--	1	0.5
Oligoporus fragilis	--	--	--	--	--	--	1	0.5
Oligoporus stipticus	--	--	--	--	--	--	1	0.5
Phellinus gilvus	--	--	2	1.4	1	1.8	--	--
Phellinus pini	--	--	--	--	--	--	3	1.4
Polyporus alveolaris	--	--	1	0.7	1	1.8	--	--
Polyporus elegans	--	--	--	--	1	1.8	--	--

Table 4. (continued)

Fungus species	*Acer rubrum*		*Liquidambar styraciflua*		*Liriodendron tulipifera*		*Pinus taeda*	
	# observed	%	# observed	%	# observed	%	# observed	%
Porodisculus pendens	–	–	1	0.7	–	–	–	–
Pycnoporus cinnabarinus	1	2.9	–	–	1	1.8	–	–
Schizopora paradoxa	–	–	1	0.7	–	–	–	–
Skeletocutis nivea	2	5.9	–	–	–	–	–	–
Trametes elegans	–	–	3	2.1	1	1.8	–	–
Trametes pubescens	–	–	1	0.7	1	1.8	–	–
Trametes versicolor	13	38.2	15	10.3	7	12.3	–	–
Trametes villosa	–	–	–	–	–	–	1	0.5
Trichaptum abietinum	–	–	–	–	–	–	159	73.9
Trichaptum biforme	9	26.5	52	35.9	5	8.8	–	–
Tyromyces chioneus	–	–	1	0.7	–	–	–	–

Table 5. Range of substrate conditions under which each polypore species was observed by: host taxa, out of the total 24 taxa (see Table 2 for full listing); host diameter (cm); host decay class (1 = newly downed debris; 2 = moderately decayed; 3 = well decayed). Observations are those from January 1997 through February 1998, Schenck Forest and adjacent Department of Corrections land, Wake County, NC.

Polypore species	Number of host taxa	Host diameters (cm)	Host decay classes
Abortiporus biennis	2	31	1
Antrodia albida	2	<2.5 - 13	3
Antrodia heteromorpha	2	31	1
Antrodia serialis	a	d	3
Antrodia sinuosa	2	15	3
Bjerkandera adusta	4	4 - 31	1 - 3
Bondarzewia berkeleyi	1	46	living tree
Cerrena unicolor	1	7	1
Chaetoporellus latitans	2	8	3
Climacocystis borealis	1	d	d
Coltricia cinnamomea	2	15 - 51	3 - 5
Coltriciella dependens	1	25	5
Coriolopsis rigida	2	8	3
Daedaliopsis confragosa	9	<2.5 - 18	1 - 5
Dichomitus squalens	1	d	d
Fomitopsis spraguei	1	36	5
Ganoderma applanatum	1	48	living tree
Ganoderma lucidum	1	c	5
Globifomes graveolens	2	15 - 25	1 - 5
Gloeophyllum sepiarium	2	5 - 20	1 - 3
Gloeoporus dichrous	10	<2.5 - 30	1 - 5
Grifola frondosa	1	36	living tree
Hapalopilus nidulans	3	5 - 30	1 - 5
Heterobasidion annosum	2	18 - 51	3 - 5
Inonotus ludovicianus	1	30 - 51	5
Irpex lacteus	7	<2.5 - 25	1 - 3
Ischnoderma resinosa	1	25	3
Laetiporus sulphureus	b	b	b
Lenzites betulina	8	<2.5 - 61	1 - 5
Meripilus giganteus	1	46	5
Nigroporus vinosus	2	11 - 33	3 - 5
Oligoporus caesius	1	<2.5 - 25	1 - 3
Oligoporus fragilis	1	<2.5 - 25	3
Oligoporus stipticus	1	20	3
Perenniporia compacta	2	5 - 10	1
Phaeolus schweinitzii	b	b	b
Phellinus gilvus	10	4 - 46	1 - 5
Phellinus pini	2	36 - 41	living tree - 1
Polyporus alveolaris	2	<2.5 - 5	1 - 3
Polyporus arcularius	2	13 - 15	3
Polyporus elegans	2	<2.5 - 8	3

Table 5 (continued)

Porodisculus pendulus	1	<2.5	3
Pycnoporus cinnarbarinus	2	[d]	1
Schizopora paradoxa	1	<2.5 - 9	3 - 5
Skeletocutis nivea	1	4	5
Spongipellis delectans	1	4 - 5	1 - 5
Spongipellis spumeus	1	[d]	3
Trametes cervina	1	61	3
Trametes conchifer	2	<2.5 - 5	1
Trametes elegans	6	<2.5 - 36	1
Trametes hirsuta	4	<2.5 - 64	1 - 3
Trametes pubscens	2	<2.5	1 - 3
Trametes versicolor	13	<2.5 - 61	1 - 5
Trametes villosa	1	[d]	1
Trichaptum abietinum	2	<2.5 - 42	1 - 5
Trichaptum biforme	10	<2.5 - 61	1 - 5
Tyromyces chioneus	2	4 - 15	3
Tyromyces fissilis	[a]	20	3

[a] this species was only found on an unidentified hardwood.
[b] this species was not observed during the current survey at the Schenck. Herbarium records record it on one species.
[c] found growing on the ground from buried roots or wood.
[d] not recorded on collection.

Table 6. Polypores observed to occur on substrate[a] with other wood-decay fungi at Schenck Forest and adjacent Department of Corrections land, Wake County, NC., from January 1997 through February 1998.

