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DIVERSITY OF THE INSECT FAUNA WITHIN THE UNIQUE SINKING POND HABITAT IN MIDDLE TENNESSEE

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ABSTRACT—A research project was initiated in 1997 at Sinking Pond, Coffee County, Tennessee, to document the insect species in this unique habitat. Insects were collected using nine sampling methods: beat sheeting, canopy fogging, direct collecting, leaf-litter sampling, light trapping, malaise trapping, Manitoba trapping, pitfall trapping, and sweep netting. A database listing the insect species collected at Sinking Pond was created to provide a foundation for future comparative studies. This research also compared insect diversity among sampling methods, assessed the ecological significance of select species, and identified potential indicator species. A total of 13,162 insect specimens were collected representing 877 species in 193 families in 19 orders. Specimens from seven of the insect orders comprised 98.4% of the insect specimens. Coleoptera represented the majority, followed by Collembola, Hymenoptera, Diptera, Hemiptera, Lepidoptera, and Orthoptera. The overall Shannon diversity index score (H′) was 4.98, a high diversity, while evenness (J) was 0.73, a moderately high value. Collection of some insect species, such as the trichopteran *Wormaldia shawnee* (Ross), from Sinking Pond represented new state records. Four species, *Cicindela unipunctata* Fab., *Enodia anthedon* Clark, *Glaucopsyche lygdamus* (Doubleday), and *Speyeria cybele* (Fab.), are on one of the rare, threatened or endangered species lists of Alabama or North Carolina. Also, 16 species were documented that represented disjunct species. Thirteen introduced species to Sinking Pond were identified, four of which could potentially adversely affect the community structure.

Sinking Pond is a unique, seasonally flooded karst depression managed by Arnold Air Force Base (AAFB) that was designated a national natural landmark in 1975. Within Sinking Pond's watershed, two other karst depressions occur that intermittently overflow into Sinking Pond (Wolfe, 1996). The water level of Sinking Pond is governed by underground water sources and by the overflow from the two other sinkhole ponds in the watershed. Sinking Pond normally remains filled with water from November through July and becomes relatively dry throughout the remaining months. The pond (c. 52 ha) can empty or fill as much as 2 m in as little as 24 h, and water depths vary from 0 to 3.5 m (Wolfe, 1996).

Patterson (1989) documented several unique attributes of the vegetation associated with Sinking Pond. Vegetation within the pond is limited due to wet and dry periods, and little shrub growth exists in the areas exposed to high levels of flooding. As the water becomes shallower (≤ 25 cm), vegetation is dominated by small trees, shrubs, and grasses that form a dense area of vegetation that can tolerate flooding. The Sinking Pond watershed has at least seven tree community types (Patterson, 1989) comprised primarily of: blackgum (*Nyssa sylvatica* Marshall), northern red oak (*Quercus rubra* L.), post oak (*Q. stellata* Wangenh.), red maple (*Acer rubrum* L.), river birch (*Betula nigra* L.), scarlet oak (*Q. coccinea* Muench.), southern red oak (*Q. falcata* Michaux), water oak (*Q. nigra* L.), white oak (*Q. alba* L.), willow oak (*Q. phellos* L.), and overcup oak (*Q. lyrata* Walter). The dominant community type within the Sinking Pond watershed is the white oak community, which can be found most often on well drained upper slopes (Patterson, 1989; Pyne et al., 1998). This area (the pond and the immediate area beyond the pond) contains extensive growths of willow oak, and water tupelo (*Nyssa aquatica* L.) swamps (comparable to the disjunct Gulf Coastal Plain water tupelo community) are present within the flood zone of the pond. The edge of the pond (bank area), 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 makes up only a small percentage (9%) of the communities in the Sinking Pond area (Patterson, 1989).

The overcup oak habitat contains several federally and state listed species of concern, e.g., Eggert's sunflower (*Helianthus eggertii* Small), Southern twayblade (*Listera australis* Lindl.), the dusky gopher frog (*Lithobates sevosus* (Goin and Netting)), the mole salamander (*Ambystoma talpoideum* (Holbrook)), and the four-toed salamander (*Hemidactylum scutatum* (Temminck and Schlegel)) (Patterson, 1989; Clebsch and Pyne, 1995; Carver et al., 1998). Eggert's sunflower was removed from the federal listing in 2005 (Merritt, 2005) but remains listed as a threatened species in Tennessee (Crabtree, 2008). Overcup oak and water tupelo 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 in the U.S.: 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." Insect biodiversity

within the area is quite high. For example, 7% of the bark beetles, 25% of the ambrosia beetles of eastern U.S. (Grant et al., 2003), and 19% of all tenebrionid species known from the eastern U.S. (Lambdin et al., 2003; Wiggins et al., 2007) have been documented from habitats within AAFB.

National landmark status does not carry restrictions or regulations pertaining to management or future development of these sites (United Nations, 1988). Several studies have been conducted to document rare, threatened or endangered (RTE) arthropods present at AAFB (Lambdin and Grant, 1999; Mullen et al., 1995). However, no RTE species were documented, although 144 insect species have been listed as rare in Tennessee by the Tennessee Department of Environment and Conservation's Division of Natural Areas (Withers, 2009). Information on the insects associated with Sinking Pond may be used to develop more comprehensive management practices by AAFB (i.e., selection of appropriate delivery systems for chemical applications against pest species). Sinking Pond and other compound sink wetlands 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 dependent on damp conditions, such as overcup oak (Wolfe, 1996). Hawksworth (1991) stated that "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?" Because inventories are important tools in addressing conservation and management problems and because Sinking Pond constitutes such a unique habitat, a research project was initiated in 1997 to assess the insect species at Sinking Pond. The specific objectives of this research were to establish baseline data on insect species associated with Sinking Pond, to evaluate species diversity, and to assess the ecological significance of select species.

MATERIALS AND METHODS

Study Site—Sinking Pond is located in Coffee County, Tennessee (coordinates 35°24′37″N, −86°4′10″W), and comprises approximately 52 ha, while the basin and watershed including the pond comprise over 159 ha.

Sampling Methods—Because of the diverse feeding habits, behavior, and activity of insect species, nine sampling methods (beat-sheet sampling, canopy fogging, direct collecting, leaf-litter sampling, light trapping, malaise trapping, Manitoba trapping, pitfall trapping, and sweep-net sampling) were utilized within the collection area that occupied the western area of Sinking Pond (Fig. 1) to sample the insect fauna. Sampling of the fauna was conducted at weekly, biweekly, or monthly intervals as appropriate to the season, sampling method, and insect group of interest (Vlach, 1999; Lambdin and Grant, 1999; Lambdin et al., 2003).

Beat-Sheet Sampling: In 1997, ten beat-sheet samples were collected on 17 September, and five beat-sheet samples were collected weekly until 5 November. In 1998, five samples were taken bimonthly from 18 June to 30 September. Each sample was obtained by laying a cloth sheet (94.1 cm^2), secured at opposing sides with dowel rods, under branches and foliage of randomly selected trees and shrubs and shaking or striking the vegetation to dislodge any arthropods. Specimens were transferred into a sealable plastic bag (900 ml), labeled, and taken to the laboratory for identification.

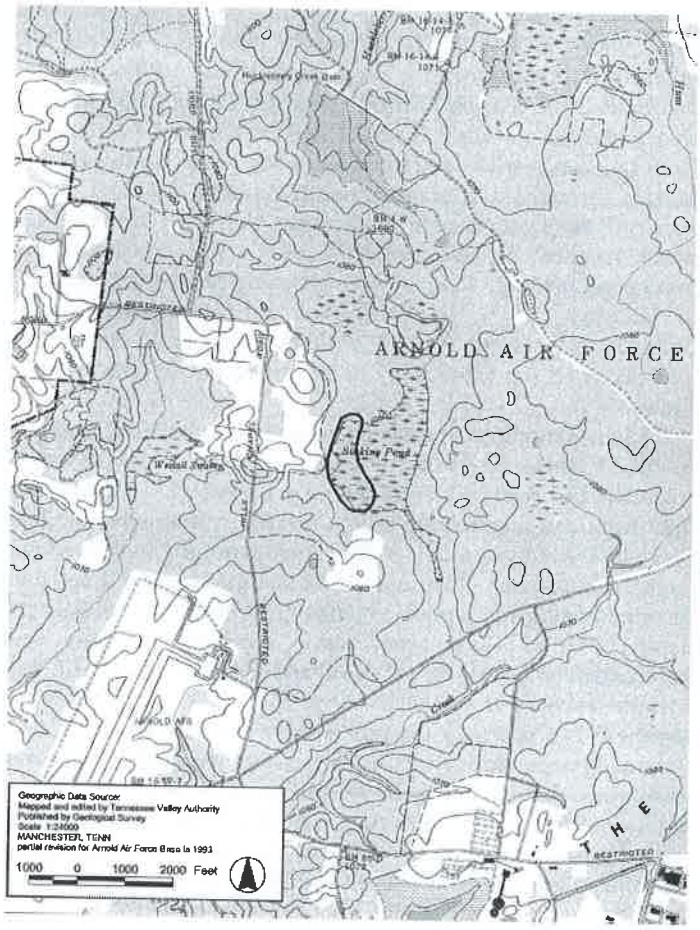

FIG. 1. Map of Sinking Pond area sampled for insect fauna, Arnold Air Force Base, Coffee County, Tennessee, 1997–1998.

Canopy Fogging: No fogging collections were made in 1997. In 1998, three randomly selected trees were sampled monthly from 20 May to 14 October. Selected trees were treated with a broad spectrum, synthetic, pyrethrin insecticide (30 ml of Asana XL, 0.66 emulsifiable concentrate mixed with 3000 ml of water). Chemical applications were made using a modified Dyna Fog Golden Eagle (model 2610) fogger. Each tree was fogged only once during the study. Plastic sheets (3 × 7.5 m) were placed around the base of the tree 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 (3030 ml of solution) used to fog the canopy was formulated to provide fog over a 4-to-6-min period. After 2–4 h, 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: Visual searches for insect specimens were made weekly from 9 October to 5 November, 1997. In 1998, collections were made from 26 March to 18 November. Visual searches were made by removing dead bark; looking under rocks and stones; breaking open rotting logs; examining dead animals; examining branches, foliage, and flowers; and hand-picking arthropods. Collecting also concentrated on finding new niches and substrates to collect from within the site. Insects flying in different areas of Sinking Pond were

collected where possible using an aerial net. Most specimens were placed in a "kill" jar saturated with ethyl acetate and taken to the laboratory for processing

Leaf-Litter Samples: In 1997, ten 900-ml leaf-litter samples were collected monthly from 17 September to 19 November from randomly selected areas around the pond. Each leaf-litter sample consisted of a sealable bag filled with leaf-litter 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). In 1998, five leaf-litter samples were obtained per month from 30 March through 30 September and taken to the laboratory to be processed in the Tullgren funnels.

Light Trapping: Nocturnal insects were collected using a modified Universal black light trap equipped with photoelectric cells. The light trap consisted of a 12-watt, U-shaped black light tube and a collecting unit. The trap contained four clear Plexiglass windows (12.5 × 25.4 cm) arranged at 90° angles from one another. This unit held an aluminum funnel that directed insects into a plastic bucket (29.4 cm diameter, 26.8 cm depth) with a killing agent (ethyl acetate). The light was automatically activated at dusk and remained lit until the battery discharged (usually within 6–8 h). Arthropods were removed and taken to the laboratory. A light trap collection was made once during 1997 on 9 October. In 1998, collections were made bimonthly from 31 March to 6 October, and an additional light trap collection was made on 19 November. Arthropods were removed from the trap the following morning, placed in kill jars or specimen cups, and taken to the laboratory for processing and identification.

Malaise Trapping: Samples from one trap positioned at the mid to upper canopy level on an overcup oak 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 2.54 cm^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. Insects struck the barrier and flew 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 30–60 ml of a 50/50 mixture ethylene glycol and water. Each week the collection cup was unscrewed from the collecting head, capped, and taken to the laboratory.

Manitoba Trapping: Collections from one trap were taken weekly 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. 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 attempted to fly out through the clear plastic and became 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 were collected, placed in a kill jar, and taken to the laboratory for processing.

Pitfall Trapping: Ten numbered pitfall traps were used to sample the insect fauna weekly from 1 October to 5 November 1997. In 1998, five of the original pitfall traps were used to collect insects 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 propylene glycol 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 both near and 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 to the laboratory.

The five pitfall traps that were used throughout the study were placed within four different plant community types associated with Sinking Pond as described 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* (L.) Yates) 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 (*Carya alba* (L.) Nutt.)/shagbark hickory (*Carya ovata* (Mill.) K. Koch)/willow oak/sweetgum (*Liquidambar styraciflua* L.) 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* (L.) 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, which means "critically imperiled globally." This community is probably endemic to Coffee County, Tennessee.

Sweep-Net Sampling: Ten sweep-net samples were taken 17 September 1997, 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.

Processing and Identification of Specimens—After collection, most specimens were stored in a freezer until they could be sorted and identified, with the exception of pitfall, malaise trap, leaf-litter, and Odonata and Lepidoptera samples. Pitfall and malaise samples were placed in labeled vials of ethanol, and leaf-litter samples were transferred to Tullgren funnels where vials containing alcohol were used to collect specimens. Specimens of Odonata and Lepidoptera were placed in paper triangles or mounted on pins. Each specimen was provided a label with the following information: site collected, date collected, trap type, and sample number. Insects were identified to order, family, genus, or species using standard dichotomous keys. Some specimens were sent to specialists for identification or verification (Lambdin and Grant, 1999).

TABLE 1. The number and percentage of insect species and specimens collected at Sinking Pond, Coffee County, Tennessee, for each order during 1997 and 1998.

