To the Graduate Council:

I am submitting herewith a thesis written by Joshua Justin Vlach entitled "An Assessment of Arthropod Diversity Using Nine Collection Methods at Sinking Pond: A Registered Natural Landmark in Coffee County, Tennessee". I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Entomology and Plant Pathology.

Paris P Lambdin

Paris L. Lambdin, Major Professor

We have read this thesis and recommend its acceptance:

Jerome F Grant

David A Etnier

Accepted for the Council:

[signature]

Associate Vice Chancellor
and Dean of the Graduate School

AN ASSESSMENT OF ARTHROPOD DIVERSITY USING NINE COLLECTION METHODS AT SINKING POND: A REGISTERED NATURAL LANDMARK IN COFFEE COUNTY, TENNESSEE

A Thesis

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ABSTRACT

Sinking Pond, located in Coffee County, TN, at the coordinates 35°24'37"N, 86°4'10"W, comprises 52 ha, while the basin and watershed surrounding the pond are more than 155 ha (including the pond). The water level in the pond can rise and fall 2 m within 24 hours, and water depths vary from 0 to 3.5 m. Sinking Pond is a unique habitat which is representative of karst topography, a landscape type associated with most major cave systems. Sinking Pond is located in an area of middle TN called the Barrens, which contains many animal and plant species disjunct, or separated, from their established distributions.

The Sinking Pond watershed has at least seven tree community types. The primary reason for Sinking Pond's uniqueness is a community of overcup oak (*Quercus lyrata* Walter), river birch (*Betula nigra* L.), and resurrection fern (*Pleopeltis polypodioides* Andrews and Windham), which is found in the deepest and most regularly flooded areas. This old-growth forest habitat type occurs nowhere else in Tennessee, or the world, and has been tentatively labeled G1 by the Tennessee Chapter of the Nature Conservancy. A G1 ranking indicates that less than five occurrences of this habitat occur globally and that it is "critically imperiled".

Currently no studies have been conducted to assess the arthropod community of this unique site. As a result, a research project was initiated in 1997 at Sinking Pond to sample and document the terrestrial arthropod community, and to compile a list of species associated with Sinking Pond. This information was developed into a database to be used in future studies of the site. The invertebrate information was used to evaluate diversity,

assess ecological significance of select species, and identify potential indicator species. The nine sampling techniques used were: beat sheeting, canopy fogging, direct collecting, leaf-litter sampling, light trapping, malaise trapping, Manitoba trapping, pitfall trapping, and sweep netting.

A total of 23,929 arthropod specimens, representing 28 orders, was collected. Of these, 12,816 (53.6%) were adult insects in 20 orders and 11,113 (46.4%) were non-insects in 8 orders. From these insect and non-insect orders, 826 different species were identified in 200 families. Specimens from eight insect orders (Coleoptera, Collembola, Hymenoptera , Diptera, Homoptera, Hemiptera, Lepidoptera, and Orthoptera) made up 98.3% of the insect specimens. The five orders with the highest number of species were Coleoptera, Diptera, Lepidoptera, Homoptera, and Collembola, respectively. The Shannon diversity index (H') was calculated as 4.69, a high diversity score, and evenness was 0.69, which represents an average value.

Four species, *Cicindela unipunctata* F., *Enodia anthedon* Clark, *Glaucopsyche lygdamus* (Doubleday), and *Speyeria cybele* (F.), from Sinking Pond were on the rare, threatened, or endangered species lists of Alabama or North Carolina. These species do not appear to be rare in TN.

From the species identified, 12 may represent disjunct species. Their presence may suggest that the unique habitat of Sinking Pond have attributes that enable the survival of these unusual genotypes.

Eight introduced species were identified in the collections from Sinking Pond. These included five beetle species, *Cyrtepistomis castaneous* (Roelofs) (Curculionidae), *Demotina modestus* Baly (Chrysomelidae), *Coccinella septempunctata* L. (Coccinellidae), *Harmonia axyridis* (Pallas) (Coccinellidae), and *Popillia japonica* Newman (Scarabaeidae), and three hymenopterans, *Apis mellifera* L. (Apidae), and *Tertramorium caespitum* (L.) and *Wasmannia auropunctata* (Roger), both in family Formicidae. Some of these species could potentially have an adverse effect on the community of Sinking Pond.

A diverse arthropod fauna was identified associated with Sinking Pond. The database of arthropod information developed during this study may be helpful in evaluating the effects of changes in the community, such as from exotic species. Baseline data are needed to evaluate any future changes or impacts on this community. Additionally, information on species that may be useful as indicators of ecosystem health would be instrumental in the management of this unique habitat.

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CHAPTER I

INTRODUCTION

The importance of biodiversity has received increased attention in recent years. Many authors have emphasized the need for a dramatic increase in the amount of effort directed towards learning about biodiversity (Stork 1988, Thomas and Thomas 1994, Blackmore 1996, Dobyns 1997). Vane-Wright (1993) argues for the preservation of as much biodiversity as possible because future generations will need to "...undertake restoration ecology, potentially on a vast scale, in order to sustain the biosphere in a condition fit for human life."

The Importance of Biodiversity

Biodiversity is a combination of 'biological diversity' that refers to the number and variety of organisms that exist within an area. Evidence demonstrates the importance of increasing our knowledge and maintaining the maximum amount of biodiversity. The most elementary reason for acquiring information about biodiversity is an organism's or habitat's intrinsic value; the idea that individuals obtain satisfaction from the knowledge that diversity of organisms and habitats exist. Other similar values which benefit individuals are aesthetic, ethical, and spiritual benefits (Simpson 1997). Because so little is known regarding the number of species and their biology, it is important that these data be obtained prior to the loss of a given species. Approximately 1.70 to 1.82 million species of organisms have been described, but total estimated numbers of species are as high as 100 million (Stork 1988, OECD 1996).

Biodiversity has financial values as well. Boussienguet (1991) noted that, "Our knowledge of biodiversity, the raw material for biotechnologies and for agricultural development, is still in its infancy." One example, biological control, has become increasingly important in recent years as chemical pest controls lose their effectiveness and the use of pesticides is being reduced in general. Among the millions of unknown arthropod species, potential natural controls for pests, as well as for future pests, may already exist. Similarly, potential cures for numerous diseases may be discovered among existing organisms in their various habitats, and these valuable genetic resources could be lost. Antibiotics, natural insecticides, fungicides, and repellents are some of the useful chemicals that have been discovered that invertebrates produce (Schowalter 1990, Beattie 1994). In addition, diversity is important to the ecosystem and biome as a factor in nutrient cycling and other ecological processes (Simpson 1997). One of the most important and often unseen roles invertebrates play is in maintaining general ecosystem and biome health. Their function is primarily to assist in decomposition of plant and animal tissues, cycling nutrients back into the soil, and maintaining food webs.

Deforestation, urban expansion, wetland destruction, and pollution represent processes that can decrease the biodiversity of an area. We do not know how much diversity can be lost before a healthy, or self-sustaining ecosystem, can no longer be maintained (Gaston et al. 1993). When developing management plans to conserve the maximum amount of diversity, it is often the case that not enough information is known about the invertebrates in the community to make good decisions that will protect their diversity. For example, protecting areas for mammal diversity may not necessarily protect areas of high invertebrate species richness (Kerr 1997).

Insect Diversity

Considerable data have been accumulated on vertebrate and plant species distribution, population structure, and diversity. Until recently, arthropod species, populations, and their distributions were often overlooked. As a result, relatively little is known about them in most areas and environments. Worldwide, more than one million insect species have been described, and estimates of total numbers of insect species range from 2 to 80 million (Stork 1988, Hawksworth and Mound 1991). Of the insect species described, the immature stages and life histories are known for less than 1% of these, and although they are represented by an immense number of species, Insecta comprises one of the groups with the fewest species listed as rare, threatened, and endangered (RTE) (Hawksworth and Mound 1991). Insects are generally given a low priority, and have received much less attention than birds or mammals.

Arthropods, therefore, are rarely considered in conservation plans (Kim 1993). To exclude arthropods that are associated with every plant and vertebrate species in every habitat type and may make up more than 90% of all animal species would seem to represent poor planning (Asquith et al. 1990, Gaston et al. 1993). The acquisition of baseline data and information on all aspects of the ecosystem is essential to formulate management objectives (Bynum 1996). For an understanding of the effects of environmental changes, whether they are from development, pollution, or introduction of foreign pests, baseline data are needed to evaluate any future changes or impacts on species. Insects have numerous attributes that make them a good potential indicator group. Insects are widely distributed, a major component of most ecosystems, easily sampled, occupy many niches, and respond quickly to changes in their environment (Hawksworth 1991, Gaston et al. 1993). Groups such as insects, that are sensitive to environmental changes, can be more effectively used to assess a given ecosystem than groups such as vertebrates that respond more to physical structure and dimensions of a habitat rather than to changes in floral composition (Holloway and Stork 1991). Therefore, it is important to identify keystone and dominant insect species and any other species that may be ecological indicators to be able to monitor changes in an environment (Kim 1993). Insects have been used as environmental indicators and monitoring tools in aquatic habitats for several decades (Gaston et al. 1993). Certain species groups may be of value for monitoring larger more complex systems or ecosystems. Several organisms that are sensitive to environmental conditions and reflect a particular community's health could be selected, which would be more valuable than a single species or indicator species approach (Gaston et al. 1993). To use such groups as monitoring tools, they must first be identified. Currently, research is underway around the world to identify species that are best suited to specific monitoring tasks, and many include invertebrates (Beattie 1994).

Exotic Organisms

In assessing the overall diversity of a community, it is beneficial to know the types of exotic organisms present. According to Ehrlich (1996), "Invasion by alien organisms is the most frequent cause of documented species extinctions worldwide, and a major contributor to population extinctions." It has been suggested that intentional and accidental animal introductions have accounted for almost 20% of animal extinctions (OECD 1996). It is unknown if species complexes with keystone species occur in temperate forests that could lead to mass extinctions in some habitats (Ehrlich 1996). The three types of keystone species listed by the World Resources Institute are: predator, mutualist (such as specific pollinators), and the prey of specialized predators (Lee 1998). The most prominent example of how the loss of one species can lead to changes in a community tends to be the keystone predator. A well known example concerns the introduction of the *Opuntia* sp. cactus to Queensland, Australia, where it once covered 62,000 km^2 and vastly altered the landscape (Lee 1998). Since the introduction of *Cactoblastis cactorum* (Berg), a moth that is a keystone predator of the cactus in Australia, the cactus population has been reduced to small isolated patches. The herbivore, *C. cactorum,* fits the description of keystone predator by controlling the population of another species through its feeding (Lee 1998). The moth, which now would appear to be a minor component of the community, actually plays a significant role in maintaining the ecosystem by suppressing a pest species.

Organizational Involvement in Biodiversity

Biodiversity has become an important topic from the local to the international level. The Smithsonian Institution/Man and the Biosphere Biodiversity Program was initiated in 1987 to monitor biodiversity and forest dynamics. Permanent research plots were established in Bolivia, Peru, Guyana, Puerto Rico, U.S. Virgin Islands, and the Great Smoky Mountains National Park (GSMNP), Tennessee, U.S. (Comiskey et al. 1995). On October 24, 1989, Costa Rica's INBio (La Asociacion Instituto Nacional de

Biodiversidade) was legally established as a private, non-profit, public interest association with the goals of inventorying Costa Rica's diversity, centralizing the information, and making it easily accessible and publicly available (Gamez et al. 1993). In 1992, 170 countries signed the Declaration of the United Nations Conference on Environment and Development International Convention on Biodiversity in Rio de Janeiro which encourages biodiversity conservation at the local, national, and international level (Gaston et al. 1993, Vane-Wright 1993). The National Science Foundation has funded projects that focus on providing a better understanding of biological diversity, "especially biotic surveys and inventories" (NSF 1993). In 1994, the Department of Defense (DoD) began its Biodiversity Initiative. Some of the products of this initiative include: A DoD biodiversity management strategy, a *DoD Commander's Guide to Biodiversity*, and *A Biodiversity Handbook for Natural Resources Managers* (Ripley and Leslie 1998). In 1991, Congress directed the DoD to investigate problems concerning biodiversity. This directive was associated with the Legacy Resource Management Program which was developed to sustain cultural and natural resources on DoD lands (Vogel 1997).

Arthropod Diversity Research Methods

Past studies on biodiversity have utilized a variety of collection methods to sample the species composition of various habitats. The most common include canopy fogging, direct collecting, leaf-litter sampling, light trapping, and sweep netting.

Canopy fogging has been widely used to examine the diversity of arthropod fauna of trees, especially in tropical regions (Adis et al. 1984, Erwin 1983, Guilbert et al. 1995, Kitching et al. 1993). Canopy fogging can be used to determine and compare tree health and species composition, or simply to find out more about the diversity of an area, as in a rain forest, to show their value through their high diversity.

Leaf-litter sampling is used to study the arthropod communities in the organic matter of the forest floor. A study initiated in the GSMNP assessed the leaf-litter communities of Frasier fir, *Abies fraseri* (Pursh), infested by the exotic balsam wooly adelgid, *Adelges piceae* (Ratzeburg) (Hughes 1993). The information gathered about the leaf-litter species and populations associated with Frasier fir may be useful as a basis for future evaluation of these sites as to how the decline of these tree species affects leaf-litter communities.

Light trapping is widely used to sample nocturnal insect populations. Light trap collections were used in Funk Bottoms Wildlife Area to gather baseline information, so the recovering wetland could be monitored in the future (Williams et al. 1997). In Northwestern Ontario at Black Sturgeon Lake, light traps were used to sample the lepidopteran species within the forest and monitor for pest species (Sanders 1991).

Malaise traps were used to sample Coleoptera in North Island, New Zealand, to characterize community types (Hutcheson 1990). One factor in the use of malaise traps is the low amount of time and money expended by researchers to collect specimens when compared to methods such as fogging and sweep netting.

Pitfall traps are often used to examine mobile invertebrates living on the ground, and they are sometimes used to monitor changes in different communities. Pitfall traps were used to capture the Carabidae fauna in the unique heath habitats of Britain, to evaluate heath health and to examine the effects of different management practices on the heaths. They concluded that carabids are sensitive to site wetness and vegetation differences, but that further data on the distribution of carabids were necessary before they would be useful in assessment of the heaths (Gardner 1991). In a study in the unique coastal habitats of Nantucket Island, Massachusetts, pitfall traps were used to collect the carabid fauna of this area to develop a species list for comparison with collections made in 1920. Of the species collected, 57 were records for the area, but 42 species identified in 1920 were not found (Purrington 1996). In Tennessee, pitfall traps were used to identify potential predators (mostly Carabidae and Formicidae) of exotic lepidopterans, such as the gypsy moth (*Lymantria dispar* L.), associated with the ground layer of three tree types (sugar maple, *Acer saccharum* (Marsh), tulip poplar, *Liriodendron tulipifera* L., and white oak, *Quercus alba* L.). Of the 187 species identified, 21 were carabids and 24 were ants, which represent potential predators in the system (Gibbs 1998).

Sweep netting is a collection method generally associated with the monitoring of pest species in agricultural crops. The method is used as an inexpensive, simple method of sampling arthropod populations (Fowler 1993). Sweep netting was used by researchers who determined that orthopteran groups, such as Acrididae, Tetrigidae, and Tettigoniidae, could be indicators of the amount of disturbance experienced by grasslands (Baldi 1997).

In many studies, multiple sampling methods are used simultaneously to sample the diversity of an area. In a study comparing light traps, pitfall traps, and sweep netting in India, it was found that each sampling method captured a different proportion of the insect orders (Sanjayan et al. 1995). At Panama's Barro Colorado Nature Monument, the catches of Homoptera were compared for light trapping and sweep netting. Different methods collected different portions of the community, but the light trap sampled a more complete portion of the community (Wolda and Wong 1988). In a study in a tropical forest in South America, the types of Hymenoptera sampled by sweep netting, malaise trapping, and canopy fogging differed (Noyes 1989). To obtain a more comprehensive sample of the Erotylidae (Coleoptera) species of Beall Woods State Park, malaise traps, leaf-litter samples, and direct collections from fungi were used (Goodrich 1997). Because each sampling method is somewhat specific to the insect species collected, a mixture of sampling techniques can result in more comprehensive collection of the species within a given habitat. The different methods sample species associated with different aspects of the habitat, and can provide researchers with insight as to where certain species spend most of their time. The use of multiple sampling techniques allows comparisons between sampling methods. This information can then be used to determine which method may be best in particular situations.

Importance of Old-Growth Forests

According to Devall (1992), it is necessary to preserve old-growth forests in the southern U.S. and make them more abundant through better management practices, to maintain old-growth ecosystem functions as well as maintain biological diversity. Chandler and Peck (1992) provided two reasons why old-growth forests should be of interest: 1) historical value as they represent pre-colonial forests, and 2) ecological interest for comparison with younger forests. The loss of old-growth forests also may reduce medical and pest-management resources, since the invertebrates that live within them produce a wide variety of chemicals for defense, detoxifying food, etc. (Schowalter

1990). Many invertebrates depend on resources that can be found only in old growth stands of trees (Schowalter 1990). Preservation of old-growth forest seems especially important since studies demonstrated that old growth Douglas-fir trees supported five times the number of arthropods as young trees (Schowalter 1990). Proportionally large numbers of flightless species have been found associated with old-growth forests (Lattin 1990). The large number of species present is probably due to the long term stability of the old-growth forest, which allowed an accumulation of wingless species. Species that no longer have the capability of flight for dispersal would be sensitive to forest fragmentation.

Sinking Pond

Sinking Pond, one of the most pristine areas located within the more than 15,783 ha of land managed by Arnold Air Force Base (AAFB), is a seasonally flooded karst depression. Sampling the arthropod community of this registered natural landmark (Fig. 1) represents a rare biological opportunity to acquire significant information about the arthropod fauna in a unique wilderness area. The primary reason for Sinking Pond's uniqueness is a community of overcup oak (*Quercus lyrata* Walter), river birch (*Betula nigra* L.), and resurrection fern (*Pleopeltis polypodioides* Andrews and Windham) which is found in the deepest and most regularly flooded areas. This old-growth forest habitat type occurs nowhere else in Tennessee, or the world, and it has been tentatively labeled G1 by the Tennessee Chapter of the Nature Conservancy. A ranking of G1 indicates that less than five occurrences of this habitat are known globally and the habitat is "critically imperiled" (HINHP 1998).

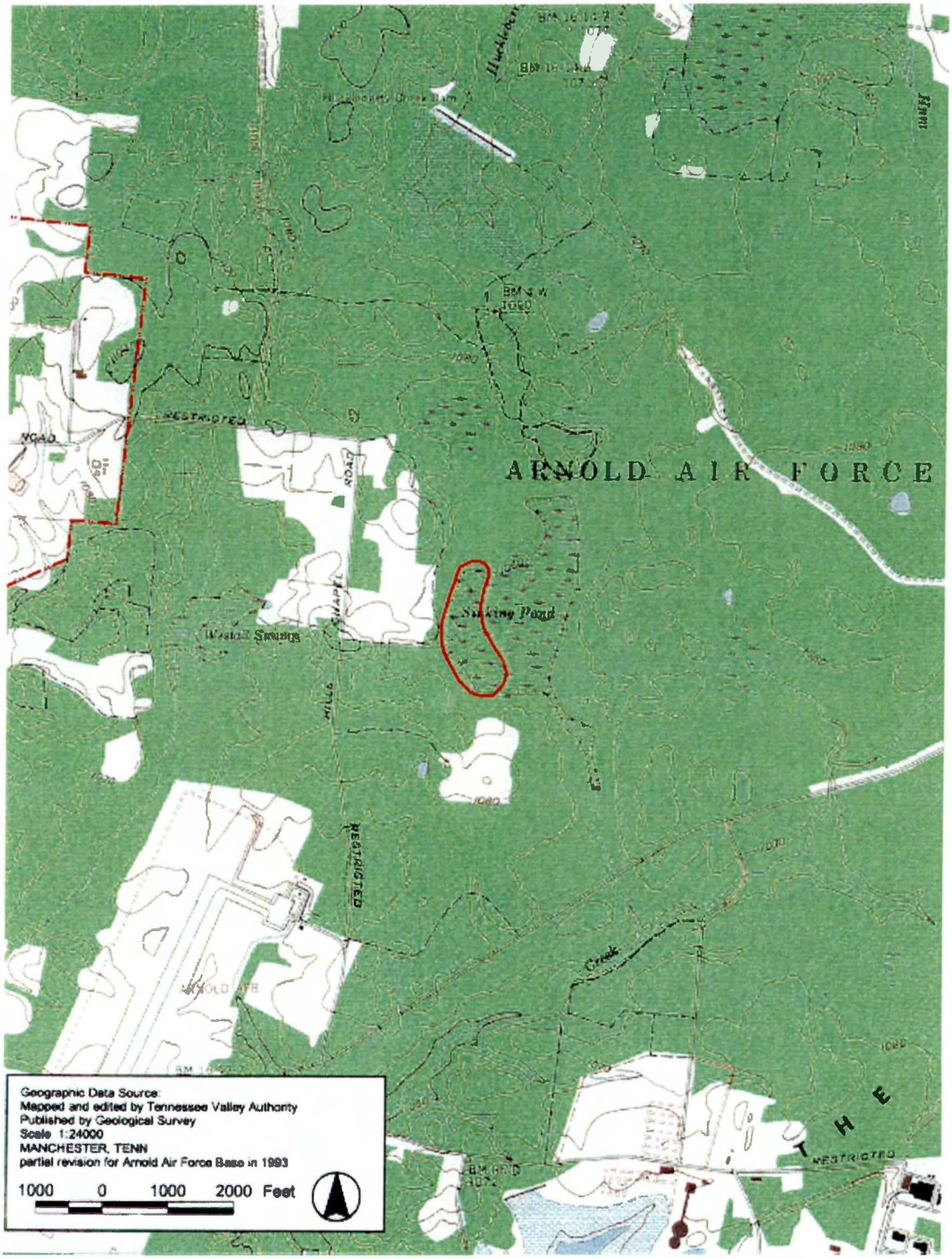

Figure 1. Map of Sinking Pond area sampled, Arnold Air Force Base, Coffee County, TN, 1997 and 1998.

Sinking Pond is located in an area called the Barrens on the Eastern Highland Rim in Coffee County, TN. These Barrens contain many disjunct animal and plant species (Patterson 1989). It is important to conserve disjunct species, because they may represent unusual genotypes which may give a species the ability to survive changes, such as new diseases, climatic change, etc. Overcup oak and water tupelo (*Nyssa aquatica* L.) are two of the 87 disjunct plant species identified from the Sinking Pond area (Patterson 1989). Disjunct species in the Barrens are generally associated with three main regions: 1) the coastal plains area of the Gulf of Mexico and southern Atlantic, 2) the northern prairies, and 3) the northern Appalachians (Wolfe 1996, Patterson 1989). According to Wolfe (1996), "Disjunct taxa are not distributed evenly across The Barrens, but are highly localized at discrete sites, notably in seasonally flooded karst depressions."

Sinking Pond is distinguished by numerous sinkholes, caverns, and underground streams and rivers with a poorly developed above-ground stream drainage system. The actual pond basin is a compound sink, resulting from numerous sinkholes collapsing together to form a large depression. Soils are typic fragiaquults of the Guthrie series, which are gray, fine-silty, siliceous, thermic soils that have low pH values (Patterson 1989).

Within Sinking Pond's watershed, two other karst depressions (sinkhole wetlands) occur: the Willow Oak (*Quercus phellos* L.) and the Water Tupelo Swamps (notable due to its disjunct Gulf Coastal Plain Water Tupelo community), which both intermittently overflow into Sinking Pond (Wolfe 1996). The water level of Sinking Pond is governed by underground water sources and the overflow from the two other sinkhole ponds in the watershed. Sinking Pond can empty or fill as much as 2 m (in an almost 52 ha pond) in as little as 24 hours, and water depths vary from 0 to 3.5 m (Wolfe 1996). The Sinking Pond watershed has at least seven tree community types (Patterson 1989) consisting of: scarlet oak (*Q. coccinea* Wangenheim)-southern red oak (*Q. falcata* Michaux), southern red oak (*Q. rubra* L.), white oak (*Q. alba* L.), post oak (*Q. obtusiloba* Michaux), water oak (*Q. aquatica* Catesby)-red maple (*Acer rubrum* L.)-blackgum (*Nyssa sylvatica* Marshall), willow oak, and overcup oak community type. The dominant community type in the Sinking Pond watershed is the white oak community type, which can be found most often on well drained upper slopes (Patterson 1989).

Vegetation within the pond is limited due to wet and dry periods, and little or no shrub growth exists in the areas of the pond exposed to high levels of flooding. As the water becomes shallower (25 cm or less), vegetation is dominated by small trees, shrubs, and grasses forming a dense area of vegetation that can tolerate flooding. Also found in the less intensely flooded areas are willow oak communities and water oak-red maple-blackgum communities (Patterson 1989). The edge of the pond, not experiencing seasonal flooding, is characterized most commonly by southern red oak communities and white oak communities (Patterson 1989). The overcup oak component of the forest area only makes up a small percentage (9%) of the communities in the Sinking Pond area (Patterson 1989).

Because it is such a unique habitat, Sinking Pond has become, to some degree, a research forest with studies conducted in many different areas. The United States Geological Survey (Wolfe 1996) included Sinking Pond in its "Hydrology and Tree-

Distribution Patterns of Karst Wetlands at Arnold Engineering and Development Center, Tennessee." A study conducted by personell at The University of Tennessee identified seven different plant communities and five soil types present in the Sinking Pond area (Patterson 1989). The Nature Conservancy and The University of Tennessee conducted surveys in association with AAFB for rare, threatened, or endangered (RTE) plant species. The Southern twayblade, *Listera australis* Lindley, was found at Sinking Pond (Clebsch and Pyne 1995). Surveys for RTE invertebrates, fish, amphibians, reptiles, mammals, and birds were conducted by Middle Tennessee State University and The United States Forest Service on AAFB which identified three species of RTE amphibians associated with the Sinking Pond area (Mullen et al. 1995).

This dynamic setting represents a unique habitat that contains several Federally and State listed RTE species, e.g., Eggert's sunflower (*Helianthus eggertii* Small), and Southern twayblade, the dusky gopher frog (*Rana capito sevosa* LeConte), the mole salamander (*Ambystoma talpoideum* (Holbrook)), the 4-toed salamander (*Hemidactylum scutatum* (Schlegel)), as well as one of Tennessee's largest great blue heron (*Ardea herodias* L.) nesting colonies (Patterson 1989).

Arthropod Biodiversity Databases

Developing a database of arthropod biodiversity information could be useful, especially when cross referenced with the Geographical Information Systems. Blackmore (1996) stated that, ". . .all countries stand to benefit from global biodiversity information systems comprising distributed, but interconnected, databases". This information could be used for comparison with other areas to determine where differences occur, to gauge the effects of human activities, or other future changes in and around the Sinking Pond area. Also, with the invasion of the gypsy moth now imminent in Tennessee, and much of the Sinking Pond area consisting of oak, a primary host of the moth, the baseline data could be useful in the near future for gauging the overall effect of the gypsy moth on the community structure of Sinking Pond.

National landmark status does not carry restrictions or regulations pertaining to management or future development of these sites (UN 1988). As more unique information is learned about the area, it is less likely that the area will become developed or significantly altered in the future as more extensive management practices are developed by AAFB. Sinking Pond, and any other compound sink wetland with a visible internal drain, are sensitive to factors that affect, and especially lower, the local water table. If the water table was lower, the flooding regime may not be extensive enough to support those species which are dependent on damp conditions, such as overcup oak. Also, increased sedimentation from land use, such as logging practices (e.g., the managed loblolly pine sites adjacent to the Sinking Pond area) could potentially "plug" the internal drain, and therefore, cause Sinking Pond to be flooded for a longer period of time. In this instance, the flooding regime may exceed the flood tolerance of some of the species in the pond (Wolfe 1996).

