

March, 2009

**Ant Diversity at Noxubee National Wildlife Refuge in Oktibbeha,  
Noxubee, and Winston Counties, Mississippi  
Report #2009-01**



A report submitted to the Noxubee National Wildlife Refuge, March 2009

by

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**Cover Figure.** Full-face view of *Amblyopone pallipes* (Haldeman).

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## **ABSTRACT**

The Mississippi Entomological Museum conducted a survey of ants at the Noxubee National Wildlife Refuge in Oktibbeha, Noxubee, and Winston Counties, Mississippi. Collections were made from 21 September 2007 through 31 October 2008 at 57 sites in six primary habitats: pine forests, mixed pine-hardwood forests, bottomland hardwood forests, upland hardwood forests, open habitats (fields, grasslands, roadsides, and a sand pit) and disturbed, open mixed pine-hardwood forests located near buildings and picnic areas. A total of 95 species representing 30 genera in 7 subfamilies were collected during the study. The highest diversity of ants was found in bottomland hardwood forests with 59 species, followed by mixed pine-hardwood forests with 58, upland hardwood forests with 56, pine forests with 43, disturbed, open pine-hardwood forests with 38, and fields, grasslands, and sandpit with 19. Eight new state records, two apparently undescribed species, and several other rarely collected species are reported. Eight exotic species were collected at the refuge, and they generally were found only in disturbed areas.

## INTRODUCTION

The Noxubee National Wildlife Refuge (NWR) occupies approximately 19,425 ha in Oktibbeha, Noxubee, and Winston Counties in east-central Mississippi. The refuge is located in the Coastal Plain with the majority of it in the Flatwoods region, but with some areas in the North Central Plateau and Black Belt physiographic regions. The refuge is comprised of three primary habitat types including forests (approximately 18,000 ha), fields and grasslands (approximately 572 ha - not including most road and power-line right-of-ways), and wetlands (approximately 574 ha). Forested areas at the refuge include four major types: pine (8815 ha), pine-hardwood (1898 ha), bottomland hardwood (6106 ha), and upland hardwood (1308 ha) (current area statistics from Richard Smith-Noxubee NWR Forester, Pers. Comm). Fields are primarily small grassy areas managed for wildlife, but also include strips of land along roadsides, and a managed grassland site at Morgan Hill. Wetlands also form an important component of the refuge with two major lakes, Bluff (324 ha) and Loakfoma (162 ha); four green tree reservoirs; sixteen smaller reservoirs; several natural ponds; the Noxubee River; and numerous streams. During flood episodes, the Noxubee River and its tributaries may inundate more than half of the bottomland forests (U. S. Fish and Wildlife Service, 2004).

The purpose of this study was to document ant species compositions in each of the primary terrestrial habitats at the refuge, document potential new species or new state records for Mississippi, and to ascertain levels of exotic species activity at the refuge. The results of this survey add to earlier surveys of ants in Mississippi by Marion Smith (1924a, b, c; 1927; 1928a, b; 1931; 1932), Hill (2006), MacGown and Brown (2006), and MacGown et al. (2005), and ultimately to a larger project being conducted by the Mississippi Entomological Museum (MEM) on ant distributions in Mississippi. A web site on ants of the Noxubee NWR with faunal lists, photos of ants, and other information is available online at <http://www.mississippientomologicalmuseum.org.msstate.edu/Researchtaxapages/Formicidaepages/faunal.lists/Noxubee.Ants.htm>.

## METHODS

A total of 76 collection events were made on 23 days from 21 September 2007 through 31 October 2008 at 56 different sites in Noxubee, Oktibbeha, and Winston Counties (Table 1, Fig. 105). In addition, species collected at a pine-hardwood site (site 57) in Oktibbeha County during a study by Hill (2006) are included here. Collections for the current study were made in six terrestrial habitats including pine forests (mature and young forests, and recently burned or unburned); pine-hardwood forests (with 25-55% pines present); bottomland hardwood forests (including cypress dominated areas such as sloughs and lake borders); upland hardwood forests; disturbed, open mixed pine-hardwood forests located near buildings and picnic areas; and open habitats including fields, grasslands, roadsides, and a sand pit.

Collecting methods included baiting, beating and sweeping vegetation, litter sampling, and visually searching for ants and their colonies. Additionally, some records of ants collecting from previous years by MEM staff were included in this study, especially if habitat information was associated with the specimens. Voucher specimens were deposited in the MEM.

## Habitat Descriptions (Figs. 97-104)

Pine forests of the refuge (Fig. 97), composed primarily of loblolly (*Pinus taeda* L.) and scattered shortleaf pine (*Pinus echinata* P. Miller), are in various stages of growth from newly planted to mature pine forests. Older stands of pine are regularly burned to keep understory in check, which lessens the possibility of wildfires, and for management of red cockaded woodpecker (*Picoides borealis* Vieillot) and other wildlife that require open forest conditions.

Mixed pine-hardwood forests (Fig. 98) are typically dominated by loblolly pine and have a variety of hardwoods including oaks (*Quercus* spp.), hickories (*Carya* spp.), blackgum (*Nyssa sylvatica* Marsh.) and sweetgum (*Liquidambar styraciflua* L.). Eastern red cedar (*Juniperus virginiana* L.) is intermixed at one locality, where an old home site appeared to have been present many years earlier. In some cases pine-hardwood habitat was difficult to distinguish from pine forests, which sometimes had a small percentage of hardwoods present, or upland hardwood forests, which sometimes had a small percentage of pines present.

Due to the relative flat topography of the area, bottomland forests (Fig. 99, 100) at the refuge are extensive. Bald cypress [*Taxodium distichum* (L.)] and water tupelo (*Nyssa aquatica* L.) are found in the wettest areas that are most often inundated with water. A variety of other species such as cherry bark oak (*Quercus pagoda* Rafinesque), overcup oak (*Q. lyrata* Walter), water oak (*Q. nigra* L.), willow oak (*Q. phellos* L.), American beech (*Fagus grandifolia* Ehrhart), box elder (*Acer negundo* L.), red maple (*A. rubrum* L.), sweetgum, river birch (*Betula nigra* L.), yellow-poplar (*Liriodendron tulipifera* L.), elms (*Ulmus* spp.), pawpaw (*Asimina triloba* Adanson), and sycamore (*Platanus occidentalis* L.) are common in areas that are flooded less frequently or rarely.

Upland hardwood forests (Fig. 101) are associated with sloped or rolling terrain and tend to be relatively xeric, except at ravine bottoms where they may be more mesic, and soils tend to be somewhat sandy. The overstory of upland hardwood forests at Noxubee NWR are dominated by species such as white oak (*Quercus alba* L.), southern red oak (*Q. falcata* Michaux), post oak (*Q. stellata* Wangenh.), and hickories (*Carya* spp.). Flowering dogwood (*Cornus florida* L.), redbud (*Cercis canadensis* L.), black cherry (*Prunus serotina* Ehrhart), and other smaller trees are typical understory species.

Although disturbed, open forested habitats (Fig. 102) near buildings and picnic areas at the refuge comprise only a small percentage of the total land mass, we included them in this study because of their likelihood of harboring various exotic species that might have been lacking or found in reduced numbers in surrounding natural areas. Sites included in this category were the areas immediately surrounding the headquarters at Bluff Lake, the Education Center and Pavilion near Loakfoma Lake, and the refuge housing area near Bluff Lake. These sites included a mix of pines and other hardwoods, with unnaturally open understories created by mowing, and ornamental plantings and mulched areas.

Grasslands and fields (Fig. 103) accounted for only about 3% of the entire refuge. These areas included forest openings (between 1 and 150 acres each), the Morgan Hill prairie restoration area, and utility rights-of-way. Other open areas included a sand pit and roadsides. Morgan Hill is the only area managed as a natural grassland at the refuge. Restoration efforts at this site have included the planting of various grass species such as Indian grass (*Sorghastrum nutans* Nash), switch grass (*Panicum virgatum* L.), and big

bluestem (*Andropogon gerardii* Vitman) (Hill, 2004). This area is burned approximately every two years to control growth of woody vegetation, such as eastern red cedar. The sandpit (Fig. 104), located in Winston County, is a large sand deposit located in the southwest portion of the refuge and is used by the refuge for construction and/or road needs.

## RESULTS

Our survey of ants at Noxubee National Wildlife Refuge revealed a diverse fauna including 95 species in 30 genera and 7 subfamilies including eight new state records, two apparently undescribed species, and eight exotic species. (Table 1, Figs. 1-96). This total is more than half of the 175 species that the MEM has documented in the entire state of Mississippi (MacGown, 2009a), some of which are restricted to the coastal region. For its size, the diversity of ants at the refuge is among the highest in eastern North America and compares favorably with other similar studies. Only eight more species (103 total) (MacGown and Hill, 2009) are currently known to occur in the Smoky Mountains National Park, an area that occupies approximately 207,200 ha (800 square miles) and has been studied extensively. As a result of a survey of ants of the Savannah River Plant in South Carolina (Van Pelt and Gentry, 1985), which occupies approximately 80,937 ha, 89 total species were collected during a two-year period in seven primary habitats. Seventy-two species were documented (MacGown and Brown, 2006) for the comparably sized (approximately 16,000 ha) Tombigbee National Forest in Mississippi, which is adjacent to the Noxubee NWR. Seventy-two species were also reported from a survey of ants in longleaf pine-flatwoods in northern Florida, with a study area of over 50,000 ha (Lubertazzi and Tschinkel, 2003). A survey of ants of sand dunes along the little Ochoopee River in Georgia resulted in collections of 77 species (MacGown et al., in press), which was quite high considering the study sites only totaled about 1,200 ha (the total area of the dunes system is approximately 16,000 ha). The high species diversity at Noxubee NWR is even more remarkable considering that prior to government ownership in the 1930s and 1940s, much of the land included in the present refuge boundaries were overgrazed by cattle and extensively farmed (United States Fish and Wildlife Service, 2004).