Fungus	Associated fungi (substrate[a])
Abortiporus biennis	*P. compacta* (Lt); *T. versicolor* (Qs, Lt)
Antroida albida	*D. confragosa* (Ls); *Stereum* sp. (Ls)
Bjerkandera adusta	*T. hirusta* (Qs); *T. versicolor* (Qa) *Laxitextum bicolor* (Qs); *Stereum* sp.
Cerrena unicolor	*I. lacteus* (Lt)
Coltricia cinnamomea	*C. dependens* (Pt); *H. annosum* (Pt); *N. vinosus* (Pt)
Coltriciella dependens	*C. cinnamomea* (Pt)
Coriolopsis rigisa	*T. biforme* (Ar)
Daedaliopsis confragosa	*A. albida* (Lt); *G. dichrous* (Ls); *I. lacteus* (Ls); *L. betulina* (Ls); *T. elegans* (Ls); *T. versicolor* (hd, Ls); *T. biforme* (hd, Ls, Lt); *Stereum* sp. (Ls, Lt); *Merulius* sp. (Ls)
Globifomes graveolens	*T. elegans* (Ls); *Pluerotus ostreatus* *(Ls)
Gloeoporus dichrous	*D. confragosa* (Ls); *L. betulina* (Ls); *T. versicolor* (Ls)
Heterobasidion annosum	*C. cinnamomea* (Pt); *N. vinosus* (Pt); *Phellinus pini* (Pe)
Irpex lacteus	*C. unicolor* (Lt); *D. confragosa* (Ls); *L. betulina* (hd); *S. commune* (Lt); *Stereum* sp. (Prs)
Lenzites betulina	*D. confragosa* (Ls); *G. dichrous* (Ls); *I. lacteus* (hd); *S. nivea* (Ar); *T. versicolor* (Ls); *T. biforme* (Ar, Ls, Qa)
Nigroporus vinosus	*C. cinnamomea* (Pt); *H. annosum* (Pt); *Stereum* sp. (Ls)
Perenniporia compacta	*A. biennis* (Lt); *T. versicolor* (Lt)
Phellinus gilvus	*P. alveolaris* (Qs); *T. biforme* (Ar, Bn, Qs); *P. rudis* * (Ls); *P. ostreatus* * (Qs); *Stereum* sp.* (Cc, Ls, Qa, Qs)
Phellinus pini	*H. annosum* (Pe)
Polyporus alveolaris	*P. gilvus* (Qs); *T. biforme* (Qs); *P. ostreatus* * (Qs); *Stereum* sp.* (Qs)

Table 6 (continued)

Polyporus elegans	*T. hirusta* (Qa)
Skeletocutis nivea	*L. betunlina* (Ar)
Trametes elegans	*D. confragosa* (Ls); *G. graveolens* (Ls)
Trametes hirsuta	*B. adusta* (Qs); *P. elegans* (Qa); *T. versicolor* (Qs); *L. bicolor* * (Qs); *P. rudis* * Qs); *S. commune* *(Lt); *Stereum* sp.* (Qs)
Trametes versicolor	*A. biennis* (Lt, Qs); *B. adusta* (Qa); *D. confragosa* (hd, Ls); *G. dichrous* (Ls, Qa); *L. betulina* (Ls); *P. compacta* (Lt); *T. hirsuta* (Qs); *T. biforme* (Ls); *P. rudis* * (Qs); *S. commune* * (Qs, Ls); *Stereum* sp. * (Cc, Ls, Qa, Qs)
Trichaptum biforme	*C. rigida* (Ar); *D. confragosa* (hd, Ls, Lt); *L.* betulina (Ar, Ls, Qa); *P.* alveolaris (Qs) *P. gilvus* (Ar, Bn, Qs); *T. versicolor* (Ls); *P. stipticus* * (Cc); *P. ostreatus* * (Ws); *S. commune* * (Ls); *Stereum* sp. * (Ar, hd, Ls, Lt, Qs)
Laxitextum bicolor	*B. adusta* (Qs); *T. hirsuta* (Qs)
Merulius sp.	*D. confragosa* (Ls)
Panus rudis	*P. gilvus* (Ls); *T. hirusta* (Qs); *T. versicolor* (Qs)
Panus stipticus	*T. biforme* (Cc)
Pleurotus ostreatus	*G. graveolens* (Ls); *P. gilvus* (Qs); *P. alveolaris* (Qs); *T. biforme* (Qs)
Schzophyllum commune	*I. lacteus* (Lt); *T. hirsuta* (Lt); *T. versicolor* (Ls, Qs); *T. biforme* (Ls)
Stereum sp.	*A. albida* (Ls); *B. adusta* (Qa); *D. confragosa* (Ls, Lt); *I. lacteus* (Prs); *N. vinosus* (Ls); *P. gilvus* (Cc, Ls, Qa); *T. hirustai* (Qs); *T. versicolor* (Cc, Ls, Qa, Qs); *T. biforme* (Ar, hd, Ls, Lt, Qs)

a: Substrate abbreviations are as follows: Ar = *Acer rubrum;* Bn = *Betula nigra;* Cc = *Carpinus caroliniana;* Ls = *Liquidambar styraciflua;* Lt = *Liriodendron tulipifera;* Qa = *Quercus alba; Qs* = *Quercus* sp. (species in the red oak group)