Order	Families	Species (n = 877)	% of Insect Species	Specimens (n = 13,162)	% of Insect Specimens
Protura	1	1	0.11	31	0.24
Collembola	10	57	6.50	4315	32.78
Diplura	1	1	0.11	6	0.05
Odonata	4	12	1.37	47	0.36
Phasmida	1	2	0.23	6	0.05
Orthoptera	5	13	1.48	115	0.87
Blattaria	1	2	0.23	42	0.32
Isoptera	1	1	0.11	1	~ 0
Plecoptera	1	2	0.23	2	0.02
Psocoptera	1	6	0.68	34	0.26
Hemiptera	28	117	13.30	855	6.49
Thysanoptera	1	2	0.34	3	0.02
Neuroptera	4	5	0.57	28	0.21
Coleoptera	58	386	44.01	5539	42.08
Mecoptera	2	3	0.34	5	0.04
Diptera	36	122	13.91	892	6.78
Trichoptera	4	7	0.80	19	0.14
Lepidoptera	18	82	9.23	260	1.98
Hymenoptera	16	57	6.50	962	7.31

Data Analysis—Data consisting of order, family, genus, species, author, collection site, collection date, method of collection, and number of specimens were entered into the BIOTA database (Colwell, 1996). Collection data for each species were examined for each sampling method. The number of insects was tabulated to provide species lists and diversity comparisons. Comparisons with the RTE arthropod lists of Alabama, 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. Exotic species and potential indicator species for the Sinking Pond area were identified and documented. Comparisons between the numbers of specimens and species collected were made among the nine sampling methods to evaluate the numbers of insects obtained by each sampling method. 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) used was

$$H' = -\varphi(p_i \ln p_i) - [(s-1)/2N] \quad (i = 1 \text{ to } s)$$

H' = diversity of species
s = the number of species
p_i = proportion of individuals of the total sample belonging to the i^{th} species
ln = natural log
N = total number of all individuals
thus: $H_{max.} = \ln s$
evenness = $J = H'/H_{max.}$

The Shannon index compares samples of different sizes to assess the number of species and 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, reducing the Shannon index score. Species richness is the total number of species in an area. $H_{max.}(H_{max.})$ 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; thus, evenness is essentially the percentage of the diversity collected from the potential diversity a collection with s species could have. Evenness is a component of diversity and its interpretation. The highest evenness values are the result of a collection of species which is 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, both evenness and diversity were considered in the assessment of each sampling method at Sinking Pond.

RESULTS AND DISCUSSION

The nine sampling methods used collected 13,162 insect specimens representing 877 species in 193 families in 19 orders (Table 1). Although the highest numbers of insect specimens collected were in the two orders Coleoptera (42.1%) and

TABLE 2. Species richness, Shannon diversity, maximum potential diversity, and evenness value for nine sampling methods, combined and individually, employed at Sinking Pond, Coffee County, Tennessee, during 1997 and 1998.

Trap	Number of Species	Single [a] Species	H′ [b]	H_{max} [c]	Evenness
Beat	45	15	3.28	4.85	0.85
Canopy Fog	121	36	3.42	4.93	0.68
Direct	226	161	4.76	5.79	0.92
Leaf Litter	62	44	2.62	4.17	0.67
Light	287	218	3.52	5.70	0.59
Malaise	43	12	3.30	3.80	0.85
Manitoba	30	16	3.22	3.51	0.96
Pitfall	135	65	3.07	4.81	0.65
Sweep	222	100	4.57	5.38	0.81
Overall	877	667	4.98	7.13	0.73

[a] Number of species unique to the specified trapping method.
[b] H′ = the Shannon index value.
[c] H_{max}= H_{max} = the maximum potential value of the Shannon index.

Collembola (32.8%), 71.2% of all species collected were from the orders Coleoptera (44.0%), Diptera (13.9%), and Hemiptera (13.3%). Most orders (13) were represented by fewer than 20 species.

Overall diversity (H′ = 4.98 and H_{max} = 7.13) demonstrates that the combined collections were successful in collecting a greater amount of diversity from the site than any single collection method (Table 2). The calculated evenness (J) of 0.73 represents a moderately high value; therefore, the H′ represents about 73% of the diversity that could potentially be found in a collection of 877 species. Insect species diversity (H′) varied among sampling methods, as the lowest diversity was found with leaf-litter sampling and the highest diversity with direct sampling (Table 2). A listing of insect species associated with Sinking Pond was compiled (Table 3). The number of orders (Fig. 2A), families (Fig. 2B) and species (Fig. 2C) captured varied by trapping method. Each of the sampling methods captured from six (beat-sheet and Manitoba trapping) to 11 orders (direct and sweep-net sampling) (Fig. 2A–C). Light trapping captured the most species, primarily Coleoptera and Lepidoptera, followed by direct collecting and sweep netting.

Beat-sheet sampling collected 71 specimens representing six orders, 24 families and 45 species (Fig. 2), and represented 0.54% of all insect specimens (n = 13,162). The greatest numbers of species collected using beat-sheets were in the Coleoptera, Diptera, Hemiptera, and Lepidoptera, respectively. A high species to specimen ratio may have resulted from the wide variety of plant species sampled. Most of the hymenopteran species present were Formicidae, which may have been foraging on plants or tending plant-feeding insects. Species evenness for beat-sheet sampling was high (Table 2), and it can be inferred that the specimens sampled in beat sheeting were 85.0% of estimated maximum potential diversity. Although diversity appeared to be high (Table 2), 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 15 species (33.3% of all species sampled by this method) captured that were not found by any other sampling method (Table 2).

Canopy fogging collected 828 specimens representing 10 orders, 57 families, and 121 species (Fig. 2A–C). The highest numbers of species were in the orders Coleoptera, Diptera, Hymenoptera, and Hemiptera. The coleopteran species represented were primarily herbivorous species which may have been feeding on trees, but there were several predatory species as well. Approximately one-half of the Diptera, as adults or larvae, were associated with plants in some state of decay; therefore, these adults may be using the tree canopy as a place for mating and resting. The remaining Diptera were primarily predatory species, while the majority of the hymenopteran species collected were ants. This method collected 6.28% of all insect specimens. Species diversity and evenness for canopy fogging may have been low for the number of species captured by this method (Table 2), because some species were captured on only one sampling date. Fifty-nine species (48.8% of the species) captured by canopy fogging were not found by another sampling method which may be due to the spatial separation of the tree canopy from the other habitats or to a higher degree of habitat specialization in the canopy species. From the data examined, 14 unique families and 36 unique species were identified from the 14 October 1998 fogging sample when compared to the other Sinking Pond fogging samples. Families collected from the overcup oak canopy were significantly different (Π^2 = 703.26; SD = 56, P = 0.001) from the families collected in the other fogging samples.

Direct collections obtained 587 specimens representing 11 orders, 108 families, and 226 species (Fig. 2). The highest numbers of species collected were in the orders Coleoptera, Diptera, Lepidoptera, and Hymenoptera, respectively. Coleopterans collected included detritivores, carrion feeders, predators, herbivores, and wood-boring species. Dipteran species collected tended to be the larger, more obvious species, but they represented a variety of niches. The large number of lepidopteran species collected by direct collection may have been influenced by their conspicuous presence. Direct collecting accounted for 4.45% of all insect specimens obtained. Diversity for this sampling method was the highest and evenness the second highest when compared to the eight other

methods (Table 2). Direct collections captured 161 species (71.2%) that were not found by any other sampling method, which represents more unique species than were captured by any other sampling methods except light trapping (Table 2). Direct collections were artificially biased, because sampling was conducted to acquire new species, rather than to just randomly accumulate specimens.

Leaf-litter samples consisted of 2989 specimens that were identified. Collembolan populations are often large, as many as 100,000 per m^3 of soil (Borror et al., 1989). Leaf-litter samples collected seven orders representing 22 families and 62 species (Fig. 2A–C), and represented 22.7% of all specimens. Leaf-litter samples had the lowest diversity score for any of the sampling methods and evenness also was low (Table 2), due to the large amount of variation in numbers of specimens per species. Forty-four species were found to be unique to this sampling method (Table 2). The high proportion of unique species found in the samples may be a result of many of these species spending their entire life cycle in the leaf-litter, and they are not generally collected by other methods. Additionally, many of these species are also sensitive to dessication, especially the soft-bodied Collembola. The composition of leaf litter is dependent on the plant community; therefore, species inhabiting 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 leaf-litter have limited dispersal abilities, so species collected would be inhabitants of the area and not transients moving through the area. As a result, species in the leaf-litter may be potential indicators of the community. One species, *Isotomiella minor* (Schäffer), was collected on 80% of the 1997 sampling dates with an average of 20.75 specimens per leaf-litter sample. Three species, *Lepidocyrtus cinereus* Folsom, *Mesaphorura yosiii* (Rusek), and an *Orchesella* species, were present on all 1997 leaf-litter collection dates. These may represent species that are well adapted to the particular leaf-litter composition of Sinking Pond. Not enough information is known about these species, such as why they may be common in this habitat, to suggest them as indicator species.

Light trapping collected 4547 specimens from nine orders, 69 families, and 287 species (Fig. 2). This method collected 34.5% of all specimens. The three dominant insect orders by number of species were Coleoptera, Lepidoptera, and Hemiptera. Light trap collections had the highest species richness and the third highest diversity (Table 2). There were 218 species (75.7% 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 were Lepidoptera (61 species) and aquatic beetles (26 species in the families: Dytiscidae, Gyrinidae, Haliplidae, and Hydrophilidae). Specimens of Plecoptera, Trichoptera and Neuroptera also were collected primarily by this method.

The malaise trap collected 103 specimens representing nine orders, 27 families, and 43 species (Fig. 2A–C). This method collected 0.78% of all specimens. This trap captures those insects with the behavior to fly or crawl upward toward the light when confronted with a barrier as opposed to those that drop to the ground. The small number of specimens collected using this sampling method suggests that there were not many insects flying along the edge of the pond. Species associated with the wet edges of ponds are often Diptera, but these species

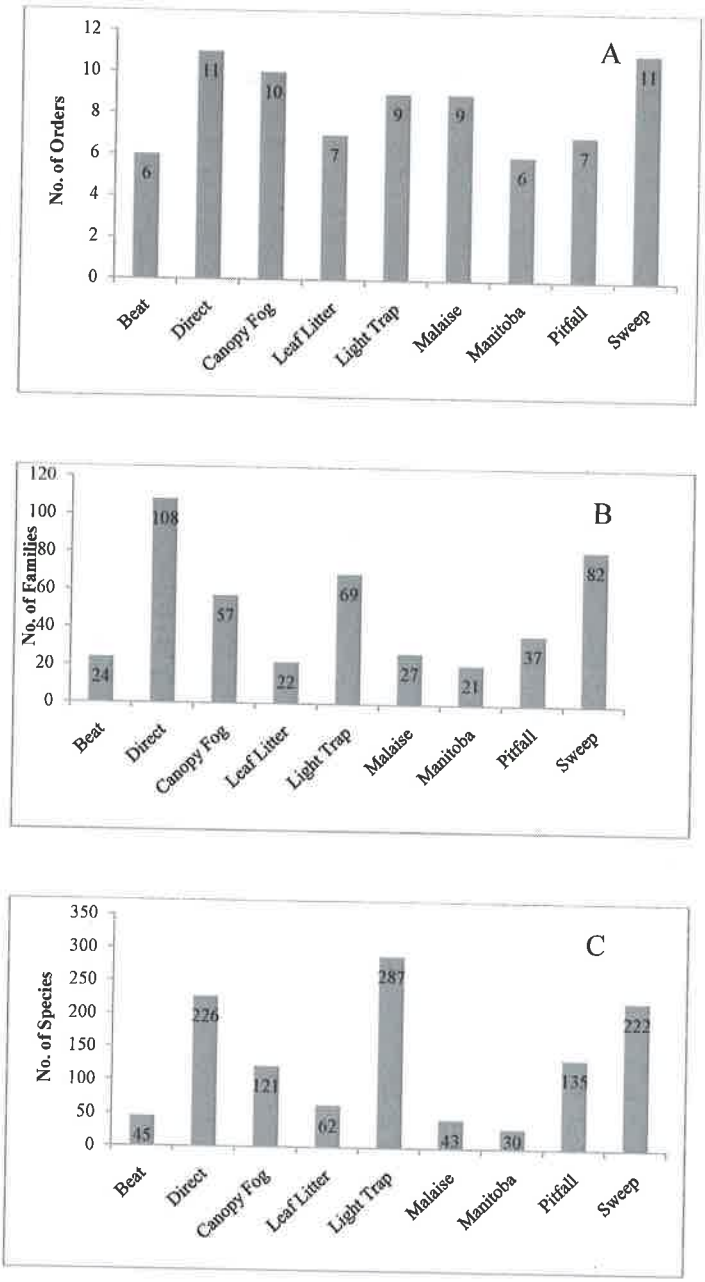

FIG. 2A–C. Number of insect orders, families, and species identified using nine collection methods at Sinking Pond, Coffee County, Tennessee, 1997–1998.

may have stayed close to the moist ground and avoided the suspended trap. Also, the pond was patrolled by odonates for the majority of the sampling season, but they were not captured by this method. The orders represented by the largest number of species were Diptera, Hemiptera, and Coleoptera. Dipterans may have represented the majority of the species collected because the trap was placed near the moist edge of the pond with sparse vegetation. As such, most of the dipteran species collected are generally associated with decay and fungus, although two tabanid species were collected. Because traps were generally placed in areas of sparse vegetation, the hemipteran species may have been collected as they moved into a new area to feed. A high diversity can be inferred from diversity and evenness values (Table 2), but the Shannon index

TABLE 3. Insect species identified from nine collection methods at Sinking Pond, Coffee County, Tennessee, during 1997–1998.