### Habitat/Ant Species Associations

#### Pine Forests

The 43 species of ants collected in pine forests represented the lowest species diversity of the primary wooded habitats. Pine forests at the refuge are burned regularly; thus, it is likely that many of the litter dwelling species are adversely affected, although some of these species may survive at peripheries of burned areas. Our collections appeared to confirm this, as we collected only four of the soil and litter dwelling dacetine species in pine forests, which is the most speciose group in Mississippi.

In general, pine forests were dominated by relatively common species such as *Aphaenogaster* spp., *Camponotus* spp., *Crematogaster* spp. (especially *C. ashmeadi* Mayr), *Hypoconerops opacior* Forel, *Monomorium minimum* Buckley, *Paratrechina faisonensis* Forel, *Pheidole* spp., *Ponera pennsylvanica* Buckley, *Solenopsis* sp. cf. *carolinensis* Forel, and the hybrid imported fire ant, *Solenopsis invicta* x *richteri* (native to South America). The relative abundance of larger species such as *Aphaenogaster* spp,



*Camponotus* spp., as well as extremely high numbers of *Crematogaster ashmeadi* in the pine forests, including red-cockaded woodpecker habitat, suggest that a plentiful supply of food was available to the woodpeckers, which are known to consume large quantities of ants, especially *C. ashmeadi* (Hess and James, 1998). Random sampling on pine trees in the area resulted in high numbers of *C. ashmeadi*, and it is likely that colonies of *C. ashmeadi* are found in a high percentage of the mature loblolly pine trees at the refuge. This agrees with Tschinkel's (2002) findings that *C. ashmeadi* was the most dominant arboreal ant in pine forests in northern Florida with the majority of pines in the area supporting multiple colonies of this species. Similarly, colonies of the minute thief ant, *S. sp. cf. carolinensis*, and the little black ant, *M. minimum*, were exceedingly abundant in these forests, especially in rotting pine logs and in pine bark at bases of trees. High levels of imported fire ant colonies in *P. borealis* habitat may be attributed to periodical burning, which creates open habitat ideal for colonization. Fire ants have been reported to have negative impacts on a number of bird species in Mississippi and other areas (Allen et al., 2004), although they have not been reported to have adverse effects on red cockaded woodpecker populations.

Despite the relative low diversity of ants, three species, *Hypoponera inexorata* (Wheeler), *Myrmica pinetorum* (Wheeler), and *Solenopsis tennesseensis* Smith, were collected only in pine forests. Of these, *S. tennesseensis*, a new state record, was the most surprising, as we typically have collected this species along the coast or in inland sand dune habitats in the Southeast. *Pyramica metazytes* Bolton, a rarely collected species only described a few years ago (Bolton, 2000), was also found in pine forests.

### **Pine-Hardwood Forests**

Although pine-hardwood habitat comprised only a small fraction of the refuge, the 58 species collected there represent the second highest species total for the different habitats. High diversity of ants in pine-hardwood forests may be due to higher diversity of trees and shrubs, increased complexity of the vegetative structure, and reduced amount of prescribed burning. Some ant species are only associated with hardwood trees and would not be found in pure pine stands. It has been shown that complex vegetative structure (i.e. shrubs, vines, and other second growth vegetation) provides increased habitat, which in turn results in an increase in diversity of ant species (Hill, 2006), whereas, burning decreases structure and eliminates leaf litter and coarse woody debris, thereby likely reducing diversity.

Species diversity was greatest in the dacetines, with 13 species found, followed by 11 species of *Camponotus*. However, the most common ants (ants collected at most sites) were *Aphaenogaster carolinensis* Wheeler, *A. fulva* Roger, *Crematogaster ashmeadi*, *Hypoponera opacior*, *Monomorium minimum*, *Myrmicina americana* Emery, *Paratrechina faisonensis*, *Pheidole dentata* Mayr, *P. dentigula* Smith, *Ponera pennsylvanica*, *Solenopsis sp. cf. carolinensis*, *S. invicta* x *richteri*, and *Strumigenys louisianae* Roger.

Four species were collected only in pine-hardwood forests including *Proceratium croceum* Roger, *Pyramica reflexa* (Wesson and Wesson), *Solenopsis abdita* Thompson, and *Strumigenys silvestrii* Emery. *Solenopsis abdita* and *Strumigenys silvestrii* represent new state records for Mississippi, although we have also collected these species elsewhere in the state. *Pyramica reflexa* was only reported for the first time for Mississippi in 2006 (MacGown and Brown, 2006). Only three exotic species were collected in pine-

hardwoods including *Strumigenys silvestrii* (native to South America), *Paratrechina vividula* (Nylander) (thought to be native to Europe, but some people consider it native to US), and *Solenopsis invicta* x *richteri*. *Strumigenys silvestrii* and *P. vividula* were collected at only one locality; an area intermixed with cedars that showed signs of past disturbance. *Solenopsis invicta* x *richteri* were abundant in open areas and along edges of the habitat.

### **Bottomland Hardwood Forests**

It may seem counterintuitive that we found the highest species diversity (59 species) in bottomland forests, because of the environmental stresses of periodic flooding. Obviously, in areas that are consistently flooded, most ants cannot live in soil or leaf litter, so they are relegated to living in elevated areas or arboreally. Indeed, many species in these forests nest in rotting wood, trees, vines, or other plant material, or in high spots. As a result of frequent flooding, there tends to be large accumulations of litter, many rotting logs, and standing dead trees, all of which provide suitable nesting sites for various species of ants. In less frequently flooded areas, ground nesting species are much more abundant.

Not surprisingly, we collected a high percentage of arboreal and rotting wood specialists (24 species). The highest diversity in wood nesting species was found in the *Camponotus* genus with 10 species. Notable arboreal species included *Aphaenogaster mariae* Forel, only recently reported for the state (MacGown and Brown, 2006), and *Temnothorax longispinosus* (Roger), which represents a new state record. Other interesting arboreal species included *Camponotus impressus* Roger, *C. mississippiensis*, Smith, *Pseudomyrmex ejectus* (Smith), and *P. pallidus* (Smith), all of which are specialized stem and cavity nesters, and *Crematogaster vermiculata* Emery, which nests in cypress trees and is a new state record.

Despite the improbability of finding soil and litter nesting species, we collected 33 species that typically nest in the soil or litter. Of these species, *Aphaenogaster carolinensis* Wheeler, *Hypoponera opacior*, *Lasius alienus* (Foerster), and *Myrmecina americana* were the most abundant at the sites. Although *H. opacior* typically nests in the soil, we also found colonies in rotting tree trunks above ground, which would have protected them from flood events. *Lasius alienus* colonies were also found in other habitats, but nowhere else were they found in such abundance as in the bottomland hardwood forests. Several of the dacetines from this habitat are rarely collected species. *Pyramica abdita* (Wesson and Wesson) and *P. pergandei* (Emery) represent new state records for Mississippi and *Discothyrea testacea* Roger was only recently reported for Mississippi (MacGown and Brown, 2006). Workers of a yellow colored *Brachymyrmex* species, apparently undescribed, and were collected at one site. They are similar to others that have been collected elsewhere in the state, and differ from our only native species, *B. depilis* Emery, which was also collected in bottomland forests, by having stiff erect setae on the body. Additional castes of this minute species are needed before serious analysis of its taxonomic status can be made.

Nine species were collected only in bottomland habitat including *Brachymyrmex* sp., *Camponotus caryae*, *C. impressus*, *Crematogaster vermiculata*, *Proceratium pergandei*, *Pseudomyrmex pallidus*, *Pyramica abdita*, *P. pergandei*, and *Temnothorax longispinosus*. Only two exotic species, *Hypoponera opaciceps* (Mayr) and *Solenopsis*

*invicta x richteri* were collected in these bottomland forests, and they were found only in disturbed areas along the edges, on trails, or in openings of the primary habitat.

### **Upland Hardwood Forests**

Although upland hardwood forests account for only about 1300 ha at the refuge, they provide important habitat for many ant species, which was illustrated by the 56 species we collected. The elevated sloped forests with sandy soils and deep litter layers provide good drainage for soil nesting species and unlike bottomland forests, most of the species collected in upland hardwood forests typically nest in the soil and/or litter.

Based on presence at the most localities, the following species appeared to be the most abundant or indicative of the upland hardwood forests: *Aphaenogaster carolinensis*, *A. fulva*, *Camponotus americanus*, *Crematogaster lineolata* (Say), *Formica pallidefulva* Latreille, *Hypoconerops opacior*, *Myrmecina americana*, *Paratrechina faisonensis*, *P. parvula*, *Pheidole dentata*, *P. dentigula*, *Ponera exotica* Smith, *P. pennsylvanica*, *Prenolepis imparis* (Say), *Pyramica angulata* (Smith), *P. ornata* (Mayr), *S. sp. cf. carolinensis*, *Strumigenys louisianae*, *Temnothorax curvispinosus* (Mayr), and *Trachymyrmex septentrionalis* (McCook).

Three species were collected only in upland hardwood forests including *Proceratium crassicornis* Emery, *Pyramica laevinasis* (Smith), and *Pyramica hyalina* Bolton. *Pyramica hyalina* was described in 2000 (Bolton, 2000) from 7 specimens, one of which was collected at Noxubee NWR (habitat not recorded). Other notable species were *Aphaenogaster mariae*, *Discothyrea testacea*, and *Pyramica missouriensis* (Smith). Three species appeared to define the upland sites, and although we may have collected them at other habitats, their occurrence in the upland sites was predictable. These species were *Paratrechina parvula*, *Ponera exotica* Smith, and *Pyramica angulata*. Only two exotic species, *Cyphomyrmex rimosus* Mayr (native to Neotropics) and *Solenopsis invicta x richteri*, were collected in this habitat. *Cyphomyrmex rimosus* was collected at only one site, which was at the border of the refuge and the Mississippi State University John Starr Memorial Forrest. Thus far, this is the northernmost record of this species in the state. In general, *Solenopsis invicta x richteri* was collected or observed only along the edges of the habitats or along open trails.