* indicates a non-poroid, but common, wood-decay fungus

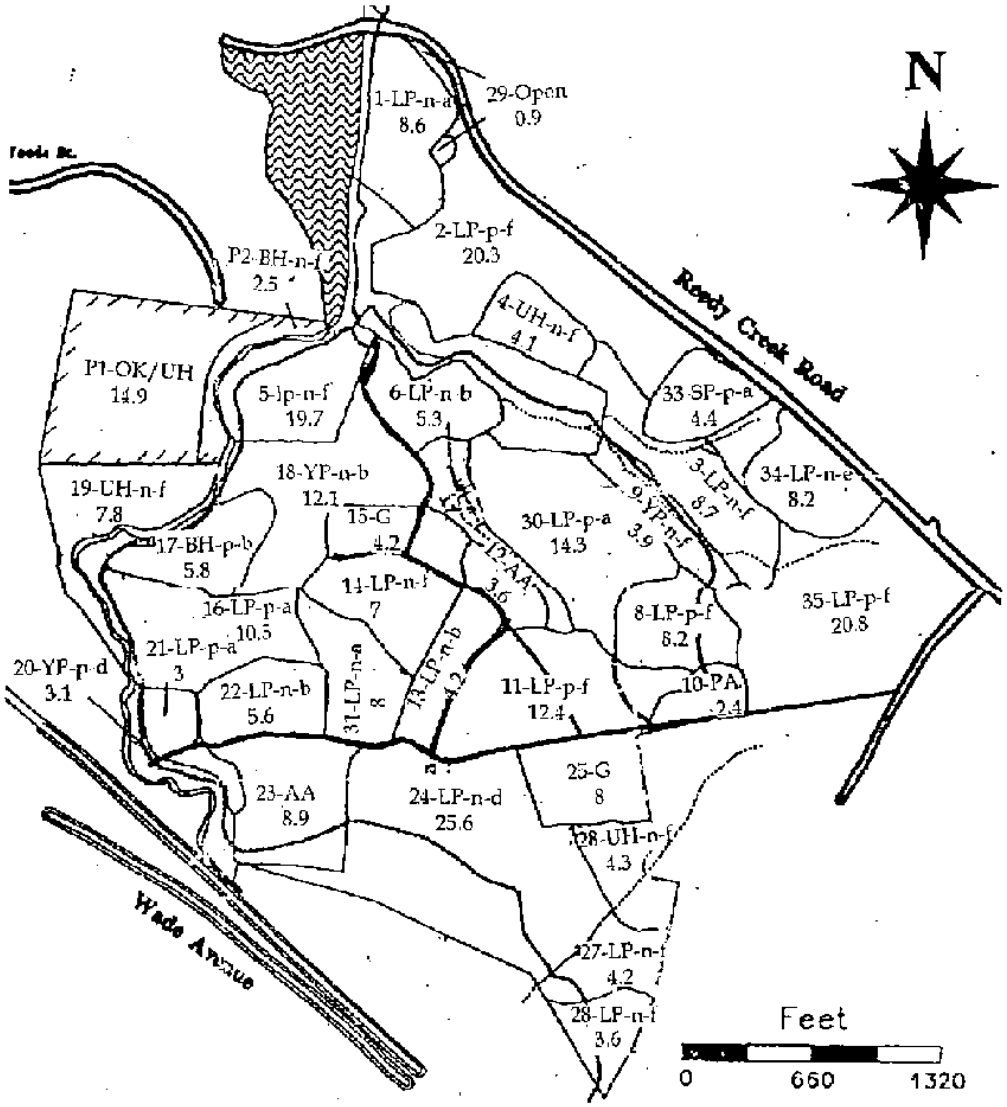


Figure 1. Schenck Forest and adjacent Department of Corrections land included in study site. Wake County, NC. Stand legend: stand number - stand type (with LP = loblolly pine; UH = upland hardwood; YP = yellow poplar; BH = bottomland hardwood; SP = seedtree; G = grafted seed tree plantation; AA = arboretum; and PA = picnic area) - n = natural or p = plantation - age in years (with a = < 10; b = 11-20; c = 21-30; d = 31-40; e = 41-50; and f = > 50) - acreage. Map courtesy the College of Forest Resources, North Carolina State University.

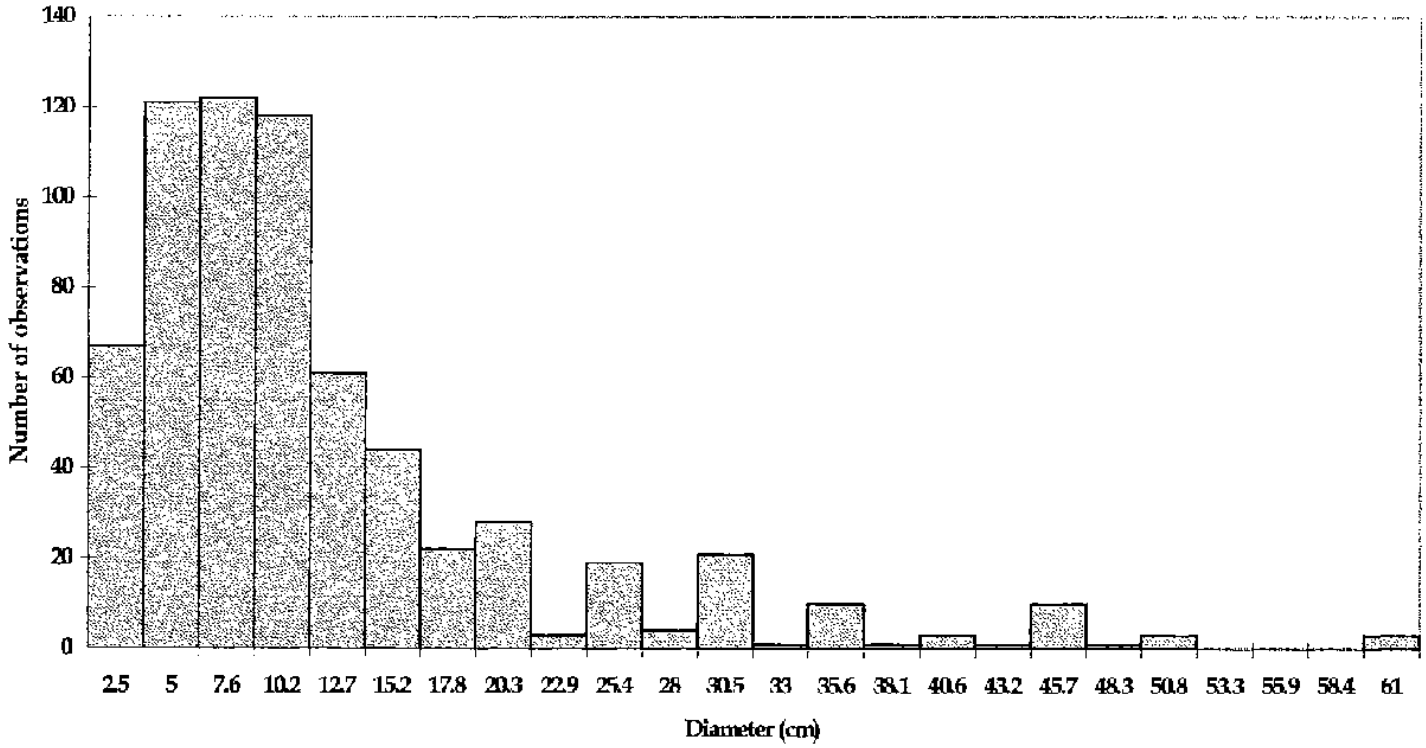


Figure 2. Diameter (cm) distribution of coarse woody debris observed as substrate for polypore basidiocarps from January 1997 through February 1998, Schenck Forest and adjacent Department of Correcitons land, Wake County, NC.

