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Ant Diversity at Noxubee National Wildlife Refuge in Oktibbeha, Noxubee, and Winston Counties, Mississippi

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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 September 21, 2007, through October 31, 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, pine/hardwood forests located near buildings and picnic areas. A total of 96 species representing 30 genera in seven subfamilies were collected during the study. Sixty species were collected in bottomland hardwood forests, which represented the highest diversity for all habitats, followed closely by mixed pine/hardwood forests, which had 59 species. Six 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.

Ant Diversity at Noxubee National Wildlife Refuge in Oktibbeha, Noxubee, and Winston Counties, Mississippi

Introduction

The Noxubee National Wildlife Refuge occupies approximately 19,425 hectares in Oktibbeha, Noxubee, and Winston Counties in east-central Mississippi. The refuge is located in the Coastal Plain, primarily in the Flatwoods physiogeographic region, but with some areas in the North Central Plateau and Black Belt regions. The refuge is comprised of three primary habitat types including forests (approximately 18,000 hectares), fields and grasslands (approximately 572 hectares, not including most road and power-line right-of-ways), and wetlands (approximately 574 hectares). Forested areas at the refuge currently include four major types: pine (8,815 hectares), pine/hardwood (1,898 hectares), bottomland hardwood (6,106 hectares), and upland hardwood (1,308 hectares) (Richard Smith, Noxubee NWR Forester, Pers. Comm). Fields and grassland habitats include small grassy areas managed for wildlife, 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 reservoirs, Bluff Lake (324 hectares) and Loakfoma Lake (162 hectares), along with four green tree reservoirs, 16 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 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 (2009a), 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.

Methods

A total of 76 collection events (= samples) were made on 23 days from September 21, 2007, through October 31, 2008, at 56 different sites in Noxubee, Oktibbeha, and Winston Counties (Figure 1, Table 1). Species collected at a pine/hardwood site at the Noxubee National Wildlife Refuge (site 57) in Oktibbeha County during a study by Hill (2006) also are included here. Additionally, some records of ants collected from previous years by MEM staff were included in this study, especially if habitat information was associated with the specimens. 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, 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. Voucher specimens were deposited in the MEM.