### **Disturbed, Open Pine-Hardwood Forests**

With 38 species collected, diversity in disturbed, open pine-hardwood forests was relatively low compared to other wooded habitats at the refuge. In many of our collections of ants in the southeastern United States, we have found that many areas that are highly disturbed tend to have had less overall diversity, but higher levels of introduced species (higher numbers and more species). Thus, we expected to find more exotic ant species at the disturbed mixed forest sites (and disturbed open sites) than at other sites. Our expectations were realized as we found six of the eight introduced species collected at the refuge including *Brachymyrmex patagonicus* Mayr (dark rover ant), *Hypoconerops opaciceps*, *Linepithema humile* (Mayr) (Argentine ant), *Paratrechina vividula*, *Pyramica membranifera* (Emery), and *Solenopsis invicta x richteri* in this habitat. *Solenopsis invicta x richteri*, which is ubiquitous in this part of Mississippi, was abundant in this habitat and in other similarly open areas throughout the refuge. However, in some regards, we would consider the Argentine ants to be the most problematic of these species because of their potential to build huge populations that may displace other species. This

species was likely introduced to the refuge in hardwood or pine mulch, potting soil, or in ornamental plants and was found only in a disturbed, mulched area near the headquarters. At the time of this study *L. humile* was found only in reduced numbers, and therefore, was probably introduced recently. *Brachymyrmex patagonicus*, another Argentinean import, has been increasing its range in the Southeast at an alarming rate since its introduction to the United States about 30 years ago (MacGown et al., 2007b). This species, similar to Argentine ants, is known to build large populations and is difficult to control. *Pyramica membranifera*, thought to be of either of Old World Tropics or European origin, is a minute soil/litter inhabiting species now common in the southern portions of the state. Because of its cryptic behavior, it is not likely to cause noticeable problems.

Perhaps somewhat surprisingly, the unnatural open mowed areas beneath trees with various bare spots of soil actually created ideal nesting sites for several native species, which were not found or were only found in reduced numbers elsewhere at the refuge. The genus *Pheidole* seemed to especially benefit from this habitat and we found three species, including one apparently undescribed species in the *crassicornis* group, nesting in these openings beneath trees. This apparently undescribed species, which does not fit any of the descriptions of species provided by Wilson (2003), has also been collected at other similar localities in the Southeast. We also found colonies of *Paratrechina arenivaga* (Wheeler) in the same area, which was the only place we collected it on the refuge. Another isolated group of trees located next to the pavilion at the Larry Box Environmental Education Center had various pieces of old trash present (i.e. bottles, cans, wire, etc.), but also had several interesting ant species present including the rarely collected *Pyramica metazytes*.

### **Fields, Grasslands, and Sandpit**

Open habitats, especially non-sandy ones, are not known to sustain high diversity of ant species. This is in part due to the lack of structure (i.e. vegetative structure, woody debris, etc.) and because of high temperatures during the warm seasons that can negatively affect foraging or nesting of many species. Additionally, many of the open habitats at the refuge, such as those along roadsides, are disturbed and have severely compacted soils, which may not be suitable as nesting sites for some ant species. For these reasons, we did not expect to find high diversity, and were not surprised to find only 19 species.

Many of the species collected at these sites appear to be restricted to nesting in open areas including *Dorymyrmex bureni* (Trager), *Forelius mccooki* (McCook), *Formica biophilica* Trager, *Pheidole bicarinata* Mayr, *P. tysoni* Forel, and *S. invicta* x *richteri*. Two of these species, *D. bureni* and *F. biophilica*, were found only in this habitat. *Formica biophilica* was described only recently as a species in a revision of the group by Trager et al. (2007). Three exotic species were found in the open habitats including *B. patagonicus*, *P. vividula*, and *S. invicta* x *richteri*. Of these, *S. invicta* x *richteri* was by far the most dominant and abundant species.

## **DISCUSSION**

### **Diversity**

The high number of native species (87) and relatively few exotic species (8) collected at the refuge are indicative of a healthy ecosystem with a balanced diversity of natural habitats. In contrast, we have observed that highly disturbed sites in the Southeast

typically have low diversity and are usually dominated by exotic species. Similarly, at the refuge, exotic species were usually found at disturbed sites, such as near buildings or roadways. However, in natural areas, we found proportions of native species to exotic ones to be high. Bottomland hardwood forests were the most diverse habitat that we collected in with 59 species, followed by mixed pine-hardwood forests with 58, upland hardwood forests with 56, pine forests with 43, disturbed mixed forests with 38, and fields, grasslands, mowed roadsides, and sandpit with 19. Seventy-one of the species collected at the refuge primarily nest in the soil or leaf litter, whereas 24 species nest either in rotting wood or arboreally.

Similar to Mississippi and the Southeast in general, the highest diversity was seen in the tribe Dacetini with 20 species represented (18 *Pyramica*, 2 *Strumigenys*), which is only 7 less than the total known to occur in the entire state (MacGown et al., 2005; unpublished data, MacGown and Hill) and almost half of the 42 species known to occur in the entire Southeast (MacGown, 2009b). Because dacetines are minute, cryptic, soil and litter inhabiting ants, they are uncommonly collected, meaning that more species may be found at the refuge. Also following a similar trend in Mississippi, the second highest diversity was seen in the genus *Camponotus* with 13 species, which was only two less than the total known from the entire state (MacGown et al., 2007a). However, unlike the dacetines, we feel more confident that all possible species in this region were collected at the refuge as the only two species we did not find have more southern distributions and are only found in areas of deep sand.

Twenty-eight species were unique to only one habitat, and each habitat had species that were unique to it (see table 1 for complete list of species and habitats). Three species were found only in pine forests, five only in pine-hardwood forests, nine only in bottomland hardwood forests, five only in upland hardwood forests, four only in disturbed, open pine-hardwood forests, and two only in open areas. Thirteen species were found in only two habitats, 24 species in only three habitats, 10 species were found in four habitats, 13 species were found in five habitats, and only seven species were found in all of the primary habitats that we collected. These species that showed the least habitat preference included *Formica pallidefulva*, *Hypoponera opacior*, *Myrmecina americana*, *Paratrechina faisonensis*, *Ponera pennsylvanica*, *Solenopsis* sp. cf. *carolinensis*, and *S. invicta* x *richteri* (inclusion of the latter species is somewhat misleading because it was found only in disturbed areas of the major habitats).

The ant-loving cricket, *Myrmecophilus pergandei* Bruner, only recently reported from Mississippi (MacGown and Hill, 2006), was collected in three habitats including bottomland hardwood, pine, and disturbed, open mixed pine-hardwood forests. This small cricket lives in colonies of a variety of ant species where it mimics the ants' behavior to receive food. At the refuge, we collected this species in colonies of *Camponotus pennsylvanicus*, *Lasius alienus*, and *Solenopsis invicta* x *richteri*. This was the first reported incident of the cricket in a colony of an exotic ant species.

### **New State Records**

Ten of the species that we collected at the refuge, including two undescribed species, have not been reported to occur in Mississippi and represent new state records: *Brachymyrmex* sp., *Crematogaster vermiculata*, *Pheidole* sp., *Pyramica abdita*, *P. pergandei*, *Solenopsis abdita*, *S. tennesseensis*, *Stenamma impar* Forel, *Strumigenys silvestrii*, and *Temnothorax longispinosus*. All of these species have been collected at

other localities in the state as well. *Pyramica abdita*, *P. pergandei*, *S. impar*, and *T. longispinosus* were previously considered to have more northern distributions, whereas *S. abdita* and *S. silvestrii* were only known to occur in Florida until they were recently discovered to occur in other southeastern states by the MEM.

### **Exotic Species**

Of the 95 species collected at the refuge, only eight are considered to be exotic including *Brachymyrmex patagonicus*, *Cyphomyrmex rimosus*, *Hypoponera opaciceps*, *Linepithema humile*, *Paratrechina vividula*, *Pyramica membranifera*, *Solenopsis invicta x richteri*, and *Strumigenys silvestrii*. All of the introduced species that we collected at the refuge were found in or were very near highly to moderately disturbed areas. Of these species, fire ants had the most obvious presence at the refuge and were found in open disturbed areas in each of the habitats we collected in, but were not found in undisturbed wooded areas. All of the other exotic species were much less abundant. However, both *B. patagonicus* and *L. humile*, both of which are known for their explosive growth potential, should be closely monitored.

*Poecilcrypticus formicophilus* Gebien, an exotic tenebrionid beetle thought to be associated with imported fire ants (MacGown, 2005), was collected in bottomland hardwood forests, pine forests, and in fields. This small distinctive orange and black beetle has become increasing common in recent years, and its distribution appears to follow that of the imported fire ants in the United States.

### **Pest Species**

Fourteen of the species collected are considered to be pest species including *Brachymyrmex patagonicus*, *Camponotus americanus*, *C. castaneus*, *C. chromaoides* (red carpenter ant), *C. decipiens*, *C. pennsylvanicus* (black carpenter ant), *Crematogaster ashmeadi* (acrobat ant), *Lasius alienus*, *Linepithema humile*, *Monomorium minimum* (little black ant), *Paratrechina vividula*, *Solenopsis invicta x richteri*, and *Tapinoma sessile* (odorous house ant). Selected other species that were collected are sometimes considered less important nuisance pests.