"Indeed, if we do not have adequate species inventories for the protected areas, what are we aiming to conserve, and how can we be sure we are conserving it?" (Hawksworth 1991). Because problems like these need to be addressed, a research project was initiated in 1997 to assess the arthropod community at Sinking Pond. The specific objectives of this research were: to establish baseline data on arthropod species associated with Sinking Pond, evaluate species diversity, assess the ecological significance of select species (e.g. introduced insect species), and identify potential indicator species.

CHAPTER II

MATERIALS AND METHODS

Sinking Pond is located in Coffee County, TN, at the coordinates 35°24'37"N, 86°4'10"W (Figure 1), and comprises 52 ha, while the basin and watershed surrounding the pond comprise more than 155 ha (including the pond). Nine sampling methods were utilized in data acquisition. These included: beat-sheeting, canopy fogging, direct collecting, leaf-litter sampling, light trapping, malaise trapping, Manitoba trapping, pitfall trapping, and sweep netting.

Sampling Methods

Beat-sheet Sampling

In 1997, ten beat-sheet samples were collected on 17 September, and five beat-sheet samples were collected each week until 5 November. In 1998, five samples were taken every other week from 18 June to 30 September. Each sample consisted of laying a cloth sheet (94 cm by 106 cm), secured at opposing sides with dowel rods, under branches and foliage of randomly selected plants and shaking the vegetation to dislodge any arthropods. Specimens were transferred into a sealable plastic bag (900ml), labeled, and taken to the laboratory for identification.

Canopy Fogging

No fogging collections were made in 1997. In 1998, samples were taken monthly from 20 May to 14 October. The 14 October sample was taken from an overcup oak canopy, while samples collected on the other dates were from various other hardwood species. Trees were selected that had a branch strong enough to support the fogger, and with sufficient open spaces to lay plastic sheets beneath the canopy. Selected trees were treated with a broad spectrum, synthetic, pyrethrin insecticide (30 ml of Asana XL, 0.66 emulsifiable concentrate mixed with 3,000 ml of water). Chemical applications were made using a modified Dyna Fog Golden Eagle (model 2610) fogger. Each tree or group of trees was fogged only once during the study. Plastic sheets (3 m by 7.5 m) were placed around the base of the tree on the ground to collect specimens that fell from the canopy. A throw rope was used to place a nylon rope in the tree. The fogger was then attached to the rope, started, and pulled into the canopy of the tree(s). The insecticide (3,030 ml of solution) used to fog the canopy was formulated to provide fog for 4 to 6 minutes. After 2-4 hours, insects were retrieved from the plastic sheets using a modified, hand held, Dust Buster Vacuum®, placed in plastic bags, labeled, and taken to the laboratory.

Direct Collections

In 1997, visual searches for arthropods were made weekly from 9 October to 5 November. In 1998, collections were made once each week from 26 March to 18 November, with the exception of the weeks of 23 April and 7 October, when no samples were taken. Visual searches were made by removing dead bark, looking under rocks and stones, inspecting rotting logs, examining dead animals, examining branches, foliage, and flowers, and hand-picking arthropods. Searches usually concentrated on collecting new species, and only a few specimens of each species were collected. Collecting also concentrated on finding new habitats and substrates to collect from within the site. Insects flying in different areas of Sinking Pond were collected using an aerial net. Most specimens were then placed in a "kill" jar (a jar with plaster of Paris in the bottom and saturated with ethyl acetate), and taken to the laboratory. Some specimens (e.g., Lepidoptera and Odonata) were then placed into paper triangles to reduce the potential for damage to their bodies and wings.

Leaf-Litter Samples

In 1997, ten leaf-litter samples (900 ml) were collected on a monthly basis (17 September to 19 November) from randomly selected areas. Each leaf-litter sample consisted of a sealable bag filled with leaf-litter from randomly selected areas within 15 m of the water's edge and within the pond basin as the water receded. Samples were taken to the laboratory for processing through Tullgren funnels using procedures outlined in Haarlov (1947). All specimens were sorted from these collections. In 1998, five leaf-litter samples were taken per month, 30 March through 30 September, and taken to the laboratory where they were combined into one gross sample, and then divided into three samples to be processed in the Tullgren funnels and collected in three separate vials. Only insects from 30 March and 26 June were sorted and identified for 1998.

Light Traps

A light trap collection was made once during 1997 on 9 October. In 1998, collections were made approximately twice per month from 31 March to 6 October, and an additional light trap collection was made on 19 November. Nocturnal arthropods attracted to lights were collected using a Universal® black light trap activated at dusk by a photoelectric cell and operate until the battery died (ca. 4 to 6 hours). The trap consisted of 4 clear plexiglass windows (12.5 cm by 25.4 cm) arranged at 90° angles from one another. The windows were positioned on top of a metal funnel and capped by a metal plate. The U-shaped black-light bulb was positioned at the point where the plexiglass windows diverge. The funnel was positioned upon a white plastic bucket (29.4 cm diameter, 26.8 cm depth) used to collect insects. Kill jars, with a 2 cm layer of sawdust covered by a 2 cm layer of plaster of Paris, were saturated with ethyl acetate and placed in the bottom of the bucket. Arthropods were removed from the trap the following morning, placed in kill jars or empty specimen cups, and taken to the laboratory.

Malaise Traps

Samples were taken weekly in 1997 (1 October through 19 November) and 1998 (March 31 through October 14). A 60 cm^3 cube frame was constructed of 1.9 cm diameter PVC pipe. The frame was covered with No-see-um® fabric (73 perforations per 645 mm^2) on two parallel sides, and the fabric was used to form a flat surface, positioned perpendicular to the ground in the middle of the cube that would act as a barrier to flying insects. Some insects strike the barrier and fly upwards where the fabric was formed into a pyramid-shaped top (also constructed of No-see-um® fabric) funneling the insects into the collecting head (two plastic specimen bottles each 7.5 cm wide by 5 cm long by 12.5 cm high glued together). Insects were captured in a 120-ml collecting cup (60 mm wide by 65 mm deep) containing 30 to 60 ml of a 50/50 mixture ethylene glycol and water. In 1997, one trap was placed within the empty basin under the canopy of an overcup oak. During 1998, the trap was moved (three times) to keep it at the water and land interface along potential insect flight paths. Each week the collection cup was unscrewed from the collecting head, capped, and taken to the laboratory.

Manitoba Traps

Collections were made from one trap each week from 18 June 1998 to 7 October 1998. The trap consisted of a sheet (2 m^2) of plastic with a stake (2 m tall) supporting it at its center (Goodwin et al. 1985). The corners of the plastic were pulled taut with ropes to form a tent-like structure. The plastic was clear at the top of the tent and black at the base. Insects would fly under the tent, then attempt to fly out through the clear plastic and become trapped. The top of the stake was modified to support a collecting bucket (11 cm diameter and 14 cm tall), which contained ammonium carbonate. The specimens in the bucket were collected once per week, placed in a kill jar, and taken to the laboratory for processing.

Pitfall Traps

Ten pitfall traps were numbered 16, 22, 23, 24, 25, 26, 31, 48, 49, and 72, and collected weekly from 1 October to 5 November 1997. In 1998, five of the original pitfall traps (22, 23, 25, 31, and 49) were collected weekly from 9 April to 29 October. Each pitfall trap consisted of a 120-ml collection cup (60 mm wide and 65 mm deep) filled with a 50/50 mixture of water and ethyl acetate placed within a second cup. These were then placed in shallow holes dug into the ground so that the top of the collection cup was level with the substrate. A plastic cover, equipped with four radial fins (which guide arthropods into the collection cup) was placed over the centrally positioned collection cup. Traps were placed randomly along the western edge of the pond above the highest water mark to insure they would not become submerged. On each sampling date, the collection cup with preservative was removed, capped, and taken back to the lab. All samples from

1997 and 1998 were sorted except for 15 samples from 1998: one sample on 19 August, two samples on 9 September, four samples on 23 September, five samples on 7 October, and three samples on 21 October.

The five pitfall traps that were used throughout the study had the community type associated with the immediate area surrounding the trap tentatively described on 23 June 1998 by Geoff Call, a biologist from AAFB, using the classifications of Pyne et al. (1998). Pitfall trap number 23 (35°24' 32"N, 86°04' 14"W, elevation 296 m) was in a white oak-(southern red oak, post oak)/slender spanglegrass (*Chasmanthium laxum* Michaux) forest. Pitfall trap number 22 (35°24' 37"N, 86°04' 12"W, elevation 299 m) and pitfall number 25 (35°24' 34"N, 86°04' 14"W, elevation 298 m) were both in a white oak-(mockernut hickory, shagbark hickory)-(willow oak)/sweetgum forest. Pitfall number 31 (35°24' 32"N, 86°04' 17"W, elevation 295 m) was in a southern red oak-white oak-(scarlet oak)/sourwood (*Oxydendrum arboreum* DeCandolle)/hillside blueberry (*Vaccinium pallidum* Aiton) forest. Pitfall number 49 (35°24' 37"N, 86°04' 10"W, elevation 297 m) was in a willow oak-water oak-(swamp blackgum, *Nyssa biflora* Walter) forest. The provisional community type found at pitfall number 49 also has been given the tentative label of G1 by the Tennessee Chapter of the Nature Conservancy. This community is probably endemic to Coffee County, TN (Call, personal communication 1998).

Sweep-net Sampling

In 1997, ten sweep-net samples were taken on 17 September, using a canvas bag 82 cm deep and 38 cm in diameter. On the remaining dates, five sweeps were taken weekly until 5 November. In 1998, five sweep-net samples were taken weekly from 31

March to 21 October. One sweep-net sample consisted of swinging the net through the foliage once each step, each stroke counting as one sweep, for a total of twenty sweeps. Each sample was transferred to a sealable plastic bag (900 ml) and taken to the laboratory. All sweep net samples for 1998 were sorted except for: four samples from 3 June, three samples from 14 July, two samples from 28 July, and four samples from 12 August.

Processing and Identification of Specimens

Insects were stored in a freezer until they could be sorted and identified, with the exception of pitfall and malaise trap samples which were stored as they were collected, and the leaf-litter samples which were transferred from the Tullgren funnel collecting tubes and placed in plastic specimen vials of alcohol. Specimens were either placed in vials of alcohol, paper triangles, or mounted on a pin or a paper point. Each specimen was given a label with the following information: site collected, date collected, trap type, and sample number. Arthropods were identified to order, family, genus, or species using standard dichotomous keys (Appendix A). Some specimens were provided to specialists for identification or verification (Appendix B).

Analysis of Data

Data consisting of specimen number, order, family, genus, species, or species code, author, site collected, date collected, method of collection, taxonomist, and number of specimens were entered into the BIOTA database (Colwell 1996). The number of insects was tabulated to provide species lists, diversity comparisons, and lists of species of unique importance. Orders in the tables are listed according to the phylogenetic order outlined by Borror et al. (1989).

Comparisons with the RTE arthropod lists of Alabama, Arizona, Georgia, Kentucky, North Carolina, Missouri, and Virginia were made to species identified from Sinking Pond. Species lists also were examined for species with distributions that may indicate a potentially disjunct species. The species list also was examined for exotic species.

Comparisons between the numbers of specimens and species collected were made between the sampling methods to evaluate the importance of each sampling method. The species lists of pitfall traps used for the entire sampling period (and having their immediate plant community tentatively described) were compared to establish any differences between orders, families, and species lists that may be attributed to differences in community type.

To establish any differences between the 14 October 1998 fogging (of an overcup oak tree canopy) and the other fogging collections at Sinking Pond, Statistical Analysis Software (SAS) was used to perform Chi square analysis to compare the samples at the family level (SAS Institute 1997). Comparisons were made for this tree type because it is the dominant species in the tentative G1 community of overcup oak, river birch, and resurrection fern.

Diversity and evenness were calculated, using SAS, for each individual sampling method and for all collection methods combined using the Shannon index (= Shannon-Wiener or Shannon-Weaver index) (SAS Institute 1997). The formula (Smith 1986, Whittaker 1975, Heyer et al. 1994) reads as follows:

$$H' = -\sum_{i=1}^{s}(\rho_i)(\log_2 \rho_i)$$

H' = diversity of species
s = the number of species
ρ_i = proportion of individuals of the total sample belonging to the i^{th} species

where: $H_{maximum} = \ln s$
ln = natural log

evenness = J = H'/Hmax.

The Shannon index was selected due to its wide use in animal biodiversity studies. It can be used to compare samples of different size, and it considers the number of species as well as the abundance of species present. The Shannon index is essentially a measure of randomness; the more difficult it is to predict the identity of a specimen selected from the data set at random, the more diverse the data set will be. A large number of a dominant species present makes it easier to predict what the randomly selected specimen would be, which reduces the Shannon index score.

Species richness is the total number of species in an area. $H_{maximum}$ (H_{max}) is an estimate of the maximum diversity value for s species. Species evenness is measured on a scale of 0 to 1, where one represents the most even value for a community, and evenness is essentially the percentage of the diversity collected of the potential diversity a collection with s species could have.

CHAPTER III

RESULTS AND DISCUSSION

From the nine collecting methods, 23,929 specimens were collected representing 28 arthropod orders (Table 1). Of these, 12,816 (53.6%) were insect specimens in 20 orders and 11,113 (46.4%) were non-insect specimens in 8 orders. From these insect and non-insect orders, an estimated 826 different species were identified in 200 families (Table 2).

Two insect orders, Coleoptera and Collembola, comprised 74.3% (9,521) of the insect specimens (Table 3). The remaining orders were represented by 3,295 specimens and included: Blattaria, Diplura, Diptera, Hemiptera, Homoptera, Hymenoptera, Isoptera, Lepidoptera, Mecoptera, Neuroptera, Odonata, Orthoptera, Phasmida, Plecoptera, Protura, Psocoptera, Thysanoptera, and Trichoptera (Fig. 2). The Coleoptera were represented by the most species. The majority of the orders (13) were represented by fewer than 20 species; these included the Blattaria, Diplura, Isoptera, Mecoptera, Neuroptera, Odonata, Orthoptera, Phasmida, Plecoptera, Protura, Psocoptera, Thysanoptera, and Trichoptera (Fig. 3 and Table 3).

Overall diversity calculated using the Shannon index was 4.69 (H') with a H_{MAX} of 6.72, which was the highest H' value. The high diversity calculated supports the premise that combined collections would be successful in collecting a greater amount of diversity from the site than any single collection method (Table 4). The calculated evenness (J) of

Table 1. Number of specimens for each trap type, specimens per taxon per sampling method and overall, from Sinking Pond, Coffee Co., TN, 1997 and 1998.

Taxon	Beat	Canopy Fog	Direct	Leaf-Litter	Light	Malaise	Manitoba	Pitfall	Sweep	Totals
Protura	-	-	-	31	-	-	-	-	-	31
Collembola	-	-	-	2,396	-	4	-	1,915	-	4,315
Diplura	-	-	-	6	-	-	-	-	-	6
Odonata	-	1	38	-	-	-	-	-	8	47
Phasmida	1	-	1	-	-	-	-	-	4	6
Orthoptera	-	18	9	-	3	1	2	73	9	115
Blattaria	-	-	-	-	12	-	-	30	-	42
Isoptera	-	-	1	-	-	-	-	-	-	1
Plecoptera	-	-	-	-	2	-	-	-	-	2
Psocoptera	4	23	-	-	-	2	-	-	5	34
Hemiptera	2	265	23	3	8	1	2	13	56	373
Homoptera	15	60	68	-	96	45	-	2	196	482
Thysanoptera	-	2	-	-	-	1	-	-	-	3
Neuroptera	-	6	2	-	15	2	-	-	3	28
Coleoptera	13	217	93	534	4,039	19	5	183	103	5,206
Mecoptera	-	-	3	-	-	-	-	-	2	5
Diptera	30	54	41	14	28	24	19	346	326	883
Trichoptera	-	-	-	-	19	-	-	-	-	19
Lepidoptera	-	3	34	-	203	-	13	-	3	256
Hymenoptera	6	178	45	5	15	4	8	569	132	962
Araneae	177	285	1	43	-	2	1	189	552	1,249
Opiliones	2	1	-	-	3	-	-	98	6	110
Acari	-	2	-	9,099	-	-	-	61	-	9,162
Pseudoscorpiones	-	1	-	21	-	-	-	1	-	23
Crustacea	-	-	-	1	-	-	-	522	-	523
Diplopoda	-	1	1	3	-	-	-	37	1	43
Chilopoda	-	-	-	1	-	-	-	-	-	1
Symphyla	-	-	-	1	-	-	-	1	-	2
Totals	250	1,117	361	12,158	4,443	105	49	4,040	1,406	**23,929**

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998.

Order Family	Genus	species	Sampling Method*	No. of Spec.
Protura				
Family	Genus	species 1	LI	31
Collembola				
Entomobryidae	*Entomobrya*	*assutu* Folsom	ML,PF	5
Entomobryidae	*Entomobrya*	*purpurascens* Packard	LI,PF	20
Entomobryidae	*Entomobrya*	species 1	LI,PF	17
Entomobryidae	*Homidia*	*sauteri* Borner	LI	4
Entomobryidae	*Lepidocyrtus*	*cinereus* Folsom	LI,ML,PF	388
Entomobryidae	*Lepidocyrtus*	species 2	LI	5
Entomobryidae	*Lepidocyrtus*	species 3	LI	5
Entomobryidae	*Orchesella*	*celsa* Christiansen & Tucker	PF	7
Entomobryidae	*Orchesella*	species 1	LI,PF	42
Entomobryidae	*Pseudosinella*	*aera* Christiansen and Belli	LI	7
Entomobryidae	*Pseudosinella*	*sexoculata* Schott	LI	4
Entomobryidae	*Pseudosinella*	species 1	LI	1
Entomobryidae	*Pseudosinella*	*violenta* (Folsom)	LI	21
Hypogastrurida	*Hypogastrura*	species 1	LI,PF	123
Hypogastrurida	*Xenylla*	species 1	LI	6
Isotomidae	*Appendisotoma*	species 1	LI	35
Isotomidae	*Folsomia*	*marchicus* (Frenzel)	LI	1
Isotomidae	*Folsomia*	*prima* Mills	LI	64
Isotomidae	*Folsomia*	*stella* Christiansen & Tucker	LI	5
Isotomidae	*Folsomides*	*parvulus* Stach	LI	29
Isotomidae	*Isotoma*	*monochaeta* Kos	LI	1
Isotomidae	*Isotoma*	species 1	LI	1
Isotomidae	*Isotoma*	*viridis* Bourlet	LI,PF	51
Isotomidae	*Isotomiella*	*minor* (Schaffer)	LI	87
Isotomidae	*Isotomodes*	*falsus* Christiansen & Belling	LI	1
Isotomidae	*Isotomodes*	*minor* (Schaffer)	LI	214
Isotomidae	*Isotomurus*	species 1	LI	1
Isotomidae	*Micrisotoma*	*achromata* Bellinger	LI	1
Isotomidae	*Proisotoma*	*minima* (Absolon)	LI	141
Neanuridae	*Anurida*	*pygmaea* (Borner)	LI	92
Neanuridae	*Anurida*	*tullbergi* Schott	LI	22
Neanuridae	*Friesea*	*sublimis* Macnamara	LI	1

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Collembola				
Neanuridae	*Neanura*	*muscorum* (Templeton)	LI	10
Neanuridae	*Neanura*	species 1	LI,PF	3
Neanuridae	*Neanura*	species 2	LI	7
Neanuridae	*Odontella*	*cornifer* Mills	LI	12
Neanuridae	*Odontella*	species 1	LI	1
Neanuridae	*Pseudachorutes*	*aureofasciatus* (Harvey)	PF	9
Neanuridae	*Pseudachorutes*	species 1	LI,PF	7
Neanuridae	*Sensillanura*	*caeca* Folsom	LI	22
Neelidae	*Neelus*	species 1	LI	1
Oncopoduridae	*Harlomillsia*	*oculata* (Mills)	LI	3
Onychiuridae	*Onychiurus*	species 1	LI	103
Onychiuridae	*Tullbergia*	*mala* Christiansen & Belling	LI	3
Onychiuridae	*Tullbergia*	*silvicola* Folsom	LI	3
Onychiuridae	*Tullbergia*	*yosiii* Rusek	LI	182
Poduridae	*Podura*	*aquatica* Linnaeus	LI	4
Sminthuridae	*Arrhopalites*	species 1	LI	1
Sminthuridae	*Ptenothrix*	*pineolea* Wray	PF	1
Sminthuridae	*Ptenothrix*	species 1	LI,PF	7
Sminthuridae	*Sminthurides*	*malmgreni* (Tullberg)	LI	18
Sminthuridae	*Sminthurinus*	*quadrimaculatus* (Ryder)	ML	1
Sminthuridae	*Sminthurinus*	species 1	LI	9
Sminthuridae	*Sminthurus*	species 2	LI	14
Sminthuridae	*Sphaeridia*	*pumilis* (Krausbauer)	LI	17
Tomoceridae	*Tomocerus*	*elongatus* Maynard	PF	2
Tomoceridae	*Tomocerus*	*flavescens* Tullberg	LI,PF	100
Tomoceridae	*Tomocerus*	species 1	PF	1
unidentified			LI,PF	2372
Diplura				
Japygidae	*Parajapyx*	*isabellae* (Grassi)	LI	6
Odonata				
Aeshnidae	*Aeshna*	*umbrosa* Walker	DI	1
Aeshnidae	*Epiaeschna*	*heros* (Fabricius)	DI	1
Coenagrionidae	*Ischnura*	*hastata* (Say)	DI	2
Lestidae	*Lestes*	*disjunctus* Walker	DI,SW	6

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Odonata				
Lestidae	*Lestes*	*rectangularis* Say	DI,FG,SW	9
Lestidae	*Lestes*	species 1	DI	1
Libellulidae	*Libellula*	*incesta* Hagen	DI	2
Libellulidae	*Libellula*	*lydia* Drury	DI	2
Libellulidae	*Libellula*	*semifasciata* Burmeister	DI	1
Libellulidae	*Libellula*	*vibrans* Fabricius	DI	3
Libellulidae	*Pachydiplax*	*longipennis* (Burmeister)	DI	8
Libellulidae	*Sympetrum*	*ambiguum* (Rambur)	DI,SW	11
Phasmida				
Heteronemiidae	*Anisomorpha*	*buprestoides* (Stoll)	BT	1
Heteronemiidae	*Diapheromera*	*femorata* Say	DI,SW	5
Orthoptera				
Acrididae	*Arphia*	*sulphurea* (Fabricius)	SW	1
Gryllacrididae	*Ceuthophilus*	*brevipes* Scudder	PF	4
Gryllidae	*Acheta*	*assimilis* (Fabricius)	FG,PF,SW	36
Gryllidae	*Nemobious*	*fasciatus* DeGeer	LT,ML,PF	35
Gryllidae	*Oecanthus*	*augustipennis* Fitch	DI,FG,LT,PF, SW	16
Gryllidae	*Oecanthus*	*latipennis* Riley	MN	2
Gryllidae	Oecanthus	species 1	FG,PF,SW	9
Tetrigidae	*Tetrix*	*arenosus* Burmeister	DI	1
Tetrigidae	*Tettigidea*	*armata* Morse	DI	1
Tetrigidae	*Tettigidea*	*lateralis* (Say)	DI,PF,SW	6
Tettigoniidae	*Microcentrum*	*retinerve* (Burmeister)	DI	1
Tettigonidae	*Neoconocephalus*	*triops* (Linnaeus)	DI	1
Tettigonidae	*Pterophylla*	*camellifolia* (Fabricius)	DI	2
Blattaria				
Blattellidae	*Ischnoptera*	*deropeltiformes* (Brunner)	PF	12
Blattellidae	*Parcoblatta*	*bolliana* Saussure & Zehntner	LT,PF	30
Isoptera				
Family	Genus	species 1	DI	1
Plecoptera				
Perlidae	*Acroneuria*	*frisoni*? Stark and Brown	LT	1
Perlidae	*Perlesta*	species 1	LT	1

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Psocoptera				
Psocidae	*Psocus*	species 1	BT,FG,SW	8
Family	Genus	species 1	BT,SW	4
Family	Genus	species 2	BT,FG,ML	4
Family	Genus	species 3	FG	1
Family	Genus	species 4	BT	1
Family	Genus	species 5	FG	16
Hemiptera				
Aradidae	*Mezira*	*granulata* (Say)	DI	1
Belostomatidae	*Lethocerus*	*griseus* (Say)	LT	2
Berytidae	*Jalysus*	species 1	SW	12
Coreidae	*Acanthocephala*	*terminalis* (Dallas)	FG	1
Coreidae	*Leptoglossus*	*fulvicornis* (Westwood)	DI	1
Corimelaenidae	*Corimelaena*	*obscura* McPherson & Sailer	DI,SW	5
Corimelaenidae	*Corimelaena*	*pulicaria* (Germar)	DI	1
Corimelaenidae	*Galgupha*	*aterrima* Malloch	SW	1
Corixidae	*Hesperocorixa*	species 1	DI	1
Corixidae	*Sigara*	species 1	LT	1
Corixidae	*Trichocorixa*	*calva* (Say)	LT	1
Gerridae	*Gerris*	*argenticollis* Parshley	DI	4
Hydrometridae	*Hydrometra*	species 1	DI	1
Lygaeidae	*Ischnorrhynchus*	species 1	FG	1
Miridae	*Fulvius*	*brunneus* (Provancher)	PF	12
Miridae	*Hyaliodes*	*vitripennis* (Say)	BT,FG	15
Miridae	Genus	species 1	FG,LT,PF,SW	27
Miridae	*Phytocoris*	*depictus* Knight	FG	6
Nabidae	*Nabis*	*sordidus* Reuter	BT,SW	22
Nepidae	*Ranatra*	*nigra* Herrich-Schaeffer	DI	3
Notonectidae	*Notonecta*	*irrorata* Uhler	DI	3
Pentatomidae	*Banasa*	*dimidiata* (Say)	SW	1
Pentatomidae	*Brochymena*	*arborea* (Say)	DI,SW	2
Pentatomidae	*Brochymena*	*cariosa* Stal	DI	1
Pentatomidae	*Euschistus*	*servus* (Say)	DI	1
Pentatomidae	*Euschistus*	*tristigmus* (Say)	SW	2
Pentatomidae	*Mormidea*	*lugens* (Fabricius)	SW	3

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Hemiptera				
Pentatomidae	Genus	species 1	FG	1
Pentatomidae	*Podisus*	*maculiventris* (Say)	DI,FG,LT	5
Pentatomidae	*Thyanta*	species 1	LT	1
Phymatidae	*Phymata*	*fasciata* (Gray)	DI	1
Reduviidae	*Arilus*	*cristatus* (Linnaeus)	MN	2
Reduviidae	*Empicoris*	*tuberculatus* (Banks)	FG	5
Reduviidae	*Melanolestes*	*picipes* (Herrich-Schaeffer)	DI	1
Reduviidae	*Metapterus*	*fraternus* (Say)	DI	1
Rhopalidae	*Stictopleurus*	*crassicornis* (Linnaeus)	FG	1
Tingidae	*Corythuca*	*arcuata* (Say)	FG,LI,ML,SW	221
Tingidae	*Corythuca*	species 1	SW	2
Tingidae	*Gelchossa*	*oblonga* (Say)	SW	1
Homoptera				
Aphidae	Genus	species 1	DI	14
Cercopidae	*Aphrophora*	*quadrinotata* Say	SW	1
Cercopidae	Genus	species 1	SW	1
Cercopidae	Genus	species 2	SW	1
Cercopidae	*Prosapia*	*bicincta* Say	DI,LT,ML	4
Cicadellidae	*Agallia*	*quadripunctata* (Provancher)	SW	13
Cicadellidae	*Agalliopsis*	*novella* (Say)	SW	1
Cicadellidae	Genus	species 1	FG	23
Cicadellidae	Genus	species 2	SW	13
Cicadellidae	Genus	species 3	LT,SW	7
Cicadellidae	Genus	species 4	ML,SW	3
Cicadellidae	Genus	species 5	LT	1
Cicadellidae	Genus	species 6	FG	1
Cicadellidae	Genus	species 7	LT,SW	8
Cicadellidae	Genus	species 8	SW	1
Cicadellidae	Genus	species 9	SW	1
Cicadellidae	Genus	species 10	ML	1
Cicadellidae	Genus	species 11	SW	1
Cicadellidae	Genus	species 12	SW	1
Cicadellidae	Genus	species 13	LT	1
Cicadellidae	Genus	species 14	LT	1