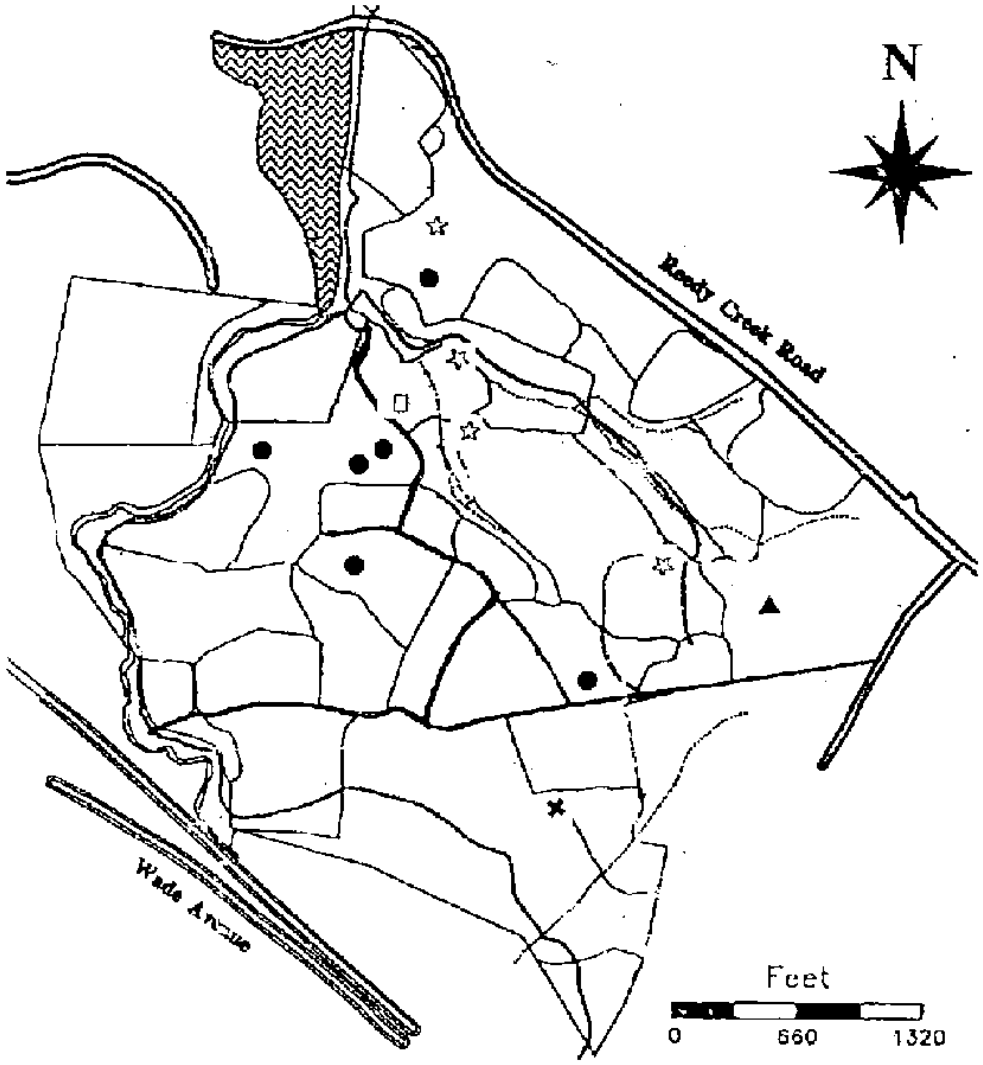


Figure 3. Location of disease-causing polypores observed from January 1997 through February 1998, Schenck Forest and adjacent Department of Corrections land, Wake County, NC. □ = *Bondarzewia berkeleyi*; ▲= *Ganoderma applanatum*; ☆ = *Heterobasidion annosum*; ✖ = *Inonotus ludovicianus*; ● = *Phellinus pini*.

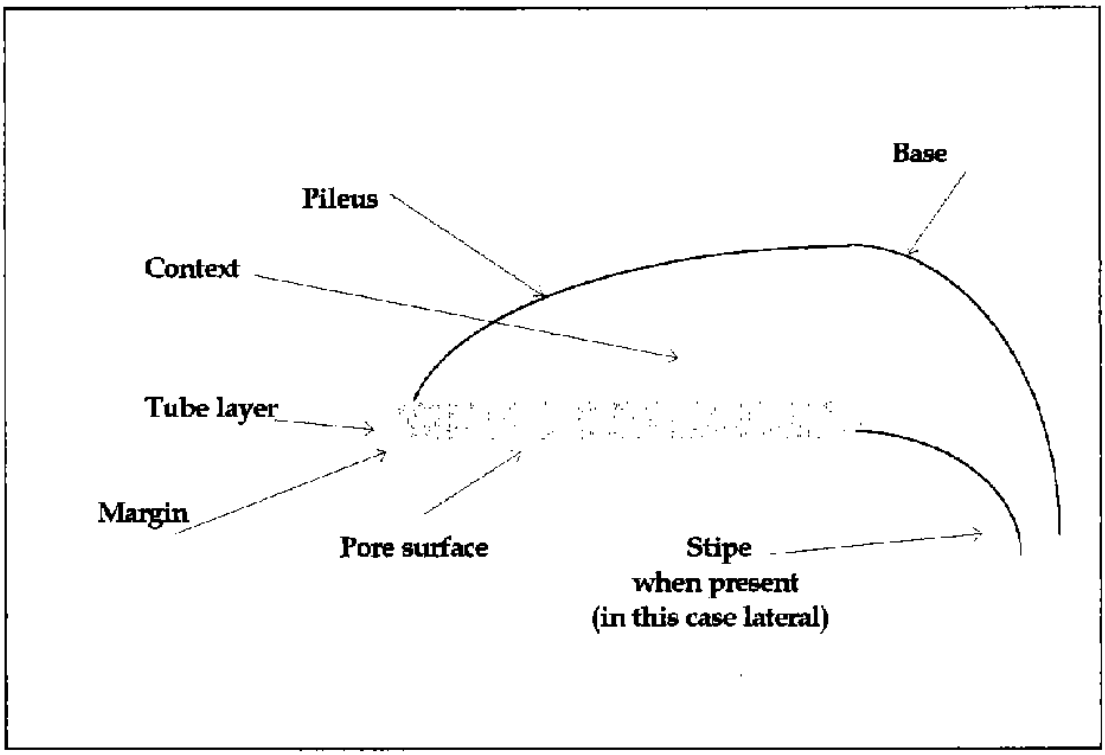
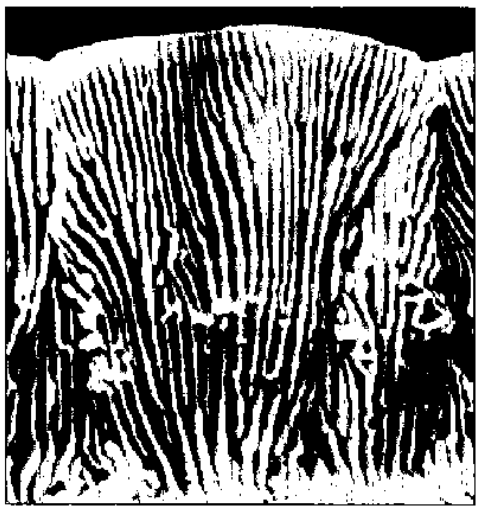
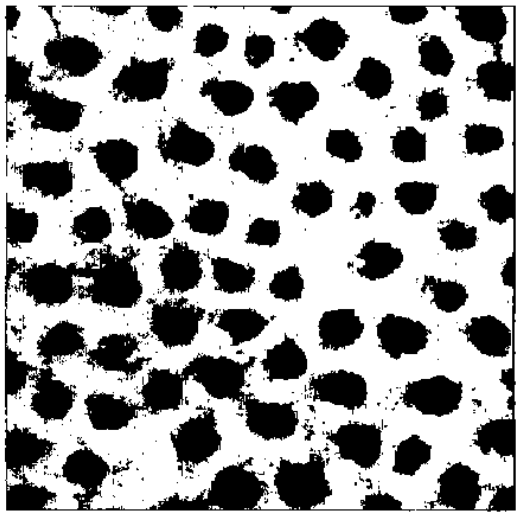