Order	Family	Genus	species	Method(s) *	# Collected
Protura	Unident.	Unident.	species 1	LL	31
Collembola	Entomobryidae	*Entomobrya*	*assuta* Folsom	ML, PF	5
Collembola	Entomobryidae	*Entomobrya*	*purpurascens* Packard	LL, PF	20
Collembola	Entomobryidae	*Entomobrya*	species 1	LL, PF	17
Collembola	Entomobryidae	*Homidia*	*sauteri* Börner	LL	4
Collembola	Entomobryidae	*Lepidocyrtus*	*cinereus* Folsom	LL, ML, PF	388
Collembola	Entomobryidae	*Lepidocyrtus*	species 2	LL	5
Collembola	Entomobryidae	*Lepidocyrtus*	species 3	LL	5
Collembola	Entomobryidae	*Orchesella*	*celsa* Christiansen & Tucker	PF	7
Collembola	Entomobryidae	*Orchesella*	species 1	LL, PF	42
Collembola	Entomobryidae	*Pseudosinella*	*aera* Christiansen and Bellinger	LL	7
Collembola	Entomobryidae	*Pseudosinella*	*sexoculata* Schött	LL	4
Collembola	Entomobryidae	*Pseudosinella*	species 1	LL	1
Collembola	Entomobryidae	*Pseudosinella*	*violenta* (Folsom)	LL	21
Collembola	Hypogastruridae	*Hypogastrura*	species 1	LL, PF	123
Collembola	Hypogastruridae	*Xenylla*	species 1	LL	6
Collembola	Isotomidae	*Appendisotoma*	species 1	LL	35
Collembola	Isotomidae	*Folsomia*	*prima* Mills	LL	64
Collembola	Isotomidae	*Folsomia*	*stella* Christiansen & Tucker	LL	5
Collembola	Isotomidae	*Folsomides*	*marchicus* (Frenzel)	LL	1
Collembola	Isotomidae	*Folsomides*	*parvulus* Stach	LL	29
Collembola	Isotomidae	*Isotoma*	species 1	LL	1
Collembola	Isotomidae	*Isotoma*	*viridis* Bourlet	LL ,PF	51
Collembola	Isotomidae	*Isotomiella*	*minor* (Schäffer)	LL	301
Collembola	Isotomidae	*Isotomodes*	*falsus* Christiansen & Bellinger	LL	1
Collembola	Isotomidae	*Isotomurus*	species 1	LL	1
Collembola	Isotomidae	*Micrisotoma*	*achromata* Bellinger	LL	1
Collembola	Isotomidae	*Proisotoma*	*minima* (Absolon)	LL	141
Collembola	Isotomidae	*Pseudisotoma*	*monochaeta* Kos	LL	1
Collembola	Neanuridae	*Anurida*	*tullbergi* Schött	LL	22
Collembola	Neanuridae	*Friesea*	*sublimis* Macnamara	LL	1
Collembola	Neanuridae	*Micranurida*	*pygmaea* (Börner)	LL	92
Collembola	Neanuridae	*Neanura*	*muscorum* (Templeton)	LL	10
Collembola	Neanuridae	*Neanura*	species 1	LL, PF	3
Collembola	Neanuridae	*Neanura*	species 2	LL	7
Collembola	Neanuridae	*Pseudachorutes*	*aureofasciatus* (Mac Gillivray)	PF	9
Collembola	Neanuridae	*Pseudachorutes*	species 1	LL, PF	7
Collembola	Neanuridae	*Sensillanura*	*caeca* (Folsom)	LL	22
Collembola	Neanuridae	*Superodontella*	*cornifer* Mills	LL	12
Collembola	Neanuridae	*Superodontella*	species 1	LL	1
Collembola	Neelidae	*Neelus*	species 1	LL	1
Collembola	Oncopoduridae	*Harlomillsia*	*oculata* (Mills)	LL	3
Collembola	Onychiuridae	*Mesaphorura*	*silvicola* Folsom	LL	3
Collembola	Onychiuridae	*Mesaphorura*	*yosiii* (Rusek)	LL	182
Collembola	Onychiuridae	*Onychiurus*	species 1	LL	103
Collembola	Onychiuridae	*Tullbergia*	*mala* Christiansen & Bellinger	LL	3
Collembola	Poduridae	*Podura*	*aquatica* L.	LL	4
Collembola	Sminthuridae	*Arrhopalites*	species 1	LL	1
Collembola	Sminthuridae	*Bothriovolsus*	*pineolae* (Wray)	PF	1
Collembola	Sminthuridae	*Ptenothrix*	species 1	LL, PF	7
Collembola	Sminthuridae	*Sminthurides*	*malmgreni* (Tullberg)	LL	18
Collembola	Sminthuridae	*Sminthurinus*	*quadrimaculatus* (Ryder)	ML	1
Collembola	Sminthuridae	*Sminthurinus*	species 1	LL	9
Collembola	Sminthuridae	*Sminthurus*	species 2	LL	14
Collembola	Sminthuridae	*Sphaeridia*	*pumilis* (Krausbauer)	LL	17
Collembola	Tomoceridae	*Pogonognathellus*	*elongatus* Maynard	PF	2

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Collembola	Tomoceridae	*Pogonognathellus*	species 1	LL, PF	100
Collembola	Tomoceridae	*Pogonognathellus*	species 2	PF	1
Collembola	Unident.	Unident.	species 1	LL, PF	2372
Diplura	Japygidae	*Parajapyx*	*Isabellae* (Grassi)	LL	6
Odonata	Aeshnidae	*Aeshna*	*umbrosa* Walker	DI	1
Odonata	Aeshnidae	*Epiaeschna*	*heros* (Fab.)	DI	1
Odonata	Coenagrionidae	*Ischnura*	*hastata* (Say)	DI	2
Odonata	Lestidae	*Lestes*	*disjunctus* Selys	DI, SW	6
Odonata	Lestidae	*Lestes*	*rectangularis* Say	DI, FG, SW	9
Odonata	Lestidae	*Lestes*	species 1	DI	1
Odonata	Libellulidae	*Libellula*	*incesta* Hagen	DI	2
Odonata	Libellulidae	*Libellula*	*semifasciata* Burmeister	DI	1
Odonata	Libellulidae	*Libellula*	*vibrans* Fab.	DI	3
Odonata	Libellulidae	*Pachydiplax*	*longipennis* (Burmeister)	DI	8
Odonata	Libellulidae	*Plathemis*	*lydia* Drury	DI	2
Odonata	Libellulidae	*Sympetrum*	*ambiguum* (Rambur)	DI, SW	11
Orthoptera	Acrididae	*Arphia*	*sulphurea* (Fab.)	SW	1
Orthoptera	Gryllidae	*Allonemobious*	*fasciatus* (De Geer)	LT, ML, PF	35
Orthoptera	Gryllidae	*Gryllus*	*assimilis* (Fab.)	FG, PF, SW	36
Orthoptera	Gryllidae	*Oecanthus*	*latipennis* Riley	MN	2
Orthoptera	Gryllidae	*Oecanthus*	*niveus* (De Geer)	DI, FG, LT, PF, SW	16
Orthoptera	Gryllidae	*Oecanthus*	species 1	FG, PF, SW	9
Orthoptera	Rhaphidophoridae	*Ceuthophilus*	*brevipes* Scudder	PF	4
Orthoptera	Tetrigidae	*Tetrix*	*arenosa* Burmeister	DI	1
Orthoptera	Tetrigidae	*Tettigidea*	*armata* Morse	DI	1
Orthoptera	Tetrigidae	*Tettigidea*	*lateralis* (Say)	DI, PF, SW	6
Orthoptera	Tettigoniidae	*Neoconocephalus*	*triops* (L.)	DI	1
Orthoptera	Tettigoniidae	*Pterophylla*	*camellifolia* (Fab.)	DI	2
Orthoptera	Tettigoniidae	*Microcentrum*	*retinerve* (Burmeister)	DI	1
Phasmatodea	Heteronemiidae	*Anisomorpha*	*buprestoides* (Stoll)	BT	1
Phasmatodea	Heteronemiidae	*Diapheromera*	*femorata* (Say)	DI, SW	5
Plecoptera	Perlidae	*Acroneuria*	*frisoni*? Stark & Brown	LT	1
Plecoptera	Perlidae	*Perlesta*	species 1	LT	1
Isoptera	Unident.	Unident.	species 1	DI	1
Blattodea	Blattellidae	*Ischnoptera*	*deropeltiformis* (Brunner)	PF	12
Blattodea	Blattellidae	*Parcoblatta*	*bolliana* (Saussure & Zehntner)	LT, PF	30
Hemiptera	Aradidae	*Mezira*	*granulata* (Say)	DI	1
Hemiptera	Belostomatidae	*Lethocerus*	*griseus* (Say)	LT	2
Hemiptera	Berytidae	*Jalysus*	species 1	SW	12
Hemiptera	Coreidae	*Acanthocephala*	*terminalis* (Dallas)	FG	1
Hemiptera	Coreidae	*Leptoglossus*	*fulvicornis* (Westwood)	DI	1
Hemiptera	Corixidae	*Hesperocorixa*	species 1	DI	1
Hemiptera	Corixidae	*Sigara*	species 1	LT	1
Hemiptera	Corixidae	*Trichocorixa*	*calva* (Say)	LT	1
Hemiptera	Gerridae	*Gerris*	*argenticollis* Parshley	DI	4
Hemiptera	Hydrometridae	*Hydrometra*	species 1	DI	1
Hemiptera	Lygaeidae	*Kleidocerys?*	species 1	FG	1
Hemiptera	Miridae	*Fulvius*	*brunneus* (Provancher)	PF	12
Hemiptera	Miridae	*Hyaliodes*	*vitripennis* (Say)	BT, FG	15
Hemiptera	Miridae	*Phytocoris*	*depictus* Knight	FG	6
Hemiptera	Miridae	Unident.	species 1	FG, LT, PF, SW	27
Hemiptera	Nabidae	*Hoplistoscelis*	*sordidus* (Reuter)	BT, SW	22
Hemiptera	Nepidae	*Ranatra*	*nigra* Herrich-Schäffer	DI	3
Hemiptera	Notonectidae	*Notonecta*	*irrorata* Uhler	DI	3
Hemiptera	Pentatomidae	*Banasa*	*dimidiata* (Say)	SW	1
Hemiptera	Pentatomidae	*Brochymena*	*arborea* (Say)	DI, SW	2

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Hemiptera	Pentatomidae	*Brochymena*	*cariosa* Stål	DI	1
Hemiptera	Pentatomidae	*Euschistus*	*servus* (Say)	DI	1
Hemiptera	Pentatomidae	*Euschistus*	*tristigmus* (Say)	SW	2
Hemiptera	Pentatomidae	*Mormidea*	*lugens* (Fab.)	SW	3
Hemiptera	Pentatomidae	*Podisus*	*maculiventris* (Say)	DI, FG, LT	5
Hemiptera	Pentatomidae	*Thyanta*	species 1	LT	1
Hemiptera	Pentatomidae	Unident.	species 1	FG	1
Hemiptera	Phymatidae	*Phymata*	*fasciata* (Gray)	DI	1
Hemiptera	Reduviidae	*Arilus*	*cristatus* (L.)	MN	2
Hemiptera	Reduviidae	*Barce*	*fraterna fraterna* (Say)	DI	1
Hemiptera	Reduviidae	*Empicoris*	*errabundus* (Say)	FG	5
Hemiptera	Reduviidae	*Melanolestes*	*picipes* (Herrich-Schäffer)	DI	1
Hemiptera	Rhopalidae	*Stictopleurus*	*crassicornis* (L.)	FG	1
Hemiptera	Thyreocoridae	*Corimelaena*	*obscura* McPherson & Sailer	DI, SW	5
Hemiptera	Thyreocoridae	*Corimelaena*	*pulicaria* (Germar)	DI	1
Hemiptera	Thyreocoridae	*Galgupha*	*aterrima* Malloch	SW	1
Hemiptera	Tingidae	*Corythucha*	*arcuata* (Say)	FG, LL, ML, SW	221
Hemiptera	Tingidae	*Corythucha*	species 1	SW	2
Hemiptera	Tingidae	*Leptopharsa*	*oblonga* (Say)	SW	1
Hemiptera	Aphidae	Unident.	species 1	DI	14
Hemiptera	Cercopidae	*Aphrophora*	*quadrinotata* Say	SW	1
Hemiptera	Cercopidae	*Prosapia*	*bicincta* (Say)	DI, LT, ML	4
Hemiptera	Cercopidae	Unident.	species 1	SW	1
Hemiptera	Cercopidae	Unident.	species 2	SW	1
Hemiptera	Cicadellidae	*Agallia*	*quadripunctata* (Provancher)	SW	13
Hemiptera	Cicadellidae	*Agalliopsis*	*novellus* (Say)	SW	1
Hemiptera	Cicadellidae	*Cloanthus*	species 1	BT, SW	4
Hemiptera	Cicadellidae	*Coelidia*	*borealis* (Spångberg)	SW	2
Hemiptera	Cicadellidae	*Coelidia*	*olitoria* (Say)	DI, ML, SW	5
Hemiptera	Cicadellidae	*Colladonus*	*clitellarius* (Say)	SW	1
Hemiptera	Cicadellidae	*Draeculacephala*	*antica* (Walker)	LT, ML, SW	7
Hemiptera	Cicadellidae	*Erythroneura*	*comes* (Say)	BT, SW	5
Hemiptera	Cicadellidae	*Erythroneura*	*hamata* Beamer	BT, SW	7
Hemiptera	Cicadellidae	*Erythroneura*	*kansana*? Group	ML	1
Hemiptera	Cicadellidae	*Erythroneura*	*micheneri* Hepner	LT	1
Hemiptera	Cicadellidae	*Erythroneura*	*obliqua*? group	FG, PF, SW	7
Hemiptera	Cicadellidae	*Erythroneura*	*ontari* Robinson	FG, SW	3
Hemiptera	Cicadellidae	*Erythroneura*	species 1	BT, LT, ML, PF, SW	116
Hemiptera	Cicadellidae	*Erythroneura*	*vulnerata* group	SW	3
Hemiptera	Cicadellidae	*Eutettix*	*luridus* (Van Duzee)	LT	1
Hemiptera	Cicadellidae	*Graphocephala*	*versuta* (Say)	SW	6
Hemiptera	Cicadellidae	*Gyponana*	species 2	LT, SW	2
Hemiptera	Cicadellidae	*Oncometopia*	*orbona* (Fab.)	BT, SW	2
Hemiptera	Cicadellidae	*Sibovia*	*occatoria* (Say)	SW	1
Hemiptera	Cicadellidae	Unident.	species 1	FG	23
Hemiptera	Cicadellidae	Unident.	species 2	SW	13
Hemiptera	Cicadellidae	Unident.	species 3	LT, SW	7
Hemiptera	Cicadellidae	Unident.	species 4	ML, SW	3
Hemiptera	Cicadellidae	Unident.	species 5	LT	1
Hemiptera	Cicadellidae	Unident.	species 6	FG	1
Hemiptera	Cicadellidae	Unident.	species 7	LT, SW	8
Hemiptera	Cicadellidae	Unident.	species 8	SW	1
Hemiptera	Cicadellidae	Unident.	species 9	SW	1
Hemiptera	Cicadellidae	Unident.	species 10	ML	1
Hemiptera	Cicadellidae	Unident.	species 11	SW	1
Hemiptera	Cicadellidae	Unident.	species 12	SW	1