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Homoptera				
Cicadellidae	Genus	species 15	FG	1
Cicadellidae	Genus	species 16	SW	1
Cicadellidae	*Cloanthus*	species 1	BT,SW	4
Cicadellidae	*Colladonus*	*clitellarius* (Say)	SW	1
Cicadellidae	*Draeculacephala*	*antica* (Walker)	LT,ML,SW	7
Cicadellidae	*Erythroneura*	*comes* (Say)	BT,SW	5
Cicadellidae	*Erythroneura*	*hamata* Beamer	BT,SW	7
Cicadellidae	*Erythroneura*	*kansana*? Baker	ML	1
Cicadellidae	*Erythroneura*	*micheneri* Hepner	LT	1
Cicadellidae	*Erythroneura*	*obliqua*? (Say)	FG,PF,SW	7
Cicadellidae	*Erythroneura*	*ontari* Robinson	FG,SW	3
Cicadellidae	*Erythroneura*	species 1	BT,LT,ML,PF, SW	116
Cicadellidae	*Erythroneura*	*vulnerata* Fitch	SW	3
Cicadellidae	*Eutettix*	*luridus* (Van Duzee)	LT	1
Cicadellidae	*Graphocephala*	*versuta* (Say)	SW	6
Cicadellidae	*Gyponana*	species 2	LT,SW	2
Cicadellidae	*Jassus*	*borealis* Spangberg	SW	2
Cicadellidae	*Jassus*	*olitorius* Say	DI,ML,SW	5
Cicadellidae	*Oncometopia*	*undata* (Fabricius)	BT,SW	2
Cicadellidae	*Sibovia*	*occatoria* (Say)	SW	1
Cicadidae	*Magicicada*	*tredecassini* Alexander & Moore	DI	1
Cicadidae	*Tibicen*	*canicularis* (Harris)	DI	2
Cixiidae	*Bothriocera*	species 1	ML,SW	3
Cixiidae	Genus	species 1	BT,SW	5
Cixiidae	Genus	species 2	SW	1
Cixiidae	Genus	species 3	FG	1
Cixiidae	Genus	species 4	FG	1
Cixiidae	Genus	species 5	DI,LT	2
Cixiidae	Genus	species 6	SW	2
Cixiidae	*Oliarus*	species 1	FG,LT,SW	6
Delphacidae	*Liburniella*	*ornata* Stal	SW	1
Derbidae	*Cedusa*	species 1	LT,SW	3

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Homoptera				
Derbidae	Genus	species 1	SW	1
Derbidae	*Neocenchrea*	*heidemanni* (Ball)	SW	2
Derbidae	*Otiocerus*	*amyotii* Fitch	DI,SW	2
Derbidae	*Syntames*	*brunneus* McAtee	BT,SW	2
Derbidae	*Syntames*	*uhleri* (Ball)	SW	1
Flatidae	*Anormenis*	*chloris* (Melsheimer)	SW	1
Flatidae	Genus	species 1	SW	1
Flatidae	*Metcalfa*	*pruinosa* (Say)	LT	1
Membracidae	*Cyrtolobus*	*pallidifrontis* (Emmuns)	FG	1
Membracidae	*Enchenopa*	*binotata* (Say)	SW	1
Membracidae	*Entylia*	*carinata* (Forster)	BT	1
Membracidae	*Heliria*	*gibberata* Ball	LT	1
Membracidae	Genus	species 1	LT	1
Membracidae	Genus	species 2	LT	1
Membracidae	Genus	species 3	FG	1
Membracidae	Genus	species 4	BT	2
Membracidae	*Platycotis*	*vittata* (Fabricius)	BT,DI,FG, LT,ML,SW	45
Membracidae	*Spissistilus*	*festinus* (Say)	DI,FG,LT,SW	58
Membracidae	*Stictocephala*	*lutea* (Walker)	SW	4
Membracidae	*Stictocephala*	species 1	BT,SW	3
Membracidae	*Telamona*	*reclivata* Fitch	BT,LT	3
Psyllidae	Genus	species 1	DI	43
Psyllidae	Genus	species 2	BT	1
Psyllidae	Genus	species 3	SW	1
Psyllidae	Genus	species 4	FG,SW	2
Thysanoptera				
Phlaeothripidae	*Neheegeria*?	species 1	ML	1
Phlaeothripidae	Genus	species 1	FG	2
Neuroptera				
Chrysopidae	Genus	species 1	DI,FG,LT,ML, SW	6
Corydalidae	*Chauliodes*	*rastricornis* Rambur	DI,LT	12
Corydalidae	*Chauliodes*	species 1	LT	2
Hemerobiidae	Genus	species 1	FG,ML,SW	7

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	**Sampling** Method*	**No. of** Spec.
Neuroptera				
Sialidae	*Sialis*	*mohri*? Ross	LT	1
Coleoptera				
Aderidae	*Zonantes*	*subfasciatus* (LeConte)	SW	2
Alleculidae	*Hymenorus*	*humeralis* LeConte	LT	1
Alleculidae	*Isomira*	species 1	FG,LT	3
Alleculidae	*Lobopoda*	*punctulata* (Melsheimer)	FG,LT	2
Anobiidae	*Tricorynus*	*dichrous* (Fall)	LT	1
Anobiidae	*Tricorynus*	*gravis* (LeConte)	FG,LT	3
Anthicidae	*Anthicus*	species 1	FG	1
Anthicidae	*Sapintus*	species 1	LT,SW	2
Anthribidae	*Toxonotus*	*cornutus* (LeConte)	FG	1
Bostrichidae	*Lichenophanes*	*bicornis* (Weber)	LT	2
Bostrichidae	*Stephanopachys*	species 1	FG	2
Brentidae	*Arrhenodes*	*minuta* (Drury)	LT	1
Buprestidae	*Acmaeodera*	*tubulus* (Fabricius)	SW	1
Buprestidae	*Agrilis*	species 3	FG	2
Byturidae	*Byturus*	*unicolor* Say	SW	1
Cantharidae	*Cantharis*	*carolinus* Fabricius	LT	1
Cantharidae	*Cantharis*	*rectus* Melsheimer	SW	13
Cantharidae	*Cantharis*	species 1	SW	1
Cantharidae	*Cantharis*	species 2	LT	4
Cantharidae	*Malthodes*	species 1	SW	2
Carabidae	*Abacidus*	*atratus* Newman	PF	1
Carabidae	*Acupalpus*	species 1	LT,SW	6
Carabidae	*Agonum*	*albicrus* (Dejean)	LT,PF	8
Carabidae	*Agonum*	*decorum* (Say)	LT	1
Carabidae	*Agonum*	*errans* (Say)	LT	3
Carabidae	*Agonum*	*melanarium*? Dejean	PF	1
Carabidae	*Agonum*	*punctiforme* (Say)	LT	2
Carabidae	*Agonum*	*tenue*? (LeConte)	LT,PF	12
Carabidae	*Badister*	*maculatus* LeConte	LT	1
Carabidae	*Bembidion*	species 1	LT,LI	334
Carabidae	*Bembidion*	species 2	LT,PF,SW	122

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Coleoptera				
Carabidae	*Brachinus*	*alternans* Dejean	DI	2
Carabidae	*Brachinus*	*fumans* (Fabricius)	DI,PF	9
Carabidae	*Brachinus*	*ovipennis* LeConte	LT,PF	2
Carabidae	*Calleida*	*viridipennis* (Say)	FG	2
Carabidae	*Calosoma*	*scrutator* Fabricius	LT	1
Carabidae	*Chlaenius*	*erythropus* Germar	DI,LT,PF	36
Carabidae	*Chlaenius*	*impunctifrons* Say	PF	1
Carabidae	*Chlaenius*	*platyderus* Chaudoir	PF	1
Carabidae	*Clivina*	*bipustulata* (Fabricius)	LT	75
Carabidae	*Clivina*	*americana*? Dejean	LT	151
Carabidae	*Cyclotrachelus*	*sigillatus* Say	PF	2
Carabidae	*Cymindis*	*complanatus* Dejean	FG,LT	2
Carabidae	*Cymindis*	*limbata* (Dejean)	FG,LT	5
Carabidae	*Dicaelus*	*furvus* Dejean	PF	1
Carabidae	*Galerita*	*bicolor* Drury	PF	11
Carabidae	*Harpalus*	*faunus* Say	LT	2
Carabidae	*Harpalus*	species 1	LT,PF	4
Carabidae	*Lebia*	*grandis* Hentz	LT	4
Carabidae	*Lebia*	*ornata* Say	LT,SW	4
Carabidae	*Lebia*	*viridis* Say	LT	2
Carabidae	*Leptotrachelus*	*dorsalis* (Fabricius)	LT	1
Carabidae	*Loxandrus*	species 1	DI,LT	3
Carabidae	*Myas*	*coracinus* (Say)	PF	4
Carabidae	*Pasimachus*	*punctulatus* Haldeman	PF	1
Carabidae	*Platynus*	*decentis* (Say)	DI	3
Carabidae	*Pterostichus*	*coracinus* Newman	PF	1
Carabidae	*Pterostichus*	*haldemani* LeConte	PF	7
Carabidae	*Pterostichus*	*longicornis* Fall	PF	1
Carabidae	*Pterostichus*	*lucublandus* (Say)	PF	1
Carabidae	*Pterostichus*	species 1	DI,PF	7
Carabidae	*Selenophorus*	*opalinus* LeConte	LT	1
Carabidae	*Selenophorus*	species 1	LT	2
Carabidae	*Stenolophus*	*lecontei* Chaudoir	LT	9
Carabidae	*Stenolophus*	*ochropezus* (Say)	BT,LT	101

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Coleoptera				
Carabidae	*Stenolophus*	*spretus*? Dejean	LT	1
Carabidae	*Synuchus*	*impunctatus* (Say)	PF	1
Carabidae	*Tachys*	species 1	LT,ML	115
Cerambycidae	*Anelaphus*	*pumilus* (Newman)	LT	1
Cerambycidae	*Astylidius*	*parvus* (LeConte)	FG	2
Cerambycidae	*Astylopsis*	*macula* (Say)	SW	1
Cerambycidae	*Goes*	*tigrinus* (DeGeer)	LT	1
Cerambycidae	*Hyperplatys*	*aspera* (Say)	DI	1
Cerambycidae	*Lepturges*	*confluens* (Haldeman)	LT	1
Cerambycidae	*Oberea*	*ruficollis* (Fabricius)	DI	1
Cerambycidae	*Prionus*	*imbricornis* (Linnaeus)	LT	1
Cerambycidae	*Strangalia*	*luteicornis* (Fabricius)	DI	1
Cerambycidae	*Typocerus*	*velutinus* (Olivier)	DI	1
Cerambycidae	*Urgleptes*	*querci* (Fitch)	FG	1
Chrysomelidae	*Acalymma*	*vittata* (Fabricius)	SW	2
Chrysomelidae	*Altica*	*betulae*? Schaeffer	SW	1
Chrysomelidae	*Altica*	species 2	SW	3
Chrysomelidae	*Capraita*	*quercata* (Fabricius)	DI,SW	12
Chrysomelidae	*Ceratoma*	*trifurcata* (Forster)	SW	1
Chrysomelidae	*Chaetocnema*	*pulicaria* Melsheimer	SW	1
Chrysomelidae	*Colaspis*	*brunnea* (Fabricius)	LT	1
Chrysomelidae	*Demotina*	*modestus* Baly	FG,SW	5
Chrysomelidae	*Diabrotica*	*undecimpunctata* Barber	SW	2
Chrysomelidae	*Distigmoptera*	*pilosa* (Illiger)	SW	1
Chrysomelidae	*Nodonota*	*clypealis* Horn	DI	1
Chrysomelidae	*Nodonota*	*puncticollis*? (LeConte)	LT	1
Chrysomelidae	*Paria*	*fragariae* Wilcox	FG,SW	10
Chrysomelidae	*Paria*	*scutellaris* Notman	FG	2
Chrysomelidae	*Paria*	species 1	BT	1
Chrysomelidae	*Rhabdopterus*	*praetextus* (Say)	BT,ML	2
Chrysomelidae	*Sumitrosis*	*rosea* (Weber)	SW	1
Chrysomelidae	*Systena*	*marginallis* (Illiger)	SW	1
Chrysomelidae	*Tymnes*	*metasternalis* Crotch	FG	1
Chrysomelidae	*Tymnes*	*tricolor* (Fabricius)	DI	1

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Coleoptera				
Cicindelidae	*Cicindela*	*unipunctata* Fabricius	PF	2
Cleridae	*Cymatodera*	*undulata* (Say)	MN	1
Cleridae	*Enoclerus*	*ichneumoneus* (Fabricius)	FG	1
Cleridae	*Placopterus*	*thoracicus* (Olivier)	FG	1
Coccinellidae	*Axion*	*tripustulata* (DeGeer)	DI	1
Coccinellidae	*Coccinella*	*septempunctata* Linnaeus	SW	1
Coccinellidae	*Cycloneda*	*munda* (Say)	FG	2
Coccinellidae	*Didion*	*punctatum* (Melsheimer)	FG	1
Coccinellidae	*Harmonia*	*axyridis* (Pallas)	BT,DI,FG,ML	90
Coccinellidae	*Scymnus*	*americanus* Mulsant	FG	1
Coccinellidae	*Scymnus*	*kansanus* Casey	FG	1
Coccinellidae	*Scymnus*	species 1	FG	1
Colydiidae	*Eucicones*	*marginicollis* (Melsheimer)	LT	2
Curculionidae	*Anthonomus*	*rubidus* LeConte	LT	1
Curculionidae	*Apteromechus*	*texanus* Fall	LT	1
Curculionidae	*Aulobaris*	*pusilla* (LeConte)	DI	1
Curculionidae	*Conotrachelus*	*anaglypticus* (Say)	LT	1
Curculionidae	*Conotrachelus*	*posticatus* Boheman	PF	10
Curculionidae	*Cryptorhynchus*	*minutissimus* LeConte	FG	2
Curculionidae	*Curculio*	*iowensis* (Casey)	FG	2
Curculionidae	*Cyrtepistomis*	*castaneus* (Roelofs)	BT,DI,FG,LT, PF,SW	70
Curculionidae	*Eubulus*	*obliquus* (Say)	LT	1
Curculionidae	*Eubulus*	*parochus* (Herbst)	ML	1
Curculionidae	*Eugnamptus*	*angustatus* (Herbst)	FG,SW	2
Curculionidae	*Eugnamptus*	*sulcifrons* Gyllenhal	FG	1
Curculionidae	*Rhinoncus*	*longulus* (LeConte)	SW	1
Curculionidae	*Smincronyx*	*amoenus* (Say)	SW	1
Derodontidae	*Derodontus*	*maculatus* (Melsheimer)	DI	1
Dytiscidae	*Acilius*	*fraternus* (Harris)	DI	2
Dytiscidae	*Agabetes*	*acuductus* (Harris)	DI	1
Dytiscidae	*Agabus*	*gagates* Aube	LT	126
Dytiscidae	*Bidessonotus*	*inconspicuous* (LeConte)	LT	1472
Dytiscidae	*Copelatus*	*chevrolati* Guignot	LT	2

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Coleoptera				
Dytiscidae	*Copelatus*	*glyphicus* (Say)	LT	40
Dytiscidae	*Coptotomus*	*lenticus* Hilsenhoff	LT	5
Dytiscidae	*Hydroporus*	*undulatus* Say	LT	52
Dytiscidae	*Laccophilus*	*fasciatus* (Aube)	LT	1
Dytiscidae	*Rhantus*	*calidus* (Fabricius)	LT	5
Dytiscidae	*Thermonectus*	*basillaris* (Harris)	LT	6
Elateridae	*Ampedus*	*sanguinipennis* (Say)	SW	1
Elateridae	*Ctenicera*	*signaticollis* (Melsheimer)	FG	3
Elateridae	*Ctenicera*	species 1	LT	1
Elateridae	*Glyphonyx*?	species 1	BT,SW	3
Elateridae	*Hemirhipus*	*fascicularis* Fabricius	LT	2
Elateridae	*Lacon*	*impressicollis* (Say)	LT	1
Elateridae	*Lacon*	*marmorata* (Fabricius)	LT	1
Elateridae	*Limonius*	*griseus* Beauvois	LT	3
Elateridae	*Limonius*	*quercinus* (Say)	FG,LT,SW	25
Elateridae	*Melanotus*	*ignobilis* (Melsheimer)	LT,SW	2
Elateridae	*Melanotus*	*insipiens*? (Say)	LT	3
Elateridae	*Melanotus*	species 1	BT,FG,LT,SW	46
Elateridae	*Orthostethus*	*infuscatus* (Germar)	LT	3
Endomychidae	*Rhanidea*	*unicolor* (Ziegler)	LT	1
Endomychidae	*Stenotarsus*	*hispidus* (Herbst)	FG	1
Erotylidae	*Ischyrus*	*quadripunctatus* (Olivier)	LT	1
Erotylidae	*Megalodacne*	*fasciata* (Fabricius)	DI	4
Erotylidae	*Tritoma*	*unicolor* Say	LT	1
Eucnemidae	*Deltometopus*	*rufipes* (Melsheimer)	DI	1
Eucnemidae	*Dirrhagofarsus*	*lewisi* Reitter	FG	1
Eucnemidae	*Dromaeolus*	*badius* (Say)	LT	1
Eucnemidae	*Dromaeolus*	species 1	SW	1
Eucnemidae	*Isorhipis*	*obliqua* (Say)	LT	2
Gyrinidae	*Dineutus*	*carolinus* LeConte	DI,LT	2
Haliplidae	*Peltodytes*	*dunavani* Young	LT,SW	2
Helodidae	*Cyphon*	*padi* (Linnaeus)	FG,LT,ML	46
Helodidae	*Cyphon*	*variabilis* Thunberg	FG,LT,ML,SW	80
Helodidae	*Prionocyphon*	*discoideus* (Say)	ML	1

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Coleoptera				
Helodidae	*Scirtes*	*tibialis* Guerin	LT	1
Heteroceridae	*Tropicus*	*pusillus* (Say)	LT	45
Histeridae	*Atholus*	*nubilus* (LeConte)	SW	1
Histeridae	*Margaronotus*	*foedatus* LeConte	DI	2
Histeridae	*Platysoma*	*lecontei* (Marseul)	LT	3
Hydrophilidae	*Berosus*	*exiguus* Say	LT	19
Hydrophilidae	*Berosus*	*pantherinus* LeConte	LT	2
Hydrophilidae	*Cercyon.*	species 1	LT	3
Hydrophilidae	*Enochrus*	*diffusus* (LeConte)	LT	10
Hydrophilidae	*Enochrus*	*ochraceus* (Melsheimer)	LT	9
Hydrophilidae	*Enochrus*	*perplexus* (LeConte)	LT	7
Hydrophilidae	*Helocombus*	*bifidus* (LeConte)	LT	49
Hydrophilidae	*Hydrochara*	*obtusata* (Say)	LT	1
Hydrophilidae	*Hydrochara*	*soror* Smetana	LT	3
Hydrophilidae	*Hydrochus*	*rufipes* Melsheimer	LT,PF	630
Hydrophilidae	*Hydrochus*	*rugosus* Mulsant	LT	1
Hydrophilidae	*Hydrophilus*	*triangularis* Say	LT	4
Hydrophilidae	*Tropisternus*	*lateralis* Say	LT	4
Hydrophilidae	*Tropisternus*	*mixtus* (LeConte)	LT	1
Hydrophilidae	*Tropisternus*	*striolatus* LeConte	LT	3
Lampyridae	*Lucidota*	*atra* (Fabricius)	DI,FG	2
Lampyridae	*Photinus*	species 1	FG,PF,SW	4
Lathridiidae	*Corticaria*	species 1	FG	1
Lathridiidae	*Melanophthalma*	species 1	ML	3
Leptodiridae	*Catops*	*simplex* Say	PF	1
Leptodiridae	*Ptomophagus*	*consobrinus* (LeConte)	PF	2
Lucanidae	*Pseudolucanus*	*capreolus* (Linnaeus)	LT	1
Lycidae	*Calopteron*	*reticulatum* (Fabricius)	DI,MN	4
Lycidae	*Calopteron*	*terminale* (Say)	DI	1
Lycidae	*Eropterus*	*trilineatus* (Melsheimer)	FG	1
Melandryidae	*Dircaea*	*quadrimaculata* (Say)	LT	2
Melandryidae	*Phloeotrya*	*vaudoueri* Mulsant	LT	2
Melandryidae	*Synchroa*	*punctata* Newman	LT	4
Melandryidae	*Synstrophus*	*repandus* (Horn)	LT	2

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Coleoptera				
Meloidae	*Meloe*	*americanus* Leach	LT	1
Mordellidae	*Glipa*	*hilaris* (Say)	MN	1
Mordellidae	*Mordellistena*	*ambusta* LeConte	LT	1
Mordellidae	*Mordellistena*	*pubescens* (Fabricius)	FG	1
Mordellidae	*Mordellistena*	species 1	PF	1
Mordellidae	*Mordellistena*	*trifasciata* (Say)	SW	1
Nitidulidae	*Carpophilus*	*antiquus* (Melsheimer)	LT	2
Nitidulidae	*Carpophilus*	*floralis* Erichson	LT	2
Nitidulidae	*Colopterus*	*niger* (Say)	LT	1
Nitidulidae	*Colopterus*	*truncatus* (Randall)	LT	4
Nitidulidae	*Glischrochilus*	*obtusus* (Say)	LT	3
Nitidulidae	*Glischrochilus*	*sanguinolentus* (Olivier)	LT	3
Nitidulidae	*Pallodes*	*pallidus* (Beauvois)	PF	2
Nitidulidae	*Prometopia*	*sexmaculata* (Say)	LT	3
Nitidulidae	*Stelidota*	*geminata* (Say)	LI,PF	5
Passalidae	*Odontotaenius*	*disjunctus* (Illiger)	DI	3
Pselaphidae	*Cylindrarctus*	*longipalpus* (LeConte)	LI,LT	9
Pselaphidae	Genus B	species 1	LT	2
Pselaphidae	*Reichenbachia*	species 1	LT,PF	23
Ptiliidae	*Ptinella*	species 1	LI	521
Ptilodactylidae	*Ptilodactyla*	species 1	BT,LT,SW	3
Pyrochroidae	*Dendroides*	*canadensis* Latreille	DI	1
Scaphidiidae	*Eubaeocera*	species 1	PF	1
Scarabaeidae	*Anomala*	*marginata* (Fabricius)	LT	7
Scarabaeidae	*Aphodius*	*badipes* Melsheimer	LT	1
Scarabaeidae	*Aphodius*	*bicolor* Say	PF	1
Scarabaeidae	*Aphodius*	*stercorosus* Melsheimer	LT	2
Scarabaeidae	*Ataenius*	*fattigi* Cartwright	LT	6
Scarabaeidae	*Ataenius*	*strigatus* (Say)	LT	11
Scarabaeidae	*Ateuchus*	*histeroides* Weber	DI,LT	4
Scarabaeidae	*Bolboceras*	species 1	PF	2
Scarabaeidae	*Bolbocerosoma*	*farctum* (Fabricius)	PF	1
Scarabaeidae	*Cloeotus*	*globosus* Say	LT	8
Scarabaeidae	*Copris*	*fricator* (Fabricius)	LT	8

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Coleoptera				
Scarabaeidae	*Copris*	*minutus* (Drury)	PF	3
Scarabaeidae	*Cotinus*	*nitida* (Linnaeus)	DI	1
Scarabaeidae	*Cyclocephala*	*immaculata* (Olivier)	LT	1
Scarabaeidae	*Deltochilum*	*gibbosum* (Fabricius)	DI,PF	3
Scarabaeidae	*Dyscinetus*	*morator* (Fabricius)	LT	25
Scarabaeidae	*Euphoria*	*fulgida* (Fabricius)	DI,LT	2
Scarabaeidae	*Geotrupes*	*blackburni* (Fabricius)	PF	7
Scarabaeidae	*Geotrupes*	*splendidus* (Fabricius)	DI,PF	3
Scarabaeidae	*Hoplia*	*modesta* Haldeman	SW	1
Scarabaeidae	*Macrodactylus*	*angustatus* (Beauvois)	DI	7
Scarabaeidae	*Onthophagus*	*hecate* Panzer	PF	8
Scarabaeidae	*Parastasia*	*brevipes* (LeConte)	LT	1
Scarabaeidae	*Phyllophaga*	*hirticula* (Knoch)	LT	1
Scarabaeidae	*Phyllophaga*	species 1	LT	2
Scarabaeidae	*Popillia*	*japonica* Newman	DI,SW	5
Scarabaeidae	*Pseudocanthon*	*perplexus* (LeConte)	LT,PF	5
Scarabaeidae	*Serica*	species 1	LT	9
Scarabaeidae	*Trox*	*aequalis* (Say)	LT	6
Scarabaeidae	*Trox*	*capillaris* Say	DI	1
Scarabaeidae	*Trox*	*monachus* Herbst	DI,PF	6
Scolytidae	Genus	species 1	LT	1
Scolytidae	Genus	species 2	LT	5
Scolytidae	*Monarthrum*	*mali* (Fitch)	LT,PF	18
Scolytidae	*Xylosandrus*?	species 1	LT	1
Scydmaenidae	*Napochus*	species 1	LT,PF	21
Scydmaenidae	*Napochus*	species 2	LT	1
Silphidae	*Necrophila*	*americana* (Linnaeus)	DI	5
Silphidae	*Nicrophorus*	*orbicollis* Say	LT,PF	4
Silphidae	*Nicrophorus*	*pustulatus* Herschel	DI,LT	7
Silphidae	*Oiceoptoma*	*inaequale* (Fabricius)	DI	5
Silphidae	*Oiceoptoma*	*noveboracense* (Forster)	DI	5
Staphylinidae	*Homaeotarsus*	*bicolor* (Gravenhorst)	LT	2
Staphylinidae	*Homaeotarsus*	*cinctus* (Say)	LT	1
Staphylinidae	*Homaeotarsus*	*pimerianus* (LeConte)	DI	2