Figure 4. Basidiocarp features used in identifying polypore fungi.

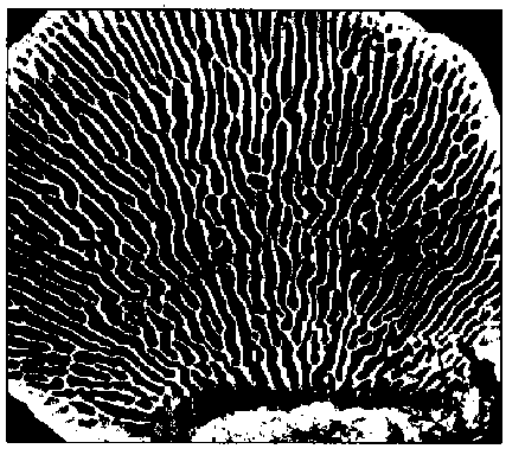


a.



b.

c.



d.

Figure 5. Pore shapes of polypore fungi: a. lamellate pores, *Lenzites betulina;* b. regular and round pores, *Fomes* sp.; c. toothed or hydnoid pores, *Irpex lacteus;* d. daedaloid pores, *Daedalia quercina.* (Photos courtesy of L.F. Grand.)

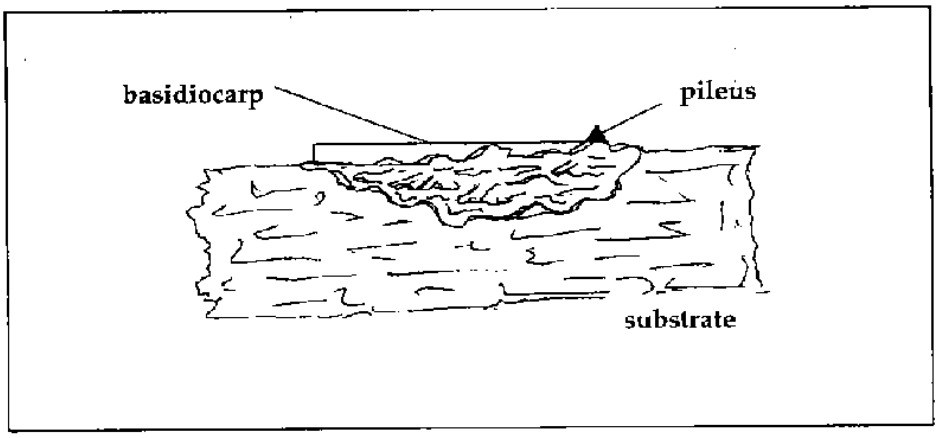


Figure 6. An effused-reflexed to resupinate basidiocarp. Note how basidiocarp lies flat on the substrate. The pileus is formed when the margins reflex at the top, enabling the pore surface to face downward. (Drawing courtesy of Heather Hartzog.)

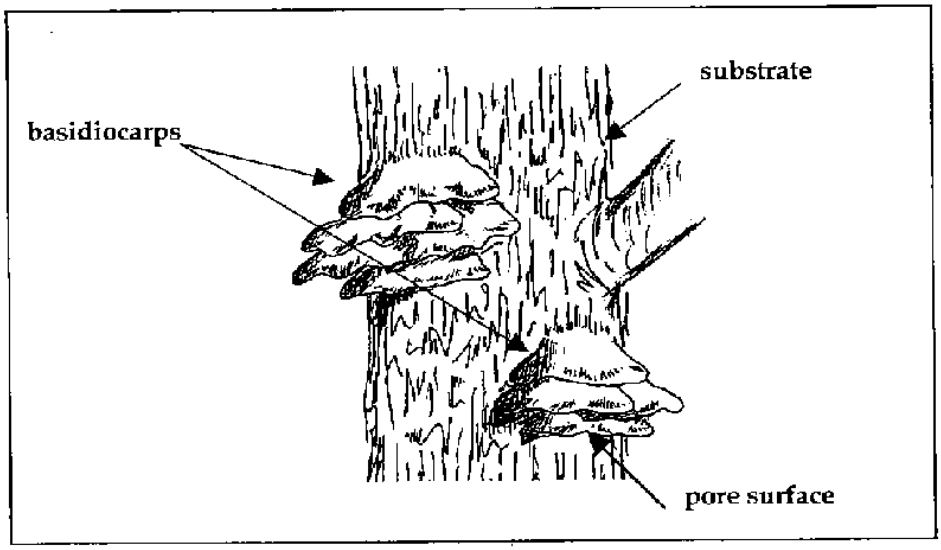


Figure 7. Sessile basidiocarps on a standing tree. The pore surface always develops facing downward (Drawing courtesy of Heather Hartzog.)