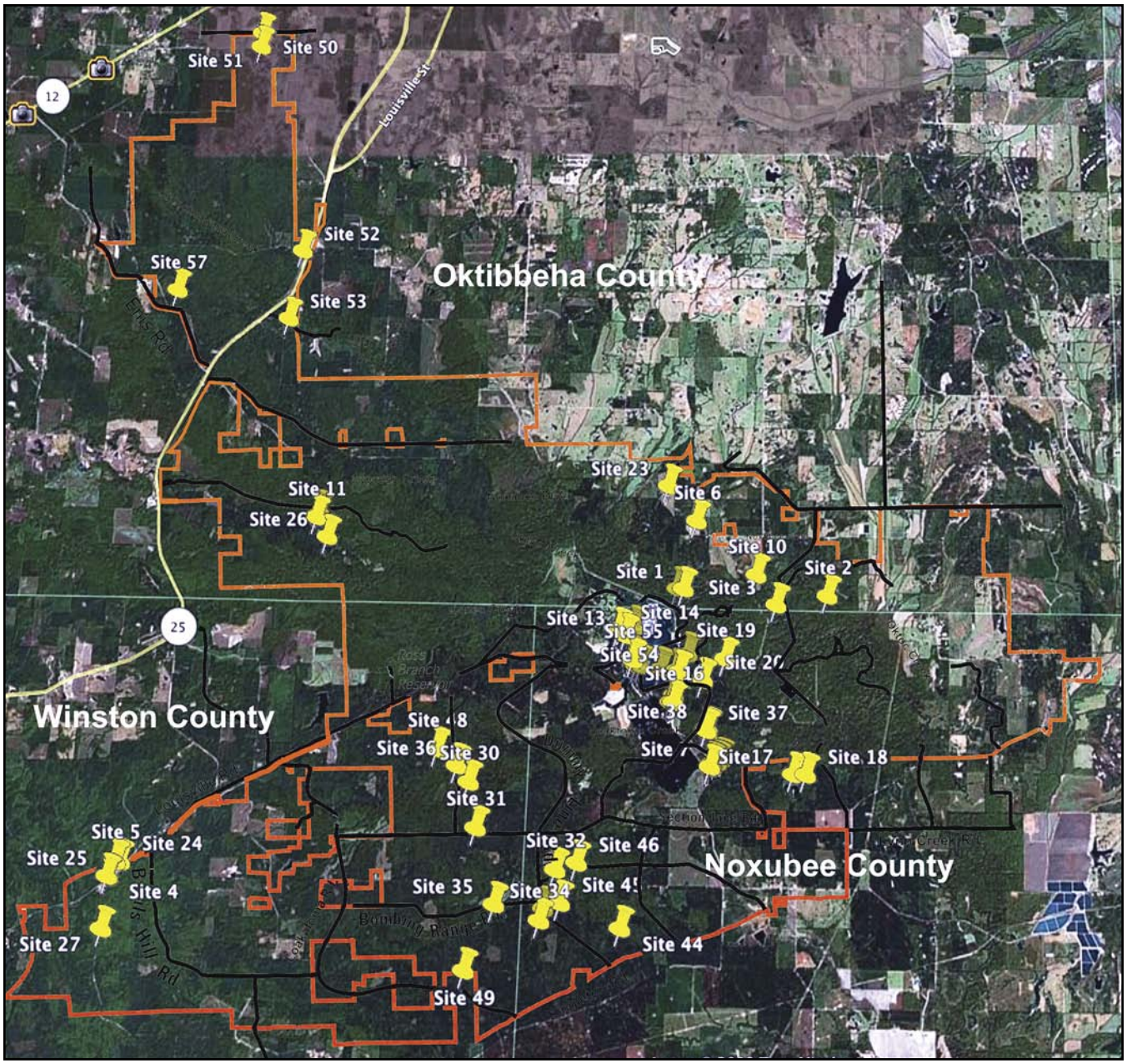


Figure 1. Collecting sites at Noxubee National Wildlife Refuge (outlined in red).

Table 1. List of collecting sites with county names, latitude/longitude coordinates, collecting dates, and brief descriptions of habitats.