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Coleoptera				
Staphylinidae	Genus E	species 16	LT	6
Staphylinidae	Genus E	species 17	LT	2
Staphylinidae	Genus E	species 22	LT	4
Staphylinidae	Genus E	species 25	LT	6
Staphylinidae	Genus E	species 5	LT	2
Staphylinidae	Genus G	species 7	LT	6
Staphylinidae	Genus H	species 8	PF	4
Staphylinidae	Genus I	species 9	PF	7
Staphylinidae	Genus K	species 40	PF	1
Staphylinidae	Genus M	species 13	PF	1
Staphylinidae	Genus N	species 15	BT,SW	3
Staphylinidae	Genus O	species 23	PF	1
Staphylinidae	Genus P	species 24	LT	2
Staphylinidae	Genus Q	species 26	LT	55
Staphylinidae	Genus Q	species 27	LT	68
Staphylinidae	Genus S	species 30	PF	2
Staphylinidae	Genus T	species 32	LT	2
Staphylinidae	Genus T	species 34	LT	1
Staphylinidae	*Staphylinus*	*fossator* Gravenhorst	PF	1
Staphylinidae	*Staphylinus*	*maculosus* Gravenhorst	DI,PF	6
Staphylinidae	*Stenus*	species 1	FG	1
Staphylinidae	*Stenus*	species 2	BT	1
Staphylinidae	*Sunius*	*confluentus* (Say)	LT	2
Staphylinidae	*Tachinus*	*fimbriatus* Gravenhorst	PF	16
Tenebrionidae	*Anaedus*	*brunneus* (Siegler)	LT,PF	3
Tenebrionidae	*Centronopus*	*calcaratus* (Fabricius)	DI	1
Tenebrionidae	*Diaperis*	*nigronotata* Pie	LT	2
Tenebrionidae	*Haplandrus*	*fulvipes* (Herbst)	FG	1
Tenebrionidae	*Idiobates*	*castaneous* (Knoch)	DI	1
Tenebrionidae	*Platydema*	*picilabrum* Melsheimer	FG,LT	8
Tenebrionidae	*Strongylium*	*crenatum* Maklin	FG,LT	5
Tenebrionidae	*Strongylium*	*tenuicolle* (Say)	LT	1
Tenebrionidae	Genus	species 1	LT	1
Tenebrionidae	*Uloma*	*mentalis* Horn	DI	2

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Coleoptera				
Trogossitidae	*Tenebroides*	*corticalis* (Melsheimer)	LT	1
Trogossitidae	*Tenebroides*	*rugosipennis* Horn	FG	5
Mecoptera				
Bittacidae	*Bittacus*	*stigmaterus* Say	SW	1
Panorpidae	*Panorpa*	*debilis* Banks	DI	2
Panorpidae	*Panorpa*	*nebulosa*? Westwood	DI,SW	2
Diptera				
Anthomyzidae	*Mumetopia*	*occipitalis* Melander	SW	1
Asilidae	*Asilus*	species 1	DI,MN,SW	7
Asilidae	*Laphria*	species 1	DI,MN	5
Asilidae	*Laphria*	species 2	DI	1
Asilidae	*Leptogaster*	species 1	SW	2
Asilidae	*Leptogaster*	species 2	SW	1
Asilidae	*Ommatius*	*gemma* Brimley	DI,FG	2
Bombyliidae	*Anthrax*	species 1	DI	1
Bombyliidae	*Villa*	species 1	DI	3
Calliphoridae	*Cochliomyia*	species 1	FG,SW	20
Calliphoridae	*Phaenicia*	species 1	PF	1
Calliphoridae	*Phormia*	*regina* (Meigen)	FG,SW	16
Ceratopogonidae	*Dasyhelea*	species 1	SW	1
Ceratopogonidae	*Stilobezzia*	species 1	SW	1
Chaoboridae	*Chaoborus*	species 1	SW	1
Chloropidae	*Apotropina*	species 1	SW	2
Chloropidae	*Elachiptera*	species 1	FG	1
Chloropidae	*Homaluroides*	species 1	SW	1
Clusiidae	*Clusia*	*lateralis* (Walker)	DI	1
Conopidae	*Stylogaster*	species 1	DI	1
Culicidae	*Aedes*	species 1	DI,SW	8
Culicidae	*Aedes*	*triseriatus* (Say)	DI,SW	7
Culicidae	*Culex*	species 1	SW	1
Culicidae	*Culiseta*	species 1	SW	1
Culicidae	*Psorophera*	species 1	DI	1
Culicidae	*Toxorynchites*	*septentrionalis* (Dyar & Knab)	LT	1
Dolichopodidae	*Campsicnemus*	species 1	BT,SW	2

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Diptera				
Dolichopodidae	*Chrysotus*	species 1	ML,SW	8
Dolichopodidae	*Condylostylus*	species 1	FG	1
Dolichopodidae	*Condylostylus*	species 2	DI	2
Dolichopodidae	*Dolichopus*	species 1	FG,SW	6
Dolichopodidae	*Gymnopternus*	species 1	DI,FG,PF,SW	44
Dolichopodidae	*Hercostomus*	*tibialis*? (Van Duzee)	FG,SW	8
Dolichopodidae	*Sciapus*	species 1	MN	1
Dolichopodidae	*Tachytrechus*	species 1	PF,SW	2
Drosophilidae	*Chymomyza*	species 1	PF,SW	13
Drosophilidae	*Cladochaeta*	species 1	SW	2
Drosophilidae	*Drosophila*	species 1	BT,MN,PF,SW	22
Drosophilidae	*Leucophenga*	species 1	FG,SW	4
Drosophilidae	*Scaptomyza*	species 1	SW	14
Empididae	*Chelipoda*	*sicaria* Melander	BT,DI	2
Empididae	*Drapetis*	species 1	PF,SW	3
Empididae	*Euhybus*	species 1	SW	3
Empididae	*Oedalea*	*astylata* Melander	FG	1
Empididae	*Rhamphomyia*	species 1	FG	1
Empididae	*Syneches*	species 1	LT,SW	2
Empididae	*Tachyempis*	*calva* (Melander)	SW	1
Ephydridae	*Discocerina*	species 1	ML	1
Ephydridae	*Ochthera*	species 1	BT,DI,FG,SW	39
Ephydridae	*Paralimna*	*punctipennis* (Wiedemann)	BT,DI,FG,SW	21
Ephydridae	*Psilopa*	*dupla*? Cresson	SW	1
Ephydridae	*Scatella*	species 1	LI	1
Heleomyzidae	*Suillia*	species 1	SW	1
Lauxaniidae	*Camptoprosopella*	species 1	FG	1
Lauxaniidae	*Homoneura*	species 1	BT,SW	3
Lauxaniidae	*Melanomyza*	species 1	SW	2
Lauxaniidae	*Minettia*	species 1	FG,SW	3
Lonchaeidae	*Lonchaea*	species 1	FG	1
Micropezidae	*Rainieria*	*antennaepes* (Say)	DI,SW	3
Muscidae	*Caricea*	species 1	ML,SW	2
Muscidae	*Caricea*	species 2	SW	1

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Diptera				
Muscidae	*Coenosia*	species 1	SW	4
Muscidae	*Drymeia*	species 1	FG,ML	2
Muscidae	*Neodexiopsis*	species 1	SW	3
Muscidae	*Phaonia*	species 1	DI,MN,PF,SW	9
Muscidae	*Potamia*	species 2	SW	1
Mycetophilidae	*Acnemia*	*flaveola* Coquillett	SW	1
Mycetophilidae	*Boletina*	species 1	SW	1
Mycetophilidae	*Dynatosoma*	species 1	SW	1
Mycetophilidae	*Exechia*	species 1	ML,PF,SW	3
Mycetophilidae	*Lygistorrhina*	*sanctaecatharin* Thompson	SW	1
Mycetophilidae	*Macrocera*	species 1	SW	1
Mycetophilidae	*Mycetophila*	species 1	PF,SW	5
Mycetophilidae	*Mycomya*	species 1	PF,SW	9
Mycetophilidae	*Neoempheria*	species 1	SW	1
Mycetophilidae	*Orphelia*	species 1	SW	3
Mycetophilidae	*Rymosia*	species 1	SW	1
Mycetophilidae	*Sceptonia*	species 1	SW	1
Phoridae	*Conicera*	*dauci* (Meigen)	DI,PF	8
Phoridae	*Diplonevra*	*hamata* Borgmeier	SW	1
Phoridae	*Dohrniphora*	species 1	BT,LI,ML,PF, SW	269
Phoridae	*Gymnophora*	species 1	BT,ML,PF	14
Phoridae	*Pulciphora*	*virginiensis*? Malloch	PF	9
Phoridae	*Spiniphora*	*excisa*? (Becker)	SW	1
Phoridae	*Triphleba*	*lugubris* Fries	PF,SW	2
Psychodidae	*Telmatoscopus*	species 1	ML	2
Rhagionidae	*Chrysopilus*	species 1	SW	2
Sarcophagidae	*Boettcheria*	species 1	ML,PF,SW	4
Sarcophagidae	*Udamopygna*	*niagarana* Parker	FG	1
Scatopsidae	*Colobostema*	*variatum* Cook	DI	1
Sciaridae	*Bradysia*	species 1	ML,PF	4
Sciaridae	*Corynoptera*	species 1	LI,ML,PF	25
Sciaridae	*Epidapus*	species 1	PF	2
Sciaridae	*Lycoriella*	species 1	BT,ML,PF	5

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Diptera				
Sciaridae	*Pseudosciara*	*forceps* (Pettey)	PF	1
Sciaridae	*Schwenkfeldina*	species 1	DI,MN,PF,SW	8
Sciaridae	*Sciara*	species 1	LT,ML	25
Sciomyzidae	*Euthycera*	*arcuata* (Loew)	SW	1
Sciomyzidae	*Limnia*	*boscii*? (Robineau-Desvoidy)	DI	1
Sepsidae	*Sepsis*	species 1	SW	4
Sphaeroceridae	*Leptocera*	*fontinalis* (Fallen)	PF,SW	72
Sphaeroceridae	*Pterogramma*	species 1	PF	13
Stratiomyidae	*Ptecticus*	species 1	DI	1
Syrphidae	*Cheilosia*	species 1	LT	1
Syrphidae	*Epistrophella*	species 1	FG,MN	3
Syrphidae	*Syrphus*	species 1	MN,SW	4
Syrphidae	*Xylota*	species 1	DI	1
Tabanidae	*Tabanus*	*fulvulus* Wiedeman	ML,MN	4
Tabanidae	*Tabanus*	*molestus* Say	MN	1
Tabanidae	*Tabanus*	*pallidescens* Phillip	ML	1
Tabanidae	*Tabanus*	*sulcifrons* Macquart	MN	1
Tachinidae	*Anisia*	species 1	MN	1
Tachinidae	*Hemyda*	*aurata* Desvoidy	DI	1
Tachinidae	*Peleteria*	species 1	DI	1
Tipulidae	*Epiphragma*	*solatrix*? (Osten Sacken)	SW	8
Tipulidae	*Tipula*	species 1	DI,SW	17
Xylophagidae	*Dialysis*	species 1	LT	1
Xylophagidae	*Rachicerus*	species 1	DI,FG,SW	5
Trichoptera				
Hydropsychidae	*Cheumatopsyche*	species 1	LT	1
Hydropsychidae	*Hydropsyche*	*betteni* Ross	LT	2
Leptoceridae	*Oecetis*	*inconspicua* (Walker)	LT	1
Leptoceridae	*Oecetis*	species 1	LT	12
Philoptamidae	*Wormaldia*	*shawnee* (Ross)	LT	1
Phryganeidae	*Agrypnia*	*vestita* (Walker)	LT	1
Phryganeidae	*Ptilostomis*	species 1	LT	1
Lepidoptera				
Arctiidae	*Apantesis*	*phalerata* (Harris)	LT	1

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Lepidoptera				
Arctiidae	*Cisthene*	*packardii* (Grote)	LT	5
Arctiidae	*Cisthene*	*plumbea* Stretch	LT	2
Arctiidae	*Halysidota*	*tessellaris* (J.E. Smith)	LT	28
Arctiidae	*Haploa*	*clymene* (Brown)	LT	1
Arctiidae	*Haploa*	*lecontei* (Guerin-Meneville)	LT	2
Arctiidae	*Hypoprepia*	*fucosa* Hubner	LT	15
Arctiidae	*Spilosoma*	*virginica* (F.)	LT	1
Danaidae	*Danaus*	*plexippus* (Linnaeus)	DI	1
Drepanidae	*Drepana*	*arcuata* Walker	LT	1
Epipyropidae	*Fulgoraecia*	*exigua* (Edwards)	DI	1
Geometridae	*Anacamptodes*	*defectaria* (Guenee)	LT	4
Geometridae	*Ectropis*	*crepuscularia* (Denis & Schiffermuller)	LT	1
Geometridae	*Euchlaena*	*pectinaria* (Denis & Schiffermuller)	LT	1
Geometridae	*Eupithecia*	*miserulata* Grote	LT	1
Geometridae	*Hypagyrtis*	*unipunctata* (Haworth)	LT	6
Geometridae	*Hypomecis*	*umbrosaria* (Hubner)	LT	1
Geometridae	*Lambdina*	*fervidaria* (Hubner)	LT	1
Geometridae	*Nemoria*	*rubrifrontaria* (Packard)	FG	1
Geometridae	*Probole*	*amicaria* (Herrich-Schaffer)	LT	4
Geometridae	*Protoboarmia*	*porcelaria* (Guenee)	LT	1
Geometridae	*Scopula*	*limboundata* (Hawthorn)	LT	1
Geometridae	*Semiothisa*	*transitaria* (Walker)	LT	1
Hesperiidae	*Epargyreus*	*clarus* (Cramer)	MN	2
Hesperiidae	*Erynnis*	*juvenalis* (F.)	DI	1
Lasiocampidae	*Artace*	*cribraria* (Ljungh)	LT	5
Lasiocampidae	*Malacosoma*	*americanum* (F.)	LT	1
Lasiocampidae	*Malacosoma*	*distria* Hubner	LT	4
Limacodidae	*Lithacodes*	*fasciola* (Herrich-Schaffer)	DI	1
Limacodidae	*Sibine*	*stimulea* (Clemens)	DI	1
Lycaenidae	*Celastrina*	*argiolus* (Cramer)	DI	5
Lycaenidae	*Everes*	*comyntas* (Godart)	DI	2
Lycaenidae	*Glaucopsyche*	*lygdamus* (Doubleday)	DI	2

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Lepidoptera				
Noctuidae	*Acronicta*	*lobeliae* Guenee	LT	1
Noctuidae	*Agrotis*	*ipsilon* Hufnagel	LT	1
Noctuidae	*Amphipyra*	*pyramidoides* Guenee	DI	2
Noctuidae	*Catocala*	*ilia* Cramer	DI	2
Noctuidae	*Catocala*	*lachrymosa* Guenee	DI	1
Noctuidae	*Helicoverpa*	*zea* (Boddie)	LT	1
Noctuidae	*Idia*	*americalis* (Guenee)	FG	1
Noctuidae	*Lesmone*	*detrahens* (Walker)	LT	1
Noctuidae	*Lithacodia*	*synochitis* (Grote & Robinson)	LT	1
Noctuidae	*Metaxaglaea*	*semitaria* Franclemont	LT	1
Noctuidae	*Phoberia*	*atomeris* Hubner	LT	1
Noctuidae	*Plathypena*	*scabra* (Fabricius)	LT,SW	5
Noctuidae	*Polygrammate*	*hebraeicum* Hubner	LT	18
Noctuidae	*Protolampra*	*brunneicollis* (Grote)	LT	1
Noctuidae	*Spodoptera*	*ornithogalli* (Guenee)	MN	1
Noctuidae	*Sunira*	*bicolorago* (Guenee)	LT	2
Noctuidae	*Thioptera*	*nigrofimbria* (Guenee)	LT	1
Notodontidae	*Datana*	*drexelii* H. Edwards	LT	1
Notodontidae	*Heterocampa*	*biundata* Walker	LT	2
Notodontidae	*Heterocampa*	*umbrata* Walker	LT	1
Notodontidae	*Hyperaeschra*	*georgica* (Herrick & Schaffer)	LT	3
Notodontidae	*Nadata*	*gibbosa* (J.E. Smith)	LT	6
Nymphalidae	*Basilarchia*	*arthemis* (F.)	DI,MN	3
Nymphalidae	*Junonia*	*coenia* (Hubner)	MN	3
Nymphalidae	*Phyciodes*	*tharos* (Drury)	MN	6
Nymphalidae	*Speyeria*	*cybele* (F.)	DI	1
Nymphalidae	*Vanessa*	*atalanta* (Fruhstorfer)	DI	1
Papilionidae	*Eurytides*	*marcellus* (Cramer)	DI	1
Papilionidae	*Papilio*	*troilus* L.	DI	1
Pieridae	*Eurema*	*nicippe* (Cramer)	DI	1
Pyralidae	*Desmia*	*funeralis* (Hubner)	LT	1
Pyralidae	*Herculia*	*infimbrialis* Dyar	DI,LT	15
Pyralidae	*Herculia*	*olinalis* (Guenee)	LT	1
Pyralidae	*Herpetogramma*	*thestialis* (Walker)	LT	1

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Lepidoptera				
Pyralidae	*Hypsopygia*	*costalis* (F.)	LT	1
Pyralidae	*Spoladea*	*recurvalis* (F.)	LT	1
Saturniidae	*Actias*	*luna* (L.)	DI	1
Saturniidae	*Anisota*	*stigma* (F.)	LT	6
Saturniidae	*Automeris*	*io* (F.)	LT	1
Saturniidae	*Callosamia*	*angulifera* (Walker)	LT	1
Saturniidae	*Citheronia*	*regalis* (F.)	LT	1
Saturniidae	*Dryocampa*	*rubicunda* (F.)	LT	42
Satyridae	*Cyllopsis*	*gemma* (Hubner)	DI	4
Satyridae	*Enodia*	*anthedon* Clark	DI,SW	2
Satyridae	*Hermeuptychia*	*sosybius* (F.)	DI	1
Tortricidae	*Sparganothis*	*reticulatana* (Clemens)	FG	1
Hymenoptera				
Anthophoridae	*Xylocopa*	*virginica* (L.)	DI	1
Apidae	*Apis*	*mellifera* L.	DI	1
Chrysididae	*Chrysis*	*coerulans* F.	DI,MN	2
Colletidae	*Hylaeus*	species 1	MN	1
Cynipidae	Genus	species 1	FG,SW	5
Diapriidae	Genus	species 1	SW	9
Diapriidae	Genus	species 2	BT,SW	3
Formicidae	*Aphaenogaster*	*fulva* Roger	DI,FG,PF,SW	112
Formicidae	*Aphaenogaster*	*lamellidens* Mayr	BT,PF,SW	122
Formicidae	*Aphaenogaster*	*rudis* (Emery)	PF	3
Formicidae	*Aphaenogaster*	species 1	PF	7
Formicidae	*Aphaenogaster*	species 1	FG	2
Formicidae	*Aphaenogaster*	*tennesseensis* (Mayr)	FG,PF	19
Formicidae	*Aphaenogaster*	*texana* Wheeler	PF,SW	10
Formicidae	*Camponotus*	*ferrugineus* (F.)	BT,DI,FG,PF, SW	95
Formicidae	*Camponotus*	*nearcticus* Emery	FG	50
Formicidae	*Camponotus*	*pennsylvanicus* (DeGeer)	DI,FG,LT,PF	50
Formicidae	*Camponotus*	*rasius* Wheeler	FG,PF,SW	50
Formicidae	*Camponotus*	species 1	PF	2
Formicidae	*Camponotus*	species 1	DI,LT	3

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Hymenoptera				
Formicidae	*Crematogaster*	*lineolata* (Say)	BT,FG,SW	15
Formicidae	*Crematogaster*	species 1	ML	1
Formicidae	*Dolichoderus*	*mariae* Forel	SW	4
Formicidae	*Formica*	*pallidefulva* Emery	FG,PF,SW	8
Formicidae	*Formica*	*rubicunda* Emery	FG,PF,SW	14
Formicidae	*Formica*	*schaufussi* Mayr	MN,PF	6
Formicidae	*Formica*	species 1	SW	1
Formicidae	*Lasius*	*alienus* (Foerster)	PF,SW	3
Formicidae	*Lasius*	*umbratus* (Nylander)	PF	1
Formicidae	*Leptothorax*	species 1	FG	1
Formicidae	*Myrmecina*	*americana* (Emery)	FG,PF	2
Formicidae	*Myrmica*	*punctiventris* Roger	FG	3
Formicidae	*Paratrechina*	*melanderi* (Wheeler)	ML,PF,SW	29
Formicidae	*Paratrechina*	*parvula* (Mayr)	BT,PF,SW	5
Formicidae	*Ponera*	*coarctata* Buckley	PF	3
Formicidae	*Ponera*	species 1	FG,LT	2
Formicidae	*Prenolepis*	species 1	PF,SW	8
Formicidae	*Prenolepsis*	*imparis* (Say)	FG,PF,SW	253
Formicidae	*Tapinoma*	*sessile* (Say)	FG,PF,SW	15
Formicidae	*Tetramorium*	*caespitum* (L.)	PF	1
Formicidae	*Wasmannia*	*auropunctata* (Roger)	SW	1
Halictidae	*Augochlorella*	species 1	DI	1
Halictidae	*Sphecodes*	species 1	SW	1
Ichneumonidae	*Ophion*	species 1	SW	2
Mutillidae	*Dasymutilla*	*occidentalis* (L.)	DI	1
Pelecinidae	*Pelecinus*	*polyturator* (Drury)	DI,SW	4
Platygastridae	Genus	species 1	LI	5
Scoliidae	*Scolia*	*bicincta* F.	DI	3
Sphecidae	*Chlorion*	*ichneumoneum* L.	DI	1
Sphecidae	*Eremnophila*	*aureonotata* (Cameron)	DI,MN	2
Sphecidae	*Trypoxylon*	*lactitarse* Saussure	MN	1
Sphecidae	*Trypoxylon*	species 1	MN	1
Tiphiidae	*Tiphia*	species 1	SW	3
Vespidae	*Polistes*	*annularis* (L.)	DI	3

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Hymenoptera				
Vespidae	*Vespa*	*crabro* L.	DI	1
Vespidae	*Vespula*	*maculata* (L.)	DI,MN,SW	6
Vespidae	*Vespula*	*maculifrons* Buysson	DI,SW	4
Araneae				
Anyphaenidae	*Anyphaena*	species 1	BT	1
Araneidae	*Acanthepeira*	species 1	SW	1
Araneidae	*Acanthepeira*	*stellata* (Walckenaer)	SW	1
Araneidae	*Araneus*	*miniatus* (Walckenaer)	BT	1
Araneidae	*Araneus*	species 1	BT	1
Araneidae	*Eustala*	*emertoni* (Banks)	LI	1
Araneidae	*Micrathena*	*mitrata* (Hentz)	SW	4
Corinnidae	*Castianeira*	species 1	DI	1
Corinnidae	*Trachelas*	*similis* F.O.P. Cambridge	BT	1
Ctenidae	*Anahita*	*punctulata* (Hentz)	PF	1
Ctenizidae	*Myrmeciophila*	*fluviatilis* (Hentz)	PF	1
Ctenizidae	*Ummidia*	*audouini* (Lucas)	PF	1
Dictynidae	*Dictyna*	*sublata* Hentz	ML,SW	2
Gnaphosidae	*Gnaphosa*	species 1	PF	1
Linyphiidae	*Grammonota*	species 1	LI	1
Linyphiidae	*Lepthyphantes*	*nebulosa* (Sundevall)	LI	1
Linyphiidae	*Lepthyphantes*	*sabulosa* (Keyserling)	PF	1
Linyphiidae	*Pityohyphantes*	species 1	BT	1
Lycosidae	*Pardosa*	species 1	SW	1
Lycosidae	*Pirata*	species 1	LI	1
Lycosidae	*Schizocosa*	*ocreata* (Hentz)	PF	2
Philodromidae	*Philodromus*	*placidus* Banks	SW	1
Philodromidae	*Philodromus*	species 1	SW	2
Salticidae	*Hentzia*	species 1	BT	1
Salticidae	*Pelegrina*	species 1	SW	1
Salticidae	*Sassacus*	species 1	SW	1
Salticidae	*Thiodina*	*peurpera* (Hentz)	BT,SW	2
Tetragnathidae	*Tetragnatha*	*caudata* Emerton	SW	1
Tetragnathidae	*Tetragnatha*	*laboriosa* (Hentz)	SW	5
Tetragnathidae	*Tetragnatha*	*versicolor* Walckenaer	ML	1

Table 2. Taxa and sampling method(s) for each species collected from Sinking Pond, Coffee Co., TN, 1997 and 1998 (Continued).

Order Family	Genus	species	Sampling Method*	No. of Spec.
Araneae				
Theridiidae	*Theridion*	*albidum* Banks	SW	1
Theridiidae	*Theridion*	*pictipes* Keyserling	SW	1
Thomisidae	*Synema*	*parvulum* (Hentz)	BT	1
Thomisidae	*Xysticus*	*ferox* (Hentz)	PF	2
Thomisidae	*Xysticus*	*fraternus* Banks	PF	2
Thomisidae	*Xysticus*	species 1	PF	1
Araneae unidentified			BT,FG,LI,PF, SW	2446
Opiliones unidentified			BT,FG,LT,PF, SW	110
Acari unidentified			FG,LI,PF	9162
Pseudoscorpiones unidentified			FG,LI,PF	23
Crustacea unidentified			LI,PF	523
Diplopoda unidentified			FG,DI,LI,PF, SW	43
Chilopoda unidentified			LI	1
Symphyla unidentified			LI,PF	2

* BT = beat sheeting, FG = canopy fogging, DI = direct collections, LI = leaf litter, LT = light trap, ML = malaise trap, MN = Manitoba trap, PF = pitfall trap, and SW = sweep netting.

Table 3. The taxa, percentage of species, and the number and percentage of specimens for each insect order collected from Sinking Pond, Coffee Co., TN, 1997 and 1998.

Order	No. of Families	No. of Species	% of Insect Species (n = 790)	No. of Specimens	% of Insect Specimens (n = 12,816)
Protura	1	1	0.13	31	0.24
Collembola	10	57	7.22	4,315	33.67
Diplura	1	1	0.13	6	0.05
Odonata	4	12	1.52	47	0.37
Phasmida	1	2	0.25	6	0.05
Orthoptera	5	13	1.65	115	0.90
Blattaria	1	2	0.25	42	0.33
Isoptera	1	1	0.13	1	~ 0
Plecoptera	1	2	0.25	2	0.02
Psocoptera	1	6	0.76	34	0.26
Hemiptera	18	39	4.94	373	2.91
Homoptera	10	78	9.87	482	3.76
Thysanoptera	1	2	0.25	3	0.02
Neuroptera	4	5	0.64	28	0.22
Coleoptera	52	305	38.61	5,206	40.62
Mecoptera	2	3	0.38	5	0.04
Diptera	35	118	14.94	883	6.89
Trichoptera	4	7	0.89	19	0.15
Lepidoptera	18	79	10.00	256	2.00
Hymenoptera	16	57	7.22	962	7.51

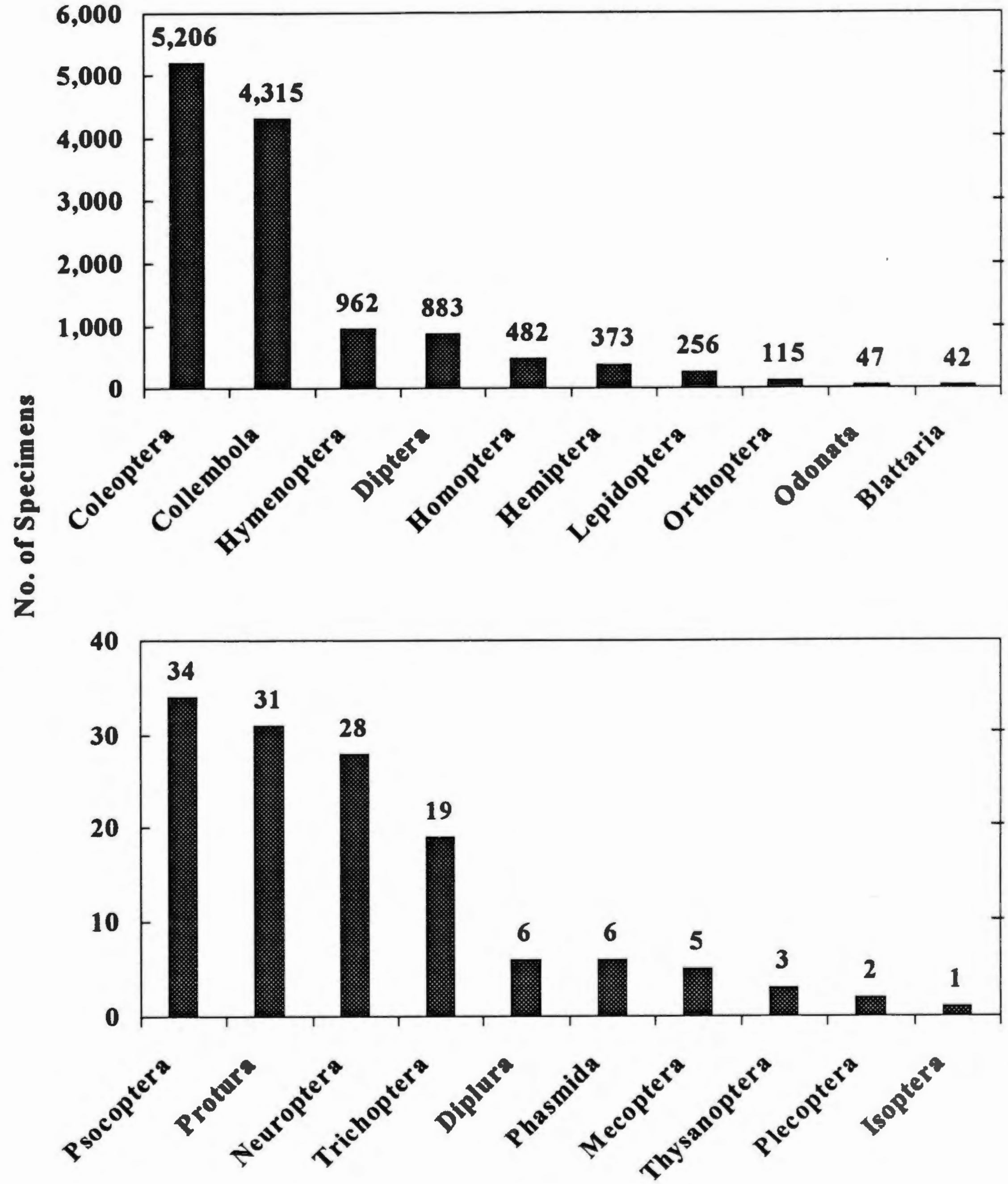

Fig. 2. Number of specimens collected per insect order from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 12,816).