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Hemiptera	Cicadellidae	Unident.	species 13	LT	1
Hemiptera	Cicadellidae	Unident.	species 14	LT	1
Hemiptera	Cicadellidae	Unident.	species 15	FG	1
Hemiptera	Cicadellidae	Unident.	species 16	SW	1
Hemiptera	Cicadidae	*Magicicada*	*tredecassini* Alexander & Moore	DI	1
Hemiptera	Cicadidae	*Tibicen*	*canicularis* (Harris)	DI	2
Hemiptera	Cixiidae	*Bothriocera*	species 1	ML, SW	3
Hemiptera	Cixiidae	*Oliarus*	species 1	FG, LT, SW	6
Hemiptera	Cixiidae	Unident.	species 1	BT, SW	5
Hemiptera	Cixiidae	Unident.	species 2	SW	1
Hemiptera	Cixiidae	Unident.	species 3	FG	1
Hemiptera	Cixiidae	Unident.	species 4	FG	1
Hemiptera	Cixiidae	Unident.	species 5	DI, LT	2
Hemiptera	Cixiidae	Unident.	species 6	SW	2
Hemiptera	Delphacidae	*Liburniella*	*ornata* (Stål)	SW	1
Hemiptera	Derbidae	*Cedusa*	species 1	LT, SW	3
Hemiptera	Derbidae	*Neocenchrea*	*heidemanni* (Ball)	SW	2
Hemiptera	Derbidae	*Omolicna*	*brunnea* (McAtee)	BT, SW	2
Hemiptera	Derbidae	*Omolicna*	*uhleri* (Ball)	SW	1
Hemiptera	Derbidae	*Otiocerus*	*amyotii* Fitch	DI, SW	2
Hemiptera	Derbidae	Unident.	species 1	SW	1
Hemiptera	Flatidae	*Anormenis*	*chloris* (Melichar)	SW	1
Hemiptera	Flatidae	*Metcalfa*	*pruinosa* (Say)	LT	1
Hemiptera	Flatidae	Unident.	species 1	SW	1
Hemiptera	Membracidae	*Cyrtolobus*	*pallidifrontis* (Emmons)	FG	1
Hemiptera	Membracidae	*Enchenopa*	*binotata* (Say)	SW	1
Hemiptera	Membracidae	*Entylia*	*carinata* (Forster)	BT	1
Hemiptera	Membracidae	*Heliria*	*gibberata* Ball	LT	1
Hemiptera	Membracidae	*Platycotis*	*vittata* (Fab.)	BT, DI, FG, LT , ML, SW	45
Hemiptera	Membracidae	*Spissistilus*	*festinus* (Say)	DI, FG, LT, SW	58
Hemiptera	Membracidae	*Stictocephala*	*lutea* (Walker)	SW	4
Hemiptera	Membracidae	*Stictocephala*	species 1	BT, SW	3
Hemiptera	Membracidae	*Telamona*	*reclivata* Fitch	BT, LT	3
Hemiptera	Membracidae	Unident.	species 1	LT	1
Hemiptera	Membracidae	Unident.	species 2	LT	1
Hemiptera	Membracidae	Unident.	species 3	FG	1
Hemiptera	Membracidae	Unident.	species 4	BT	2
Hemiptera	Psyllidae	Unident.	species 1	DI	43
Hemiptera	Psyllidae	Unident.	species 2	BT	1
Hemiptera	Psyllidae	Unident.	species 3	SW	1
Hemiptera	Psyllidae	Unident.	species 4	FG, SW	2
Thysanoptera	Phlaeothripidae	*Neheegeria*?	species 1	ML	1
Thysanoptera	Phlaeothripidae	Unident.	species 1	FG	2
Psocoptera	Psocidae	*Psocus*	species 1	BT, FG, SW	8
Psocoptera	Unident.	Unident.	species 1	BT, SW	4
Psocoptera	Unident.	Unident.	species 2	BT, FG, ML	4
Psocoptera	Unident.	Unident.	species 3	FG	1
Psocoptera	Unident.	Unident.	species 4	BT	1
Psocoptera	Unident.	Unident.	species 5	FG	16
Coleoptera	Aderidae	*Zonantes*	*subfasciatus* (LeConte)	SW	2
Coleoptera	Anobiidae	*Tricorynus*	*dichrous* (Fall)	LT	1
Coleoptera	Anobiidae	*Tricorynus*	*gravis* (LeConte)	FG, LT	3
Coleoptera	Anthicidae	*Anthicus*	species 1	FG	1
Coleoptera	Anthicidae	*Sapintus*	species 1	LT, SW	2

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Coleoptera	Anthribidae	*Toxonotus*	*cornutus* (Say)	FG	1
Coleoptera	Biphyllidae	*Diplocoelus*	*rudis* (LeConte)	DI	4
Coleoptera	Bostrichidae	*Endecatomus*	*rugosus* (Randall)	DI	1
Coleoptera	Bostrichidae	*Lichenophanes*	*bicornis* (Weber)	LT	2
Coleoptera	Bostrichidae	*Stephanopachys*	species 1	FG	2
Coleoptera	Brentidae	*Arrhenodes*	*minuta* (Drury)	LT	1
Coleoptera	Buprestidae	*Acmaeodera*	*tubulus* (Fab.)	SW	1
Coleoptera	Buprestidae	*Agrilus*	species 3	FG	2
Coleoptera	Byturidae	*Byturus*	*unicolor* Say	SW	1
Coleoptera	Cantharidae	*Cantharis*	*rectus* Melsheimer	SW	13
Coleoptera	Cantharidae	*Cantharis*	species 1	LT, SW	5
Coleoptera	Cantharidae	*Malthodes*	species 1	SW	2
Coleoptera	Cantharidae	*Rhaxonycha*	*carolinus* (Fab.)	LT	1
Coleoptera	Carabidae	*Abacidus*	*atratus* Newman	PF	1
Coleoptera	Carabidae	*Acupalpus*	species 1	LT, SW	6
Coleoptera	Carabidae	*Agonum*	*albicrus* Dejean	LT, PF	8
Coleoptera	Carabidae	*Agonum*	*decorum* Say	LT	1
Coleoptera	Carabidae	*Agonum*	*errans* Say	LT	3
Coleoptera	Carabidae	*Agonum*	*melanarium*? Dejean	PF	1
Coleoptera	Carabidae	*Agonum*	*punctiforme* Say	LT	2
Coleoptera	Carabidae	*Agonum*	*tenue*? LeConte	LT, PF	12
Coleoptera	Carabidae	*Aspidoglossa*	*subangulata* (Chaudoir)	LT	3
Coleoptera	Carabidae	*Badister*	*maculatus* LeConte	LT	1
Coleoptera	Carabidae	*Bembidion*	species 1	LL, LT	334
Coleoptera	Carabidae	*Bembidion*	species 2	LT, PF, SW	122
Coleoptera	Carabidae	*Brachinus*	*alternans* Dejean	DI	2
Coleoptera	Carabidae	*Brachinus*	*fumans* (Fab.)	DI, PF	9
Coleoptera	Carabidae	*Brachinus*	*ovipennis* LeConte	LT, PF	2
Coleoptera	Carabidae	*Calleida*	*viridipennis* (Say)	FG	2
Coleoptera	Carabidae	*Calosoma*	*scrutator* Fab.	LT	1
Coleoptera	Carabidae	*Chlaenius*	*erythropus* Germar	DI, LT, PF	36
Coleoptera	Carabidae	*Chlaenius*	*impunctifrons* Say	PF	1
Coleoptera	Carabidae	*Chlaenius*	*platyderus* Chaudoir	PF	1
Coleoptera	Carabidae	*Cicindela*	*unipunctata* Fab.	PF	2
Coleoptera	Carabidae	*Clivina*	*americana*? Dejean	LT	151
Coleoptera	Carabidae	*Clivina*	*bipustulata* Fab.	LT	75
Coleoptera	Carabidae	*Clivina*	*dentipes* Dejean	LT	6
Coleoptera	Carabidae	*Clivina*	*impressifrons* LeConte	LT	13
Coleoptera	Carabidae	*Coptodera*	*aerata* Dejean	DI	2
Coleoptera	Carabidae	*Cyclotrachelus*	*sigillatus* Say	PF	2
Coleoptera	Carabidae	*Cymindis*	*complanatus* Dejean	FG, LT	2
Coleoptera	Carabidae	*Cymindis*	*limbatus* Dejean	FG, LT	5
Coleoptera	Carabidae	*Dicaelus*	*furvus* Dejean	PF	1
Coleoptera	Carabidae	*Galerita*	*bicolor* Drury	PF	11
Coleoptera	Carabidae	*Harpalus*	*faunus* Say	LT	2
Coleoptera	Carabidae	*Harpalus*	species 1	LT, PF	4
Coleoptera	Carabidae	*Lebia*	*grandis* Hentz	LT	4
Coleoptera	Carabidae	*Lebia*	*ornata* Say	LT, SW	4
Coleoptera	Carabidae	*Lebia*	*viridis* Say	LT	2
Coleoptera	Carabidae	*Leptotrachelus*	*dorsalis* Fab.	LT	1
Coleoptera	Carabidae	*Loxandrus*	species 1	DI, LT	3
Coleoptera	Carabidae	*Mioptachys*	*flavicauda* Say	DI	3
Coleoptera	Carabidae	*Myas*	*coracinus* Say	PF	4
Coleoptera	Carabidae	*Pasimachus*	*punctulatus* Haldeman	PF	1
Coleoptera	Carabidae	*Platynus*	*decentis* Say	DI	3
Coleoptera	Carabidae	*Poecilus*	*lucoblandus lucublandus* (Say)	PF	1
Coleoptera	Carabidae	*Pterostichus*	*coracinus* Newman	PF	1
Coleoptera	Carabidae	*Pterostichus*	*haldemani* LeConte	PF	7

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Coleoptera	Carabidae	*Pterostichus*	*longicornis* Fall	PF	1
Coleoptera	Carabidae	*Pterostichus*	species 1	DI, PF	7
Coleoptera	Carabidae	*Selenophorus*	*opalinus* LeConte	LT	1
Coleoptera	Carabidae	*Selenophorus*	species 1	LT	2
Coleoptera	Carabidae	*Stenolophus*	*lecontei* Chaudoir	LT	9
Coleoptera	Carabidae	*Stenolophus*	*ochropezus* Say	BT, LT	101
Coleoptera	Carabidae	*Stenolophus*	*spretus*? Dejean	LT	1
Coleoptera	Carabidae	*Synuchus*	*impunctatus* Say	PF	1
Coleoptera	Carabidae	*Tachys*	species 1	LT, ML	115
Coleoptera	Carabidae	*Tachyta*	species 1	DI	1
Coleoptera	Cerambycidae	*Anelaphus*	*pumilus* (Newman)	LT	1
Coleoptera	Cerambycidae	*Astylidius*	*parvus* (LeConte)	FG	2
Coleoptera	Cerambycidae	*Astylopsis*	*macula* (Say)	SW	1
Coleoptera	Cerambycidae	*Goes*	*tigrinus* (De Geer)	LT	1
Coleoptera	Cerambycidae	*Hyperplatys*	*aspersa* (Say)	DI	1
Coleoptera	Cerambycidae	*Lepturges*	*confluens* (Haldeman)	LT	1
Coleoptera	Cerambycidae	*Oberea*	*ruficollis* (Fab.)	DI	1
Coleoptera	Cerambycidae	*Prionus*	*imbricornis* (L.)	LT	1
Coleoptera	Cerambycidae	*Strangalia*	*luteicornis* (Fab.)	DI	1
Coleoptera	Cerambycidae	*Typocerus*	*deceptus* Knull	DI	1
Coleoptera	Cerambycidae	*Typocerus*	*velutinus* (Olivier)	DI	1
Coleoptera	Cerambycidae	*Urgleptes*	*querci* (Fitch)	FG	1
Coleoptera	Cerylonidae	*Mychocerus*	*depressus* LeConte	DI	3
Coleoptera	Cerylonidae	*Philothermus*	*glabriculus* LeConte	DI	1
Coleoptera	Chrysomelidae	*Acalymma*	*vittata* (Fab.)	SW	2
Coleoptera	Chrysomelidae	*Altica*	*betulae*? Schäffer	SW	1
Coleoptera	Chrysomelidae	*Altica*	species 2	SW	3
Coleoptera	Chrysomelidae	*Brachypnoea*	*clypealis* (Horn)	DI	1
Coleoptera	Chrysomelidae	*Brachypnoea*	*puncticollis*? (Say)	LT	1
Coleoptera	Chrysomelidae	*Capraita*	*quercata* (Fab.)	DI, SW	12
Coleoptera	Chrysomelidae	*Cerotoma*	*trifurcata* (Förster)	SW	1
Coleoptera	Chrysomelidae	*Chaetocnema*	*pulicaria* Melsheimer	SW	1
Coleoptera	Chrysomelidae	*Chalepus*	*bicolor* (Olivier)	DI	1
Coleoptera	Chrysomelidae	*Colaspis*	*brunnea* (Fab.)	LT	1
Coleoptera	Chrysomelidae	*Demotina*	*modesta* Baly	FG, SW	5
Coleoptera	Chrysomelidae	*Diabrotica*	*undecimpunctata howardi* Barber	SW	2
Coleoptera	Chrysomelidae	*Distigmoptera*	*pilosa* (Illiger)	SW	1
Coleoptera	Chrysomelidae	*Paria*	*fragariae* Wilcox	FG, SW	10
Coleoptera	Chrysomelidae	*Paria*	*scutellaris* (Notman)	FG	2
Coleoptera	Chrysomelidae	*Paria*	species 1	BT	1
Coleoptera	Chrysomelidae	*Rhabdopterus*	*praetextus* (Say)	BT, ML	2
Coleoptera	Chrysomelidae	*Sumitrosis*	*rosea* (Weber)	SW	1
Coleoptera	Chrysomelidae	*Systena*	*marginalis* (Illiger)	SW	1
Coleoptera	Chrysomelidae	*Tymnes*	*metasternalis* (Crotch)	FG	1
Coleoptera	Chrysomelidae	*Tymnes*	*tricolor* (Fab.)	DI	1
Coleoptera	Ciidae	*Ceracis*	*thoracicornis* (Ziegler)	DI	1
Coleoptera	Ciidae	*Cis*	*creberrimus* Mellié	DI	2
Coleoptera	Ciidae	*Cis*	*fuscipes* Mellié	DI	1
Coleoptera	Cleridae	*Cymatodera*	*undulata* (Say)	MN	1
Coleoptera	Cleridae	*Enoclerus*	*ichneumoneus* (Fab.)	FG	1
Coleoptera	Cleridae	*Placopterus*	*thoracicus* (Olivier)	FG	1
Coleoptera	Coccinellidae	*Axion*	*tripustulata* (De Geer)	DI	1
Coleoptera	Coccinellidae	*Coccinella*	*septempunctata* L.	SW	1
Coleoptera	Coccinellidae	*Cycloneda*	*munda* (Say)	FG	2
Coleoptera	Coccinellidae	*Didion*	*punctatum* (Melsheimer)	FG	1
Coleoptera	Coccinellidae	*Harmonia*	*axyridis* (Pallas)	DI, FG, ML	90
Coleoptera	Coccinellidae	*Scymnus*	*americanus* Mulsant	FG	1