## **ACKNOWLEDGMENTS**

Thanks to James G. Lewis for pinning and labeling specimens for this study and for photographing some of the ants. Thanks to Ant Web (<http://antweb.org>) for use of images in figures 49, 59, 65, 84, 85, and 92. This research was supported by state project MIS-311020 of the Mississippi Agricultural and Forestry Experiment Station, the USDA-ARS Areawide Management of Imported Fire Ant Project, and the Noxubee National Wildlife Refuge.

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**Table 1.** Ant species collected at Noxubee National Wildlife Refuge with habitats and sites that each species were collected in. Bottomland hardwood forest (BL), upland hardwood forest (UP), pine forest (PI), mixed pine-hardwood forest (PH), disturbed mixed forest (DF), and field, roadside and sandpit (OA). Exotic species are indicated by a bold capital **E** and new state records are preceded by an asterisk (\*).

Genus/species	BL	UP	PI	PH	DF	OA	Sites
<i>Amblyopone pallipes</i> (Haldeman)	X	X					4, 19, 26, 27
<i>Aphaenogaster carolinensis</i> Wheeler	X	X	X	X	X		2, 4, 6, 8, 9, 10, 11, 14, 17, 18, 21, 23, 25, 26, 27, 29, 34, 36, 37, 38, 39, 42, 43, 46, 50, 51, 52, 53
<i>Aphaenogaster fulva</i> Roger	X	X	X	X	X		1, 2, 4, 8, 9, 11, 13, 14, 17, 21, 25, 26, 27, 29, 30, 32, 34, 37, 39, 40, 45, 46, 50, 51, 52, 53
<i>Aphaenogaster lamellidens</i> Mayr	X	X	X	X	X		1, 2, 6, 11, 12, 13, 20, 26, 42, 46, 47, 50, 51, 52, 53
<i>Aphaenogaster mariae</i> Forel	X	X					2, 4, 10, 26
<i>Aphaenogaster treatae</i> Forel		X	X	X	X		4, 13, 15, 45
<i>Brachymyrmex depilis</i> Emery	X	X	X		X		2, 5, 15, 40, 42, 51
<i>Brachymyrmex patagonicus</i> Mayr <b>E</b>					X	X	5, 15, 16
* <i>Brachymyrmex</i> sp.	X						2
<i>Camponotus americanus</i> Mayr		X	X	X			4, 13, 25, 27, 57
<i>Camponotus caryae</i> (Fitch)	X						26
<i>Camponotus castaneus</i> (Latreille)	X		X	X	X		13, 26, 42, 57
<i>Camponotus chromaiodes</i> Bolton	X	X	X	X	X		2, 9, 13, 14, 26, 43, 51, 53
<i>Camponotus decipiens</i> Emery	X			X		X	2, 16, 54
<i>Camponotus discolor</i> (Buckley)				X			54
<i>Camponotus impressus</i> (Roger)	X						1
<i>Camponotus mississippiensis</i> Smith	X	X		X			3, 17, 53
<i>Camponotus nearcticus</i> Emery	X	X		X			11, 25, 37
<i>Camponotus obliquus</i> Smith			X	X			48, 49
<i>Camponotus pennsylvanicus</i> (DeGeer)	X	X	X	X	X		2, 4, 13, 15, 17, 26, 29, 30, 40, 46, 47, 57
<i>Camponotus snellingi</i> Bolton	X	X	X	X	X		2, 11, 13, 25, 26, 30, 42, 48, 49, 51
<i>Camponotus subbarbatus</i> Emery	X		X	X			2, 26, 49, 50, 52, 57
<i>Crematogaster ashmeadi</i> Mayr	X	X	X	X	X		2, 4, 8, 9, 10, 11, 13, 15, 17, 19, 26, 31, 34, 45, 46, 47, 48, 49, 51, 53, 57
<i>Crematogaster lineolata</i> (Say)	X	X	X	X			2, 4, 18, 20, 25, 27, 30, 44, 52, 57
<i>Crematogaster minutissima</i> Mayr		X		X			4, 25, 27, 57
<i>Crematogaster pilosa</i> Emery	X		X				30, 31, 33
* <i>Crematogaster vermiculata</i> Emery	X						2, 11
<i>Cryptopone gilva</i> (Roger)	X	X	X	X			4, 13, 25, 26, 30, 44

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Genus/species	BL	UP	PI	PH	DF	OA	Sites
<i>Cyphomyrmex rimosus</i> (Spinola) <b>E</b>		X					53
<i>Discothyrea testacea</i> Roger	X	X		X	X		9, 14, 15, 19, 21, 24, 27, 37, 39, 50
<i>Dorymyrmex bureni</i> (Trager)						X	5
<i>Forelius mccookii</i> (McCook)				X	X	X	5, 7, 15, 16, 17, 43, 55
<i>Formica biophilica</i> Trager						X	7
<i>Formica dolosa</i> Buren		X		X		X	5, 17, 27
<i>Formica pallidefulva</i> Latreille	X	X	X	X	X	X	4, 5, 13, 22, 25, 26, 27, 42, 57
<i>Hypoponera inexorata</i> (Wheeler)			X				13
<i>Hypoponera opaciceps</i> (Mayr) <b>E</b>	X				X		40, 41, 47
<i>Hypoponera opacior</i> (Forel)	X	X	X	X	X	X	2, 4, 7, 8, 10, 11, 12, 13, 15, 16, 18, 19, 20, 21, 25, 26, 27, 29, 31, 36, 38, 42, 43, 45, 46, 50, 52, 53, 57
<i>Lasius alienus</i> (Foerster)	X	X	X	X			1, 2, 4, 6, 8, 11, 14, 20, 23, 29, 30, 31, 32, 35, 36, 40, 45, 46, 48, 51, 52, 53
<i>Lasius umbratus</i> (Nylander)	X			X			10, 14, 26
<i>Linepithema humile</i> (Mayr) <b>E</b>					X		15
<i>Monomorium minimum</i> (Buckley)	X		X	X	X	X	2, 7, 8, 13, 15, 16, 17, 18, 30, 33, 34, 42, 43, 45, 47, 49
<i>Myrmecina americana</i> Emery	X	X	X	X	X	X	2, 4, 7, 8, 9, 10, 11, 12, 14, 15, 17, 18, 19, 20, 24, 25, 26, 27, 29, 30, 31, 33, 34, 35, 36, 37, 38, 40, 44, 46, 50, 51, 52, 53, 57
<i>Myrmica pinetorum</i> Wheeler			X				13
<i>Myrmica punctiventris</i> Roger	X	X		X			11, 26, 30, 36, 46, 57
<i>Paratrechina arenivaga</i> (Wheeler)					X		15
<i>Paratrechina faisonensis</i> (Forel)	X	X	X	X	X	X	4, 6, 7, 8, 9, 11, 13, 14, 17, 18, 20, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 39, 40, 46, 50, 51, 52, 53, 56
<i>Paratrechina parvula</i> (Mayr)		X	X				4, 13, 25, 26, 27
<i>Paratrechina vividula</i> (Nylander) <b>E?</b>				X	X	X	5, 8, 15, 16, 47, 55
<i>Pheidole bicarinata</i> Mayr					X	X	15, 16, 22
<i>Pheidole dentata</i> Mayr	X	X	X	X	X		1, 4, 12, 13, 14, 15, 17, 23, 25, 26, 27, 31, 34, 37, 42, 45, 47, 48, 53, 57
<i>Pheidole dentigula</i> Smith	X	X	X	X	X		1, 4, 6, 8, 13, 14, 17, 18, 19, 20, 21, 23, 25, 27, 30, 31, 32, 34, 35, 36, 37, 38, 39, 42, 43, 45, 50, 51, 52, 53, 57
<i>Pheidole metallescens</i> Emery		X	X		X		4, 13, 21, 43
* <i>Pheidole</i> sp. <i>crassicornis</i> group					X		7, 15, 37, 42, 47

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Genus/species	BL	UP	PI	PH	DF	OA	Sites
<i>Pheidole tysoni</i> Forel				X	X	X	15
<i>Ponera exotica</i> Smith	X	X		X			4, 17, 24, 25, 26, 27, 32, 35, 53, 57
<i>Ponera pennsylvanica</i> Buckley	X	X	X	X	X	X	1, 2, 4, 6, 7, 8, 9, 10, 13, 14, 15, 17, 18, 20, 21, 23, 24, 25, 26, 27, 29, 30, 31, 32, 34, 36, 39, 42, 44, 45, 46, 50, 51, 52, 53, 57
<i>Prenolepis imparis</i> (Say)	X	X	X	X	X		1, 2, 4, 8, 10, 12, 13, 15, 21, 25, 26, 29, 30, 36, 39, 42, 44, 47, 49, 51, 52, 53, 57
<i>Proceratium crassicornis</i> (Emery)		X					4, 27
<i>Proceratium croceum</i> (Roger)				X			52
<i>Proceratium pergandei</i> (Emery)	X						2, 29
<i>Proceratium silaceum</i> Roger	X	X	X				4, 13, 20, 26, 29,
<i>Pseudomyrmex ejectus</i> (Smith)	X			X			1, 48
<i>Pseudomyrmex pallidus</i> (Smith)	X						1, 28
* <i>Pyramica abdita</i> (Wesson & Wesson)	X						2
<i>Pyramica angulata</i> (Smith)	X	X		X			4, 25, 26, 27, 30, 37, 46
<i>Pyramica clypeata</i> (Roger)	X	X		X			4, 18, 29, 30, 57
<i>Pyramica creightoni</i> (Smith)		X		X			53, 57
<i>Pyramica dietrichi</i> (Smith)	X	X				X	7, 27, 30
<i>Pyramica hyalina</i> Bolton		X					26 (also 1 older MEM record)
<i>Pyramica laevinasis</i> (Smith)		X					26
<i>Pyramica membranifera</i> (Emery) <b>E</b>					X		15, 41
<i>Pyramica metazytes</i> Bolton			X	X	X		20, 21, 24
<i>Pyramica missouriensis</i> (Smith)		X		X			4, 57
<i>Pyramica ohioensis</i> (Kennedy & Schramm)	X	X		X			6, 8, 14, 18, 29, 46, 53, 57
<i>Pyramica ornata</i> (Mayr)	X	X	X	X			9, 32, 28, 45, 52, 57
* <i>Pyramica pergandei</i> (Emery)	X						36
<i>Pyramica pilinasis</i> (Forel)		X					26
<i>Pyramica pulchella</i> (Emery)	X	X		X			4, 46, 57 also 1 older MEM record)
<i>Pyramica reflexa</i> (Wesson & Wesson)				X			9, 39
<i>Pyramica rostrata</i> (Emery)	X	X	X	X			14, 20, 30, 32, 35, 36, 37, 39, 40, 46, 51, 52, 53, 57
<i>Pyramica talpa</i> (Weber)	X		X	X			29, 33, 57
* <i>Solenopsis abdita</i> Thompson				X			37