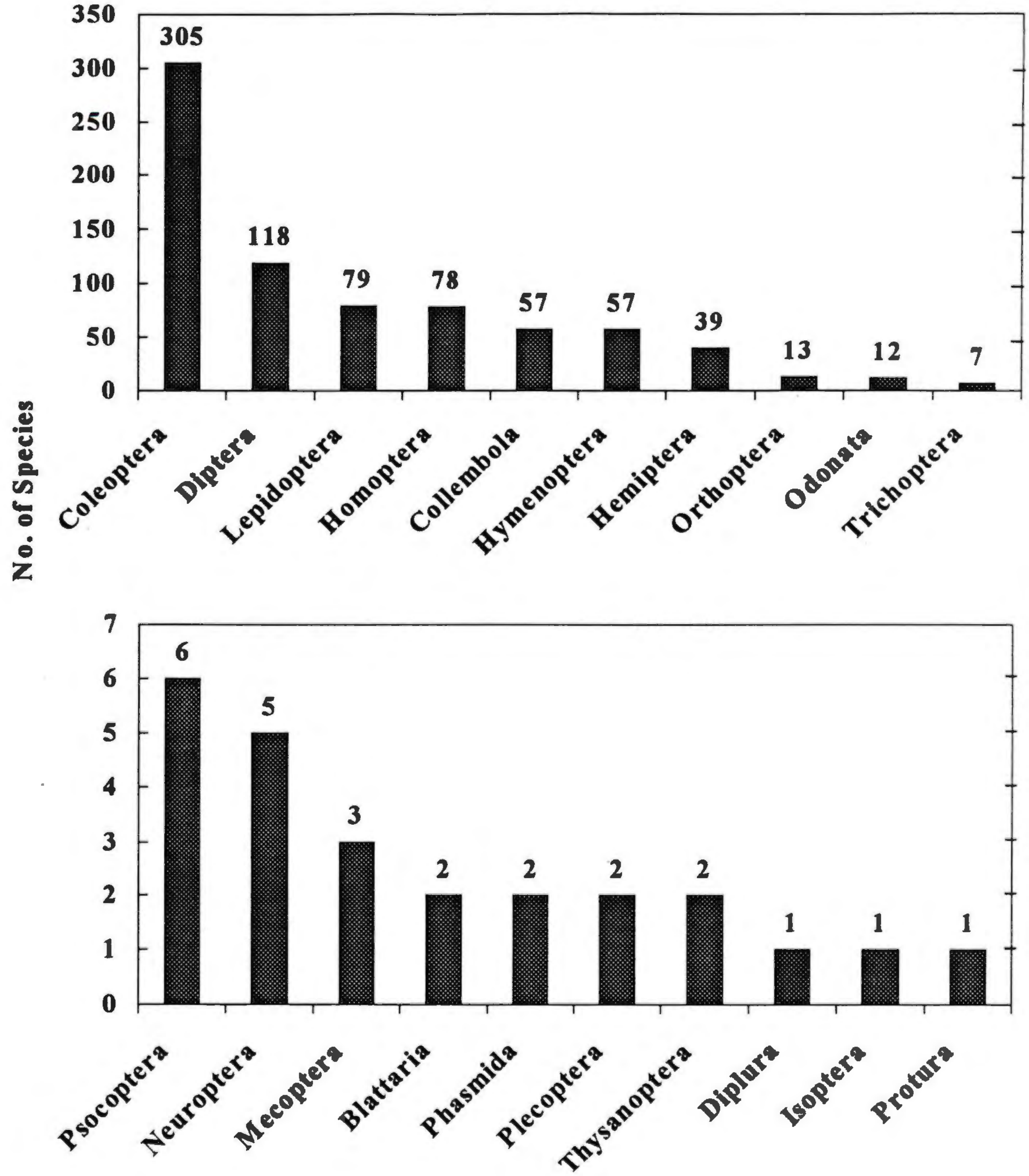

Fig. 3. Number of species identified per insect order from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 790).

Table 4. Species richness, Shannon diversity, evenness, and maximum potential diversity value for nine sampling methods combined and individually, Sinking Pond, Coffee Co., TN, 1997 and 1998.

Trap	Number of Species	H' [a]	H_{max} [b]	Evenness
Overall	826	4.69	6.72	0.69
Beat	53	3.52	3.97	0.89
Canopy Fog	120	3.29	4.79	0.69
Direct	165	4.58	5.11	0.90
Leaf Litter	64	2.88	4.16	0.68
Light	263	3.10	5.57	0.56
Malaise	44	3.13	3.78	0.82
Manitoba	29	3.19	3.37	0.95
Pitfall	138	3.09	4.93	0.62
Sweep	227	4.62	5.42	0.85

[a] H' = the Shannon index value

[b] $H_{max} = H_{maximum}$ = the maximum potential value of the Shannon index

0.69 represents a moderately high value, therefore, the H' represents about 69% of the diversity that could potentially be found in a collection of 826 species. The moderate evenness value may be the result of the combination of the sampling methods which each had varying evenness values. Values ranged from high to low, therefore, when collections were combined, an intermediate value resulted.

Species richness, the Shannon index, and evenness were calculated for each sampling method (Table 4). Each of the sampling methods captured from seven to sixteen orders (Fig. 4). The number of families (Fig. 4) and species (Fig. 5) captured varied by trap type. Light trapping captured the most species, primarily Coleoptera and Lepidoptera, followed by sweep netting, and direct collecting.

Insect Species of Interest

From the insects collected and identified from Sinking Pond, no Tennessee listed or Federally listed RTE arthropods were found. Four species, *Cicindela unipunctata* F., *Enodia anthedon* Clark, *Glaucopsyche lygdamus* (Doubleday), and *Speyeria cybele* (F.), were identified from Sinking Pond and were on one of the RTE species lists of North Carolina and Alabama. *Cicindela unipunctata* (Coleoptera: Cicindelidae) is listed in Alabama as "S?", which means its status is unknown at this time. *Enodia anthedon* (Lepidoptera: Satyridae) also was listed for Alabama, but as "SR" which refers to its having been reported from the state, but without persuasive documentation. *Glaucopsyche lygdamus* (Lepidoptera: Lycaenidae) was listed from Alabama as "SU", inferring that it is possibly in peril, but its status is uncertain. In North Carolina, this species is listed as S2S3, which means that it is either imperiled in the state due to rarity,

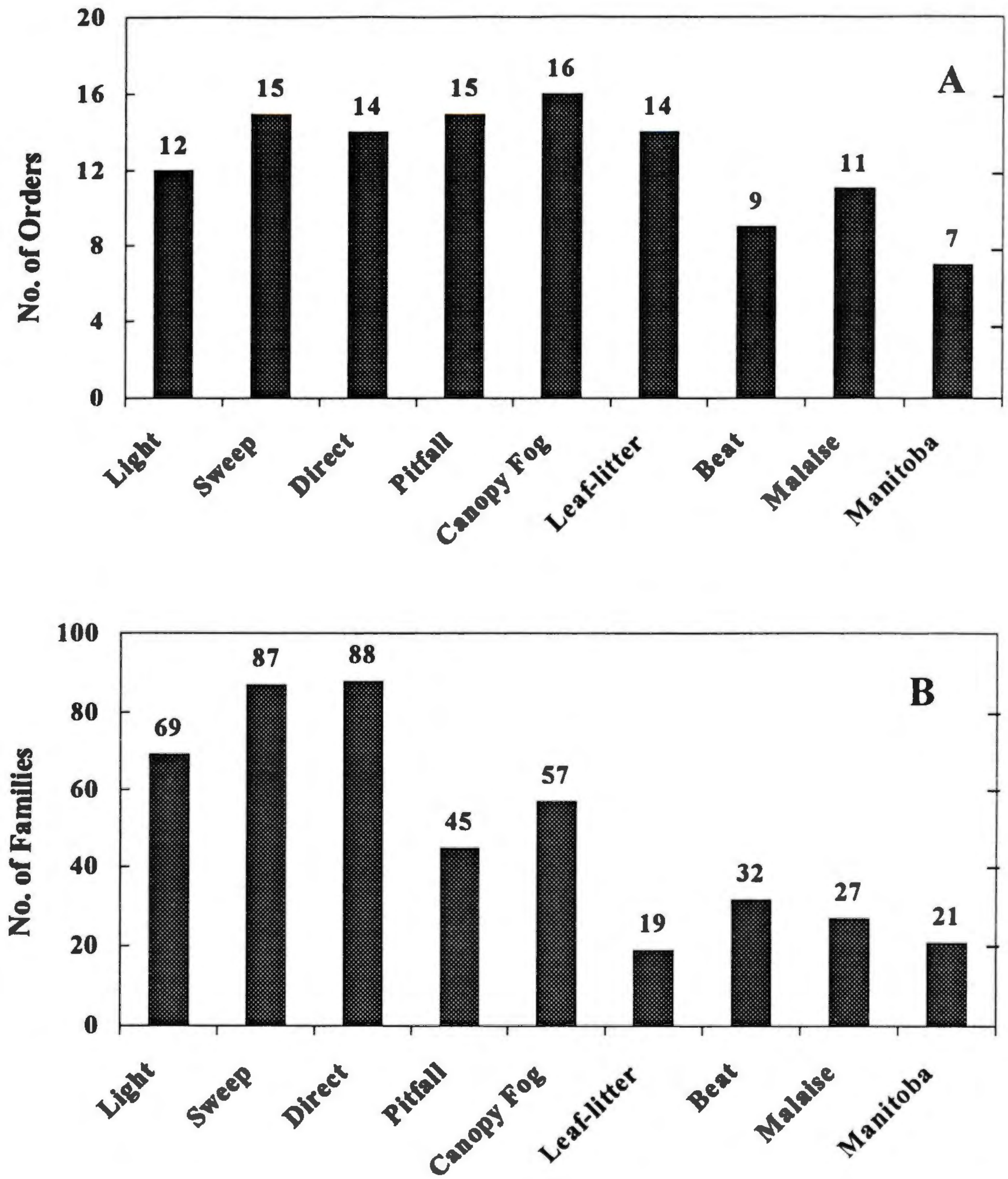

Figure 4. Number of orders (A) and families (B) captured per sampling method from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 28 and 200, respectively).

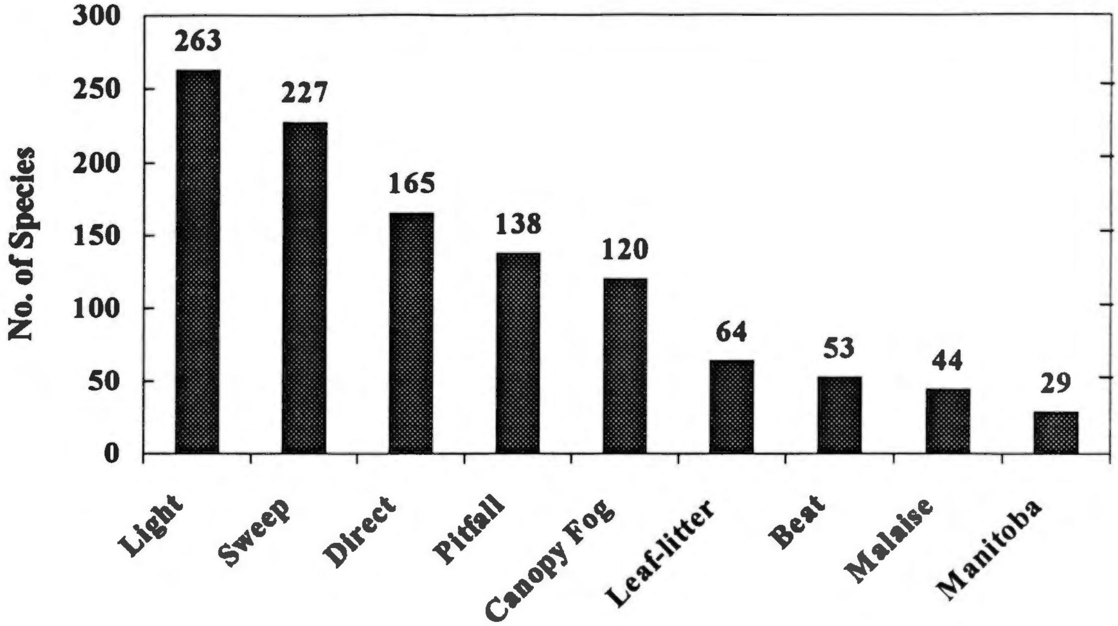

Figure 5. Number of species captured per sampling method from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 826).

or it is rare to uncommon. Also, *Speyeria cybele* (Lepidoptera: Nymphalidae) was indicated as "SU" in Alabama. However, this species is widely distributed in eastern TN.

One species, *Apteromechus texanus* Fall (Coleoptera: Curculionidae), collected has been recorded as a subtropical species (Whitehead 1979). This collection places it northeast of its recorded geographical range previously listed as Arkansas and Texas (O'Brien and Wibmer 1982). The presence of this species indicates that Sinking Pond may have a milder climate compared to surrounding areas in Tennessee.

Several beetle species were collected with recorded distributions outside of the southeastern U.S. (Downie and Arnett 1995). An Elateridae, *Ctenicera signaticollis* (Melsheimer) previously recorded from Indiana and Alabama, and an Eucnemidae, *Dirrhagofarsus lewisi* Reitter listed from Maryland and Georgia, were identified. A Helodidae, *Cyphon padi* (L.), associated with swamps and bogs in Ontario, Pennsylvania, Indiana, Florida, and Washington, was identified. A Histeridae, *Atholus nubilus* (LeConte), was reported from Indiana, Iowa, and Kansas. Two Hydrophilidae were reported from the northern U.S. and southern Canada. *Enochrous diffusus* (LeConte) was listed as far south as New York, and *Hydrochara obtusata* (Say) was listed with a similar distribution, but slightly farther south into Indiana, Ohio, and Pennsylvania. Two Staphylinidae reported with disjunct distributions were *Homaeotarsus pimerianus* (LeConte), reported from Indiana, Texas, Arizona, California, and Iowa, and *Sunius confluentus* (Say), reported from Quebec, Connecticut, New York, Indiana, and Minnesota. Three Tenebrionidae were reported with northern distributions. *Centronopus calcaratus* (F.) and *Haplandrus fulvipes* (Herbst) were listed from Connecticut, Indiana, and New York, and *Idiobates castaneous* (Knoch) was previously recorded from New York, Indiana, Pennsylvania, Maryland, and Virginia.

Other species of interest included the lepidopteran species *Fulgoraecia exigua* (Edwards) (Epipyropidae), an external parasitoid of planthoppers, and *Herculia infimbrialis* Dyar (Pyralidae), an uncommonly collected species that feeds on oaks (Covell 1984). The dipteran, *Pseudosciara forceps* (Pettey) (Sciaridae), had only been recorded previously from Florida (Steffan 1981).

Sinking Pond may be important in the maintenance of these species due to climate or other habitat characteristics that allow these species to survive. The species listed also may be indicators of the Sinking Pond's stability. Because they may depend on a particular characteristic of the Sinking Pond area, they may be sensitive to changes in the community.

Introduced Insect Species

Eight introduced species were identified in the collections from Sinking Pond. These included five beetle species: *Cyrtepistomis castaneous* (Roelofs) (Curculionidae) (the Asiatic oak weevil), *Demotina modestus* Baly (Chrysomelidae), *Coccinella septempunctata* L. (Coccinellidae), *Harmonia axyridis* (Pallas) (Coccinellidae) (the multicolored Asian lady beetle), *Popillia japonica* Newman (Scarabaeidae) (the Japanese beetle), and three hymenopterans: *Apis mellifera* L. (Apidae), and *Tertramorium caespitum* (the pavement ant) and *Wasmannia auropunctata* (Roger) (the little fire ant), both in family Formicidae. Seventy specimens of *C. castaneous* collected were widely distributed at Sinking Pond, which is suggested by their collection in several sampling methods: beat sheeting, canopy fogging, direct collecting, light trapping, malaise trapping, and sweep netting. As adults they feed on oak foliage which could cause stress to the trees. As a larva, this species feeds on the roots of trees, therefore, the inundated overcup oak community would not be affected, but the surrounding oak-dominated communities may be. There were 90 specimens of *H. axyridis* collected by four of the sampling methods (beat sheeting, canopy fogging, direct collecting, and malaise trapping). This species was imported into the United States from Asia as a biological control agent, and is now often considered a household pest as it overwinters in homes and buildings (Potter et al. 1998). The multicolored Asian lady beetle could potentially affect the Sinking Pond community by disrupting the natural proportions of the predator populations, especially if it attains large numbers. One specimen of *P. japonica* was collected. Although it is noted as a pest of lawns and grasses, the Japanese beetle adult has been reported to feed on more than 300 species of plants, and due to their ability to attain large numbers, they could injure populations of their preferred host plants if a large population became established in Sinking Pond. Also, two introduced species of ants were identified, *T. caespitum* (L.) and *W. auropunctata* (Roger). *Wasmannia auropunctata* is of neo-tropical origin and tends plant-feeding insects that secrete honeydew. *Wasmannia auropunctata* was associated with reduced species richness in tree canopies in New Caledonia, where it is also an exotic species (Guilbert 1994).

Each of the sampling methods captured 12 (malaise trapping) to 249 (light trapping) species that were not obtained in any other trap type (Table 2). Differences in the species collected by each sampling method contribute to a more complete picture of the arthropod community.

Effectiveness of Sampling Methods

Beat Sheeting collected 250 arthropod specimens representing nine orders, 32 families and 53 species (Table 2), and represented 0.55% of total insect specimens (71 of 12,816). The highest numbers of insect species were in Homoptera, Coleoptera, Diptera, and Hymenoptera, respectively (Fig. 6). The Homoptera may have been represented by the largest number, because the variety of plant species sampled may attract a more diverse herbivore fauna. A high species to specimen ratio also may have resulted from the wide variety of plant species sampled. Approximately one-half of the coleopteran species were herbivores as well. Most of the hymenopteran species present were Formicidae, which may have been foraging on plants or tending plant-feeding insects. The Shannon index for the beat sheets was 3.52 with an H maximum of 3.97 and an evenness of 0.89 (Table 4), which infers high diversity. The evenness, considered a percentage of H' for H maximum, infers that the specimens sampled in beat sheeting were 88% of estimated maximum potential diversity. The Shannon index tends to overestimate diversity when there are low numbers of specimens, therefore the H' may be inflated for this sampling method. There were 14 species (26.4% of all species sampled by this method) captured that were not found by any other sampling method.

Canopy Fogging collected 1,117 arthropod specimens representing 16 orders, 61 families, and 120 species (Table 2). The highest numbers of insect species were in the

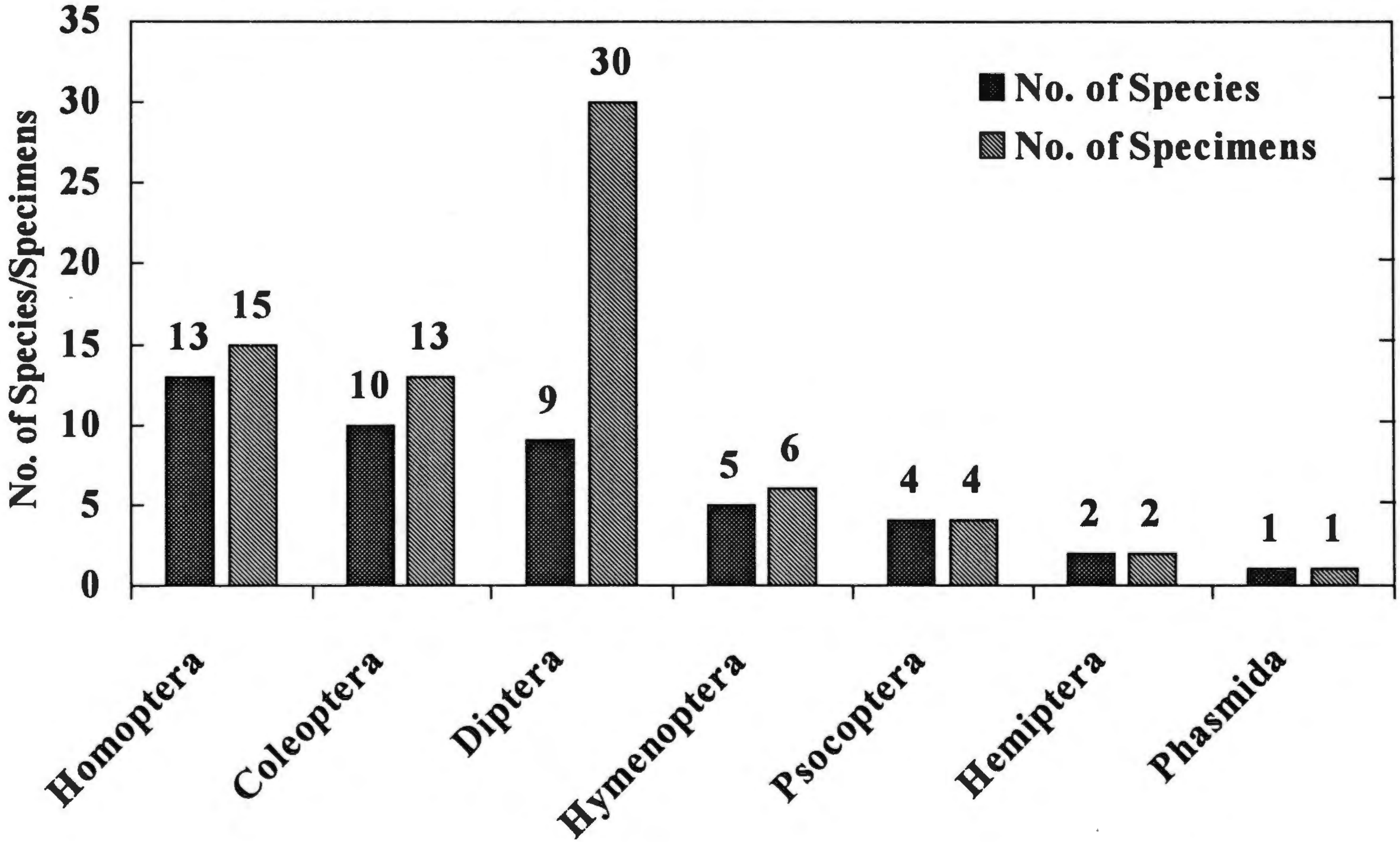

Fig. 6. Number of species and specimens per insect order collected by beat sheeting from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 44 and 71, respecitively).

orders Coleoptera, Diptera, Hymenoptera, and Homoptera (Fig. 7). The coleopteran species represented were primarily herbivorous species which may have been feeding on the trees, but there were several predatory species as well. Approximately one-half of the Diptera were associated with decay as adults or larvae, therefore, adults may use the tree canopy as a place for mating and resting. The remaining Diptera were primarily predatory and may hunt in the canopy. The majority of the Hymenoptera species collected were ants, and some of these species may inhabit the canopy. This method collected 6.45% of insect specimens. The Shannon index (H') calculated for canopy fogging was 3.29 with an H maximum of 4.79 and an evenness of 0.69 (Table 4). The diversity and evenness scores were average compared to the other sampling methods. The H' and evenness value may have been low for the number of species captured by this method, because some species were captured on only one sampling date. Fifty-eight species (49.3% of the species) captured by canopy fogging were not found by any other sampling method due to the isolated nature of the tree canopy (Table 2).

From the data examined, 14 unique families and 36 unique species were identified from the 14 October fogging sample when compared to the other Sinking Pond fogging samples. Families collected from the overcup oak canopy were significantly different ($\chi^2 = 703.26 \pm 56$ s.d., $p = 0.001$) from the families collected in the other fogging samples. Species composition could not be tested for significance because of too many species being represented on only one or a few sampling dates and the lack of replication of fogging samples on this sampling date. Without additional sampling it is unclear whether

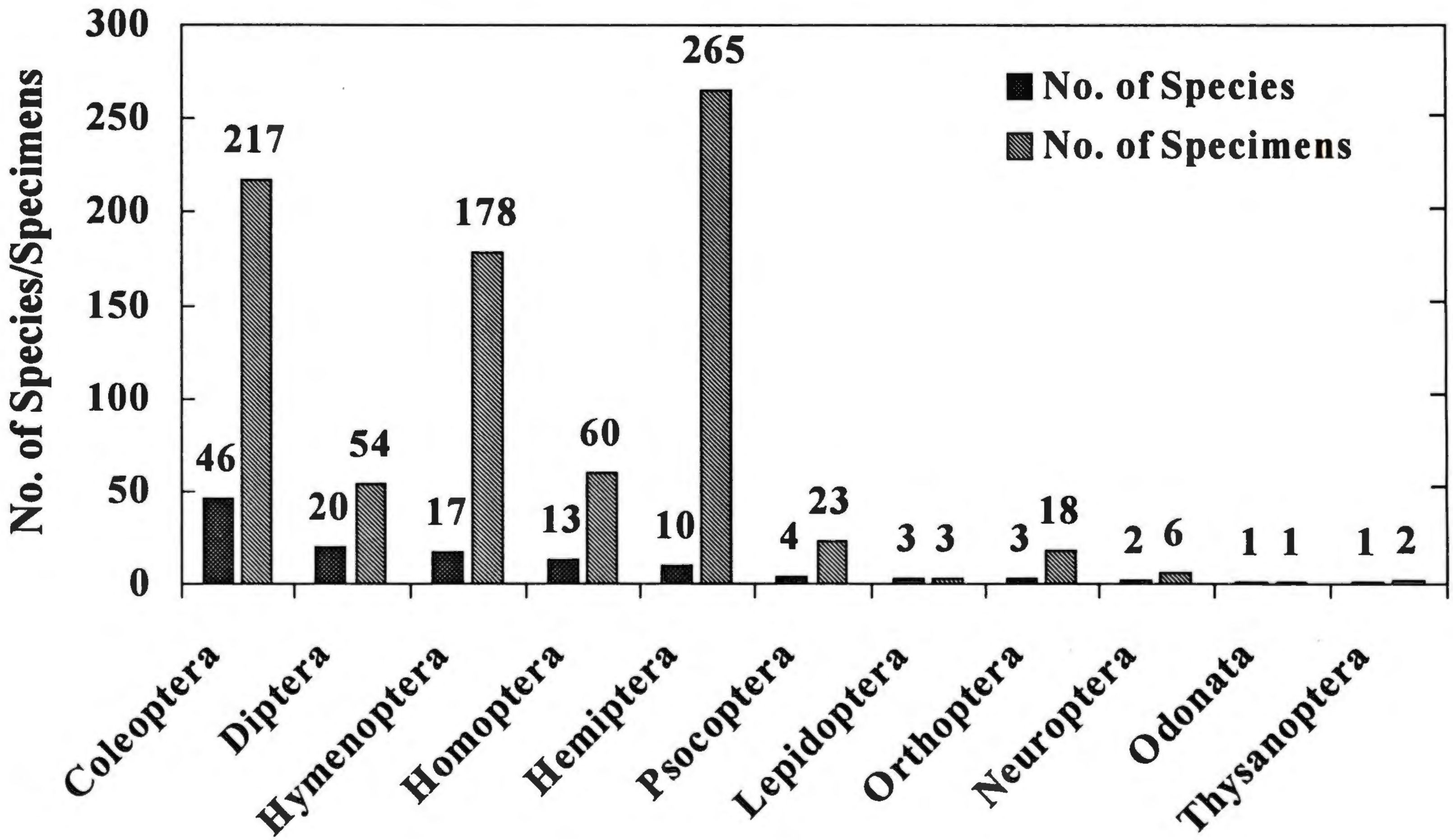

Fig. 7. Number of species and specimens per insect order collected by canopy fogging from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 120 and 827, respectively).

differences between fogging collections were a result of differences in collection date or the tree species the specimens were collected from..