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Coleoptera	Coccinellidae	*Scymnus*	*kansanus* Casey	FG	1
Coleoptera	Coccinellidae	*Scymnus*	species 1	FG	1
Coleoptera	Colydiidae	*Bothrideres*	*cryptus* Stephan	DI	3
Coleoptera	Colydiidae	*Eucicones*	*marginalis* (Melsheimer)	LT	2
Coleoptera	Curculionidae	*Ambrosiodmus*	*tachygraphus* (Zimmerman)	LT	1
Coleoptera	Curculionidae	*Anthonomus*	*rubidus* LeConte	LT	1
Coleoptera	Curculionidae	*Apteromechus*	*texanus* Fall	LT	1
Coleoptera	Curculionidae	*Aulobaris*	*pusilla* (LeConte)	DI	1
Coleoptera	Curculionidae	*Conotrachelus*	*anaglypticus* (Say)	LT	1
Coleoptera	Curculionidae	*Conotrachelus*	*posticatus* Boheman	PF	10
Coleoptera	Curculionidae	*Cryptorhynchus*	*minutissimus* LeConte	FG	2
Coleoptera	Curculionidae	*Cryptorhynchus*	*obliquus* (Say)	LT	1
Coleoptera	Curculionidae	*Curculio*	*iowensis* (Casey)	FG	2
Coleoptera	Curculionidae	*Cyrtepistomus*	*castaneus* (Roelofs)	BT, DI, FG, LT, PF, SW	70
Coleoptera	Curculionidae	*Dryocoetes*	*granicollis* (LeConte)	LT	1
Coleoptera	Curculionidae	*Eubulus*	*parochus* (Herbst)	ML	1
Coleoptera	Curculionidae	*Eugnamptus*	*angustatus* (Herbst)	FG, SW	2
Coleoptera	Curculionidae	*Eugnamptus*	*sulcifrons* Gyllenhal	FG	1
Coleoptera	Curculionidae	*Hypothenemus*	*dissimilis* (Zimmerman)	FG	2
Coleoptera	Curculionidae	*Ips*	*avulsus* (Eichhoff)	DI	4
Coleoptera	Curculionidae	*Ips*	*grandicollis* (Eichhoff)	DI	5
Coleoptera	Curculionidae	*Monarthrum*	*mali* (Fitch)	LT, PF	18
Coleoptera	Curculionidae	*Rhinoncus*	*longulus* LeConte	SW	1
Coleoptera	Curculionidae	*Smicronyx*	*amoenus* Say	SW	1
Coleoptera	Curculionidae	Unident.	species 1	LT	1
Coleoptera	Curculionidae	Unident.	species 2	LT	5
Coleoptera	Curculionidae	*Xyleborinus*	*saxeseni* (Ratzeburg)	DI, PF	2
Coleoptera	Curculionidae	*Xyleborus*	*affinis* Eichhoff	LT	8
Coleoptera	Curculionidae	*Xyleborus*	*atratus* Eichhoff	DI, LT	5
Coleoptera	Curculionidae	*Xyleborus*	*ferrugineus* (Fab.)	LT, PF	5
Coleoptera	Curculionidae	*Xyleborus*	*pelliculosus* Eichhoff	DI, LT	2
Coleoptera	Curculionidae	*Xylosandrus*	*crassiusculus* (Motschulsky)	LT	1
Coleoptera	Curculionidae	*Xylosandrus?*	species 1	LT	1
Coleoptera	Curculionidae	*Xyloterinus*	*politus* (Say)	DI	1
Coleoptera	Derodontidae	*Derodontus*	*maculatus* (Melsheimer)	DI	1
Coleoptera	Dytiscidae	*Acilius*	*fraternus* (Harris)	DI	2
Coleoptera	Dytiscidae	*Agabetes*	*acuductus* (Harris)	DI	1
Coleoptera	Dytiscidae	*Agabus*	*gagates* Aube	LT	126
Coleoptera	Dytiscidae	*Bidessonotus*	*inconspicuus* (LeConte)	LT	1472
Coleoptera	Dytiscidae	*Copelatus*	*chevrolati renovatus* Guignot	LT	2
Coleoptera	Dytiscidae	*Copelatus*	*glyphicus* (Say)	LT	40
Coleoptera	Dytiscidae	*Coptotomus*	*longulus lenticus* Hilsenhoff	LT	5
Coleoptera	Dytiscidae	*Laccophilus*	*fasciatus fasciatus* Aube	LT	1
Coleoptera	Dytiscidae	*Neoporus*	*undulatus* Say	LT	52
Coleoptera	Dytiscidae	*Rhantus*	*calidus* (Fab.)	LT	5
Coleoptera	Dytiscidae	*Thermonectus*	*basillaris basillaris* (Harris)	LT	6
Coleoptera	Elateridae	*Ampedus*	*militaris* (Harris)	SW	1
Coleoptera	Elateridae	*Ampedus*	*sanguinipennis* (Say)	SW	1
Coleoptera	Elateridae	*Ctenicera*	*signaticollis* (Melsheimer)	FG	3
Coleoptera	Elateridae	*Ctenicera*	species 1	LT	1
Coleoptera	Elateridae	*Glyphonyx?*	species 1	BT, SW	3
Coleoptera	Elateridae	*Lacon*	*discoidea* (Weber)	DI	2
Coleoptera	Elateridae	*Lacon*	*impressicollis* (Say)	LT	1
Coleoptera	Elateridae	*Lacon*	*marmoratus* (Fab.)	LT	1
Coleoptera	Elateridae	*Limonius*	*basalaris* Say	SW	4
Coleoptera	Elateridae	*Limonius*	*griseus* (Beauvois)	LT	3
Coleoptera	Elateridae	*Limonius*	*quercinus* (Say)	FG, LT, SW	25

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Coleoptera	Elateridae	*Melanotus*	*americanus* (Herbst)	LT, SW	4
Coleoptera	Elateridae	*Melanotus*	*decumanus* (Erichson)	LT	19
Coleoptera	Elateridae	*Melanotus*	*dietrichi* Quate	DI	1
Coleoptera	Elateridae	*Melanotus*	*difficilis* Blatchley	LT	1
Coleoptera	Elateridae	*Melanotus*	*emissus* (LeConte)	LT	1
Coleoptera	Elateridae	*Melanotus*	*ignobilis* (Melsheimer)	LT, SW	2
Coleoptera	Elateridae	*Melanotus*	*indistinctus* Quate	LT	4
Coleoptera	Elateridae	*Melanotus*	*insipiens*? (Say)	LT	3
Coleoptera	Elateridae	*Melanotus*	*miscellus* Quate	DI	1
Coleoptera	Elateridae	*Melanotus*	*morosus* Candeze	BT	1
Coleoptera	Elateridae	*Melanotus*	*spadix* (Erichson)	LT	1
Coleoptera	Elateridae	*Orthostethus*	species 1	BT, FG, LT, SW	46
Coleoptera	Elateridae	*Pherhimius*	*infuscatus* (Germar)	LT	3
Coleoptera	Endomychidae	*Rhanidea*	*fascicularis* (Fab.)	LT	2
Coleoptera	Endomychidae	*Stenotarsus*	*unicolor* (Ziegler)	LT	1
Coleoptera	Erotylidae	*Ischyrus*	*hispidus* (Herbst)	FG	1
Coleoptera	Erotylidae	*Megalodacne*	*quadripunctatus quadripunctatus* (Olivier)	LT	1
Coleoptera	Erotylidae	*Tritoma*	*fasciata* (Fab.)	DI	4
Coleoptera	Eucnemidae	*Deltometopus*	*unicolor* Say	LT	1
Coleoptera	Eucnemidae	*Dirrhagofarsus*	*rufipes* (Melsheimer)	DI	1
Coleoptera	Eucnemidae	*Dromaeolus*	*lewisi* (Fleutiaux)	FG	1
Coleoptera	Eucnemidae	*Dromaeolus*	*badius* (Melsheimer)	LT	1
Coleoptera	Eucnemidae	*Isorhipis*	species 1	SW	1
Coleoptera	Eucnemidae	*Melasis*	*obliqua* (Say)	LT	2
Coleoptera	Gyrinidae	*Dineutus*	*pectinicornis* Melsheimer	DI	1
Coleoptera	Haliplidae	*Peltodytes*	*carolinus* LeConte	DI, LT	2
Coleoptera	Heteroceridae	*Tropicus*	*dunavani* Young	LT, SW	2
Coleoptera	Histeridae	*Aeletes*	*pusillus* (Say)	LT	45
Coleoptera	Histeridae	*Atholus*	*floridae* Marseul	DI	10
Coleoptera	Histeridae	*Margarinotus*	*nubilus* (LeConte)	SW	1
Coleoptera	Histeridae	*Paromalus*	*foedatus* (LeConte)	DI	2
Coleoptera	Histeridae	*Platysoma*	*bistriatus* Erichson	DI	1
Coleoptera	Hydrophilidae	*Berosus*	*lecontei* Marseul	LT	3
Coleoptera	Hydrophilidae	*Berosus*	*exiguus* (Say)	LT	19
Coleoptera	Hydrophilidae	*Cercyon*	*pantherinus* LeConte	LT	2
Coleoptera	Hydrophilidae	*Enochrus*	species 1	LT	3
Coleoptera	Hydrophilidae	*Enochrus*	*diffusus* (LeConte)	LT	10
Coleoptera	Hydrophilidae	*Enochrus*	*ochraceus* (Melsheimer)	LT	9
Coleoptera	Hydrophilidae	*Helocombus*	*perplexus* (LeConte)	LT	7
Coleoptera	Hydrophilidae	*Hydrochara*	*bifidus* (LeConte)	LT	49
Coleoptera	Hydrophilidae	*Hydrochara*	*obtusata* (Say)	LT	1
Coleoptera	Hydrophilidae	*Hydrochus*	*soror* Smetana	LT	3
Coleoptera	Hydrophilidae	*Hydrochus*	*rufipes* Melsheimer	LT, PF	630
Coleoptera	Hydrophilidae	*Hydrophilus*	*rugosus* Mulsant	LT	1
Coleoptera	Hydrophilidae	*Tropisternus*	*triangularis* Say	LT	4
Coleoptera	Hydrophilidae	*Tropisternus*	*collaris striolatus* (LeConte)	LT	3
Coleoptera	Hydrophilidae	*Tropisternus*	*lateralis nimbatus* Say	LT	4
Coleoptera	Laemophloeidae	*Laemophloeus*	*mixtus* (LeConte)	LT	1
Coleoptera	Laemophloeidae	*Placonotus*	*biguttatus* (Say)	DI	1
Coleoptera	Lampyridae	*Lucidota*	*zimmermanni* (LeConte)	DI	3
Coleoptera	Lampyridae	*Photinus*	*atra* (Olivier)	DI, FG	2
Coleoptera	Latridiidae	*Corticaria*	species 1	FG, PF, SW	4
Coleoptera	Latridiidae	*Melanophthalma*	species 1	FG	1
Coleoptera	Leiodidae	*Agathidium*	species 1	ML	3
Coleoptera	Leiodidae	*Aglyptinus*	*exiguum* Melsheimer	DI	10
			laevis (LeConte)	DI	1

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Coleoptera	Leiodidae	*Anisotoma*	*basalis* (LeConte)	DI	25
Coleoptera	Leiodidae	*Anisotoma*	*discolor* (Melsheimer)	DI	27
Coleoptera	Leptodiridae	*Catops*	*simplex* Say	PF	1
Coleoptera	Leptodiridae	*Ptomaphagus*	*consobrinus* (LeConte)	PF	2
Coleoptera	Lucanidae	*Platycerus*	*virescens* (Fab.)	DI	6
Coleoptera	Lucanidae	*Pseudolucanus*	*capreolus* (L.)	LT	1
Coleoptera	Lycidae	*Calopteron*	*reticulatum* (Fab.)	DI, MN	4
Coleoptera	Lycidae	*Calopteron*	*terminale* (Say)	DI	1
Coleoptera	Lycidae	*Eropterus*	*trilineatus* (Melsheimer)	FG	1
Coleoptera	Melandryidae	*Dircaea*	*liturata* LeConte	LT	2
Coleoptera	Melandryidae	*Melandrya*	*striata* Say	DI	1
Coleoptera	Melandryidae	*Microtonus*	*sericans* LeConte	DI	1
Coleoptera	Melandryidae	*Phloeotrya*	*vaudoueri* Mulsant	LT	2
Coleoptera	Melandryidae	*Synchroa*	*punctata* Newman	LT	4
Coleoptera	Melandryidae	*Synstrophus*	*repandus* (Horn)	LT	2
Coleoptera	Meloidae	*Meloe*	*americanus* Leach	LT	1
Coleoptera	Mordellidae	*Falsomordellistena*	*pubescens* (Fab.)	FG	1
Coleoptera	Mordellidae	*Glipa*	*hilaris* (Say)	MN	1
Coleoptera	Mordellidae	*Glipostenoda*	*ambusta* (LeConte)	LT	1
Coleoptera	Mordellidae	*Mordellistena*	species 1	PF	1
Coleoptera	Mordellidae	*Mordellistena*	*trifasciata* (Say)	SW	1
Coleoptera	Mycetophagidae	*Mycetophagus*	*pini* Ziegler	DI	1
Coleoptera	Nitidulidae	*Carpophilus*	*antiquus* Melsheimer	LT	2
Coleoptera	Nitidulidae	*Carpophilus*	*corticinus* Erichson	DI	8
Coleoptera	Nitidulidae	*Carpophilus*	*floralis* Erichson	LT	2
Coleoptera	Nitidulidae	*Carpophilus*	*lugubris* Murray	DI	1
Coleoptera	Nitidulidae	*Carpophilus*	*marginatus* Erichson	DI	12
Coleoptera	Nitidulidae	*Carpophilus*	*sayi* Parsons	DI	5
Coleoptera	Nitidulidae	*Colopterus*	*niger* (Say)	LT	1
Coleoptera	Nitidulidae	*Colopterus*	*truncatus* (Randall)	LT	4
Coleoptera	Nitidulidae	*Glischrochilus*	*obtusus* (Say)	LT	3
Coleoptera	Nitidulidae	*Glischrochilus*	*quadrisignatus* (Say)	DI	1
Coleoptera	Nitidulidae	*Glischrochilus*	*sanguinolentus* (Olivier)	LT	3
Coleoptera	Nitidulidae	*Pallodes*	*pallidus* (Beauvois)	PF	2
Coleoptera	Nitidulidae	*Prometopia*	*sexmaculata* Say	LT	3
Coleoptera	Nitidulidae	*Stelidota*	*geminata* (Say)	LL, PF	5
Coleoptera	Passalidae	*Odontotaenius*	*disjunctus* (Illiger)	DI	3
Coleoptera	Pselaphidae	*Cylindrarctus*	*longipalpus* (LeConte)	LL, LT	9
Coleoptera	Pselaphidae	Unident.	species 1	LT	2
Coleoptera	Ptiliidae	*Ptinella*	species 1	LL	521
Coleoptera	Ptilodactylidae	*Ptilodactyla*	species 1	BT, LT, SW	3
Coleoptera	Pyrochroidae	*Dendroides*	*canadensis* Latreille	DI	1
Coleoptera	Rhysodidae	*Omoglymmius*	*americanus* (Laporte)	DI	4
Coleoptera	Rhyzophagidae	*Bactridium*	*nanus* Erichson	DI	11
Coleoptera	Rhyzophagidae	*Rhizophagus*	*bipunctatus* (Say)	DI	1
Coleoptera	Scaphidiidae	*Eubaeocera*	species 1	PF	1
Coleoptera	Scarabaeidae	*Anomala*	*marginata* (Fab.)	LT	7
Coleoptera	Scarabaeidae	*Aphodius*	*badipes* Melsheimer	LT	1
Coleoptera	Scarabaeidae	*Aphodius*	*bicolor* Say	PF	1
Coleoptera	Scarabaeidae	*Aphodius*	*stercorosus* Melsheimer	LT	2
Coleoptera	Scarabaeidae	*Ataenius*	*fattigi* Cartwright	LT	6
Coleoptera	Scarabaeidae	*Ataenius*	*strigatus* (Say)	LT	11
Coleoptera	Scarabaeidae	*Ateuchus*	*histeroides* Weber	DI, LT	4
Coleoptera	Scarabaeidae	*Bolboceras*	species 1	PF	2
Coleoptera	Scarabaeidae	*Bolbocerosoma*	*farctum* (Fab.)	PF	1
Coleoptera	Scarabaeidae	*Copris*	*fricator* (Fab.)	LT	8
Coleoptera	Scarabaeidae	*Copris*	*minutus* (Drury)	PF	3
Coleoptera	Scarabaeidae	*Copris*	*tullius* Olivier	LT	7