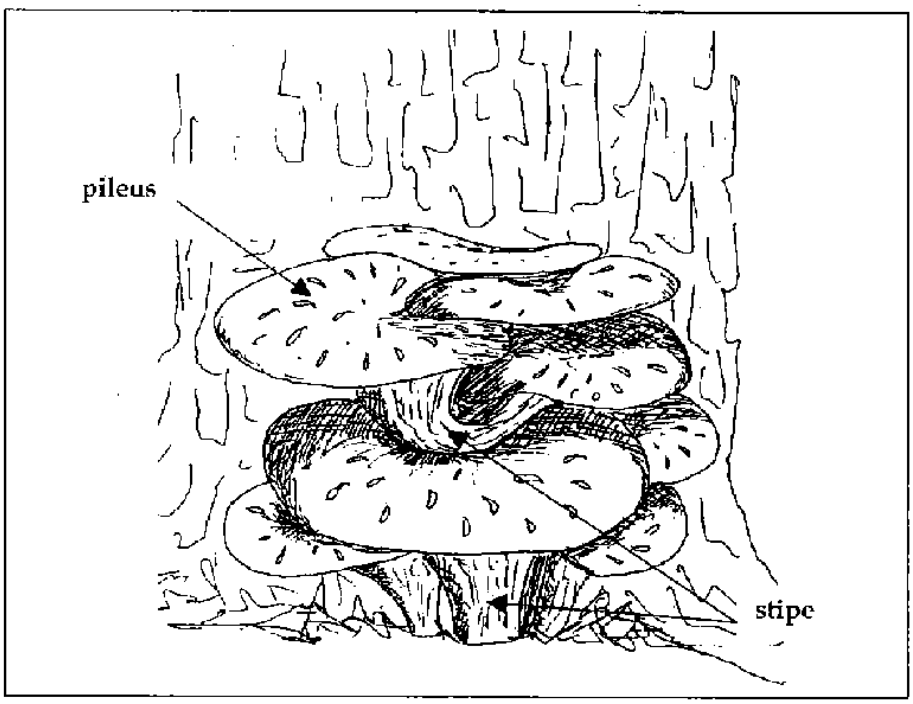


Figure 8. Stipitate basidiocarps forming at a root collar. Note the lateral stipe, joining the pileus at its base. (Drawing courtesy of Heather Hartzog.)

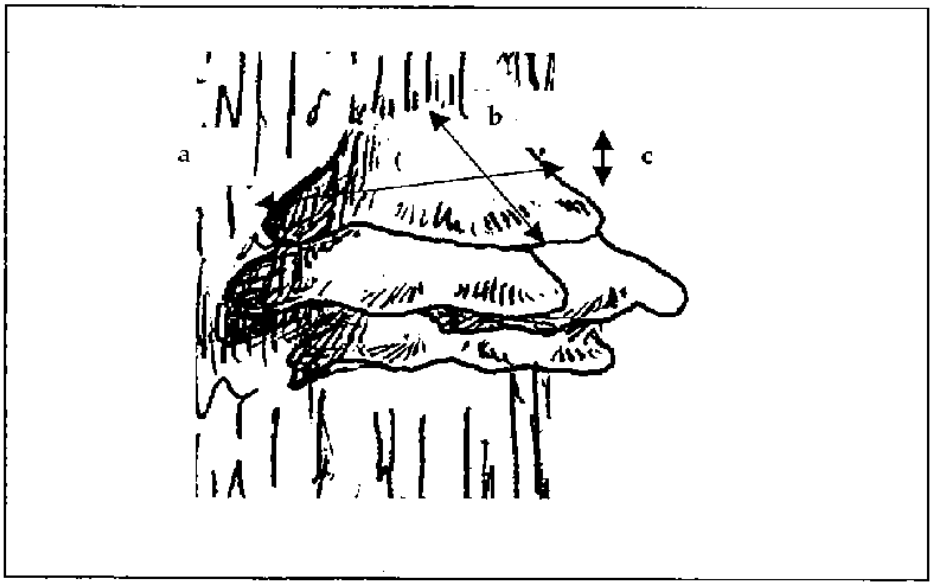


Figure 9. Basidiocarp measurements. Measurements should be made in millimeters or centimeters with: a. width; b. length; and c. thickness. (Drawing courtesy of Heather Hartzog.)

LITERATURE CITED

Abbot, D.T. and D.A. Crossley, Jr. 1982. Woody litter decomposition following clear-cutting. *Ecology* 63:35-42.

Ainsworth, G.C. 1976. *Introduction to the History of Mycology*. Cambridge (Eng.): Cambridge University Press. 359 pp.

Alexopoulos, C.J., C.W. Mims, and M. Blackwell. 1996. *Introductory Mycology*. 4th ed.. New York: John Wiley and Sons, Inc. 869 pp.

Ausmus, B. 1977. *In:* T. Persson and U. Lohm (eds.). Soil organisms as components of ecosystems: proceedings of the VI International Soil Zoology Colloquim of the International Society of Soil Science. *Ecol. Bull.* 25: 180-192.

Blanchette, R.A. 1980. Wood decomposition by *Phellinus (Fomes) pini*: a scanning electron microscopy study. *Can. J. Bot.* 58:1496-1503.

Blanchette, R.A. and C.G. Shaw. 1978. Associations among bacteria, yeasts, and basidiomycetes during wood decay. *Phytopathology* 68:631-637.

Bondartsev, A.S. 1971. *The Polyporaceae of the European USSR and Caucasia*. Jerusalem: Israel Program for Scientific Translations. 896 pp.

Brodie, H.J. 1951. The function of the cups of *Polyporus conchifer*. *Science* 114:636.

Burns, R. M., and B.H. Honkala (tech. coords.). 1990. *Silvics of North America: 2. Hardwoods*. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington DC. 877 pp.

Cain, M.D. 1996. Hardwood snag fragmentation in a pine-oak forest of southeastern Arkansas. *Am. Mid. Natl.* 136:72-83.

Cawthorne, J.W. 1970. *Soil Survey: Wake County, North Carolina*. USDA Soil Conservation Service.

Coker, W.C. 1946. The United States species of *Coltricia*. *J. Elisha Mitchell Sci. Soc.* 46:95-107.

Coker, W.C. 1948. Notes on Carolina fungi. *J. Elisha Mitchell Sci. Soc.* 64:287-303.

Conner, R.N. and B.A. Locke. 1982. Fungi and red-cockaded woodpecker cavity trees. *Wilson Bull.* 94:64-70.