Direct collections obtained 361 arthropod specimens representing 14 orders, 88 families, and 165 species (Table 2). The highest number of species collected were in the orders Coleoptera, Diptera, Lepidoptera, and Hymenoptera (Fig. 8). Direct collections may have captured a large number of coleopteran species due to the diverse array of habitats they occupy, the large number present, and the ease with which they can usually be collected. Coleopterans collected included detritivores, carrion feeders, predators, herbivores, and wood-boring species. Species of Diptera collected tended to be the larger, more obvious species, but they represented a variety of niches. The Lepidoptera most likely represented a large proportion of the species collected because most of the butterflies, as well as many of the large colorful moths, were collected in this manner. Direct collecting accounted for 2.68% of the insect specimens obtained. The Shannon index (H') for direct collections was 4.58 with an H maximum of 5.11, and an evenness of 0.90 (Table 4). The Shannon index value for this sampling method was the second highest obtained when compared to the eight other methods. Direct collections were artificially biased, because sampling was conducted to acquire new species, not just to randomly accumulate specimens. Direct collections captured 113 species (68.5% of insect and non-insect species sampled by this method) that were not found by any other sampling method, which equaled more unique species than those captured by the other sampling methods (except for sweep netting and light trapping) (Table 2).

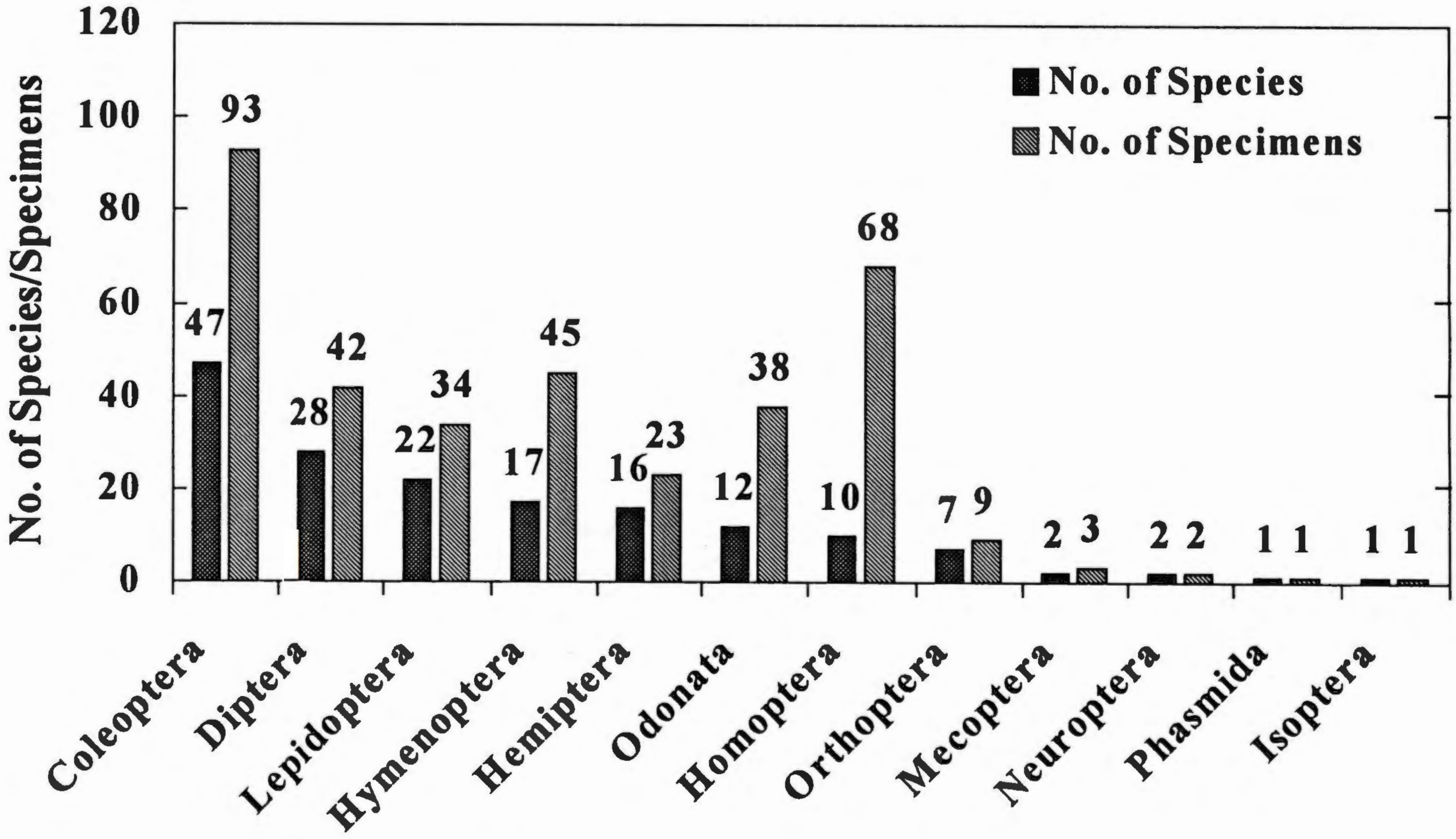

Fig. 8. Number of species and specimens per insect order collected by direct collecting from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 165 and 359, respectively).

From **leaf-litter** samples, 12,158 arthropod specimens were collected, the majority was Acari (mites) consisting of 9,099 specimens (about 38.0% of specimens from all methods) (Fig. 9 and Table 1). Three times as many mite specimens were collected compared to the two largest insect orders Collembola and Coleoptera (Fig. 9). All three of these groups are important detritus and fungus feeders in the leaf litter, although some are predatory, and contribute to the maintenance of humus and soil. The collembolan populations are often large, as there are as many as 100,000 per m^3 of soil (Borror et al. 1989). Leaf-litter samples collected 14 insect and non-insect orders representing 19 families and 64 species, and represented 50.8% of all specimens. The Shannon index (H') for this method was 2.88 with an H maximum of 4.16, and an evenness of 0.68 (Table 4). Leaf-litter samples had the lowest diversity score for any of the sampling methods, probably because of the large amount of variation in numbers of specimens per species. Forty-eight of the 60 identified species were found to be unique to this sampling method (Table 2). The high proportion of unique species found in the samples may be because many of these species spend their entire life cycle in leaf litter, and they are not generally collected by other methods. Additionally, many of these species also are sensitive to dessication, especially the soft-bodied Collembola.

Light Trapping collected 4,443 arthropod specimens from 12 orders, 69 families, and 263 species (Table 2). This method collected 34.6% of insect specimens. The three dominant insect orders by number of species were Coleoptera, Lepidoptera, and Homoptera (Fig. 10). The Shannon index (H') for light trap samples was 3.10 with an H

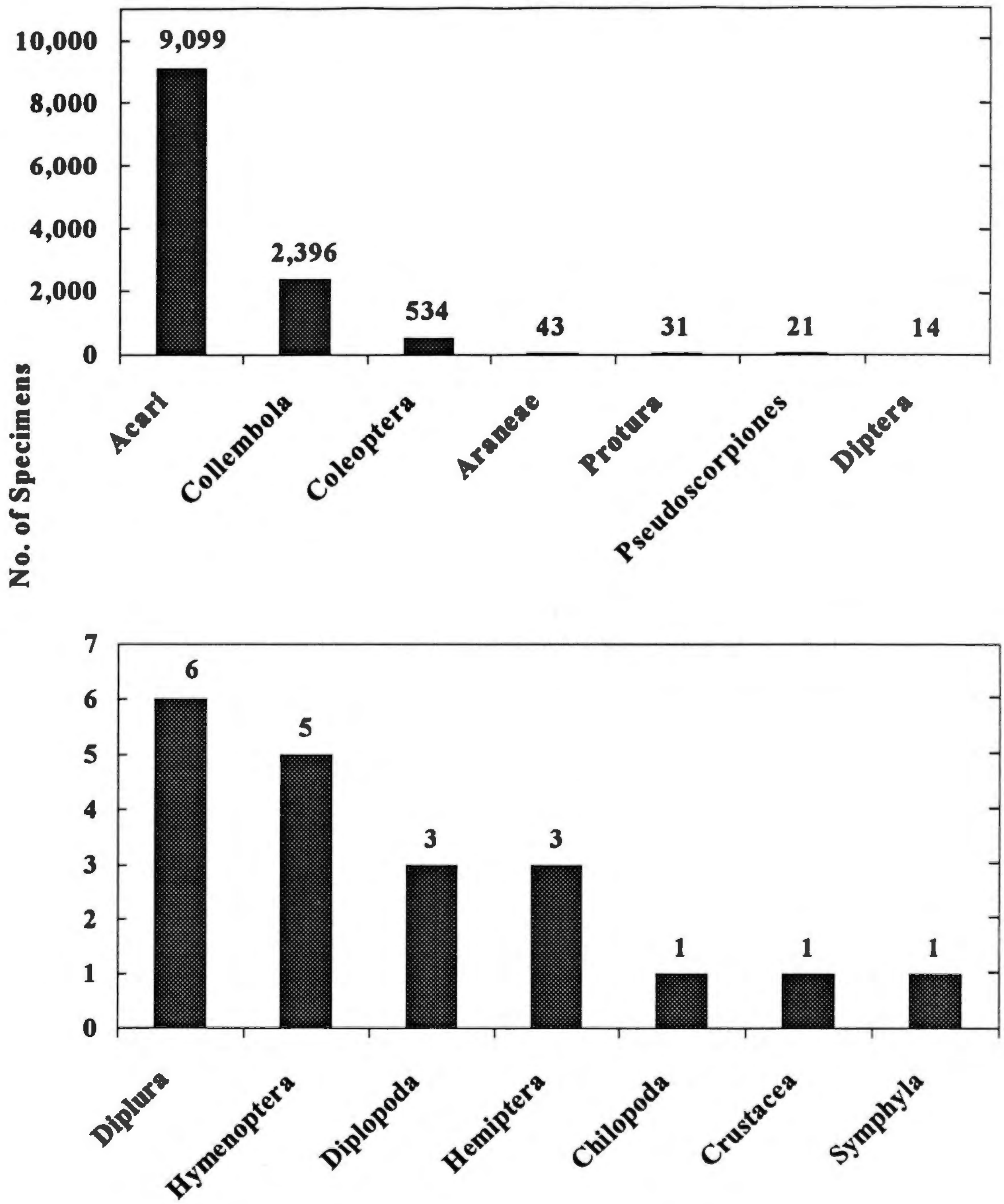

Figure 9. Number of specimens per order collected by leaf-litter samples from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 12,158 specimens).

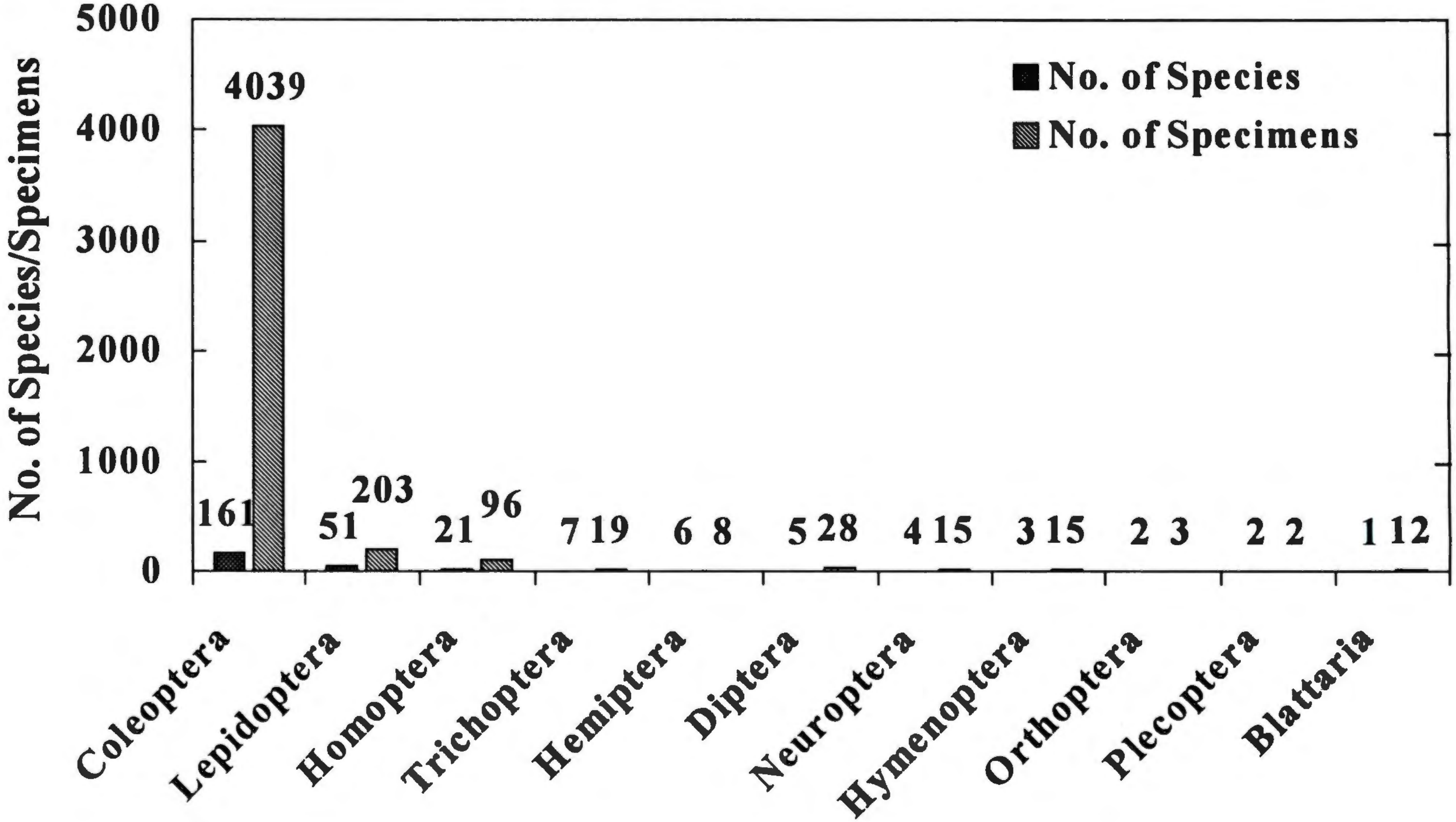

Fig. 10. Number of species and specimens per insect order collected by light traps from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 263 and 4,440, respectively).

maximum of 5.57, and an evenness of 0.56 (Table 4). Light trap collections had the highest species richness, but had the second lowest diversity score and the lowest evenness score. These seeming contradictions are likely due to the large numbers of specimens of certain taxa that are attracted to light traps, and that these peaks usually occurred on only one sampling date. There were 249 species (94.7% of the species) captured by light trapping that were unique to this sampling method (Table 2). The large number of species exclusive to this sampling method may indicate that many of the specimens were Lepidoptera (61 species) and aquatic beetles (26 species in the families: Dytiscidae, Gyrinidae, Haliplidae, and Hydrophilidae) that were not collected by the other sampling methods. Other aquatic specimens of Plecoptera, Trichoptera and Neuroptera also were sampled primarily by this method.

The **malaise trap** collected 105 arthropod specimens representing 11 orders, 27 families, and 44 species (Table 2). This method collected 0.80% of insect specimens (Fig. 11). The small number of specimens collected using this sampling method suggests that there were not many insects flying along the edge of the pond, which may be due to several factors. There was sparse vegetation along the edge of the pond, therefore, many species may not have been attracted to the area. Also, the pond was patrolled by Odonata for the majority of the sampling season, and they may have reduced the number of species in the area, but they were not captured by this method. The Orders represented by the largest number of species were Diptera, Homoptera, and Coleoptera (Fig. 11). Diptera may have represented the majority of the species collected because the trap was placed near the moist edge of the pond where there was sparse vegetation. Therefore, most of

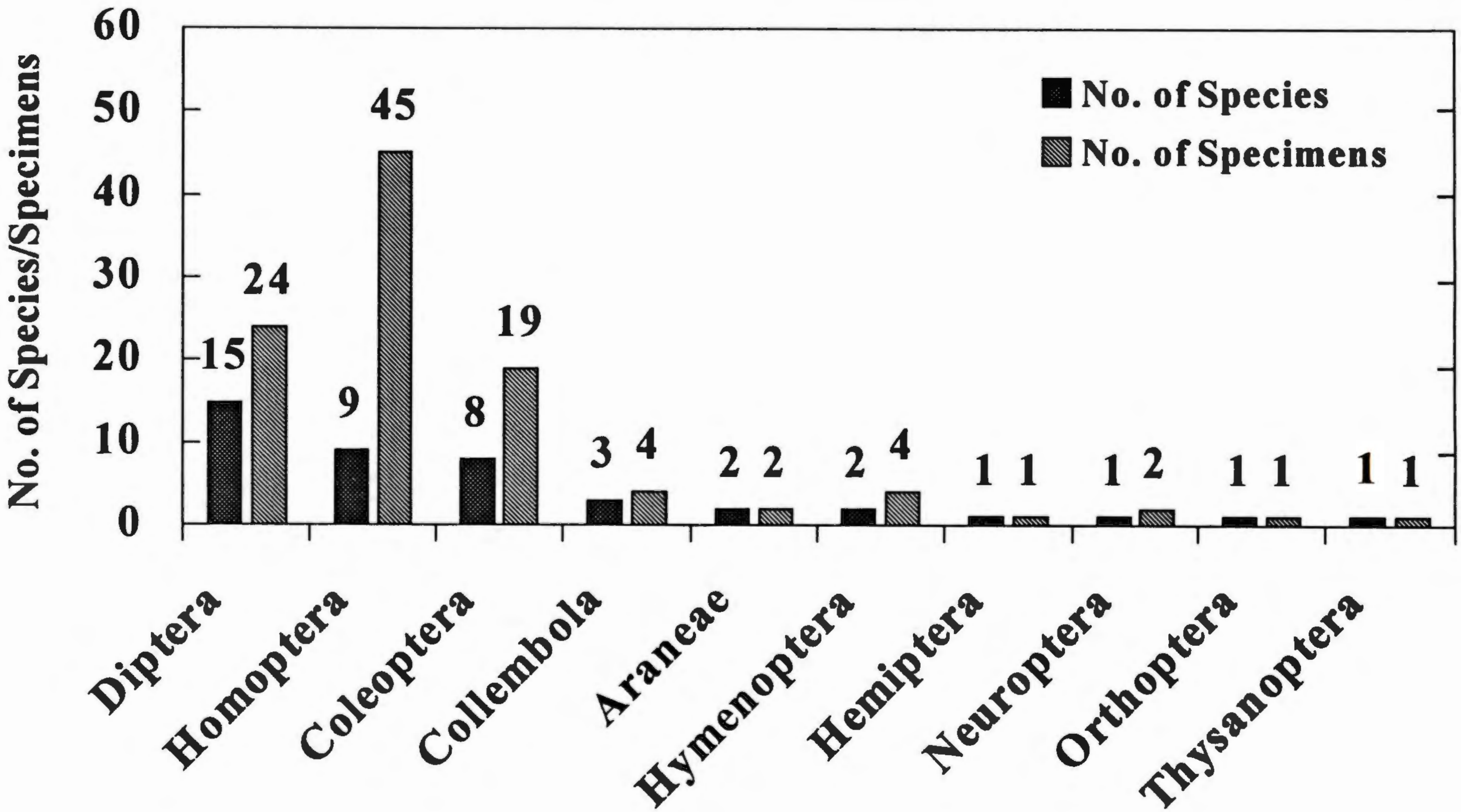

Fig. 11. Number of species and specimens per insect order collected by malaise traps from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 43 and 103, respectively).

the dipteran species collected are generally associated with decay and fungus, although two Tabanidae species were collected. Because the trap was generally placed in areas of sparse vegetation, the homopteran species collected may have been associated with the tree canopies or captured as they moved to a new area to feed. The Shannon index (H') for the malaise trap was 3.13 with an H maximum of 3.78, and an evenness of 0.82 (Table 4) which infers high diversity, but the Shannon index tends to be biased when there are a small number of specimens. Therefore, the diversity may be overestimated. The malaise trap collected 12 species (insect and non-insect) that were not found by any other sampling method (Table 2).

The **Manitoba trap** collected 49 arthropod specimens representing 7 orders, 21 families, and 29 species (Table 2). The three orders with the highest number of species were: Diptera, (the order the trap was designed to collect, or more specifically Tabanidae), Hymenoptera, and Lepidoptera (Fig.12). Although diptera were represented by the largest number of species, only three of them were Tabanidae. This trap type is intended to be placed in an open, sunny area to heat the black plastic, which serves as an attractant for Tabanidae and other blood-feeding insects. In Sinking Pond, no area receives sunlight continuously throughout the day, therefore, the effectiveness of the trap was reduced. This method collected 0.38% of all insect specimens. The Shannon index (H') for the Manitoba trap was 3.19 with an H maximum of 3.37 and an evenness of 0.95 (Table 4) which infers high diversity, but this value may be artificially high because the Shannon index tends to be biased when small numbers of specimens are collected. Each species was represented by a similar number of specimens (six or fewer), which also results in a

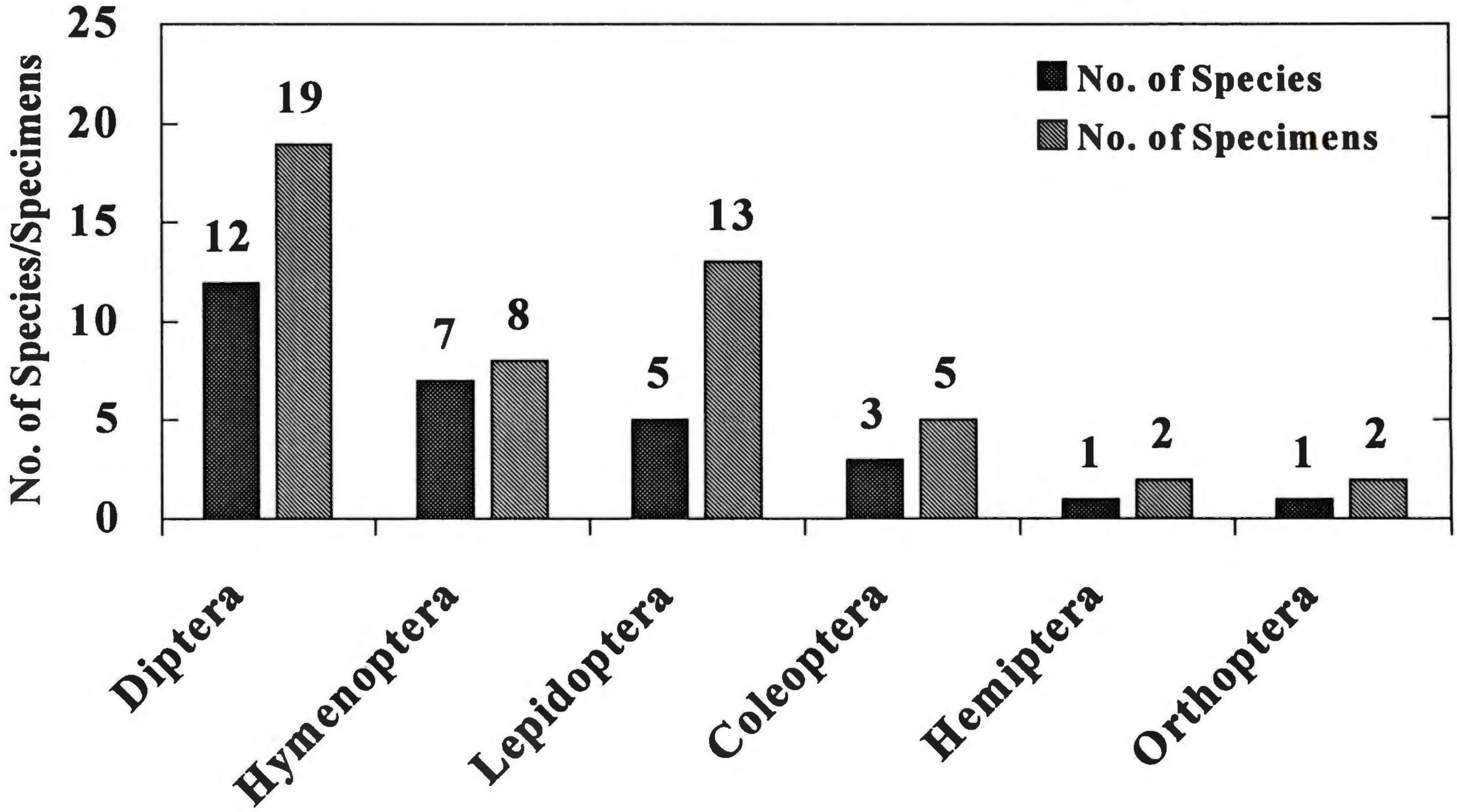

Fig. 12. Number of insect species and specimens per insect order collected by Manitoba traps from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 29 and 49, respectively).

higher evenness score. The Manitoba trap collected 15 species (51.7% of the insect species sampled by this method) that were not found by any other sampling method (Table 2). The large proportion of unique species attributed to this method and were not blood-feeders may indicate that some species were attracted to it because of its warmth, or as potential shelter, where the insects were then captured.