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Coleoptera	Scarabaeidae	*Cotinis*	*nitida* (L.)	DI	1
Coleoptera	Scarabaeidae	*Cyclocephala*	*lurida* Bland	LT	2
Coleoptera	Scarabaeidae	*Deltochilum*	*gibbosum* (Fab.)	DI, PF	3
Coleoptera	Scarabaeidae	*Dyscinetus*	*morator* (Fab.)	LT	25
Coleoptera	Scarabaeidae	*Euphoria*	*fulgida fulgida* (Fab.)	DI, LT	2
Coleoptera	Scarabaeidae	*Geotrupes*	*blackburnii blackburnii* (Fab.)	PF	7
Coleoptera	Scarabaeidae	*Geotrupes*	*splendidus* (Fab.)	DI, PF	3
Coleoptera	Scarabaeidae	*Germarostes*	*aphodiodes* (Illiger)	LT	1
Coleoptera	Scarabaeidae	*Germarostes*	*globosus* (Say)	LT	8
Coleoptera	Scarabaeidae	*Hoplia*	*modesta* Haldeman	SW	1
Coleoptera	Scarabaeidae	*Macrodactylus*	*angustatus* (Beauvois)	DI	7
Coleoptera	Scarabaeidae	*Onthophagus*	*hecate* (Panzer)	PF	8
Coleoptera	Scarabaeidae	*Parastasia*	*brevipes* (LeConte)	LT	1
Coleoptera	Scarabaeidae	*Phyllophaga*	*delata* (Horn)	LT	5
Coleoptera	Scarabaeidae	*Phyllophaga*	*ephilida* (Say)	LT	1
Coleoptera	Scarabaeidae	*Phyllophaga*	*forsteri* (Burmeister)	LT	3
Coleoptera	Scarabaeidae	*Phyllophaga*	*fusca* (Frölich)	LT	7
Coleoptera	Scarabaeidae	*Phyllophaga*	*hirticula hirticula* (Knoch)	LT	1
Coleoptera	Scarabaeidae	*Phyllophaga*	*kentuckiana* Ritcher	LT	2
Coleoptera	Scarabaeidae	*Phyllophaga*	species 1	LT	2
Coleoptera	Scarabaeidae	*Popillia*	*japonica* Newman	DI, SW	5
Coleoptera	Scarabaeidae	*Pseudocanthon*	*perplexus* (LeConte)	LT, PF	5
Coleoptera	Scarabaeidae	*Serica*	*georgiana* Leng	LT	4
Coleoptera	Scarabaeidae	*Serica*	*intermixta* Blatchley	LT	5
Coleoptera	Scarabaeidae	*Serica*	species 1	LT	9
Coleoptera	Scarabaeidae	*Valgus*	*seticollis* (Beauvois)	DI	3
Coleoptera	Scirtidae	*Cyphon*	*padi* (L.)	FG, LT, ML	46
Coleoptera	Scirtidae	*Cyphon*	*variabilis* (Thunberg)	FG, LT, ML, SW	80
Coleoptera	Scirtidae	*Prionocyphon*	*discoideus* (Say)	ML	1
Coleoptera	Scirtidae	*Scirtes*	*tibialis* Guérin	LT	1
Coleoptera	Scydmaenidae	*Napochus*	species 1	LT, PF	21
Coleoptera	Scydmaenidae	*Napochus*	species 2	LT	1
Coleoptera	Silphidae	*Necrophila*	*americana* (L.)	DI	5
Coleoptera	Silphidae	*Nicrophorus*	*orbicollis* Say	LT, PF	4
Coleoptera	Silphidae	*Nicrophorus*	*pustulatus* Herschel	DI, LT	7
Coleoptera	Silphidae	*Oiceoptoma*	*inaequale* (Fab.)	DI	5
Coleoptera	Silphidae	*Oiceoptoma*	*noveboracense* (Forster)	DI	5
Coleoptera	Silvanidae	*Cathartosilvanus*	*imbellis* (LeConte)	DI	4
Coleoptera	Silvanidae	*Silvanus*	*muticus* Sharp	DI	4
Coleoptera	Silvanidae	*Silvanus*	*planatus* Germar	DI	1
Coleoptera	Silvanidae	*Uleiota*	*dubius dubius* (Fab.)	DI	2
Coleoptera	Staphylinidae	Genus E	species 5	LT	2
Coleoptera	Staphylinidae	Genus E	species 16	LT	6
Coleoptera	Staphylinidae	Genus E	species 17	LT	2
Coleoptera	Staphylinidae	Genus E	species 22	LT	4
Coleoptera	Staphylinidae	Genus E	species 25	LT	6
Coleoptera	Staphylinidae	Genus G	species 7	LT	6
Coleoptera	Staphylinidae	Genus H	species 8	PF	4
Coleoptera	Staphylinidae	Genus I	species 9	PF	7
Coleoptera	Staphylinidae	Genus K	species 40	PF	1
Coleoptera	Staphylinidae	Genus M	speceis 13	PF	1
Coleoptera	Staphylinidae	Genus N	species 15	BT, SW	3
Coleoptera	Staphylinidae	Genus O	species 23	PF	1
Coleoptera	Staphylinidae	Genus P	species 24	LT	2
Coleoptera	Staphylinidae	Genus Q	species 26	LT	55
Coleoptera	Staphylinidae	Genus Q	species 27	LT	68
Coleoptera	Staphylinidae	Genus S	species 30	PF	2

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Coleoptera	Staphylinidae	Genus T	species 32	LT	2
Coleoptera	Staphylinidae	Genus T	species 34	LT	1
Coleoptera	Staphylinidae	*Homaeotarsus*	*bicolor* (Gravenhorst)	LT	2
Coleoptera	Staphylinidae	*Homaeotarsus*	*cinctus* (Say)	LT	1
Coleoptera	Staphylinidae	*Homaeotarsus*	*pimerianum* (LeConte)	DI	2
Coleoptera	Staphylinidae	*Platydracus*	*fossator* (Gravenhorst)	PF	1
Coleoptera	Staphylinidae	*Platydracus*	*maculosus* (Gravenhorst)	DI, PF	6
Coleoptera	Staphylinidae	*Reichenbachia*	species 1	LT, PF	23
Coleoptera	Staphylinidae	*Sepedophilus*	species 1	DI	1
Coleoptera	Staphylinidae	*Stenus*	species 1	FG	1
Coleoptera	Staphylinidae	*Stenus*	species 2	BT	1
Coleoptera	Staphylinidae	*Sunius*	*confluentus* (Say)	LT	2
Coleoptera	Staphylinidae	*Tachinus*	*fimbriatus* Gravenhorst	PF	16
Coleoptera	Tenebrionidae	*Adelina*	*pallida* (Say)	DI	6
Coleoptera	Tenebrionidae	*Anaedus*	*brunneus* (Ziegler)	LT, PF	3
Coleoptera	Tenebrionidae	*Bolitophagus*	*corticola* Say	DI	5
Coleoptera	Tenebrionidae	*Centronopus*	*calcaratus* (Fab.)	DI	1
Coleoptera	Tenebrionidae	*Corticeus*	*parallelus* (Melsheimer)	DI	1
Coleoptera	Tenebrionidae	*Diaperis*	*nigronotata* Pic	LT	2
Coleoptera	Tenebrionidae	*Haplandrus*	*fulvipes* (Herbst)	FG	1
Coleoptera	Tenebrionidae	*Hymenorus*	*humeralis* LeConte	LT	1
Coleoptera	Tenebrionidae	*Idiobates*	*castaneus* (Knoch)	DI	1
Coleoptera	Tenebrionidae	*Isomira*	species 1	FG, LT	3
Coleoptera	Tenebrionidae	*Lobopoda*	*punctulata* (Melsheimer)	FG, LT	2
Coleoptera	Tenebrionidae	*Merinus*	*laevis* (Olivier)	DI	1
Coleoptera	Tenebrionidae	*Neomida*	*bicornis* (Fab.)	DI	8
Coleoptera	Tenebrionidae	*Platydema*	*picilabrum* Melsheimer	FG, LT	8
Coleoptera	Tenebrionidae	*Strongylium*	*crenatum* Mäklin	FG, LT	5
Coleoptera	Tenebrionidae	*Strongylium*	*tenuicolle* (Say)	LT	1
Coleoptera	Tenebrionidae	*Uloma*	*imberbis* LeConte	DI	5
Coleoptera	Tenebrionidae	*Uloma*	*mentalis* Horn	DI	2
Coleoptera	Tenebrionidae	Unident.	species 1	LT	1
Coleoptera	Trogidae	*Trox*	*aequalis* (Say)	LT	6
Coleoptera	Trogidae	*Trox*	*capillaris* Say	DI	1
Coleoptera	Trogidae	*Trox*	*monachus* (Herbst)	DI, PF	6
Coleoptera	Trogidae	*Trox*	*sordidus* LeConte	DI	2
Coleoptera	Trogossitidae	*Tenebroides*	*corticalis* (Melsheimer)	LT	1
Coleoptera	Trogossitidae	*Tenebroides*	*rugosipennis* (Horn)	FG	5
Neuroptera	Chrysopidae	Chrysopa	species 1	DI, FG, LT, ML, SW	6
Neuroptera	Corydalidae	*Chauliodes*	*rastricornis* Rambur	DI, LT	12
Neuroptera	Corydalidae	*Chauliodes*	species 1	LT	2
Neuroptera	Hemerobiidae	Hemerobius	species 1	FG, ML, SW	7
Neuroptera	Sialidae	*Sialis*	*mohri* Ross	LT	1
Hymenoptera	Anthophoridae	*Xylocopa*	*virginica* (L.)	DI	1
Hymenoptera	Apidae	*Apis*	*mellifera* L.	DI	1
Hymenoptera	Chrysididae	*Chrysis*	*coerulans* Fab.	DI, MN	2
Hymenoptera	Colletidae	*Hylaeus*	species 1	MN	1
Hymenoptera	Cynipidae	Unident.	species 1	FG, SW	5
Hymenoptera	Diapriidae	Unident.	species 1	SW	9
Hymenoptera	Diapriidae	Unident.	species 2	BT, SW	3
Hymenoptera	Formicidae	*Aphaenogaster*	*fulva* Roger	DI, FG, PF, SW	112
Hymenoptera	Formicidae	*Aphaenogaster*	*lamellidens* Mayr	BT, PF, SW	122
Hymenoptera	Formicidae	*Aphaenogaster*	*rudis* (Emery)	PF	3
Hymenoptera	Formicidae	*Aphaenogaster*	species 1	FG, PF	9
Hymenoptera	Formicidae	*Aphaenogaster*	*tennesseensis* (Mayr)	FG, PF	19
Hymenoptera	Formicidae	*Aphaenogaster*	*texana* Wheeler	PF, SW	10

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Hymenoptera	Formicidae	*Camponotus*	*chromaiodes* Bolton	BT, DI, FG, PF, SW	95
Hymenoptera	Formicidae	*Camponotus*	*nearcticus* Emery	FG	50
Hymenoptera	Formicidae	*Camponotus*	*pennsylvanicus* (De Geer)	DI, FG, LT, PF	50
Hymenoptera	Formicidae	*Camponotus*	*rasilis* Wheeler	FG, PF, SW	50
Hymenoptera	Formicidae	*Camponotus*	species 1	DI, LT	3
Hymenoptera	Formicidae	*Camponotus*	species 1	PF	2
Hymenoptera	Formicidae	*Crematogaster*	*lineolata* (Say)	BT, FG, SW	15
Hymenoptera	Formicidae	*Crematogaster*	species 1	ML	1
Hymenoptera	Formicidae	*Dolichoderus*	*mariae* Forel	SW	4
Hymenoptera	Formicidae	*Formica*	*pallidefulva* Latreille	FG, PF, SW	8
Hymenoptera	Formicidae	*Formica*	*rubicunda* Emery	FG, PF, SW	14
Hymenoptera	Formicidae	*Formica*	*schaufussi* Mayr	MN, PF	6
Hymenoptera	Formicidae	*Formica*	species 1	SW	1
Hymenoptera	Formicidae	*Lasius*	*alienus* (Förster)	PF, SW	3
Hymenoptera	Formicidae	*Lasius*	*umbratus* (Nylander)	PF	1
Hymenoptera	Formicidae	*Leptothorax*	species 1	FG	1
Hymenoptera	Formicidae	*Myrmecina*	*americana* Emery	FG, PF	2
Hymenoptera	Formicidae	*Myrmica*	*punctiventris* Roger	FG	3
Hymenoptera	Formicidae	*Paratrechina*	*melanderi* (Wheeler)	ML, PF, SW	29
Hymenoptera	Formicidae	*Paratrechina*	*parvula* (Mayr)	BT, PF, SW	5
Hymenoptera	Formicidae	*Ponera*	*coarctata* (Latreille)	PF	3
Hymenoptera	Formicidae	*Ponera*	species 1	FG, LT	2
Hymenoptera	Formicidae	*Prenolepis*	species 1	PF, SW	8
Hymenoptera	Formicidae	*Prenolepis*	*imparis* (Say)	FG, PF, SW	253
Hymenoptera	Formicidae	*Tapinoma*	*sessile* (Say)	FG, PF, SW	15
Hymenoptera	Formicidae	*Tetramorium*	*caespitum caespitum* (L.)	PF	1
Hymenoptera	Formicidae	*Wasmannia*	*auropunctata auropunctata* (Roger)	SW	1
Hymenoptera	Halictidae	*Augochlorella*	species 1	DI	1
Hymenoptera	Halictidae	*Sphecodes*	species 1	SW	1
Hymenoptera	Ichneumonidae	*Ophion*	species 1	SW	2
Hymenoptera	Mutillidae	*Dasymutilla*	*occidentalis* (L.)	DI	1
Hymenoptera	Pelecinidae	*Pelecinus*	*polyturator* (Drury)	DI, SW	4
Hymenoptera	Platygastridae	Unident.	species 1	LL	5
Hymenoptera	Scoliidae	*Scolia*	*bicincta* Fab.	DI	3
Hymenoptera	Sphecidae	*Eremnophila*	*aureonotata* (Cameron)	DI, MN	2
Hymenoptera	Sphecidae	*Sphex*	*ichneumoneus* (L.)	DI	1
Hymenoptera	Sphecidae	*Trypoxylon*	*lactitarse* Saussure	MN	1
Hymenoptera	Sphecidae	*Trypoxylon*	species 1	MN	1
Hymenoptera	Tiphiidae	*Tiphia*	species 1	SW	3
Hymenoptera	Vespidae	*Dolichovespula*	*maculata* (L.)	DI, MN, SW	6
Hymenoptera	Vespidae	*Polistes*	*annularis* (L.)	DI	3
Hymenoptera	Vespidae	*Vespa*	*crabro* L.	DI	1
Hymenoptera	Vespidae	*Vespula*	*maculifrons* (Buysson)	DI, SW	4
Trichoptera	Hydropsychidae	*Cheumatopsyche*	species 1	LT	1
Trichoptera	Hydropsychidae	*Hydropsyche*	*betteni* Ross	LT	2
Trichoptera	Leptoceridae	*Oecetis*	*inconspicua* (Walker)	LT	1
Trichoptera	Leptoceridae	*Oecetis*	species 1	LT	12
Trichoptera	Philoptamidae	*Wormaldia*	*shawnee* (Ross)	LT	1
Trichoptera	Phryganeidae	*Agrypnia*	*vestita* (Walker)	LT	1
Trichoptera	Phryganeidae	*Ptilostomis*	species 1	LT	1
Lepidoptera	Arctiidae	*Apantesis*	*phalerata* (Harris)	LT	1
Lepidoptera	Arctiidae	*Cisthene*	*packardii* (Grote)	LT	5
Lepidoptera	Arctiidae	*Cisthene*	*plumbea* Stretch	LT	2
Lepidoptera	Arctiidae	*Halysidota*	*tessellaris* (J.E. Smith)	LT	28
Lepidoptera	Arctiidae	*Haploa*	*clymene* (Brown)	LT	1