Sites	County	Lat/Long	Site Name	Dates	Habitat
1	Oktibbeha	33°17'12"N 88°46'41"W	near edge of Bluff Lake	21-Sep-2007	bottomland hardwood forest
2	Noxubee	33°17'09"N 88°44'34"W	Trail of Big Trees	21-Sep-2007	bottomland hardwood forest
2	Noxubee	33°17'09"N 88°44'34"W	Trail of Big Trees	22-Apr-2008	bottomland hardwood forest
2	Noxubee	33°17'09"N 88°44'34"W	Trail of Big Trees	17-Jul-2008	bottomland hardwood forest
3	Noxubee	33°17'02"N 88°45'19"W	Trail of Big Trees — near parking area	21-Sep-2007	open parking area in bottomland hardwood forest
4	Winston	33°13'45"N 88°54'46"W	Scattertown Trail (south fork)	28-Sep-2007	upland hardwood forest
4	Winston	33°13'45"N 88°54'46"W	Scattertown Trail (south fork)	27-Mar-2008	upland hardwood forest
4	Winston	33°13'45"N 88°54'46"W	Scattertown Trail (south fork)	22-Apr-2008	upland hardwood forest
5	Winston	33°13'55"N 88°54'40"W	sand pit near Scattertown Trail	28 Sept. 2007	sand/gravel pit
5	Winston	33°13'55"N 88°54'40"W	sand pit near Scattertown Trail	27-Mar-2008	sand/gravel pit
5	Winston	33°13'55"N 88°54'40"W	sand pit near Scattertown Trail	22-Apr-2008	sand/gravel pit
5	Winston	33°13'55"N 88°54'40"W	sand pit near Scattertown Trail	5-Jun-2008	sand/gravel pit
5	Winston	33°13'55"N 88°54'40"W	sand pit near Scattertown Trail	31-Oct-2008	sand/gravel pit
6	Oktibbeha	33°18'01"N 88°46'31"W	near entrance to Refuge	25-Mar-2008	pine/hardwood
6	Oktibbeha	33°18'01"N 88°46'31"W	near entrance to Refuge	22-Apr-2008	pine/hardwood
7	Noxubee	33°15'08"N 88°46'14"W	Morgan Hill Overlook	25-Mar-2008	open field/grassland
7	Noxubee	33°15'08"N 88°46'14"W	Morgan Hill Overlook	5-Jun-2008	open field/grassland
7	Noxubee	33°15'08"N 88°46'14"W	Morgan Hill Overlook	29-Aug-2008	open field/grassland
8	Noxubee	33°15'11"N 88°46'08"W	cedar woods across road from Morgan Hill	25-Mar-2008	cedar hardwood forest
8	Noxubee	33°15'11"N 88°46'08"W	cedar woods across road from Morgan Hill	22-Apr-2008	cedar/hardwood forest
9	Noxubee	33°15'13"N 88°46'09"W	cedar woods across road from Morgan Hill	5-Jun-2008	cedar/pine forest
10	Oktibbeha	33°17'23"N 88°45'37"W	Road to trail of big trees	25-Mar-2008	bottomland hardwood forest
11	Oktibbeha	33°17'58"N 88°52'10"W	Pete's Slough	3-Apr-2008	cypress slough
12	Oktibbeha	33°18'02"N 88°52'07"W	Pine forest	3-Apr-2008	mature pine forest
13	Noxubee	33°16'38"N 88°47'31"W	Pine forest (Woodpecker Trail)	17-Apr-2008	mature pine forest-burned
13	Noxubee	33°16'38"N 88°47'31"W	Pine forest (Woodpecker Trail)	5-Jun-2008	mature pine forest-burned
14	Noxubee	33°16'42"N 88°47'37"W	beginning of Woodpecker Trail	17-Apr-2008	pine/hardwood forest-unburned
15	Noxubee	33°16'15"N 88°46'59"W	near Headquarters	22-Apr-2008	disturbed open pine/hardwood forest near HQ
15	Noxubee	33°16'15"N 88°46'59"W	near Headquarters	18-Aug-2008	disturbed open pine/hardwood forest near HQ
15	Noxubee	33°16'15"N 88°46'59"W	near Headquarters	3-Oct-2008	disturbed open pine/hardwood forest near HQ
16	Noxubee	33°15'52"N 88°46'47"W	field near Education Center	12-May-2008	field
17	Noxubee	33°15'04"N 88°45'02"W	White Pond	12-May-2008	pine/hardwood
17	Noxubee	33°15'04"N 88°45'02"W	White Pond	31-Jul-2008	pine/hardwood
18	Noxubee	33°15'04"N 88°44'51"W	White Pond (2nd site)	31-Jul-2008	pine/hardwood forest
19	Noxubee	33°16'23"N 88°46'03"W	near Oktoc Crk., just North of Douglas Bluff Rd.	27-May-2008	bottomland hardwood forest
20	Noxubee	33°16'08"N 88°46'22"W	Douglas Bluff Rd.	27-May-2008	pine forest
21	Noxubee	33°15'57"N 88°46'47"W	near pavilion at Education Center	12-May-2008	at base of Carya sp. in open field
21	Noxubee	33°15'57"N 88°46'47"W	near pavilion at Education Center	27-May-2008	at base of Carya sp. in open field
22	Noxubee	33°17'11"N 88°46'47"W	Bluff Lake Levee	27-May-2008	mowed grassy area on lake levee
23	Oktibbeha	33°18'26"N 88°46'57"W	near entrance to Refuge	27-May-2008	pine forest
24	Winston	33°13'55"N 88°54'36"W	mixed forest east of sandpit	5-Jun-2008	pine/hardwood forest
25	Winston	33°13'45"N 88°54'45"W	Scattertown Trail (north fork)	5-Jun-2008	upland hardwood forest
25	Winston	33°13'45"N 88°54'45"W	Scattertown Trail (north fork)	31-Oct-2008	upland hardwood forest
26	Oktibbeha	33°17'44"N 88°51'59"W	Pete's Slough, near dam	12-Jun-2008	cypress slough
27	Winston	33°13'10"N 88°54'47"W	Bevil Hill Road	12-Jun-2008	upland hardwood forest
28	Noxubee	33°16'23"N 88°47'25"W	Cypress Boat Launch	6-Jul-2008	cypress forest
29	Noxubee	33°16'26"N 88°46'36"W	Beaver Dam Trail	17-Jul-2008	bottomland hardwood forest
29	Noxubee	33°16'26"N 88°46'36"W	Beaver Dam Trail	24-Jul-2008	bottomland hardwood forest
30	Winston	33°14'54"N 88°49'42"W	Dummyline Road	24-Jul-2008	bottomland hardwood forest
31	Winston	33°14'23"N 88°49'34"W	Dummyline Road	24-Jul-2008	mature pine forest-recently burned
32	Noxubee	33°13'56"N 88°48'24"W	Robinson Road	24-Jul-2008	pine/hardwood forest
33	Noxubee	33°13'30"N 88°48'33"W	Williams Road	24-Jul-2008	mature pine forest
34	Noxubee	33°13'22"N 88°48'36"W	Roberson Place Road	31-Jul-2008	pine/hardwood
35	Winston	33°13'32"N 88°49'15"W	Williams Road	31-Jul-2008	upland hardwood forest
36	Winston	33°15'05"N 88°49'53"W	Dummyline Road	31-Jul-2008	bottomland hardwood forest

Table 1 (continued). List of collecting sites with county names, latitude/longitude coordinates, collecting dates, and brief descriptions of habitats.