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Genus/species	BL	UP	PI	PH	DF	OA	Sites
<i>Solenopsis</i> sp. cf. <i>carolinensis</i> Forel	X	X	X	X	X	X	1, 2, 4, 5, 6, 8, 9, 12, 13, 14, 15, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 30, 31, 32, 33, 34, 35, 36, 38, 39, 40, 42, 43, 44, 45, 46, 50, 51, 52, 53, 57
<i>Solenopsis invicta</i> x <i>richteri</i> <b>E</b>	X	X	X	X	X	X	2, 3, 5, 7, 9, 12, 13, 15, 16, 17, 18, 21, 22, 23, 31, 33, 34, 40, 41, 42, 43, 47, 50, 53, 57
* <i>Solenopsis tennesseensis</i> Smith			X				13, 33
* <i>Stenammina impar</i> Forel	X	X	X	X			4, 8, 11, 12, 46
<i>Strumigenys louisianae</i> Roger	X	X	X	X	X		4, 8, 9, 13, 14, 15, 18, 19, 20, 21, 24, 25, 26, 29, 30, 31, 32, 33, 34, 35, 37, 38, 39, 40, 41, 42, 43, 46, 53, 57
* <i>Strumigenys silvestrii</i> Emery <b>E</b>				X			8
<i>Tapinoma sessile</i> (Say)	X	X				X	2, 7, 26, 40
<i>Temnothorax curvispinosus</i> (Mayr)	X	X	X	X	X		2, 4, 8, 11, 14, 15, 21, 23, 26, 27, 29, 30, 32, 35, 42, 46, 47, 50, 51, 52, 53, 57
* <i>Temnothorax longispinosus</i> (Roger)	X						2
<i>Temnothorax pergandei</i> (Emery)	X	X	X	X			13, 27, 33, 34, 53, 57 (also 1 older MEM record)
<i>Temnothorax schaumii</i> (Roger)	X	X			X		2, 4, 15
<i>Trachymyrmex septentrionalis</i> (McCook)		X	X		X		4, 13, 15, 21, 43
<b>Total Ants per habitat</b>	<b>59</b>	<b>56</b>	<b>43</b>	<b>58</b>	<b>38</b>	<b>19</b>	

**Table 2.** Collecting sites with county names, latitude/longitude coordinates, collecting dates, and habitats.

<b>Sites</b>	<b>County</b>	<b>Lat/Long</b>	<b>Dates</b>	<b>Habitat</b>
1	Oktibbeha	33°17'12"N 88°46'41"W	21-Sep-2007	bottomland hardwood forest
2	Noxubee	33°17'09"N 88°44'34"W	21-Sep-2007	bottomland hardwood forest
2	Noxubee	33°17'09"N 88°44'34"W	22-Apr-2008	bottomland hardwood forest
2	Noxubee	33°17'09"N 88°44'34"W	17-Jul-2008	bottomland hardwood forest
3	Noxubee	33°17'02"N 88°45'19"W	21-Sep-2007	open parking area in bottomland hardwood forest
4	Winston	33°13'45"N 88°54'46"W	28-Sep-2007	upland hardwood forest
4	Winston	33°13'45"N 88°54'46"W	27-Mar-2008	upland hardwood forest
4	Winston	33°13'45"N 88°54'46"W	22-Apr-2008	upland hardwood forest
5	Winston	33°13'55"N 88°54'40"W	28 Sept. 2007	sand/gravel pit
5	Winston	33°13'55"N 88°54'40"W	27-Mar-2008	sand/gravel pit
5	Winston	33°13'55"N 88°54'40"W	22-Apr-2008	sand/gravel pit
5	Winston	33°13'55"N 88°54'40"W	5-Jun-2008	sand/gravel pit
5	Winston	33°13'55"N 88°54'40"W	31-Oct-2008	sand/gravel pit
6	Oktibbeha	33°18'01"N 88°46'31"W	25-Mar-2008	pine-hardwood forest
6	Oktibbeha	33°18'01"N 88°46'31"W	22-Apr-2008	pine-hardwood forest
7	Noxubee	33°15'08"N 88°46'14"W	25-Mar-2008	open field/grassland
7	Noxubee	33°15'08"N 88°46'14"W	5-Jun-2008	open field/grassland
7	Noxubee	33°15'08"N 88°46'14"W	29-Aug-2008	open field/grassland
8	Noxubee	33°15'11"N 88°46'08"W	25-Mar-2008	cedar-hardwood forest
8	Noxubee	33°15'11"N 88°46'08"W	22-Apr-2008	cedar-hardwood forest
9	Noxubee	33°15'13"N 88°46'09"W	5-Jun-2008	cedar-pine forest

**Table 2.** Collecting sites with county names, latitude/longitude coordinates, collecting dates, and habitats.

<b>Sites</b>	<b>County</b>	<b>Lat/Long</b>	<b>Dates</b>	<b>Habitat</b>
10	Oktibbeha	33°17'23"N 88°45'37"W	25-Mar-2008	bottomland hardwood forest
11	Oktibbeha	33°17'58"N 88°52'10"W	3-Apr-2008	cypress slough
12	Oktibbeha	33°18'02"N 88°52'07"W	3-Apr-2008	mature pine forest
13	Noxubee	33°16'38"N 88°47'31"W	17-Apr-2008	mature pine forest-burned
13	Noxubee	33°16'38"N 88°47'31"W	5-Jun-2008	mature pine forest-burned
14	Noxubee	33°16'42"N 88°47'37"W	17-Apr-2008	pine-hardwood forest-unburned
15	Noxubee	33°16'15"N 88°46'59"W	22-Apr-2008	disturbed open pine-hardwood forest nr. HQ
15	Noxubee	33°16'15"N 88°46'59"W	18-Aug-2008	disturbed open pine-hardwood forest nr. HQ
15	Noxubee	33°16'15"N 88°46'59"W	3-Oct-2008	disturbed open pine-hardwood forest nr. HQ
16	Noxubee	33°15'52"N 88°46'47"W	12-May-2008	field
17	Noxubee	33°15'04"N 88°45'02"W	12-May-2008	pine-hardwood forest
17	Noxubee	33°15'04"N 88°45'02"W	31-Jul-2008	pine-hardwood forest
18	Noxubee	33°15'04"N 88°44'51"W	31-Jul-2008	pine-hardwood forest
19	Noxubee	33°16'23"N 88°46'03"W	27-May-2008	bottomland hardwood forest
20	Noxubee	33°16'08"N 88°46'22"W	27-May-2008	pine forest
21	Noxubee	33°15'57"N 88°46'47"W	12-May-2008	at base of <i>Carya</i> sp. in open field
21	Noxubee	33°15'57"N 88°46'47"W	27-May-2008	at base of <i>Carya</i> sp. in open field
22	Noxubee	33°17'11"N 88°46'47"W	27-May-2008	mowed grassy area on lake levee
23	Oktibbeha	33°18'26"N 88°46'57"W	27-May-2008	pine forest
24	Winston	33°13'55"N 88°54'36"W	5-Jun-2008	pine-hardwood forest
25	Winston	33°13'45"N 88°54'45"W	5-Jun-2008	upland hardwood forest
25	Winston	33°13'45"N 88°54'45"W	31-Oct-2008	upland hardwood forest