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Lepidoptera	Arctiidae	*Haploa*	*lecontei* (Guérin-Méneville)	LT	2
Lepidoptera	Arctiidae	*Hypoprepia*	*fucosa* Hübner	LT	15
Lepidoptera	Arctiidae	*Spilosoma*	*virginica* (Fab.)	LT	1
Lepidoptera	Danaidae	*Danaus*	*plexippus* (L.)	DI	1
Lepidoptera	Drepanidae	*Drepana*	*arcuata* Walker	LT	1
Lepidoptera	Epipyropidae	*Fulgoraecia*	*exigua* (Edwards)	DI	1
Lepidoptera	Geometridae	*Anacamptodes*	*defectaria* (Guenée)	LT	4
Lepidoptera	Geometridae	*Ectropis*	*crepuscularia* (Denis & Schiffermüller)	LT	1
Lepidoptera	Geometridae	*Euchlaena*	*pectinaria* (Denis & Schiffermüller)	LT	1
Lepidoptera	Geometridae	*Eupithecia*	*miserulata* Grote	LT	1
Lepidoptera	Geometridae	*Hypagyrtis*	*unipunctata* (Haworth)	LT	6
Lepidoptera	Geometridae	*Hypomecis*	*umbrosaria* (Hübner)	LT	1
Lepidoptera	Geometridae	*Lambdina*	*fervidaria* (Hübner)	LT	1
Lepidoptera	Geometridae	*Macaria*	*transitaria* (Walker)	LT	1
Lepidoptera	Geometridae	*Nemoria*	*rubrifrontaria* (Packard)	FG	1
Lepidoptera	Geometridae	*Probole*	*amicaria* (Herrich-Schäffer)	LT	4
Lepidoptera	Geometridae	*Protoboarmia*	*porcelaria* (Guenée)	LT	1
Lepidoptera	Geometridae	*Scopula*	*limboundata* (Haworth)	LT	1
Lepidoptera	Hesperiidae	*Atalopedes*	*campestris* (Boisduval)	DI	1
Lepidoptera	Hesperiidae	*Epargyreus*	*clarus* (Cramer)	MN	2
Lepidoptera	Hesperiidae	*Erynnis*	*juvenalis* (Fab.)	DI	1
Lepidoptera	Lasiocampidae	*Artace*	*cribraria* (Ljungh)	LT	5
Lepidoptera	Lasiocampidae	*Malacosoma*	*americanum* (Fab.)	LT	1
Lepidoptera	Lasiocampidae	*Malacosoma*	*distria* Hübner	LT	4
Lepidoptera	Limacodidae	*Lithacodes*	*fasciola* (Herrich-Schäffer)	DI	1
Lepidoptera	Limacodidae	*Sibine*	*stimulea* (Clemens)	DI	1
Lepidoptera	Lycaenidae	*Celastrina*	*ladon* (Cramer)	DI	5
Lepidoptera	Lycaenidae	*Everes*	*comyntas* (Godart)	DI	2
Lepidoptera	Lycaenidae	*Glaucopsyche*	*lygdamus* (Doubleday)	DI	2
Lepidoptera	Noctuidae	*Acronicta*	*lobeliae* Guenée	LT	1
Lepidoptera	Noctuidae	*Agrotis*	*ipsilon* (Hufnagel)	LT	1
Lepidoptera	Noctuidae	*Amphipyra*	*pyramidoides* Guenée	DI	2
Lepidoptera	Noctuidae	*Catocala*	*ilia* (Cramer)	DI	2
Lepidoptera	Noctuidae	*Catocala*	*lacrymosa* Guenée	DI	1
Lepidoptera	Noctuidae	*Helicoverpa*	*zea* (Boddie)	LT	1
Lepidoptera	Noctuidae	*Idia*	*americalis* (Guenée)	FG	1
Lepidoptera	Noctuidae	*Lesmone*	*detrahens* (Walker)	LT	1
Lepidoptera	Noctuidae	*Maliattha*	*synochitis* (Grote & Robinson)	LT	1
Lepidoptera	Noctuidae	*Metaxaglaea*	*semitaria* (Franclemont)	LT	1
Lepidoptera	Noctuidae	*Phoberia*	*atomaris* Hübner	LT	1
Lepidoptera	Noctuidae	*Plathypena*	*scabra* (Fab.)	LT, SW	5
Lepidoptera	Noctuidae	*Polygrammate*	*hebraeicum* Hübner	LT	18
Lepidoptera	Noctuidae	*Protolampra*	*brunneicollis* (Grote)	LT	1
Lepidoptera	Noctuidae	*Spodoptera*	*ornithogalli* (Guenée)	MN	1
Lepidoptera	Noctuidae	*Sunira*	*bicolorago* (Guenée)	LT	2
Lepidoptera	Noctuidae	*Thioptera*	*nigrofimbria* (Guenée)	LT	1
Lepidoptera	Notodontidae	*Datana*	*drexelii* H. Edwards	LT	1
Lepidoptera	Notodontidae	*Heterocampa*	*biundata* Walker	LT	2
Lepidoptera	Notodontidae	*Heterocampa*	*umbrata* Walker	LT	1
Lepidoptera	Notodontidae	*Hyperaeschra*	*georgica* (Herrich-Schäffer)	LT	3
Lepidoptera	Notodontidae	*Nadata*	*gibbosa* (J.E. Smith)	LT	6
Lepidoptera	Nymphalidae	*Junonia*	*coenia* (Hübner)	MN	3
Lepidoptera	Nymphalidae	*Limenitis*	*arthemis astyanax* (Fab.)	DI, MN	3
Lepidoptera	Nymphalidae	*Phyciodes*	*tharos* (Drury)	MN	6
Lepidoptera	Nymphalidae	*Speyeria*	*cybele* (Fab.)	DI	1
Lepidoptera	Nymphalidae	*Vanessa*	*atalanta rubria* (Fruhstorfer)	DI	1

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Lepidoptera	Papilionidae	*Eurytides*	*marcellus* (Cramer)	DI	1
Lepidoptera	Papilionidae	*Papilio*	*troilus* L.	DI	1
Lepidoptera	Pieridae	*Abaeis*	*nicippe* (Cramer)	DI	1
Lepidoptera	Pieridae	*Colias*	*eurytheme* Boisduval	DI	1
Lepidoptera	Pieridae	*Eurema*	*lisa* (Boisduval & LeConte)	DI	2
Lepidoptera	Pyralidae	*Desmia*	*funeralis* (Hübner)	LT	1
Lepidoptera	Pyralidae	*Dolichomia*	*olinalis* (Guenée)	DI, LT	16
Lepidoptera	Pyralidae	*Herpetogramma*	*thestialis* (Walker)	LT	1
Lepidoptera	Pyralidae	*Hypsopygia*	*costalis* (Fab.)	LT	1
Lepidoptera	Pyralidae	*Spoladea*	*recurvalis* (Fab.)	LT	1
Lepidoptera	Saturniidae	*Actias*	*luna* (L.)	DI	1
Lepidoptera	Saturniidae	*Anisota*	*stigma* (Fab.)	LT	6
Lepidoptera	Saturniidae	*Automeris*	*io* (Fab.)	LT	1
Lepidoptera	Saturniidae	*Callosamia*	*angulifera* (Walker)	LT	1
Lepidoptera	Saturniidae	*Citheronia*	*regalis* (Fab.)	LT	1
Lepidoptera	Saturniidae	*Dryocampa*	*rubicunda* (Fab.)	LT	42
Lepidoptera	Satyridae	*Cyllopsis*	*gemma* (Hübner)	DI	4
Lepidoptera	Satyridae	*Enodia*	*anthedon* Clark	DI, SW	2
Lepidoptera	Satyridae	*Hermeuptychia*	*sosybius* (Fab.)	DI	1
Lepidoptera	Tortricidae	*Sparganothis*	*reticulatana* (Clemens)	FG	1
Mecoptera	Bittacidae	*Bittacus*	*stigmaterus* Say	SW	1
Mecoptera	Panorpidae	*Panorpa*	*debilis* Westwood	DI	2
Mecoptera	Panorpidae	*Panorpa*	*nebulosa*? Westwood	DI, SW	2
Diptera	Anthomyzidae	*Mumetopia*	*occipitalis* Melander	SW	1
Diptera	Asilidae	*Asilus*	species 1	DI, MN, SW	7
Diptera	Asilidae	*Laphria*	species 1	DI, MN	5
Diptera	Asilidae	*Laphria*	species 2	DI	1
Diptera	Asilidae	*Leptogaster*	species 1	SW	2
Diptera	Asilidae	*Leptogaster*	species 2	SW	1
Diptera	Asilidae	*Ommatius*	*gemma* Brimley	DI, FG	2
Diptera	Bombyliidae	*Anthrax*	species 1	DI	1
Diptera	Bombyliidae	*Villa*	species 1	DI	3
Diptera	Calliphoridae	*Cochliomyia*	species 1	FG, SW	20
Diptera	Calliphoridae	*Phaenicia*	species 1	PF	1
Diptera	Calliphoridae	*Phormia*	*regina* (Meigen)	FG, SW	16
Diptera	Ceratopogonidae	*Dasyhelea*	species 1	SW	1
Diptera	Ceratopogonidae	*Stilobezzia*	species 1	SW	1
Diptera	Chaoboridae	*Chaoborus*	species 1	SW	1
Diptera	Chloropidae	*Apotropina*	species 1	SW	2
Diptera	Chloropidae	*Elachiptera*	species 1	FG	1
Diptera	Chloropidae	*Homaluroides*	species 1	SW	1
Diptera	Clusiidae	*Clusia*	*lateralis* (Walker)	DI	1
Diptera	Conopidae	*Stylogaster*	species 1	DI	1
Diptera	Culicidae	*Aedes*	species 1	DI, SW	8
Diptera	Culicidae	*Culex*	species 1	SW	1
Diptera	Culicidae	*Culiseta*	species 1	SW	1
Diptera	Culicidae	*Ochlerotatus*	*triseriatus* (Say)	DI, SW	7
Diptera	Culicidae	*Psorophera*	species 1	DI	1
Diptera	Culicidae	*Toxorhynchites*	*rutilus septentrionalis* (Dyar & Knab)	LT	1
Diptera	Dolichopodidae	*Campsicnemus*	species 1	BT, SW	2
Diptera	Dolichopodidae	*Chrysotus*	species 1	ML, SW	8
Diptera	Dolichopodidae	*Condylostylus*	species 1	FG	1
Diptera	Dolichopodidae	*Condylostylus*	species 2	DI	2
Diptera	Dolichopodidae	*Dolichopus*	species 1	FG, SW	6
Diptera	Dolichopodidae	*Gymnopternus*	species 1	DI, FG, PF, SW	44

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Diptera	Dolichopodidae	*Hercostomus*	*tibialis*? (Van Duzee)	FG, SW	8
Diptera	Dolichopodidae	*Sciapus*	species 1	MN	1
Diptera	Dolichopodidae	*Tachytrechus*	species 1	PF, SW	2
Diptera	Drosophilidae	*Chymomyza*	species 1	PF ,SW	13
Diptera	Drosophilidae	*Cladochaeta*	species 1	SW	2
Diptera	Drosophilidae	*Drosophila*	species 1	BT, MN, PF, SW	22
Diptera	Drosophilidae	*Leucophenga*	species 1	FG ,SW	4
Diptera	Drosophilidae	*Scaptomyza*	species 1	SW	14
Diptera	Empididae	*Chelipoda*	*sicaria* Melander	BT, DI	2
Diptera	Empididae	*Drapetis*	species 1	PF, SW	3
Diptera	Empididae	*Euhybus*	species 1	SW	3
Diptera	Empididae	*Rhamphomyia*	species 1	FG	1
Diptera	Ephydridae	*Discocerina*	species 1	ML	1
Diptera	Ephydridae	*Ochthera*	species 1	BT, DI, FG, SW	39
Diptera	Ephydridae	*Paralimna*	*punctipennis* (Wiedemann)	BT, DI, FG, SW	21
Diptera	Ephydridae	*Psilopa*	*dupla*? Cresson	SW	1
Diptera	Ephydridae	*Scatella*	species 1	LL	1
Diptera	Heleomyzidae	*Suillia*	species 1	SW	1
Diptera	Hybotidae	*Oedalea*	*astylata* Melander	FG	1
Diptera	Hybotidae	*Syneches*	species 1	LT, SW	2
Diptera	Hybotidae	*Tachyempis*	*calva* (Melander)	SW	1
Diptera	Keroplatidae	*Orfelia*	species 1	SW	3
Diptera	Lauxaniidae	*Camptoprosopella*	species 1	FG	1
Diptera	Lauxaniidae	*Homoneura*	species 1	BT, SW	3
Diptera	Lauxaniidae	*Melanomyza*	species 1	SW	2
Diptera	Lauxaniidae	*Minettia*	species 1	FG, SW	3
Diptera	Lonchaeidae	*Lonchaea*	species 1	FG	1
Diptera	Micropezidae	*Rainieria*	*antennaepes* (Say)	DI, SW	3
Diptera	Muscidae	*Caricea*	species 1	ML, SW	2
Diptera	Muscidae	*Caricea*	species 2	SW	1
Diptera	Muscidae	*Coenosia*	species 1	SW	4
Diptera	Muscidae	*Drymeia*	species 1	FG, ML	2
Diptera	Muscidae	*Neodexiopsis*	species 1	SW	3
Diptera	Muscidae	*Phaonia*	species 1	DI, MN, PF, SW	9
Diptera	Muscidae	*Potamia*	species 2	SW	1
Diptera	Mycetophilidae	*Acnemia*	*flaveola* Coquillet	SW	1
Diptera	Mycetophilidae	*Boletina*	species 1	SW	1
Diptera	Mycetophilidae	*Dynatosoma*	species 1	SW	1
Diptera	Mycetophilidae	*Exechia*	species 1	ML, PF, SW	3
Diptera	Mycetophilidae	*Lygistorrhina*	*sanctaecatharinae* Thompson	SW	1
Diptera	Mycetophilidae	*Macrocera*	species 1	SW	1
Diptera	Mycetophilidae	*Mycetophila*	species 1	PF, SW	5
Diptera	Mycetophilidae	*Mycomya*	species 1	PF, SW	9
Diptera	Mycetophilidae	*Neoempheria*	species 1	SW	1
Diptera	Mycetophilidae	*Rymosia*	species 1	SW	1
Diptera	Mycetophilidae	*Sceptonia*	species 1	SW	1
Diptera	Odiniidae	*Traginops*	*irroratus* Coquillet	DI	1
Diptera	Phoridae	*Conicera*	*dauci* (Meigen)	DI, PF	8
Diptera	Phoridae	*Diplonevra*	*hamata* Borgmeier	SW	1
Diptera	Phoridae	*Dohrniphora*	species 1	BT, LL, ML, PF, SW	269
Diptera	Phoridae	*Gymnophora*	species 1	BT, ML, PF	14
Diptera	Phoridae	*Puliciphora*	*virginiensis*? Malloch	PF	9
Diptera	Phoridae	*Spiniphora*	*excisa*? (Becker)	SW	1

TABLE 3. Continued.