Sites	County	Lat/Long	Site Name	Dates	Habitat
37	Noxubee	33°15'33"N88°46'18"W	west of Loakfoma Levee	29-Aug-2008	palmetto-cedar thicket in pine/ hardwood forest
38	Noxubee	33°15'34"N88°46'17"W	west of Loakfoma Levee	10-Sep-2008	palmetto-cedar thicket in pine/ hardwood forest
39	Noxubee	33°15'13"N 88°46'05"W	cedar woods across road from Morgan Hill	9-Sep-2008	cedar/hardwood forest
40	Noxubee	33°16'17"N 88°47'21"W	BLHF down the road from office (on other side of road)	9-Sep-2008	bottomland hardwood forest
41	Noxubee	33°16'17"N 88°47'17"W	disturbed woods down the road from office	9-Sep-2008	disturbed open pine/hardwood forest
42	Noxubee	33°16'44"N 88°47'24"W	Residence Area	10-Sep-2008	disturbed open pine/hardwood forest
43	Noxubee	33°15'52"N 88°46'50"W	Education Center	10-Sep-2008	disturbed open pine/hardwood forest
44	Noxubee	33°13'18"N 88°47'27"W	Williams Road	22-Sep-2007	pine/hardwood forest
45	Noxubee	33°13'34"N 88°48'19"W	Williams Road	22-Sep-2007	mature pine forest/red-cockaded woodpecker colony
46	Noxubee	33°14'01"N 88°48'06"W	Section Line Road	22-Sep-2007	upland hardwood forest (lower elevation than other upland sites)
47	Noxubee	33°16'14"N 88°46'46"W	near bathroom across road from Bluff Lake picnic area	22-Sep-2007	disturbed open pine/hardwood forest
48	Winston	33°15'16"N 88°50'11"W	Dummyline Road; beat site 1	3-Oct-2008	pine/hardwood forest
49	Winston	33°12'48"N 88°49'38"W	Dummyline Road; beat site 2	3-Oct-2008	pine forest
50	Oktibbeha	33°24'11"N 88°53'33"W	Longview Road	6-Oct-2008	mixed pine/hardwood forest
51	Oktibbeha	33°24'09"N 88°53'34"W	Longview Road	6-Oct-2008	bottomland hardwood forest
52	Oktibbeha	33°21'17"N 88°52'40"W	Hwy 25 Trail	6-Oct-2008	mixed pine/hardwood forest
53	Oktibbeha	33°20'25"N 88°52'48"W	Dorman Lake Road	6-Oct-2008	upland hardwood forest
53	Oktibbeha	33°20'25"N 88°52'48"W	Dorman Lake Road	31-Oct-2008	upland hardwood forest
54	Noxubee	33°16'13"N 88°46'43"W	near Bluff Lake spillway and bathrooms	29-Aug-2008	pine/hardwood
55	Noxubee	33°16'21"N 88°47'24"W	Doyles Arm	26-Aug-2008	roadside
56	Noxubee	33°15'10"N 88°46'13"W	Morgan Hill Prairie	29-Aug-2008	grassland
57	Oktibbeha	33°20'45"N 88°54'32"W	Hwy. 25, Ennis Road	2003-2004	pine/hardwood forest (from Hill 2007)

Habitat Descriptions

Pine forests of the refuge (Figure 2), 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 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 (Figure 3) 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 (site 8).

Due to the relative flat topography of the area, bottomland forests (Figures 4, 5) at the refuge are extensive. Bald cypress [*Taxodium distichum* (L.)] and water tupelo (*Nyssa aquatica* L.) dominate the areas that are most often inundated with water. A variety of other species such as cherrybark 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 (Figure 6) 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.), and black cherry (*Prunus serotina* Ehrhart) are typical understory species.