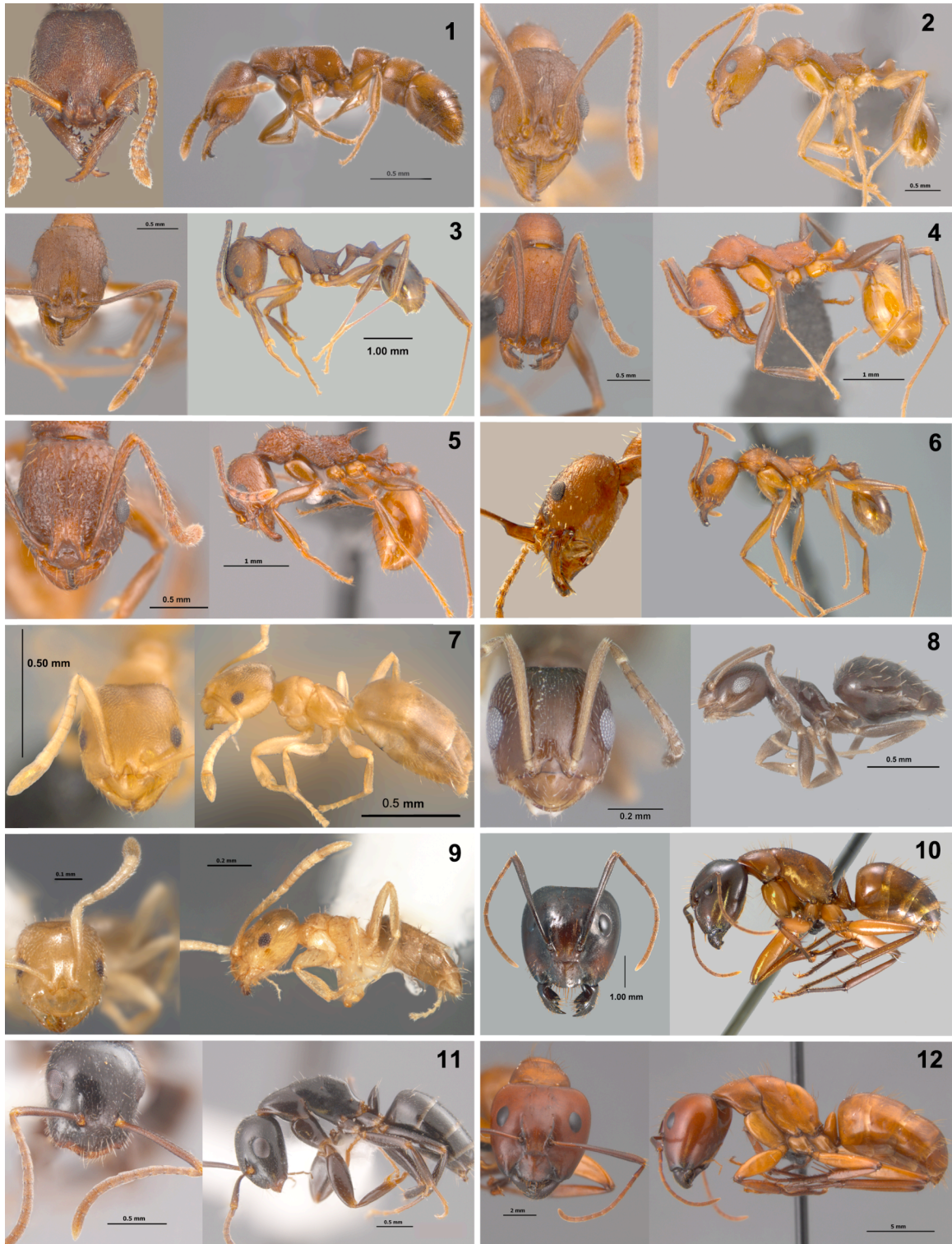
**Table 2.** Collecting sites with county names, latitude/longitude coordinates, collecting dates, and habitats.

<b>Sites</b>	<b>County</b>	<b>Lat/Long</b>	<b>Dates</b>	<b>Habitat</b>
26	Oktibbeha	33°17'44"N 88°51'59"W	12-Jun-2008	cypress slough
27	Winston	33°13'10"N 88°54'47"W	12-Jun-2008	upland hardwood forest
28	Noxubee	33°16'23"N 88°47'25"W	6-Jul-2008	cypress forest
29	Noxubee	33°16'26"N 88°46'36"W	17-Jul-2008	bottomland hardwood forest
29	Noxubee	33°16'26"N 88°46'36"W	24-Jul-2008	bottomland hardwood forest
30	Winston	33°14'54"N 88°49'42"W	24-Jul-2008	bottomland hardwood forest
31	Winston	33°14'23"N 88°49'34"W	24-Jul-2008	mature pine forest-recently burned
32	Noxubee	33°13'56"N 88°48'24"W	24-Jul-2008	pine-hardwood forest
33	Noxubee	33°13'30"N 88°48'33"W	24-Jul-2008	mature pine forest
34	Noxubee	33°13'22"N 88°48'36"W	31-Jul-2008	pine-hardwood forest
35	Winston	33°13'32"N 88°49'15"W	31-Jul-2008	upland hardwood forest
36	Winston	33°15'05"N 88°49'53"W	31-Jul-2008	bottomland hardwood forest
37	Noxubee	33°15'33"N 88°46'18"W	29-Aug-2008	palmetto-cedar thicket in pine-hardwood forest
38	Noxubee	33°15'34"N 88°46'17"W	10-Sep-2008	palmetto-cedar thicket in pine-hardwood forest
39	Noxubee	33°15'13"N 88°46'05"W	9-Sep-2008	cedar-hardwood forest
40	Noxubee	33°16'17"N 88°47'21"W	9-Sep-2008	bottomland hardwood forest
41	Noxubee	33°16'17"N 88°47'17"W	9-Sep-2008	disturbed open pine-hardwood forest
42	Noxubee	33°16'44"N 88°47'24"W	10-Sep-2008	disturbed open pine-hardwood forest
43	Noxubee	33°15'52"N 88°46'50"W	10-Sep-2008	disturbed open pine-hardwood forest
44	Noxubee	33°13'18"N 88°47'27"W	22-Sep-2007	pine-hardwood forest
45	Noxubee	33°13'34"N 88°48'19"W	22-Sep-2007	mature pine forest/red-cockaded woodpecker colony
46	Noxubee	33°14'01"N 88°48'06"W	22-Sep-2007	upland hardwood forest (lower elevation than other upland sites)

**Table 2.** Collecting sites with county names, latitude/longitude coordinates, collecting dates, and habitats.

<b>Sites</b>	<b>County</b>	<b>Lat/Long</b>	<b>Dates</b>	<b>Habitat</b>
47	Noxubee	33°16'14"N 88°46'46"W	22-Sep-2007	disturbed open pine-hardwood forest
48	Winston	33°15'16"N 88°50'11"W	3-Oct-2008	pine-hardwood forest
49	Winston	33°12'48"N 88°49'38"W	3-Oct-2008	pine forest
50	Oktibbeha	33°24'11"N 88°53'33"W	6-Oct-2008	mixed pine-hardwood forest
51	Oktibbeha	33°24'09"N 88°53'34"W	6-Oct-2008	bottomland hardwood forest
52	Oktibbeha	33°21'17"N 88°52'40"W	6-Oct-2008	mixed pine-hardwood forest
53	Oktibbeha	33°20'25"N 88°52'48"W	6-Oct-2008	upland hardwood forest
53	Oktibbeha	33°20'25"N 88°52'48"W	31-Oct-2008	upland hardwood forest
54	Noxubee	33°16'13"N 88°46'43"W	29-Aug-2008	pine-hardwood forest
55	Noxubee	33°16'21"N 88°47'24"W	26-Aug-2008	roadside
56	Noxubee	33°15'10"N 88°46'13"W	29-Aug-2008	grassland
57	Oktibbeha	33°20'45"N 88°54'32"W	2003-2004	pine-hardwood forest (from Hill 2006)