Davis, S. and R. Burns. 1990. Decolorization of phenolic effluents by soluble and immobilized phenol oxidases. *Appl. Microbiol. Biotechnol.* 32:721-726.

Dixon, W. J. and F.J. Massey. 1983. *Introcution to Statistical Analysis* 4th edition. New York: McGraw Hill. 678 pp.

Eriksson, K.-E. L., R.A. Blanchette, and P. Ander. 1990. *Microbial and Enzymatic Degradation of Wood and Wood Components*. Berlin: Springer-Verlag. 407 pp.

Farr, D.F., A. Rossman, and G. Chamuris. 1989. *Fungi on Plants and Plant Products in the United States*. St. Paul, Minn: APS Press. 1252 pp.

Franklin, J.F., H.H. Shugart and M.E. Harmon. 1987. Tree death as an ecological process. *Bioscience* 8:550-556.

French, D.W. 1993. *Forest and Shade Tree Pathology*. St. Paul: Univeristy of Minnesota, Department of Plant Pathology. 278 pp.

Gilbertson, R.L. 1981.North American wood-rotting fungi that cause brown rots. *Mycotaxon* 12:372-416.

Gilbertson, R.L. 1984. Relationships between insects and wood-rotting basidiomyceles. pp. 130-165 *In:* Q. Wheeler and M. Blackwell (eds.). *Fungus Insect Relationships: Perspectives in ecology and evolution*. New York: Columbia University Press.

Gilbertson, R.L. and L. Ryvarden. 1986. *North American Polypores. Vol. 1*. Norway: Fungiflora. pp. 1-436.

Gilbertson, R.L. and L. Ryvarden. 1987. *North American Polypores. Vol. 2*. Norway: Fungiflora. pp. 437-885.

Ginns, J. 1997. Genera of the North American Coriticiaceae *sensu lato*. *Mycologia* 90:1-35.

Grand, L.F. 1985. North Carolina Plant Disease Index. North Carolina Agriculture Research Service technical bulletin no. 240 (rev.). 157 pp.

Grand, L.F., J. Menge, and J.J. Bond. 1975. Partial checklist of fungi from Highlands, North Carolina and vicinity. *J. of the Elisha Mitchell Sci. Soc.* 91:221-229.

Graves, R.C., and A. C.F. Graves. 1966. The insects and other inhabitants of shelf fungi in the southern Blue Ridge region of western North Carolina. I. Introduction, description of the habitat, and the host fungi. *Ann. Ent. Soc. Am.* 59:381-392.

Gruschow, G.F. and K.B. Trousdell. 1958. Incidence of heart rot in mature loblolly pine in coastal North Carolina. *J. Forest.* 56:220-221.

Gruschow, G.F. and K.B. Trousdell. 1959. Incidence of rot in hardwood sawtimber in coastal North Carolina. *J. Forest.* 57:370-371.

Harmon, M.E., J.F. Franklin, F.J. Swanson, P. Sollins, S.V. Gregory, J.D. Lattin, N.H. Anderson, S.P. Cline, N.G. Aumen, J.R. Sedell, G.WI Lienhaemper, K. Cromack Jr., and K.W. Cummins. 1986. Ecology of coarse woody debris in temperate ecosystems. *Adv. Ecol. Res.* 15: 133-302.

Harvey, A.E., M.F. Jurgensen, and M.J. Larsen. 1979. *Role of forest fuels in the biology and management of soil.* USDA Forest Serv. Gen. Tech. Rept. INT-65. 8 pp.

Harvey, A.E., M.F. Jurgensen, and M.J. Larsen. 1980. Biological implications of increasing harvest intensity on the maintenance and productivity of forest soils. pp. 211-220 *In: Environmental Consequences of Timber Harvesting in Rocky Mountain Coniferous Forests.* USDA Forest Serv. Gen. Tech. Rept. INT-90. 526 pp.

Hawksworth, D.L. (ed.) 1991. *The Biodiversity of Micro-organisms and Invertebrates: its role in sustainable agriculture.* Wallingford, Oxon, UK: C.A.B. International. 302 pp.

Hawksworth, D.L., P.M. Kirk, B.C. Sutton, and D.N. Pegler. 1995. *Ainsworth and Bisby's Dictionary of the Fungi* 8th ed. Wallingford, Oxon, UK: C.A.B. International. 616 pp.

Hendrickson, O.Q. 1991. Abundance and activity of N_2-fixing bacteria in decaying wood. *Can. J. For. Res.* 21:1299-1304.

Hepting, G.H. 1971. *Diseases of Forest and Shade Trees of the United States.* USDA Forest Serv. Agriculture Handbook 386. 658 pp.

Highley, T.L. and T.K. Kirk. 1979. Mechanisms of wood decay and the unique features of heart rots. *Phytopathology* 69:1151-1157.

Jackson, J.A., M.R. Lennartz, and R.G. Hooper. 1979. Tree age and cavity initiation by red-cockaded woodpeckers. *J. Forest.* 77: 102-103

Jacobi, W.R., E.B. Cowling, N.D. Cost, and J.P. McClure. 1980a. Disease losses in North Carolina forests: I. Losses in softwoods, 1973-1974. *Plant Disease* 64:573-576.

Jacobi, W.R., E.B. Cowling, N.D. Cost, and J.P. McClure. 1980b. Disease losses in North Carolina forests: II. Losses in hardwoods, 1973-1974. *Plant Disease* 64:576-578.

Jervis, L.G. 1997. NCSU College Forests Annual Report: Report of the activities and accomplishments for the period July 1, 1996 - June 30, 1997. Unpublished. 9 pp.

Jung, H.S. 1987. Wood-rotting Aphyllophorales of the southern Appalachian spruce-fir forest. *Bibliotheca Mycologia* 119:1-260.

Jurgensen, M.F., M.J. Larsen, and A.E. Harvey. 1979. *Forest soil biology - timber harvesting relationships: a perspective.* USDA Forest Serv. Gen. Tech. Rept. INT-69. 12 pp.

Jurgensen, M.F., M.J. Larsen, and A.E. Harvey. 1980. Microbial processes associated with nitrogen cycling in northern Rocky Mountain forest soils. pp. 175-188 *In: Environmental Consequences of Timber Harvesting in Rocky Mountain Coniferous Forests.* USDA Forest Serv. Gen. Tech. Rept. INT-90. 526 pp.