Although disturbed, open, forested habitats (pine/hardwood) (Figure 7) 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 be lacking or less abundant 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 (Figure 8) account for only about 3% of the entire refuge. These areas include small forest openings (between 0.4 and 60 hectares each), the Morgan Hill prairie restoration area, and utility rights-of-way. Other open areas include a sand pit (Figure 9) 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 2 years to control growth of woody vegetation, such as eastern red cedar. The sand pit (Figure 9), located in Winston County, is a large sand deposit 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 96 species in 30 genera and seven subfamilies, including six new state records, two apparently undescribed species, and eight exotic species (Table 2, Figures 10-105). This total number of species is more than half of the 185 species that the MEM has documented in the entire state of Mississippi (MacGown, 2009b), some of which are restricted to the coastal region. For its size — 19,425 hectares — the refuge has an ant diversity that is among the highest in eastern North America and compares favorably with other similar studies. Only 12 more species (108 total) (MacGown and Hill, 2009, 2010a) are currently known to occur in the Smoky Mountains National Park, an area that occupies approximately 207,200 hectares (800 square miles) and has been studied extensively. A survey of ants of the Savannah River Plant in South Carolina, which occupies approximately 80,937 hectares, resulted in collection of 89 species during a 2-year period in seven primary habitats (Van Pelt and Gentry, 1985). Seventy-two species were reported from the 16,000-hectare Tombigbee National Forest in Mississippi, which is adjacent to the Noxubee NWR (MacGown and Brown, 2006). Similarly, 72 species were reported from a study of ants in longleaf pine-flatwoods in northern Florida, with a study area of more than 50,000 hectares (Lubertazzi and Tschinkel, 2003). A survey of ants of sand dunes along the Little Ohoopee River in Georgia resulted in collections of 77 species (MacGown et al., 2009), which was quite high considering the study area only totaled approximately 1,200 hectares (the total area of the dunes system is approximately 16,000 hectares). The high species diversity at the Noxubee National Wildlife Refuge is even more remarkable considering that before government ownership in the 1930s and 1940s, much of the land included in the present refuge boundaries was overgrazed by cattle and extensively farmed (United States Fish and Wildlife Service, 2004).

Figures 2–9. Habitats at the Noxubee Refuge: (2) pine forest; (3) pine/hardwood forest; (4) bottomland hardwood forest; (5) cypress slough (subset of bottomland hardwood forest); (6) upland hardwood forest; (7) open, disturbed pine/hardwood forest; (8) managed grassland (Morgan Hill Prairie); and (9) sand pit.

Table 2. Ant species collected at Noxubee National Wildlife Refuge with habitats and sites from which each species were collected.[1]