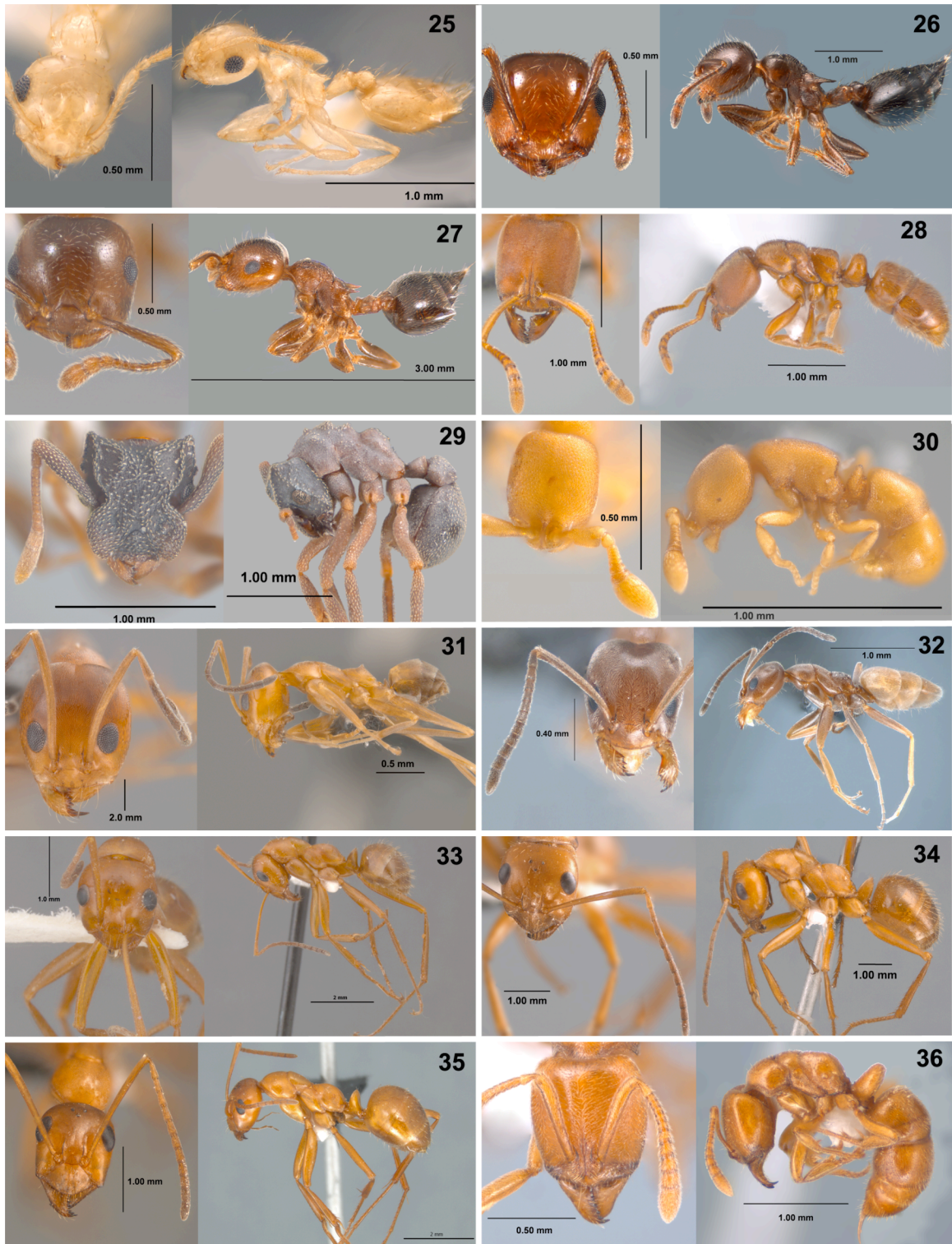




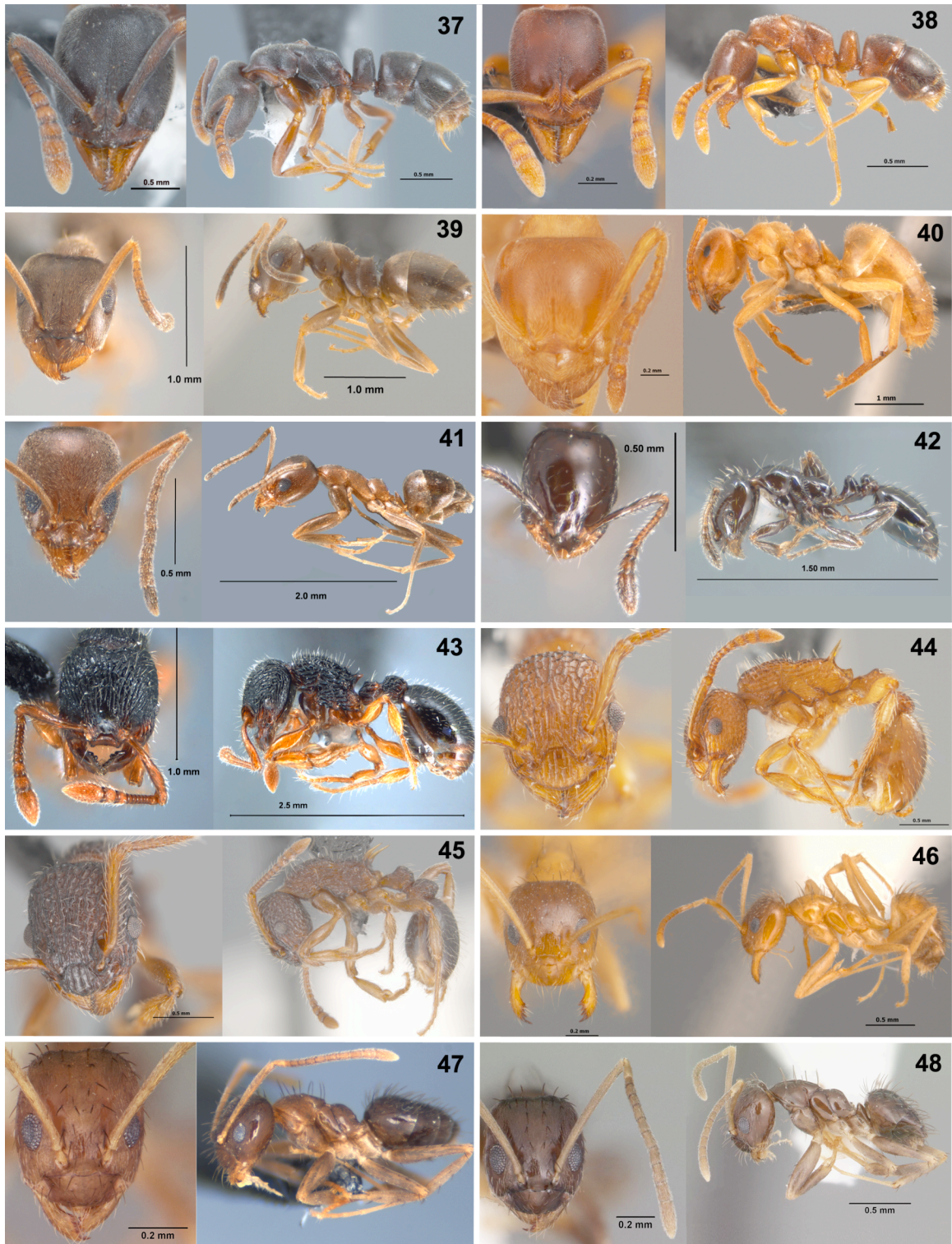
Figures 1-12. Head and profile views of (1) *Amblyopone pallipes*, (2) *Aphaenogaster carolinensis*, (3) *A. fulva*, (4) *A. lamellidens*, (5) *A. mariae*, (6) *A. treatae*, (7) *Brachymyrmex depilis*, (8) *B. patagonicus*, (9) *B. n. sp.*, (10) *Camponotus americanus*, (11) *C. caryae*, and (12) *C. castaneus*.



Figures 13-24. Head and profile views of (13) *Camponotus chromaiodes*, (14) *C. decipiens*, (15) *C. discolor*, (16) *C. impressus*, (17) *C. mississippiensis*, (18) *C. nearcticus*, (19) *C. obliquus*, (20) *C. pennsylvanicus*, (21) *C. snellingi*, (22) *C. subbarbatus*, (23) *Crematogaster ashmeadi*, and (24) *C. lineolata*.



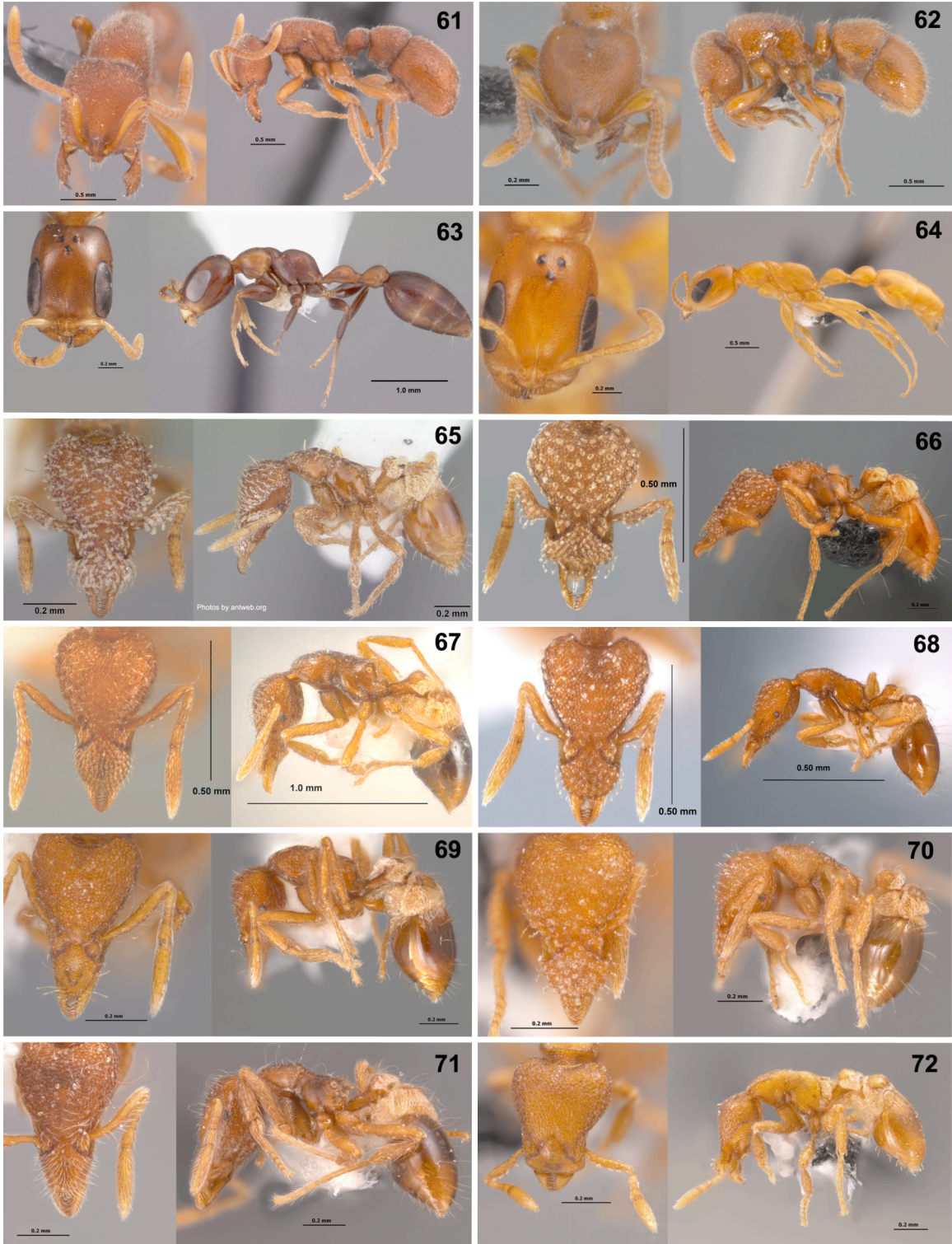
Figures 25-36. Head and profile views of (25) *Crematogaster minutissima*, (26) *C. pilosa*, (27) *C. vermiculata*, (28) *Cryptopone gilva*, (29) *Cyphomyrmex rimosus*, (30) *Discothyrea testacea*, (31) *Dorymyrmex bureni*, (32) *Forelius mccooki*, (33) *Formica biophilica*, (34) *F. dolosa*, (35) *F. pallidefulva*, and (36) *Hypoponera inexorata*.