Order	Family	Genus	species	Method(s) *	# Collected
Diptera	Phoridae	*Triphleba*	*lugubris* (Meigen)	PF,SW	2
Diptera	Psychodidae	*Telmatoscopus*	species 1	ML	2
Diptera	Rhagionidae	*Chrysopilus*	species 1	SW	2
Diptera	Sarcophagidae	*Boettcheria*	species 1	ML, PF, SW	4
Diptera	Sarcophagidae	*Udamopyga*	*niagarana* (Parker)	FG	1
Diptera	Scatopsidae	*Colobostema*	*variatum* Cook	DI	1
Diptera	Sciaridae	*Bradysia*	species 1	ML, PF	4
Diptera	Sciaridae	*Corynoptera*	species 1	LL ,ML, PF	25
Diptera	Sciaridae	*Epidapus*	species 1	PF	2
Diptera	Sciaridae	*Lycoriella*	species 1	BT, ML, PF	5
Diptera	Sciaridae	*Pseudosciara*	*forceps* (Pettey)	PF	1
Diptera	Sciaridae	*Schwenkfeldina*	species 1	DI, MN, PF, SW	8
Diptera	Sciaridae	*Sciara*	species 1	LT, ML	25
Diptera	Sciomyzidae	*Euthycera*	*arcuata* (Loew)	SW	1
Diptera	Sciomyzidae	*Limnia*	*boscii*? (Robineau-Desvoidy)	DI	1
Diptera	Sepsidae	*Sepsis*	species 1	SW	4
Diptera	Sphaeroceridae	*Leptocera*	*fontinalis* (Fallen)	PF, SW	72
Diptera	Sphaeroceridae	*Pterogramma*	species 1	PF	13
Diptera	Stratiomyidae	*Ptecticus*	species 1	DI	1
Diptera	Syrphidae	*Cheilosia*	species 1	LT	1
Diptera	Syrphidae	*Epistrophella*	species 1	FG, MN	3
Diptera	Syrphidae	*Syrphus*	species 1	MN, SW	4
Diptera	Syrphidae	*Toxomerus*	*geminatus* (Say)	SW	1
Diptera	Syrphidae	*Toxomerus*	species1	MN	2
Diptera	Syrphidae	*Xylota*	species 1	DI	1
Diptera	Tabanidae	*Tabanus*	*calens* L.	DI	5
Diptera	Tabanidae	*Tabanus*	*fulvulus* Wiedemann	ML, MN	4
Diptera	Tabanidae	*Tabanus*	*molestus* Say	MN	1
Diptera	Tabanidae	*Tabanus*	*pallidescens* Philip	ML	1
Diptera	Tabanidae	*Tabanus*	*sulcifrons sulcifrons* Macquart	MN	1
Diptera	Tachinidae	*Anisia*	species 1	MN	1
Diptera	Tachinidae	*Hemyda*	*aurata* Robineau-Desvoidy	DI	1
Diptera	Tachinidae	*Peleteria*	species 1	DI	1
Diptera	Tipulidae	*Epiphragma*	*solatrix*? (Osten-Sacken)	SW	8
Diptera	Tipulidae	*Tipula*	species 1	DI, SW	17
Diptera	Xylophagidae	*Dialysis*	species 1	LT	1
Diptera	Xylophagidae	*Rachicerus*	species 1	DI, FG, SW	5

* BT = beat sheet; DI = direct collect; FG = canopy fog; LL = leaf litter; LT = light trap; ML = malaise trap; MN = Manitoba trap; PF = pitfall trap; and SW = sweep net.

tends to be biased when there are a small number of specimens. Therefore, diversity of malaise traps may be overestimated. The malaise trap collected 12 species not obtained by any other sampling method (Table 2).

The Manitoba trap collected 51 specimens representing six orders, 21 families, and 30 species (Fig. 2). The three orders with the highest number of species were Diptera, Hymenoptera, and Lepidoptera. Although Diptera was represented by the largest number of species, only three 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 0.39% of all insect specimens. Manitoba trapping produced the third lowest diversity among sampling types but yielded the highest evenness, as each species was represented by a similar number of specimens (six or fewer) (Table 2). The Manitoba trapping collected 16 species that were not found by any other sampling method (Table 2). A large number of non-blood feeding species were collected by the Manitoba trap.

Pitfall traps collected 3133 specimens representing seven orders, 37 families, and 135 species (Fig. 2). The orders represented by the largest number of species were Coleoptera, Diptera, and Hymenoptera, respectively. The Coleoptera were represented by a large number of species in the families Carabidae, Staphylinidae, and Scarabaeidae, which are gener-

ally 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 foliage, 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. The Hymenoptera were represented by a large number of ant species that tend to live and forage on the ground. This method collected 23.8% of all insect specimens. The large number of species collected combined with low abundance of most species and high abundance of a few species resulted in an intermediate diversity value and low evenness of pitfall trap samples (Table 2). Pitfall traps collected 65 species that were not found by any other sampling method (Table 2). Species unique to pitfall traps may represent groups 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 especially in the wettest areas sampled by the pitfall traps. Because some traps were located close to the edge of the water, it is possible that a small flooding event could have washed some of these specimens out of or into the cup. In the pitfall traps, only a few species occurred on greater than 10% of the sampling dates; therefore, no species was considered an indicator species.

Sweep nets captured 853 specimens representing 11 orders, 83 families and 222 species (Fig. 2). Hemiptera and Diptera were the most commonly collected orders using sweep-net samples. Sweep-net sampling yielded the second highest diversity and intermediate evenness among sampling methods (Table 2). Using sweep netting, some species occurred on greater than 20% of the sampling dates. An unidentified wasp species in the family Diapriidae represented the most consistently collected species occurring on 21.2% of the sampling dates and averaged 0.27 specimens captured each sampling date.

Insect Species of Interest—No Tennessee listed or federally listed RTE insects were collected and identified from Sinking Pond; however, four species were on the RTE species lists of one or more neighboring states. *Glaucopsyche lygdamus* Doubleday and *Speyeria cybele* Fab. were identified from Sinking Pond, and *Cicindela unipunctata* Fab. is listed in Alabama as "S?", meaning its status is unknown at this time. *Enodia anthedon* Clark was listed in Alabama as "SR," referring to its having been reported from the state, but without persuasive documentation. *Glaucopsyche lygdamus* Doubleday was listed in Alabama as "SU," inferring that it is possibly in peril, but its status is uncertain. In North Carolina, this species is listed as S2S3, meaning it is either imperiled in the state due to rarity or it is rare to uncommon. For example, *Speyeria cybele* Fab. was indicated as "SU" in Alabama; however, this species is widely distributed in eastern Tennessee.

Disjunct Species—One collected species, *Apteromechus texanus* Fall, 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). Several beetle species were collected with recorded distributions outside of the southeastern U.S. (Downie and Arnett, 1995). An elaterid, *Ctenicera signaticollis* (Melsheimer), previously recorded from Indiana and Alabama, and an eucnemid, *Dirrhagofarsus lewisi* (Fleutiaux), listed from Maryland and Georgia, were identified. A scirtid, *Cyphon padi* (L.), associated with swamps and bogs in Ontario, Pennsylvania, Indiana, Florida, and Washington was identified. A histerid beetle, *Atholus nubilus* (LeConte), was collected that had been reported from Indiana, Iowa, and Kansas. Two hydrophilid species collected 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. Also, two staphylinid species, *Homaeotarsus pimerianus* (LeConte) reported from Indiana, Texas, Arizona, California, and Iowa, and *Sunius confluentus* (Say) reported from Quebec, Connecticut, New York, Indiana, and Minnesota, were collected. In addition, two tenebrionids were reported with northern distributions. These included *Haplandrus fulvipes* (Herbst) reported from Connecticut, Indiana, and New York, and *Idiobates castaneous* (Knoch) that had been previously recorded from New York, Indiana, Pennsylvania, Maryland, and Virginia (Wiggins et al., 2007). Other species of interest included the lepidopteran species, *Fulgoraecia exigua* (Edwards) (an external parasitoid of planthoppers) and *Dolichomia olinalis* (Guenée), an uncommonly collected species that feeds on oaks (Covell, 1984). The dipteran, *Pseudosciara forceps* (Pettey), had only been previously recorded from Florida (Stephan, 1981).

Conclusions

This research project resulted in the compilation of a list of insect species associated with Sinking Pond and development of a database of insect information that can be used in future studies. Species diversity, the ecological significance of select species, and potential indicator species at Sinking Pond were assessed. Collection of some insect species, such as the trichopteran *Wormaldia shawnee*, represented new state records (Wiggins et al., 2001). From the nine sampling techniques used, 13,162 insect specimens were collected representing 19 orders. Insect diversity for combined methods was higher than any sampling method. Therefore, using a combination of collection techniques collected a greater diversity of insects and provided a more complete assessment of the insect community than individual collection methods, which obtained fewer than 300 species each, whereas the combined collection methods amassed 877 different species identified. Of those species identified, 376 were represented by the collection of a single specimen. In addition, each method captured a number of species not sampled by other methods. Therefore, the use of multiple sampling methods was an asset during the effort to collect a representative sample of the Sinking Pond community.

Direct collecting and sweep-netting both collected a similar number of species. Light trapping collected the largest proportion of species not sampled by other methods, although some of these species may have been attracted from other habitats surrounding Sinking Pond. Light trapping also collected numerous aquatic specimens which were not collected by other methods. The number of species collected unique to each sampling method ranged from 12 (malaise trapping) to 218 (light trapping). Differences in the species collected by each sampling method contributed to a more complete picture of the insect community at Sinking Pond.

At least 13 species collected at Sinking Pond were known to be introduced. These included five beetle species [*Cyrtepis-*

tomus castaneus (Roelofs) (Asiatic oak weevil), *Demotina modestus* Baly, *Coccinella septempunctata* L. (seven-spotted lady beetle), *Harmonia axyridis* (Pallas) (Asian multicolored lady beetle), and *Popillia japonica* Newman (Japanese beetle)], and two hymenopterans [*Tertramorium caespitum* (L.) (the pavement ant) and *Wasmannia auropunctata* (Roger) (the little fire ant)]. Four of these species may adversely affect Sinking Pond. *Cyrtepistomus castaneus*, which feeds on oak foliage as an adult, was widely distributed at Sinking Pond and was collected by six sampling methods (beat sheeting, direct collecting, fogging, light trapping, pit-fall trapping, and sweep-netting). This species has been recorded to reach pest status on oaks. *Harmonia axyridis* was collected by three sampling methods (canopy fogging, direct collecting, and malaise trapping). Although *H. axyridis* was imported as a biological control agent, it is considered a household pest when it overwinters in homes and buildings (Potter et al., 1998). *Harmonia axyridis* could potentially affect the Sinking Pond community by disrupting the natural proportions of the predator populations. Although immature *P. japonica* are noted as a pest of lawns and grasses, adults feed on more than 300 plant species; thus, adults could injure plants if large populations become established in Sinking Pond. *Wasmannia auropunctata, a* neo-tropical species that tends plant-feeding insects that secrete honeydew, was associated with reduced species richness in tree canopies in New Caledonia, where it is also an exotic species (Guilbert et al., 1994). Although only one specimen was collected at Sinking Pond, it may still warrant observation. If future studies are conducted in this area, it may be beneficial to look at the effects of this species.

Twelve potentially disjunct species were collected. The occurrence of species such as *Apteromechus texanus* Fall and *Pseudosciara forceps* (Pettey), which both have ranges recorded as more southern, suggests that the area of Sinking Pond may be conducive to their survival outside of their native range. Conversely, disjunct species present at Sinking Pond may represent unusual genotypes that have the ability to survive outside of their established habitat range. As such, Sinking Pond may be important in maintaining these potentially unusual genotypes that would be sensitive to changes in the habitat. Therefore, these species may be good indicators of the current state of Sinking Pond and may be useful in evaluating future changes to this area. Information on their criteria for survival outside of their range or how Sinking Pond facilitates their survival would be beneficial.

The uniqueness of Sinking Pond stems primarily from its unique plant community and the nature of its flooding regime. The database of insects collected at Sinking Pond compiled in this study could be cross referenced with Geographical Information Systems data to verify the presence of species, estimate the population density, and evaluate community structure. 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 similar areas to determine where differences occur, to gauge the effects of human activities, or to note other future changes in and around the Sinking Pond area. For example, populations of gypsy moth, *Lymantria dispar* (L.), are expected to become established in Tennessee in the coming decade. Thus, the Sinking Pond area, which is populated with many oaks that are the primary host of gypsy moth, could be severely impacted by this introduced pest. These baseline data on the insect communities at Sinking Pond will be necessary to gauge the overall impact of gypsy moth, or any other introduced species, on the community structure of Sinking Pond.

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