Jurgensen, M.F., R.T. Graham, M.J. Larsen, and A.E. Harvey. 1992. Clear-cutting, woody residue removal, and nonsymbiotic nitrogen fixation in forest soils of the Inland Pacific Northwest. *Can. J. For. Res.* 22:1172-1178.

Lanham, J.D. and D.C. Guynn, Jr. 1996. Influences of coarse woody debris on birds in southern forests. pp. 101-107. *In:* J.W. McMinn and D.A. Crossely (eds.) *Biodiversity and Coarse Woody Debris in Southern Forests*. USDA For. Serv. Gen. Tech. Rept. SE-94. 146 pp.

Larsen, M.J., A.E. Harvey, and M.F. Jurgensen. 1980. Residue decay processes and associated environmental functions in northern Rocky Mountain forests. pp. 157-174 *In: Environmental Consequences of Timber Harvesting in Rocky Mountain Coniferous Forests.* USDA Forest Serv. Gen. Tech. Rept. INT-90. 526 pp.

Larsen, M.J., and F.F. Lombard. 1988. The status of *Meripilus giganteus* (Aphyllophorales, Polyporaceae) in North America. *Mycologia* 80:612-621.

Lincoff, G. H. 1981. *National Audubon Society Field Guide to North American Mushrooms.* New York: Alfred A. Knopf. 926 pp.

Lloyd, C.G. 1898. *Mycological writings of G.C. Lloyd.* 7 vols. Cincinnati: privately published.

Loeb, S.C. 1996. The role of coarse woody debris in the ecology of southeastern mammals. pp. 108-118. *In:* J.W. McMinn and D.A. Crossely (eds.) *Biodiversity and Coarse Woody Debris in Southern Forests*. USDA For. Serv. Gen. Tech. Rept. SE-94. 146 pp.

Loope, L., M. Duever, A. Herndon, J. Snyder, and D. Jansen. 1994. Hurricane impact on uplands and freshwater swamp forests. *Bioscience* 44:238-246.

Lowe, J.L. 1963. The Polyporaceae of the world. *Mycologia* 55:1-12.

Lowe, J.L. and R.L. Gilbertson. 1961. Synopsis of the Polyporaceae of the southeastern United States. *J. of the Elisha Mitchell Sci. Soc.* 77: 43-61.

Manion, P.D. 1991. *Tree Disease Concepts* 2nd ed. Englewood Cliffs, NJ: Prentice-Hall, Inc. 399 pp.

Maser, C., S.P. Cline, K. Cromack, Jr., J.M. Trappe, and E. Hansen. 1988. What we know about large trees that fall to the forest floor. pp. 25-45 *In*: C. Maser, R.F. Tarrant, J.M. Trappe, and J.F. Franklin (eds.) *From the Forest to the Sea: A story of fallen trees*. USDA Forest Serv. Gen. Tech. Rept. PNW-GTR-229. 153 pp.

Mayfield, M. 1996. Preliminary Report: Hurricane Fran 28 August - 8 September. url: http://www.nhc.noaa.gov/fran.html#TABLE3. October 10, 1996.

Murrill, W.A. 1914. *Northern Polypores*. New York: published by the author. 64 pp.

Murrill, W.A. 1915. *Southern Polypores*. New York: published by the author. 66 pp.

Nakasone, K.K. 1996. Diversity of lignicolous basidiomycetes in coarse woody debris. pp. 35-42. *In:* J.W. McMinn and D.A. Crossely (eds.) *Biodiversity and Coarse Woody Debris in Southern Forests*. USDA Forest Serv. Gen. Tech. Rept. SE-94. 146 pp.

NOAA, National Climatic Data Center. 1997-1998. Local climatological data for Januray 1997-December 1997. Raleigh, NC.

Overholts, L.O. 1953. *The Polyporaceae of the United States, Alaska and Canada*. Ann Arbor MI: University of Michigan Press. 466 pp.

Powell, R. 1997. Bear 187, where are you? *Wildlife in North Carolina* 61(11): 24-27.

Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. *Manual of the Vascular Flora of the Carolinas*. Chapel Hill: University of North Carolina Press. 1183 pp.

Rayner, A. and L. Boddy. 1988. *Fungal Decomposition of Wood: Its biology and ecology*. New York: John Wiley and Sons, Inc. 581 pp.

Rossman, A. 1994. A strategy for an all-taxa inventory of fungal biodiversity. pp. 169-194. In: C.-I. Peng and C.H. Chou (eds.) Biodiversity and Terrestrial Ecosystems. Inst. Botany, Adac. Sinica Monograph Series No. 14.

Sedell, J.R., P.A. Bisson, F.J. Swanson, and S.V. Gregory. 1988. What we know about large trees that fall into streams and rivers. pp. 47-81 *In*: C. Maser, R.F. Tarrant, J.M. Trappe, and

J.F. Franklin (eds.) *From the Forest to the Sea: A story of fallen trees.* USDA Forest Serv. Gen. Tech. Rept. PNW-GTR-229. 153 pp.

Stalpers, J.A. 1996. The Aphyllophoraceous fungi II: Keys to the species of the Hericiales. *Stud. Mycol.* 40: 1-185.

States, J. 1972. Basidiocarp development in *Gloeophyllum (Lenzites) saepiarium* in the natural environment. *Can. J. Bot.* 50:1017-1024.

USDA. 1995. Center for Forest Mycology Research website. USDA Forest Serv., Forest Products Laboratory. FS-FPL-4501. url: http://www.fpl.fs.fed.us/rwu4501.htm.

Wagner, S.F. 1992. *Introduction to Statistics.* New York: Harper Collins. 369 pp.

Wallace, J.B., J.W. Grubaugh, and M.R. Whiles. 1996. Influences of coarse woody debris on stream habitats and invertebrate biodiversity. pp. 119-129. *In:* J.W. McMinn and D.A. Crossely (eds.) *Biodiversity and Coarse Woody Debris in Southern Forests.* USDA Forest Serv. Gen. Tech. Rept. SE-94. 146 pp.

Whiles, M.R., and J.W. Grubaugh. 1996. Importance of coarse woody debris to southern forest herpetofauna. pp. 94-100. *In:* J.W. McMinn and D.A. Crossely (eds.) *Biodiversity and Coarse Woody Debris in Southern Forests.* USDA Forest Serv. Gen. Tech. Rept. SE-94. 146 pp.