The **pitfall traps** collected 4,040 arthropod specimens representing 15 orders, 45 families, and 138 species (Table 2). The orders represented by the largest number of species were Coleoptera, Diptera, and Hymenoptera (Fig. 13). The Coleoptera were represented by a large number of Carabidae, Staphylinidae, and Scarabaeidae species, which are generally associated with ground level habitats. The carabids and staphylinids are a major component of the predatory ground fauna, while the scarab beetles tend to feed on detritus and dung. A large number of dipteran species are associated with moisture and decay at the ground level, as demonstrated by the large number of species captured by pitfall traps. The Hymenoptera were represented by a large number of species because many ants live and forage on the ground. This method collected 24.4% of insect specimens. The Shannon index (H') for this method was 3.09 with an H maximum of 4.93, and an evenness of 0.62 (Table 4). The large number of species collected combined with low specimen numbers for most species and large numbers for a few may have resulted in the intermediate H' value and low evenness value. Pitfall traps collected 62 species (44.9% of the insect and non-insect species sampled by this method) that were not found by any other sampling method. Species unique to pitfall traps may represent groups

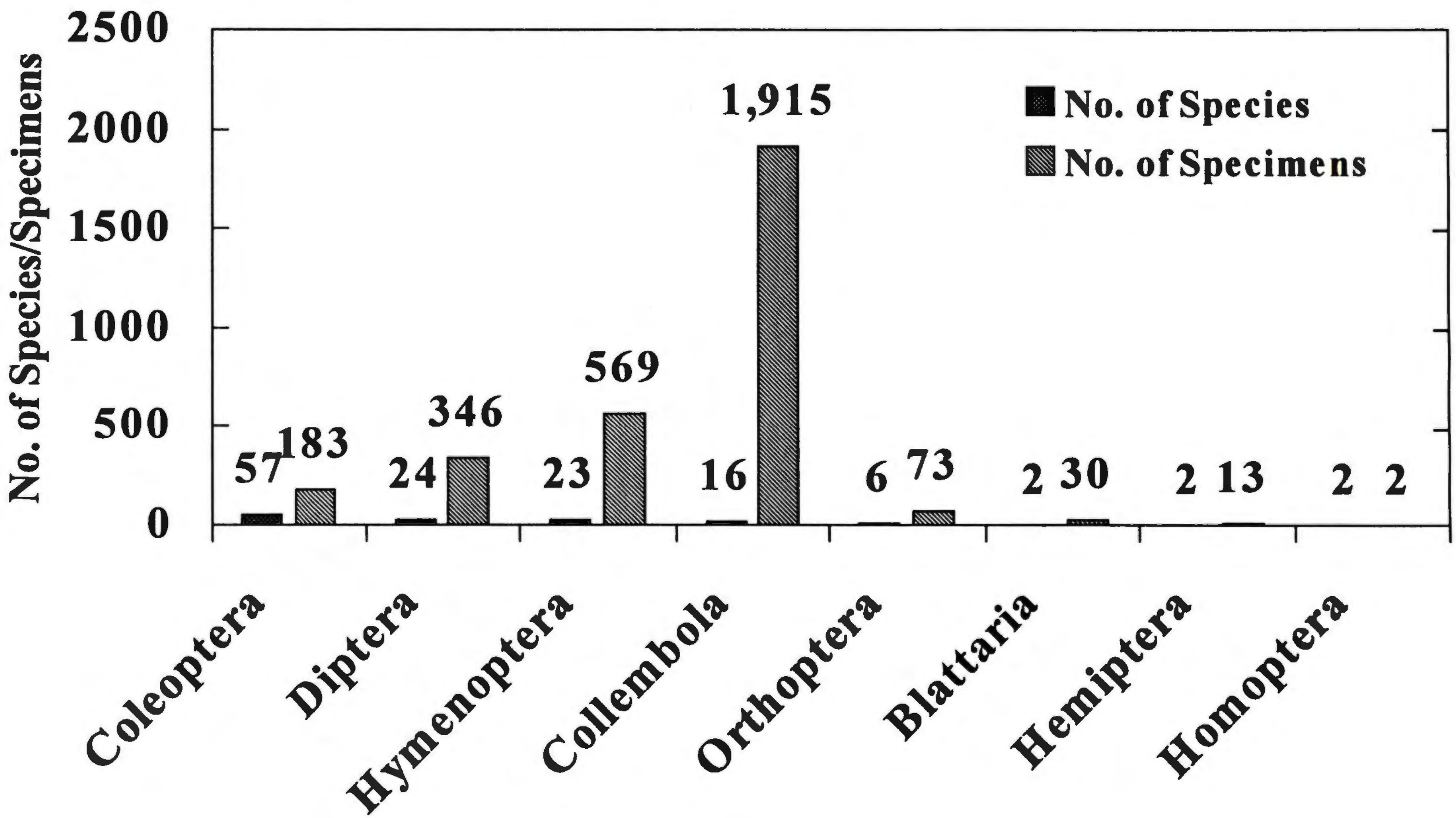

Fig. 13. Number of species and specimens per insect order collected by pitfall traps from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 132 and 3,131, respectively).

that are poor fliers, not attracted to lights, and not generally found on vegetation; species exhibiting these behaviors would not usually be sampled by the other methods.

Pitfall traps number 22, 23, 25, 31, and 49 were maintained throughout the sampling period. Comparisons between species lists revealed several differences between traps (Table 2, Appendix 3). Pitfall trap number 22 and 25 were identified as being in the same community type (white oak-(mockernut hickory, shagbark hickory)-(willow oak)/sweetgum). Twenty-four species were shared between these two traps, but pitfall trap number 22 had 34 species not found in pitfall trap 25, while pitfall trap number 25 had 27 unique species. More extensive and continued sampling would be necessary to establish differences between the tentative community types, due to the limited sampling conducted in each type of community. Eighteen species were caught in at least five of the 10 traps. Seven species were apparently widespread in Sinking Pond near or on the ground, as they were captured in several pitfall traps. Two species, *Nemobius fasciatus* DeGeer and *Parcoblatta bolliana* Saussure and Zehnter, were collected in all but one, and two (*Aphaenogaster lemellidens* Mayr and *Dohrniphora* sp.) species were caught in all ten pitfalls. Six species (*N. fasciatus, Camponotus ferrugineus* (F.), *Camponotus pennsylvanicus* (DeGeer), *Aphaenogaster fulva* Roger, *Aphaenogaster lamellidens* Mayr, and *Dohrniphora* sp.) were caught in the five pitfall traps that were maintained for the length of the study. When each individual pitfall trap is considered and all ten pitfalls are included, at least one species that did not occur in the other pitfall traps was collected from each trap (Appendix C). Because each pitfall trap caught between one and 17 unique species (an average of 7.6), a larger number of pitfall traps placed in other locations in Sinking Pond may have collected more species.

Sweep netting collected 1,406 arthropod specimens representing 15 orders, 87 families, and 227 species (Table 2). The orders represented by the largest numbers of specimens were Diptera, Homoptera, and Coleoptera (Fig. 14). The majority of the dipteran species was in two families associated with decomposition and fungus, the Muscidae and Mycetophilidae. Species of these two families may use the vegetation near the pond as a place to rest and participate in mating activities. A variety of homopterans, especially Cicadellidae, were collected. Species of this group were probably feeding on the vegetation. This method collected 6.61% of the insect specimens. The Shannon index (H') for the sweep net collections was 4.62 with an H maximum of 5.42, and an evenness of 0.85 (Table 4). This collection method sampled the highest species richness and resulted in the highest H' value. These values were largely due to the high number of species collected in combination with each species being captured in fairly low numbers. A large number of species may have been collected by this method because of the wide variety of plant species sampled by sweep netting. Sweep netting collected 115 species (50.6% of insect and non-insect species sampled with this method) that were not found by any other sampling method (Table 2).

Each sampling method collected a slightly different group of species and, therefore, sampled a different part of the overall diversity of the area. The combination of the sampling methods resulted in a more comprehensive collection of the arthropod community.

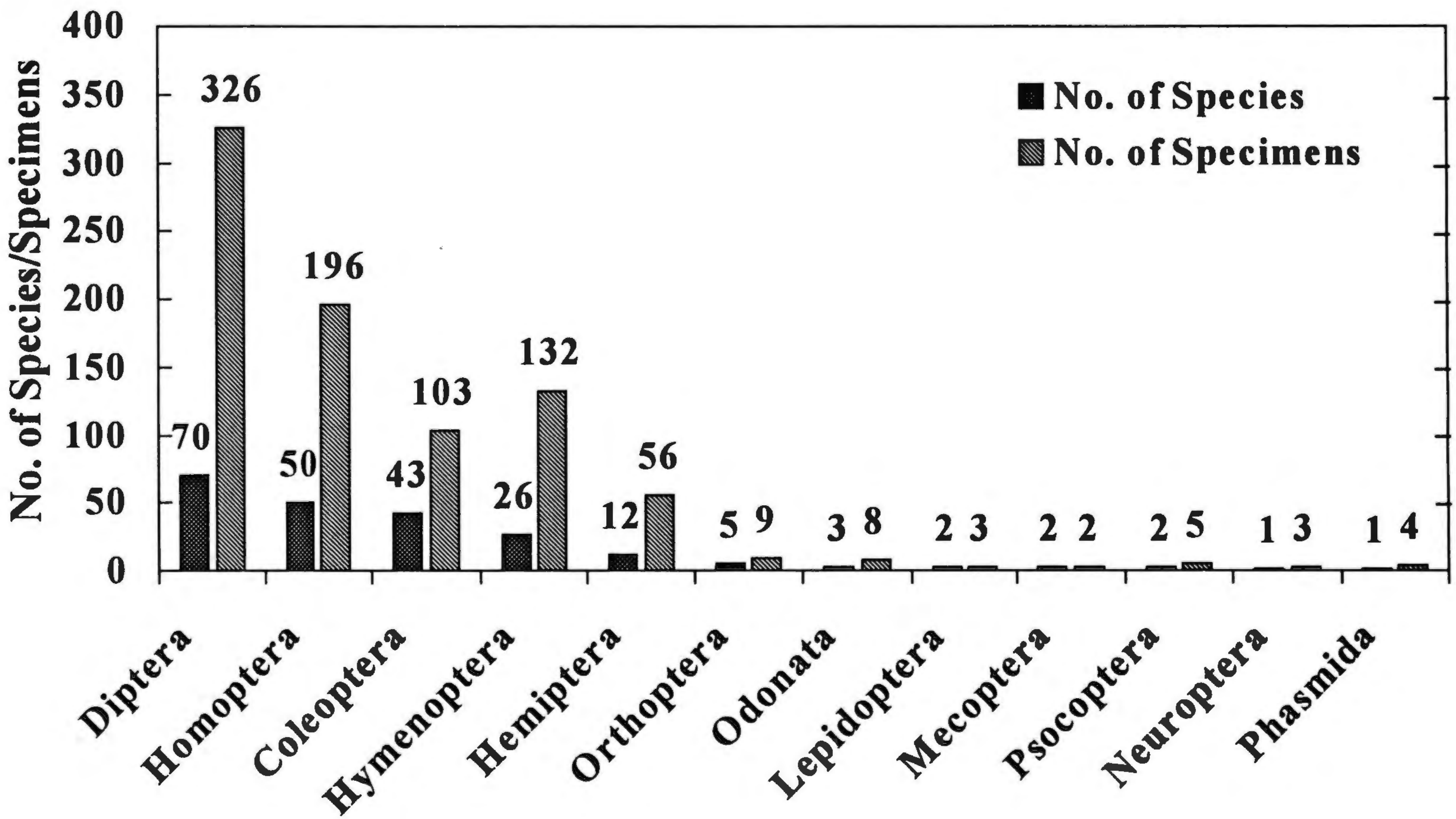

Fig. 14. Number of species and specimens per insect order collected by sweep netting from Sinking Pond, Coffee Co., TN, 1997 and 1998 (n = 217 and 847, respectively).

The Shannon index assigns the highest diversity scores to the data set with the highest number of species and with the different species spread out evenly among the samples. For example, the light traps and the sweep net samples had similar species richness (262 and 230, respectively) and similar H_{max} values. Because of differences in the proportions of species collected by each sampling method (the light trap often attracts large numbers of fewer species, while smaller numbers of individual species are sampled with sweep netting) each sampling method has a different evenness score. The large amount of variance in the number of specimens captured per species for the light trap samples results in a much lower evenness value. Evenness is essentially the percentage of H' of $H_{MAX,}$ therefore, evenness can be interpreted as the percentage of the highest possible diversity score for n number of species achieved by the calculated diversity score. The data set representing light trap collections had an evenness score of 0.56. Therefore, the calculated diversity value was slightly more than one-half of the potential diversity of a data set with 262 species. The Shannon index is biased at low specimen numbers, often giving a higher diversity score than is warranted. Thus, the diversity scores of the collections from the Manitoba trap, beat sheets, and malaise traps may have been overestimated.

Each method was useful in sampling some species of insects that would have been otherwise overlooked. Leaf-litter collections captured the largest number of specimens consisting of Acari and Collembola, respectively. Light trap and pitfall trap collections were represented by the next largest numbers of specimens. The light trap and sweep net samples collected the largest number of species. The largest number of species collected which were unique to a sampling method were found in the light trap samples, followed by sweep net and direct collections. Light trapped specimens were 95.0% unique to that trap type, followed by sweep net (50.7%) and direct collections (69.1%). The highest Shannon index value, and therefore the highest calculated diversity, was attained by sweep netting and direct collecting. The malaise trap and Manitoba trap caught the lowest number of unique specimens (less than 16 unique species). All of the remaining methods collected at least 25 unique species. Based on the comparisons of the collections, number of species, number of species unique to each method, and calculated diversity, sweep net sampling appear to be the most valuable sampling method used, followed by direct, light, and canopy fogging collections.

Insect Orders

Protura were only captured in leaf-litter samples (0.13% of all specimens). Proturans are often found associated with moist soil or decomposing plant material. They feed on the organic matter and fungal spores they found in this habitat (Borror et al. 1989).

Collembola, 10 families containing 57 species, were well represented in the leaf litter. When leaf litter is included, Collembola represented 18.0% of all specimens. Without leaf litter, they represented 8.0% of the specimens. The dominant springtail species collected were: 388 *Lepidocyrtus cinereus* Folsom (Entomobryidae), 214 *Isotomodes minor* (Schaffer) (Isotomidae), 182 *Tullbergia yosiii* Rusek (Onychiuridae), 141 *Proisotoma minima* (Absolon) (Isotomidae), and 123 *Hypogastrura* sp.

The **Diplura** contained one family, Japygidae, that was collected from leaf-litter samples. There was one species identified as *Parajapyx isabellae* (Grassi).

The **Odonata** were almost exclusively captured by direct collecting. Four families (Aeshnidae, Coenagrionidae, Lestidae, and Libellulidae) and twelve species were identified, which represented 0.20% of the specimens collected. Collections for Odonates were generally only conducted between 11 am and 4 pm; additional species may have been captured if sampling had been performed at different times of the day. Also, some species remained over the deep parts of the water or flew along in the tree canopy where they could not be collected *Sympetrum ambiguum* (Rambur) was collected during October 1997 and June to October 1998, and was still present with the absence of water in the pond.

The **Phasmida** were represented by two species, *Anisomorpha buprestoides* (Stoll) and *Diapheromera femorata* Say (Heteronemiidae), comprising 0.03% of the collections. *Diapheromera femorata* is known to feed on oaks, and it can cause substantial defoliation in large numbers (Helfer 1953).

Orthoptera collections consisted of 115 specimens (0.48%) representing five families (Acrididae, Gryllacrididae, Gryllidae, Tetrigidae, and Tettigonidae) and 13 species. A tree cricket, *Oecanthus angustipennis* Fitch (Gryllidae), was present in about 60% of the fog samples.

Blattaria was represented by two species, *Ischnoptera deropeltiformes* (Brunner) (12 specimens) and *Parcoblatta bolliana* Shuster and Zimmerman (Blattellidae) (30 specimens), from 42 specimens. These made up 0.18% of the arthropods collected.

The **Isoptera** was represented by one specimen of the worker caste. The specimen was not identified further because most keys require soldiers or reproductive adults for identification.

The **Plecoptera** was represented by the family Perlidae. Two specimens were collected (0.02% of collections) which represented the species, *Acroneuria. frisoni*? Stark and Brown and *Perlesta* species 1.

The **Psocoptera** were represented by 34 specimens (0.14% of collections) representing six species. The majority of the specimens was collected in the canopy fogging samples, but they also were collected in the beat sheet, malaise, and sweep net samples.

The **Hemiptera** comprised 1.6% (n = 373) of the specimens collected, representing 18 families and 39 species. One species, *Corythuca arcuata* (Say) (221 specimens), feeds on oaks, and it can attain numbers sufficient to cause damage to host trees (Blatchley 1928).

The **Homoptera** comprised 2.01% of the specimens, representing nine families and 78 species. The most common homopteran collected was the species *Erythroneura* species 1 (Cicadellidae) represented by 116 specimens. Two Membracidae were collected in large numbers: *Spissistilus festinus* (Say) (the 3-cornered alfalfa hopper), an occasional crop pest, was a common species (58 specimens) at Sinking Pond, and *Platycotis vittata* (F.) (45), which has been noted to be destructive to oaks, also was sampled.

The **Thysanoptera** were represented by the family Phlaeothripidae, comprising 0.01% of the collections. The family contained two unidentified species.

The **Neuroptera** includes the Megaloptera, which are sometimes given order status (Brigham et al. 1982). From 28 specimens collected, four families were identified (Chrysopidae, Corydalidae, Hemerobiidae, and Sialidae) and five species representing 0.12% of the specimens.

The **Coleoptera** were represented by 5,206 specimens, which comprised 21.8% of the specimens collected. Fifty-two families and 305 species were identified. Coleoptera was the most abundant insect order and the most species rich group overall. The species represented by the most specimens collected (1,472) was a predaceous diving beetle, *Bidessonotus inconspicuous* (LeConte) (Dytiscidae), captured in light trap samples. Another dytiscid, *Agabus gagates* Aube, also was abundant (126 specimens). The aquatic family Hydrophilidae was represented by 630 specimens of *Hydrochus rufipes* Melsheimer. The Carabidae were represented by 48 species in Sinking Pond. Two of these, *Bembidion* sp. and *Clivina americana*? Dejean, were the most abundant species.

The number of carabid species (22) collected in pitfalls at Sinking Pond appeared to be consistent with those reported in other studies. A study using pitfall traps in a mixed hardwood forest in Tennessee reported 21 species (Gibbs 1998). In Vermont, pitfall trap sampling collected 35 species of Carabidae (Rykken et al. 1997). Pitfall trap collections in heaths in Britain collected 54 species of Carabidae (Gardner 1991).

The **Mecoptera** comprised 0.02% of the specimens, representing two families, Bittacidae (hangingflies) and Panorpidae (common scorpionflies), and 3 species. Panorpidae are generally found at the edges of wooded areas, therefore, their low numbers may have been a result of the closed nature of the forest in Sinking Pond (Borror et al 1989).

The **Diptera** comprised 3.7% (n = 883) of the specimens, representing 35 families and 118 species. *Dohrniphora* sp. (Phoridae) (269) was represented by the largest number of specimens for this order. The family Sphaeroceridae contained 72 specimens of the species *Leptocera fontanalis* (Fallen). Also common was a *Gymnopternus* species (Dolichopodidae) (44 specimens) and a species of *Ochthera* (39) of the family Ephydridae. One specimen of *Stylogaster* sp. (Conopidae: Diptera) was collected feeding from the flower head of a federally threatened Eggert's sunflower (*Helianthus eggertii* Small).

The **Trichoptera** were represented by four families, Hydropsychidae, Leptoceridae, Philopotamidae, and Phryganeidae, from 19 specimens (0.08% of the collection). Seven species were identified.

The **Lepidoptera** comprised 1.07% (n = 256) of the specimens, representing 18 families and 79 species. *Dryocampa rubicunda* (F.) was one of the few lepidopteran species represented by a large number of specimens (42), which were all from light trap samples.

Comparison of the lepidopteran fauna of Sinking Pond to other studies would suggest that a considerable number of species were probably not collected. In the GSMNP, TN, a one-year study using ultraviolet light traps and direct collecting captured 675 species of Lepidoptera from ten sites (Lambdin et al. 1991). A study at Black Sturgeon Lake in northwest Ontario used light trapping, and some direct collecting, over a period of eight years to capture 564 species of Lepidoptera in 19 families (Sanders 1991).

At the Funk Bottoms Wildlife Area, in Ohio, two light traps were used to collect 3,252 moth specimens representing 306 species in 19 families (Williams et al. 1997).

Light trap samples may have been improved by using a brighter light source, but increased light intensity may have simply attracted specimens from farther away and not truly associated with Sinking Pond. The area of the light visible to insects in the habitat was another area of concern. There was only 15.6 cm between the cover of the trap and the top of the funnel where the light was visible. As a result, the light may not have been visible to insects in the tree canopies. Therefore, the use of a clear top may have attracted more of these species.

The **Hymenoptera** comprised 4.02% (n = 962) of the specimens representing 16 families and 57 species. Over one-half of these species (34) are attributed to the family Formicidae. The most abundant species were: *Prenolepsis imparis* (Say), *Aphaenogaster lamellidens* Mayr, *Aphaenogaster fulva* Roger, *Camponotus ferrugeneus* (F.), and *C. nearticus* Emery, *C. pennsylvanicus* (DeGeer), and *C. rasius* Wheeler were all represented by 50 specimens. In addition *A. fulva* was represented on 59% of the pitfall trap sampling dates.

Other Arthropods

Specimens from the following taxa generally were not identified beyond the order level for two primary reasons: a lack of keys for their identification and the time involved to identify the specimens to species. The non-insect groups included the Araneae, Opiliones, Acari, Pseudoscorpiones, Crustacea, Diplopoda, Chilopoda, and Symphyla (Table 5).

Table 5. The number and percentage of specimens for each non-insect taxa collected from Sinking Pond, Coffee Co., TN, 1997 and 1998.

Taxon	No. of Specimens	% of Total Non-insect Taxa (n = 11,113)
Subphylum Chelicerata		
Class Arachnida		
Order Araneae	1,249	11.24
Order Opiliones	110	0.99
Order Acari	9,162	82.44
Order Pseudoscorpiones	23	0.21
Subphylum Crustacea	523	4.71
Subphylum Atelocerata		
Class Diplopoda	43	0.39
Class Chilopoda	1	0.01
Class Symphyla	2	0.02

The **Araneae** were represented by 1,249 spider specimens (5.22% of the specimens collected). Fourteen families were identified containing 36 species.

The **Opiliones** represented 0.46% of specimens collected. Many species in this order are associated with leaf litter of the forest floor (Dindall 1990).

The **Acari** were numerically the largest group when leaf-litter samples were included. There were 9,162 mites collected using all trapping methods (9,099 of these specimens came from leaf litter). Therefore, mites constituted 38.29% of all specimens collected (n = 23,929). Mites from leaf-litter samples from 1998 were not sorted or counted, suggesting that their numbers would be significantly higher if all of the samples had been processed. Without leaf litter, there were only 63 mite specimens were found, comprising 0.26% of the collections.

Pseudoscorpiones were primarily captured from the leaf litter samples, and represented 0.10% of all specimens collected . Pseudoscorpiones may feed upon Collembola and Acari, which represent an abundant food source in the leaf litter (Dindall 1990).

Aquatic specimens of the class **Crustacea** were unexpected. Five-hundred and twenty-three specimens (2.19%) were collected. One specimen was from the leaf litter samples, and the remaining crustaceans were captured on a single date in pitfall 49 which was located in the wettest area of the pitfall traps. Because the trap is so close to the edge of the water, it is likely that a single flooding event washed these specimens into the cup.

Diplopoda specimens made up 0.18% of the specimens, the majority was collected in the pitfall traps. Diplopoda feed on detritus and are often associated with the upper layers of broadleaf forest leaf litter (Dindall 1990).

The **Chilopoda** and **Symphyla** were each represented by very few specimens. One specimen of each was collected in the leaf litter. Also, one specimen of Symphyla was collected in a pitfall trap. The Chilopoda were described as frequently occurring and abundant by Dindall (1990); therefore, it is likely that there were many more in the community. The Symphyla are omnivores, which are important in the breakdown of organic matter and can be found deep in the soil which allows them to survive adverse conditions. (Dindall 1990). The extremely high moisture content of the soil in Sinking Pond may prevent them from attaining large numbers.

Indicator Species

Data were examined to determine which species may be potential indicator species for the Sinking Pond area. The composition of the leaf litter is dependent upon the plant community, therefore, species occupying these habitats must be adapted to the type of litter present. Other groups may fly or move into an area, although they may not actually require resources from the habitat for the completion of their life cycles. Species in the leaf litter have limited dispersal abilities, so species collected would be inhabitants of the area. As a result, the species in the leaf litter may be potential indicators of a community. One specimen, *Isotomiella minor* (Schaffer), was sampled on 75% of the 1997 sampling dates with 20.75 average specimens per trap, and was also collected on the June 30, 1998 collection date. Two species, *Lepidocyrtus cinereus* Folsom, *Tullbergia yosiii* Rusek, were present on all of the 1997 leaf-litter collection dates. An *Orchesella* species was present on all of the 1997 dates and both 1998 dates sorted. These may represent species that are well adapted to the particular leaf-litter composition of Sinking Pond, and may be of interest for further observation if future sampling of the arthropod fauna is conducted. To identify indicator species, more in depth information on the ecology of individual species is necessary. Information concerning the relationship between Sinking Pond and individual species would be necessary.

CHAPTER IV

CONCLUSIONS

A research project was initiated in 1997 at Sinking Pond to sample and describe the terrestrial arthropod community, to compile a list of arthropod species associated with Sinking Pond, and to develop a database of arthropod information that can be used in future studies. The information collected was used to evaluate species diversity, assess the ecological significance of select species, and identify potential indicator species.

From the nine sampling techniques used (beat sheeting, canopy fogging, direct collecting, leaf-litter sampling, light trapping, malaise trapping, Manitoba trapping, pitfall trapping, and sweep netting) 23,929 arthropod specimens, representing 28 orders, were collected. Of these, 12,816 were insect specimens in 20 orders (53.6%) and 11,113 were non-insect specimens in eight orders (46.4%). From these insect and non-insect orders, an estimated 826 species were identified in 200 families (Table 2).

Overall diversity calculated using the Shannon index (H') was high (4.69) (Table 4) and evenness (J) (0.69) was average. The Shannon index (H') for the combined methods was higher than any sampling method alone; therefore, using a combination of collection techniques collected a greater diversity of arthropods and a more complete collection of the community.

The evenness is a component of diversity and its interpretation. The highest evenness values are the result of a collection of species which are represented by the same number of specimens. Species in a healthy and biologically rich community are generally represented by a range of specimen numbers. Therefore, it is important to consider both evenness and diversity when assessing a community.

Individual collection methods obtained fewer than 300 species each, but combined, they amassed more than 800 species. In addition, each method captured a number of species that were not sampled by other methods. Therefore, the use of multiple sampling methods was an asset in attempting to collect a representative sample of the Sinking Pond community. The leaf litter was represented by the largest number of specimens. When the mites are not considered, the light trap and pitfall trap collections were represented by the largest number of specimens. Light trap and sweep-net samples were represented by the largest number of species. Light trapping was represented by the largest proportion of species not sampled by other methods. Some of the species may have been attracted from other habitats surrounding Sinking Pond, and it also sampled numerous aquatic specimens which were not collected by other methods. Sweep netting and direct collecting both sampled a similar number of unique species. The highest Shannon index value, and therefore the highest calculated diversity, was attained by sweep netting and direct collecting. Based on comparisons of the collections, number of species, number of species unique to each sampling method, and calculated diversity, the sweep net samples appear to be the method that was most useful in collecting at Sinking Pond, followed by direct collecting, light trapping, and canopy fogging.

Eight introduced species were identified in the collections from Sinking Pond. Three of these (Asiatic oak weevil, Japanese beetle, and *Wasmannia auropunctata*) have the potential to adversely affect the Sinking Pond Area. The Asiatic oak weevil is an oak foliage feeder as an adult. The Japanese beetle is a generalist herbivore that is reported to feed on more than 300 species. *Wasmannia auropunctata* has been associated with reduced diversity in tree canopies in South America, and although only one specimen was collected, it may still warrant observation. If future studies are conducted in the Sinking Pond area, it may be beneficial to pay special attention to these species.