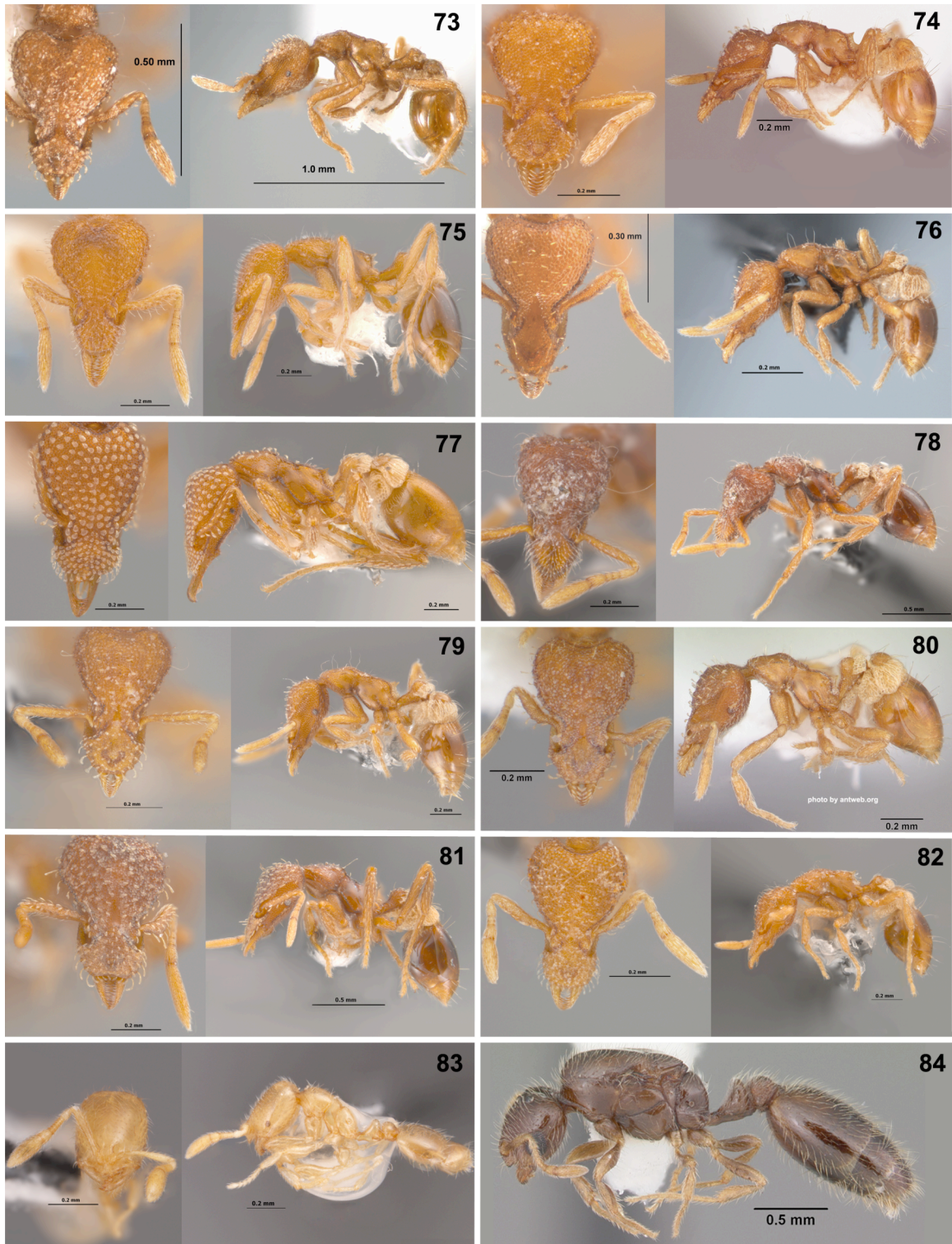
Figures 37-48. Head and profile views of (37) *Hypoponera opaciceps*, (38) *H. opacior*, (39) *Lasius alienus*, (40) *L. umbratus*, (41) *Linepithema humile*, (42) *Monomorium minimum*, (43) *Myrmecina americana*, (44) *Myrmica pinetorum*, (45) *M. punctiventris*, (46) *Paratrechina arenivaga*, (47) *P. faisonensis*, and (48) *P. parvula*.



Figures 49-60. Head and profile views of (49) *Paratrechina vividula*, (50) *Pheidole bicarinata*, (51) *P. dentata*, (52) *P. dentigula*, (53) *P. metallescens*, (54) *P. tysoni*, (55) *P. n. sp.*, (56) *Ponera exotica*, (57) *P. pennsylvanica*, (58) *Prenolepis imparis*, (59) *Proceratium crassicorne*, and (60) *P. croceum*.



Figures 61-72. Head and profile views of (61) *Proceratium pergandei*, (62) *P. silaceum*, (63) *Pseudomyrmex ejectus*, (64) *P. pallidus*, (65) *Pyramica abdita*, (66) *P. angulata*, (67) *P. clypeata*, (68) *P. creightoni*, (69) *P. dietrichi*, (70) *P. hyalina*, (71) *P. laevinasis*, and (72) *P. membranifera*.



Figures 73-84. Head and profile views of (73) *Pyramica metazytes*, (74) *P. missouriensis*, (75) *P. ohioensis*, (76) *P. ornata*, (77) *P. pergandei*, (78) *P. pilinasis*, (79) *P. pulchella*, (80) *P. reflexa*, (81) *P. rostrata*, (82) *P. talpa*, (83) *Solenopsis abdita*, and (84) profile view of queen *S. abdita*.



Figures 85-96. Head and profile views of (85) *Solenopsis* sp. cf. *carolinensis*, (86) *S. invicta* x *richteri*, (87) *S. tennesseensis*, (88) *Stenamma impar*, (89) *Strumigenys louisianae*, (90) *S. silvestrii*, (91) *Tapinoma sessile*, (92) *Temnothorax curvispinosus*, (93) *T. longispinosus*, (94) *T. pergandei*, (95) *T. schaumii*, and (96) *Trachymyrmex septentrionalis*.





Figures 97-105. Habitats at Noxubee NWR: (97) pine forest, (98) pine-hardwood forest, (99) bottomland hardwood forest, (100) cypress slough (subset of bottomland hardwood forest), (101) upland hardwood forest, (102) disturbed, open pine-hardwood forest, (103) managed grassland (Morgan Hill Prairie), and (104) sandpit.

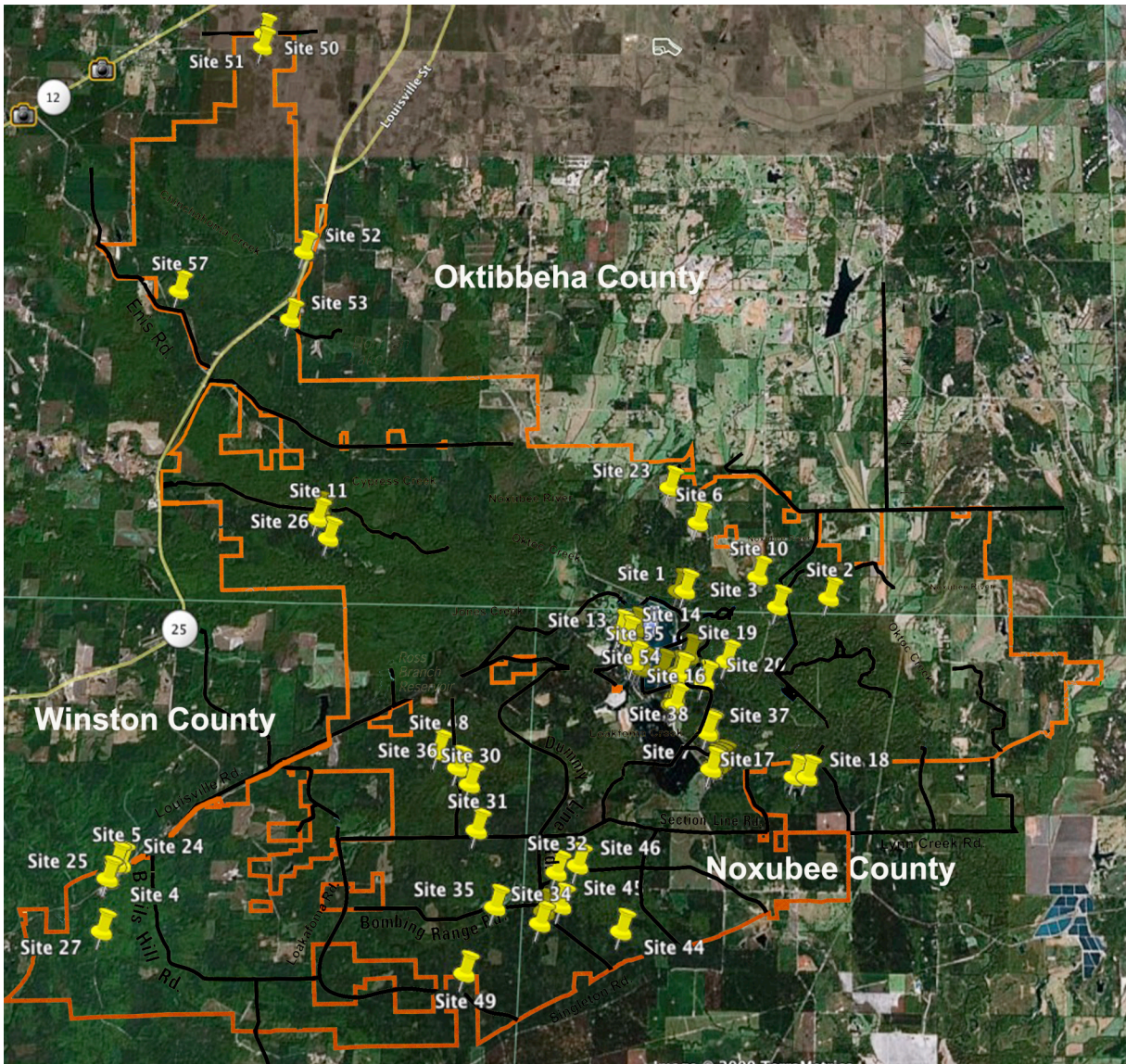


Figure 106. Map showing collecting sites (marked with yellow pins) at the Noxubee NWR with refuge borders in red. (Map modified from Google Earth and United States Fish and Wildlife Service, 2004).