The database of arthropod information developed during this study may be helpful in evaluating the effects of changes in the community. Species in Sinking Pond may be sensitive to a variety of changes in their habitat. The pond community is sensitive to changes in the water table and to sedimentation, so activities in adjacent areas that affect the water regime should be considered carefully. Such changes could cause catastrophic changes in the overcup oak community and the underground aquifers as unique habitats for insect species.

Twelve potentially disjunct species were collected. The occurrence of species such as *Apteromechus texanus* and *Pseudosciara forceps*, which both have ranges recorded as more southern, suggests that the climate of the area of Sinking Pond may be milder than other surrounding areas or may have certain attributes that enable these species to survive outside of their recorded range. Therefore, Sinking Pond may be important in maintaining these potentially unusual genotypes. Because disjunct species may depend on certain attributes present in the Sinking Pond area, they would be sensitive to change in the habitat. Therefore, these species may be good indicators of the current state of the Sinking Pond area and useful in evaluating future changes. Information on the criteria they require to survive outside of their range or how the Sinking Pond area facilitates their survival would be beneficial.

Also, no species of Coccoidea were collected due to their cryptic coloration, small size, and the specific nature of the collection methods required to sample populations. Because of their distinct association with specific plant species, future studies could elucidate the plant-insect relationships.

Sinking Pond's uniqueness stems primarily from its unique plant community type and the nature of the flooding regime in the area. A study of those arthropods associated with the soil and roots of overcup oak, underground aquifers and caves of the area, and the canopy of overcup oak and associated epiphytic resurrection fern may reveal indicator species that reflect the structure and status of the ecosystem.

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APPENDICES

Appendix A: Literature Used to Identify Taxa Collected for the Arnold Air Force Base Arthropod Survey

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Appendix B: Consultants Contributing to Species Identification

Expert	Address	Taxa
Adriean J.Mayor	801 Forest Heights Rd. Knoxville, TN 37919	Coleoptera, Hemiptera,
Arnold Strange	Florida State Collection of Arthropods, University of Florida, Gainesville, FL 32614	Hymenoptera
Charles O'Brien	Department of Entomology-Biocontrol, Florida A&M University, Tallahassee, FL 32307-4100	Coleoptera, Curculionidae
David Etnier	Department of Evolutionary Biology and Ecology, University of Tennessee, Knoxville, TN 37901	Trichoptera, Ephemeroptera, Plecoptera
David Paulsen	Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN 37901	Diptera, Lepidoptera
Edward Riley	Department of Entomology, Texas A&M University, College Station, TX 77843	Coleoptera, Chrysomelidae
Ernest Bernard	Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN 37901	Collembola, Diplura
George Harp	3206 Maplewood Terrace, Jonesboro, AR 72401-8829	Odonata
Karen Vail	Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN 37901	Hymenoptera, Formicidae
Kimberly Norris	Department of Evolutionary Biology and Ecology, University of Tennessee, Knoxville, TN 37901	Arachnida
Mark Rothschild	Maryland Dept. of Agriculture, Plant Protection Section, Salisbury, MD 21801-8437	Homoptera, Membracidae
Melinda Gibbs	Department of Entomology and Plant Pathology, University of Tennessee, Knoxville, TN 37901	Hymenoptera, Formicidae
Michael Thomas	Florida State Collection of Arthropods, University of Florida, Gainesville, FL 32614	Coleoptera, Cucujoidea
Paul Skelley	Florida State Collection of Arthropods, University of Florida, Gainesville, FL 32614	Coleoptera, Erotylidae
Robert Edwards	Department of Biology, Natural Sciences Building, Western Carolina University, Cullowhee, NC 28723-9051	Arachnida
Susan Reichert	Department of Evolutionary Biology and Ecology, University of Tennessee, Knoxville, TN 37901	Arachnida
Thomas Wood	Department of Entomology and Applied Ecology, University of Delaware, Newark, DE 19713	Homoptera, Membracidae

Appendix C. Species list for each pitfall trap.

Order	Family	Genus	species
Pitfall 16			
Blattaria	Blattellidae	*Parcoblatta*	*bolliana*
Coleoptera	Carabidae	*Abacidus*	*atratus**
Coleoptera	Curculionidae	*Conotrachelus*	*posticatus*
Coleoptera	Scarabaeidae	*Copris*	*minutus*
Coleoptera	Scarabaeidae	*Geotrupes*	*blackburni*
Coleoptera	Scarabaeidae	*Onthophagus*	*hecate*
Coleoptera	Staphylinidae	*Tachinus*	*fimbriatus*
Collembola	Entomobryidae	*Entomobrya*	*purpurascens*
Collembola	Entomobryidae	*Orchesella*	species 1
Collembola	Tomoceridae	*Tomocerus*	*flavescens*
Diptera	Drosophilidae	*Chymomyza*	species 1
Diptera	Phoridae	*Dohrniphora*	species 1
Diptera	Phoridae	*Triphleba*	*lugubris**
Diptera	Sarcophagidae	*Boettcheria*	species 1
Diptera	Sciaridae	*Lycoriella*	species 1
Hemiptera	Miridae	*Fulvius*	*brunneus*
Hymenoptera	Formicidae	*Aphaenogaster*	*lamellidens*
Hymenoptera	Formicidae	*Prenolepsis*	*imparis*
Pitfall 22			
Araneae	Lycosidae	*Schizocosa*	*ocreata*
Araneae	Thomisidae	*Xysticus*	*ferox*
Blattaria	Blattellidae	*Ischnoptera*	*deropeltiformes*
Blattaria	Blattellidae	*Parcoblatta*	*bolliana*
Coleoptera	Carabidae	*Brachinus*	*fumans*
Coleoptera	Carabidae	*Chlaenius*	*erythropus*
Coleoptera	Carabidae	*Chlaenius*	*platyderus**
Coleoptera	Carabidae	*Cyclotrachelus*	*sigillatus*
Coleoptera	Carabidae	*Dicaelus*	*furvus**
Coleoptera	Carabidae	*Galerita*	*bicolor*
Coleoptera	Carabidae	*Pterostichus*	*coracinus**
Coleoptera	Carabidae	*Pterostichus*	*longicornus**
Coleoptera	Carabidae	*Pterostichus*	species 1
Coleoptera	Carabidae	*Synuchus*	*impunctatus**
Coleoptera	Curculionidae	*Conotrachelus*	*posticatus*

Appendix C. Species list for each pitfall trap. (Continued)

Order	Family	Genus	species
Pitfall 22			
Coleoptera	Hydrophilidae	*Hydrochus*	*rufipes**
Coleoptera	Leptodiridae	*Ptomophagus*	*consobrinus*
Coleoptera	Scaphidiidae	*Eubaeocera*	species 1*
Coleoptera	Scarabaeidae	*Copris*	*minutus*
Coleoptera	Scarabaeidae	*Geotrupes*	*blackburni*
Coleoptera	Scarabaeidae	*Geotrupes*	*splendidus**
Coleoptera	Scarabaeidae	*Onthophagus*	*hecate*
Coleoptera	Scarabaeidae	*Trox*	*monachus**
Coleoptera	Staphylinidae	Genus M	species 13*
Coleoptera	Staphylinidae	*Staphylinus*	*fossator**
Coleoptera	Tenebrionidae	*Anaedus*	*brunneus**
Collembola	Entomobryidae	*Lepidocyrtus*	*cinereus*
Collembola	Entomobryidae	*Orchesella*	*celsa*
Collembola	Hypogastrurida	*Hypogastrura*	species 1
Collembola	Sminthuridae	*Ptenothrix*	*pineolea**
Collembola	Tomoceridae	*Tomocerus*	*flavescens*
Diptera	Dolichopodidae	*Gymnopternus*	species 1*
Diptera	Dolichopodidae	*Tachytrechus*	species 1*
Diptera	Drosophilidae	*Drosophila*	species 1
Diptera	Mycetophilidae	*Mycetophila*	species 1
Diptera	Phoridae	*Conicera*	*dauci*
Diptera	Phoridae	*Dohrniphora*	species 1
Diptera	Sciaridae	*Bradysia*	species 1
Diptera	Sciaridae	*Corynoptera*	species 1
Diptera	Sciaridae	*Epidapus*	species 1
Diptera	Sciaridae	*Schwenkfeldina*	species 1*
Diptera	Sphaeroceridae	*Pterogramma*	species 1
Hemiptera	Miridae	*Fulvius*	*brunneus*
Hymenoptera	Formicidae	*Aphaenogaster*	*fulva*
Hymenoptera	Formicidae	*Aphaenogaster*	*lamellidens*
Hymenoptera	Formicidae	*Aphaenogaster*	*rudis**
Hymenoptera	Formicidae	*Aphaenogaster*	species 1
Hymenoptera	Formicidae	*Aphaenogaster*	*texana*
Hymenoptera	Formicidae	*Camponotus*	*ferrugineus*

Appendix C. Species list for each pitfall trap. (Continued)

Order	**Family**	**Genus**	**species**
Pitfall 22			
Hymenoptera	Formicidae	*Camponotus*	*pennsylvanicus*
Hymenoptera	Formicidae	*Camponotus*	*rasius*
Hymenoptera	Formicidae	*Formica*	*schaufussi*
Hymenoptera	Formicidae	*Paratrechina*	*melanderi*
Hymenoptera	Formicidae	*Prenolepis*	species 1
Hymenoptera	Formicidae	*Prenolepsis*	*imparis*
Orthoptera	Gryllacrididae	*Ceuthophilus*	*brevipes*
Orthoptera	Gryllidae	*Acheta*	*assimilis*
Orthoptera	Gryllidae	*Nemobious*	*fasciatus*
Pitfall 23			
Araneae	Thomisidae	*Xysticus*	*fraternus*
Blattaria	Blattellidae	*Ischnoptera*	*deropeltiformes*
Coleoptera	Carabidae	*Chlaenius*	*erythropus*
Coleoptera	Carabidae	*Galerita*	*bicolor*
Coleoptera	Curculionidae	*Conotrachelus*	*posticatus*
Coleoptera	Curculionidae	*Cyrtepistomis*	*castaneus**
Coleoptera	Lampyridae	*Photinus*	species 1*
Coleoptera	Leptodiridae	*Ptomophagus*	*consobrinus*
Coleoptera	Mordellidae	*Mordellistena*	species 1*
Coleoptera	Nitidulidae	*Pallodes*	*pallidus**
Coleoptera	Scarabaeidae	*Aphodius*	*bicolor**
Coleoptera	Scarabaeidae	*Copris*	*minutus*
Coleoptera	Scarabaeidae	*Geotrupes*	*blackburni*
Coleoptera	Scarabaeidae	*Onthophagus*	*hecate*
Coleoptera	Scolytidae	*Monarthrum*	*mali*
Coleoptera	Silphidae	*Nicrophorus*	*orbicollis**
Coleoptera	Staphylinidae	Genus H	species 8
Coleoptera	Staphylinidae	Genus I	species 9
Coleoptera	Staphylinidae	Genus S	species 30
Coleoptera	Staphylinidae	*Tachinus*	*fimbriatus*
Collembola	Hypogastrurida	*Hypogastrura*	species 1
Collembola	Neanuridae	*Pseudachorutes*	*aureofasciatus**
Collembola	Sminthuridae	*Ptenothrix*	species 1

Appendix C. Species list for each pitfall trap. (Continued)

Order	**Family**	**Genus**	**species**
Pitfall 23			
Collembola	Tomoceridae	*Tomocerus*	*flavescens*
Diptera	Drosophilidae	*Chymomyza*	species 1
Diptera	Drosophilidae	*Drosophila*	species 1
Diptera	Mycetophilidae	*Mycetophila*	species 1
Diptera	Phoridae	*Conicera*	*dauci*
Diptera	Phoridae	*Dohrniphora*	species 1
Diptera	Phoridae	*Gymnophora*	species 1
Diptera	Phoridae	*Pulciphora*	*virginiensis*
Diptera	Sciaridae	*Corynoptera*	species 1
Diptera	Sciaridae	*Epidapus*	species 1
Diptera	Sciaridae	*Pseudosciara*	*forceps**
Hemiptera	Miridae	*Fulvius*	*brunneus*
Hymenoptera	Formicidae	*Aphaenogaster*	*fulva*
Hymenoptera	Formicidae	*Aphaenogaster*	*lamellidens*
Hymenoptera	Formicidae	*Aphaenogaster*	species 1
Hymenoptera	Formicidae	*Camponotus*	*ferrugineus*
Hymenoptera	Formicidae	*Camponotus*	*pennsylvanicus*
Hymenoptera	Formicidae	*Camponotus*	species 1
Hymenoptera	Formicidae	*Formica*	*rubicunda**
Hymenoptera	Formicidae	*Formica*	*schaufussi*
Hymenoptera	Formicidae	*Lasius*	*umbratus**
Hymenoptera	Formicidae	*Paratrechina*	*melanderi*
Hymenoptera	Formicidae	*Ponera*	*coarctata*
Orthoptera	Gryllacrididae	*Ceuthophilus*	*brevipes*
Orthoptera	Gryllidae	*Acheta*	*assimilis*
Orthoptera	Gryllidae	*Nemobious*	*fasciatus*
Pitfall 24			
Araneae	Ctenidae	*Anahita*	*punctulata**
Araneae	Linyphiidae	*Lepthyphantes*	*sabulosa**
Blattaria	Blattellidae	*Parcoblatta*	*bolliana*
Coleoptera	Carabidae	*Agonum*	*melanarium*?*
Coleoptera	Carabidae	*Agonum*	*tenue*?*
Coleoptera	Carabidae	*Galerita*	*bicolor*

Appendix C. Species list for each pitfall trap. (Continued)

Order	Family	Genus	species
Pitfall 24			
Coleoptera	Carabidae	*Myas*	*coracinus*
Coleoptera	Curculionidae	*Conotrachelus*	*posticatus*
Coleoptera	Leptodiridae	*Catops*	*simplex**
Coleoptera	Staphylinidae	*Staphylinus*	*maculosus**
Coleoptera	Staphylinidae	*Tachinus*	*fimbriatus*
Collembola	Entomobryidae	*Entomobrya*	*purpurascens*
Collembola	Entomobryidae	*Lepidocyrtus*	*cinereus*
Collembola	Entomobryidae	*Orchesella*	species 1
Collembola	Hypogastrurida	*Hypogastrura*	species 1
Collembola	Neanuridae	*Pseudachorutes*	species 1*
Collembola	Sminthuridae	*Ptenothrix*	species 1
Collembola	Tomoceridae	*Tomocerus*	*flavescens*
Diptera	Phoridae	*Dohrniphora*	species 1
Diptera	Sciaridae	*Corynoptera*	species 1
Diptera	Sciaridae	*Lycoriella*	species 1
Hymenoptera	Formicidae	*Aphaenogaster*	*fulva*
Hymenoptera	Formicidae	*Aphaenogaster*	*lamellidens*
Hymenoptera	Formicidae	*Aphaenogaster*	*tennesseensis*
Hymenoptera	Formicidae	*Paratrechina*	*melanderi*
Orthoptera	Gryllidae	*Acheta*	*assimilis*
Orthoptera	Tetrigidae	*Tettigidea*	*lateralis**
Pitfall 25			
Araneae	Ctenizidae	*Ummidia*	*audouini**
Araneae	Gnaphosidae	*Gnaphosa*	species 1*
Araneae	Thomisidae	*Xysticus*	*fraternus*
Blattaria	Blattellidae	*Ischnoptera*	*deropeltiformes*
Blattaria	Blattellidae	*Parcoblatta*	*bolliana*
Coleoptera	Carabidae	*Agonum*	*albicrus**
Coleoptera	Carabidae	*Bembidion*	species 2*
Coleoptera	Carabidae	*Chlaenius*	*erythropus*
Coleoptera	Carabidae	*Galerita*	*bicolor*
Coleoptera	Carabidae	*Harpalus*	species 1*
Coleoptera	Carabidae	*Pterostichus*	*haldemani*

Appendix C. Species list for each pitfall trap. (Continued)

Order	Family	Genus	species
Pitfall 25			
Coleoptera	Scarabaeidae	*Bolboceras*	species 1*
Coleoptera	Scarabaeidae	*Pseudocanthon*	*perplexus*
Coleoptera	Scydmaenidae	*Napochus*	species 1
Coleoptera	Staphylinidae	Genus H	species 8
Coleoptera	Staphylinidae	Genus I	species 9
Coleoptera	Staphylinidae	Genus O	species 23*
Coleoptera	Staphylinidae	Genus S	species 30
Coleoptera	Staphylinidae	*Tachinus*	*fimbriatus*
Collembola	Entomobryidae	*Lepidocyrtus*	*cinereus*
Collembola	Entomobryidae	*Orchesella*	*celsa*
Collembola	Entomobryidae	*Orchesella*	species 1
Collembola	Hypogastrurida	*Hypogastrura*	species 1
Collembola	Tomoceridae	*Tomocerus*	*elongatus**
Collembola	Tomoceridae	*Tomocerus*	species 1*
Diptera	Drosophilidae	*Drosophila*	species 1
Diptera	Muscidae	*Phaonia*	species 1*
Diptera	Mycetophilidae	*Exechia*	species 1*
Diptera	Phoridae	*Dohrniphora*	species 1
Diptera	Phoridae	*Gymnophora*	species 1
Diptera	Phoridae	*Pulciphora*	*virginiensis*?
Diptera	Sciaridae	*Bradysia*	species 1
Hemiptera	Miridae	Genus	species 1*
Hymenoptera	Formicidae	*Aphaenogaster*	*fulva*
Hymenoptera	Formicidae	*Aphaenogaster*	*lamellidens*
Hymenoptera	Formicidae	*Aphaenogaster*	species 1
Hymenoptera	Formicidae	*Aphaenogaster*	*texana*
Hymenoptera	Formicidae	*Camponotus*	*ferrugineus*
Hymenoptera	Formicidae	*Camponotus*	*pennsylvanicus*
Hymenoptera	Formicidae	*Camponotus*	species 1
Hymenoptera	Formicidae	*Myrmecina*	*americana**
Hymenoptera	Formicidae	*Paratrechina*	*melanderi*
Hymenoptera	Formicidae	*Paratrechina*	*parvula*
Hymenoptera	Formicidae	*Ponera*	*coarctata*
Hymenoptera	Formicidae	*Prenolepis*	species 1

Appendix C. Species list for each pitfall trap. (Continued)

Order	Family	Genus	species
Pitfall 25			
Hymenoptera	Formicidae	*Prenolepsis*	*imparis*
Orthoptera	Gryllacrididae	*Ceuthophilus*	*brevipes*
Orthoptera	Gryllidae	*Nemobious*	*fasciatus*
Pitfall 26			
Blattaria	Blattellidae	*Parcoblatta*	*bolliana*
Coleoptera	Carabidae	*Chlaenius*	*erythropus*
Coleoptera	Nitidulidae	*Stelidota*	*geminata**
Coleoptera	Staphylinidae	*Tachinus*	*fimbriatus*
Collembola	Hypogastruridae	*Hypogastrura*	species 1
Collembola	Tomoceridae	*Tomocerus*	*flavescens*
Diptera	Phoridae	*Dohrniphora*	species 1
Hymenoptera	Formicidae	*Aphaenogaster*	*lamellidens*
Hymenoptera	Formicidae	*Camponotus*	*ferrugineus*
Hymenoptera	Formicidae	*Camponotus*	*pennsylvanicus*
Hymenoptera	Formicidae	*Paratrechina*	*parvula*
Hymenoptera	Formicidae	*Prenolepsis*	*imparis*
Orthoptera	Gryllidae	*Acheta*	*assimilis*
Orthoptera	Gryllidae	*Nemobious*	*fasciatus*
Pitfall 31			
Blattaria	Blattellidae	*Ischnoptera*	*deropeltiformes*
Blattaria	Blattellidae	*Parcoblatta*	*bolliana*
Coleoptera	Carabidae	*Galerita*	*bicolor*
Coleoptera	Carabidae	*Pasimachus*	*punctulatus**
Coleoptera	Cicindellidae	*Cicindela*	*unipunctata**
Coleoptera	Scarabaeidae	*Bolbocerosoma*	*farctum**
Coleoptera	Scolytidae	*Monarthrum*	*mali*
Coleoptera	Staphylinidae	Genus H	species 8
Coleoptera	Staphylinidae	Genus K	species 40*
Diptera	Mycetophilidae	*Mycomya*	species 1*
Diptera	Phoridae	*Dohrniphora*	species 1
Diptera	Phoridae	*Gymnophora*	species 1
Diptera	Sciaridae	*Bradysia*	species 1

Appendix C. Species list for each pitfall trap. (Continued)

Order	**Family**	**Genus**	**species**
Pitfall 31			
Diptera	Sciaridae	*Corynoptera*	species 1
Diptera	Sphaeroceridae	*Pterogramma*	species 1
Hymenoptera	Formicidae	*Aphaenogaster*	*fulva*
Hymenoptera	Formicidae	*Aphaenogaster*	*lamellidens*
Hymenoptera	Formicidae	*Aphaenogaster*	species 1
Hymenoptera	Formicidae	*Aphaenogaster*	*tennesseensis*
Hymenoptera	Formicidae	*Aphaenogaster*	*texana*
Hymenoptera	Formicidae	*Camponotus*	*ferrugineus*
Hymenoptera	Formicidae	*Camponotus*	*pennsylvanicus*
Hymenoptera	Formicidae	*Formica*	*pallidefulva**
Hymenoptera	Formicidae	*Ponera*	*coarctata*
Hymenoptera	Formicidae	*Prenolepsis*	*imparis*
Hymenoptera	Formicidae	*Tetramorium*	*caespitum**
Orthoptera	Gryllidae	*Acheta*	*assimilis*
Orthoptera	Gryllidae	*Nemobious*	*fasciatus*
Orthoptera	Gryllidae	*Oecanthus*	*augustipennis**
Orthoptera	Gryllidae	*Oecanthus*	species 1*
Pitfall 48			
Araneae	Ctenizidae	*Myrmeciophila*	*fluviatilis**
Blattaria	Blattellidae	*Parcoblatta*	*bolliana*
Coleoptera	Carabidae	*Cyclotrachelus*	*sigillatus*
Coleoptera	Curculionidae	*Conotrachelus*	*posticatus*
Collembola	Entomobryidae	*Orchesella*	*celsa*
Collembola	Hypogastrurida	*Hypogastrura*	species 1
Collembola	Sminthuridae	*Ptenothrix*	species 1
Diptera	Drosophilidae	*Drosophila*	species 1
Diptera	Phoridae	*Dohrniphora*	species 1
Diptera	Phoridae	*Gymnophora*	species 1
Diptera	Sarcophagidae	*Boettcheria*	species 1
Diptera	Sphaeroceridae	*Leptocera*	*frontalis*
Hymenoptera	Formicidae	*Aphaenogaster*	*fulva*
Hymenoptera	Formicidae	*Aphaenogaster*	*lamellidens*
Hymenoptera	Formicidae	*Camponotus*	*pennsylvanicus*

Appendix C. Species list for each pitfall trap. (Continued)

Order	Family	Genus	species
Pitfall 48			
Hymenoptera	Formicidae	*Paratrechina*	*parvula*
Orthoptera	Gryllidae	*Nemobious*	*fasciatus*
Pitfall 49			
Araneae	Thomisidae	*Xysticus*	species 1*
Blattaria	Blattellidae	*Parcoblatta*	*bolliana*
Coleoptera	Carabidae	*Brachinus*	*fumans*
Coleoptera	Carabidae	*Brachinus*	*ovipennis**
Coleoptera	Carabidae	*Chlaenius*	*erythropus*
Coleoptera	Carabidae	*Chlaenius*	*impunctifrons**
Coleoptera	Carabidae	*Pterostichus*	*haldemani*
Coleoptera	Carabidae	*Pterostichus*	*lucublandus**
Coleoptera	Carabidae	*Pterostichus*	species 1
Coleoptera	Pselaphidae	*Reichenbachia*	species 1*
Coleoptera	Scarabaeidae	*Deltochilum*	*gibbosum**
Coleoptera	Scarabaeidae	*Onthophagus*	*hecate*
Coleoptera	Scarabaeidae	*Pseudocanthon*	*perplexus*
Coleoptera	Scydmaenidae	*Napochus*	species 1
Collembola	Entomobryidae	*Entomobrya*	*assutu**
Collembola	Entomobryidae	*Entomobrya*	species 1*
Collembola	Entomobryidae	*Lepidocyrtus*	*cinereus*
Collembola	Entomobryidae	*Orchesella*	*celsa*
Collembola	Entomobryidae	*Orchesella*	species 1
Collembola	Hypogastrurida	*Hypogastrura*	species 1
Collembola	Isotomidae	*Isotoma*	*viridis**
Collembola	Neanuridae	*Neanura*	species 1*
Collembola	Tomoceridae	*Tomocerus*	*flavescens*
Diptera	Calliphoridae	*Phaenicia*	species 1*
Diptera	Drosophilidae	*Drosophila*	species 1
Diptera	Empididae	*Drapetis*	species 1
Diptera	Phoridae	*Dohrniphora*	species 1
Diptera	Phoridae	*Gymnophora*	species 1
Diptera	Sphaeroceridae	*Leptocera*	*frontalis*
Homoptera	Cicadellidae	*Erythroneura*	*obliqua*?*

Appendix C. Species list for each pitfall trap. (Continued)

Order	Family	Genus	species
Pitfall 49			
Hymenoptera	Formicidae	*Aphaenogaster*	*fulva*
Hymenoptera	Formicidae	*Aphaenogaster*	*lamellidens*
Hymenoptera	Formicidae	*Camponotus*	*ferrugineus*
Hymenoptera	Formicidae	*Camponotus*	*pennsylvanicus*
Hymenoptera	Formicidae	*Camponotus*	*rasius*
Hymenoptera	Formicidae	*Lasius*	*alienus**
Hymenoptera	Formicidae	*Paratrechina*	*melanderi*
Hymenoptera	Formicidae	*Tapinoma*	*sessile**
Orthoptera	Gryllidae	*Nemobious*	*fasciatus*
Pitfall 72			
Araneae	Lycosidae	*Schizocosa*	*ocreata*
Araneae	Thomisidae	*Xysticus*	*ferox*
Blattaria	Blattellidae	*Parcoblatta*	*bolliana*
Coleoptera	Carabidae	*Myas*	*coracinus*
Coleoptera	Scarabaeidae	*Onthophagus*	*hecate*
Collembola	Entomobryidae	*Orchesella*	*celsa*
Collembola	Tomoceridae	*Tomocerus*	*flavescens*
Diptera	Empididae	*Drapetis*	species 1
Diptera	Phoridae	*Dohrniphora*	species 1
Diptera	Sciaridae	*Corynoptera*	species 1
Homoptera	Cicadellidae	*Erythroneura*	species 1*
Hymenoptera	Formicidae	*Aphaenogaster*	*lamellidens*
Hymenoptera	Formicidae	*Aphaenogaster*	species 1
Hymenoptera	Formicidae	*Camponotus*	*ferrugineus*
Hymenoptera	Formicidae	*Prenolepsis*	*imparis*
Orthoptera	Gryllidae	*Acheta*	*assimilis*
Orthoptera	Gryllidae	*Nemobious*	*fasciatus*

* indicates species captured exclusively in the specific pitfall trap

VITA

Joshua J. Vlach was born in Cleveland, Ohio, on May 10, 1975. He was raised in Richfield, Ohio, where he graduated from Revere High School in 1993. In May, 1997 he earned his Bachelor of Science degree in Biology from the University of Findlay in Findlay, Ohio. He was admitted into the University of Tennessee Department of Entomology and Plant Pathology in Knoxville, Tennessee, in the Fall of 1997. Under the direction of Dr. Paris Lambdin, he completed the requirements for a Master of Science degree in Entomology and Plant Pathology in August 1999. Joshua Vlach is a member of the Entomological Society of America and the Tennessee Entomological Society.