Genus/species	BL	UP	PI	PH	DF	OA	Sites
Amblyopone pallipes	X	X					4, 19, 26, 27
Aphaenogaster carolinensis	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
Aphaenogaster fulva	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
Aphaenogaster lamellidens	X	X	X	X	X		1, 2, 6, 11, 12, 13, 20, 26, 42, 46, 47, 50, 51, 52, 53
Aphaenogaster mariae	X	X					2, 4, 10, 26
Aphaenogaster treatae		X	X	X	X		4, 13, 15, 45
Brachymyrmex depilis	X	X	X		X		2, 5, 15, 40, 42, 51
Brachymyrmex patagonicus **E**					X	X	5, 15, 16
Brachymyrmex sp.	X						2
Camponotus americanus		X	X	X			4, 13, 25, 27, 57
Camponotus caryae	X						26
Camponotus castaneus	X		X	X	X		13, 26, 42, 57
Camponotus chromaiodes	X	X	X	X	X		2, 9, 13, 14, 26, 43, 51, 53
Camponotus decipiens	X			X		X	2, 16, 54
Camponotus discolor				X			54
Camponotus impressus	X						1
Camponotus mississippiensis	X	X		X			3, 17, 53
Camponotus nearcticus	X	X		X			11, 25, 37
Camponotus obliquus			X	X			48, 49
Camponotus pennsylvanicus	X	X	X	X	X		2, 4, 13, 15, 17, 26, 29, 30, 40, 46, 47, 57
Camponotus snellingi	X	X	X	X	X		2, 11, 13, 25, 26, 30, 42, 48, 49, 51
Camponotus subbarbatus	X		X	X			2, 26, 49, 50, 52, 57
Crematogaster ashmeadi	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
Crematogaster lineolata	X	X	X	X			2, 4, 18, 20, 25, 27, 30, 44, 52, 57
Crematogaster minutissima		X		X			4, 25, 27, 57
Crematogaster pilosa	X		X				30, 31, 33
**Crematogaster vermiculata*	X						2, 11
Cryptopone gilva	X	X	X	X			4, 13, 25, 26, 30, 44
Cyphomyrmex rimosus **E**		X					53
Discothyrea testacea	X	X		X	X		9, 14, 15, 19, 21, 24, 27, 37, 39, 50
Dorymyrmex bureni						X	5
Forelius mccooki				X	X	X	5, 7, 15, 16, 17, 43, 55
Formica biophilica						X	7
Formica dolosa				X		X	5, 17
Formica pallidefulva	X	X	X	X	X	X	4, 5, 13, 22, 25, 26, 27, 42, 57
Hypoponera inexorata			X				13
Hypoponera opaciceps **E**	X				X		40, 41, 47
Hypoponera opacior	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
Lasius alienus	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
Lasius umbratus	X			X			10, 14, 26
Linepithema humile **E**					X		15
Monomorium minimum	X		X	X	X	X	2, 7, 8, 13, 15, 16, 17, 18, 30, 33, 34, 42, 43, 45, 47, 49
Myrmecina americana	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
Myrmica pinetorum			X				13
Myrmica punctiventris	X	X		X			11, 26, 30, 36, 46, 57
Paratrechina arenivaga					X		15
Paratrechina faisonensis	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
Paratrechina parvula		X	X				4, 13, 25, 26, 27
Paratrechina vividula **E?**				X	X	X	5, 8, 15, 16, 47, 55
Pheidole bicarinata					X	X	15, 16, 22
Pheidole dentata	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
Pheidole dentigula	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
Pheidole metallescens		X	X		X		4, 13, 21, 43
Pheidole sp.					X		15
Pheidole tysoni				X	X	X	7, 21, 37, 42, 47, 56

[1]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.

Table 2 (continued). Ant species collected at Noxubee National Wildlife Refuge with habitats and sites from which each species were collected.[1]

Genus/species	BL	UP	PI	PH	DF	OA	Sites
Ponera exotica	X	X		X			4, 17, 24, 25, 26, 27, 32, 35, 53, 57
Ponera pennsylvanica	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
Prenolepis imparis	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
Proceratium crassicorne		X					4, 27
Proceratium croceum				X			52
Proceratium pergandei	X						2, 29
Proceratium silaceum	X	X	X				4, 13, 20, 26, 29,
Pseudomyrmex ejectus	X			X			1, 48
Pseudomyrmex pallidus	X						1, 28
Pyramica abdita	X						2
Pyramica angulata	X	X		X			4, 25, 26, 27, 30, 37, 46
Pyramica clypeata	X	X		X			4, 18, 29, 30, 57
Pyramica creightoni		X		X			53, 57
Pyramica dietrichi	X	X				X	7, 27, 30
Pyramica hyalina		X					26 (also 1 older MEM record)
Pyramica laevinasis		X					26
Pyramica membranifera **E**					X		15, 41
Pyramica metazytes			X	X	X		20, 21, 24
Pyramica missouriensis		X		X			4, 57
Pyramica ohioensis	X	X		X			6, 8, 14, 18, 29, 46, 53, 57
Pyramica ornata	X	X	X	X			9, 32, 28, 45, 52, 57
Pyramica pergandei	X						36
Pyramica pilinasis		X					26
Pyramica pulchella	X	X		X			4, 46, 57 also 1 older MEM record)
Pyramica reflexa				X			9, 39
Pyramica rostrata	X	X	X	X			14, 20, 30, 32, 35, 36, 37, 39, 40, 46, 51, 52, 53, 57
Pyramica talpa	X		X	X			29, 33, 57
**Solenopsis abdita*				X			37
Solenopsis carolinensis	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
Solenopsis invicta x *richteri* **E**	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
Solenopsis picta				X			24
**Solenopsis tennesseensis*			X				13, 33
**Stenamma impar*	X	X	X	X			4, 8, 11, 12, 46
Strumigenys louisianae	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
Strumigenys silvestrii* **E				X			8
Tapinoma sessile	X	X				X	2, 7, 26, 40
Temnothorax curvispinosus	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
**Temnothorax longispinosus*	X						2
Temnothorax pergandei	X	X	X	X			13, 27, 33, 34, 53, 57 (also 1 older MEM record)
Temnothorax schaumii	X	X			X		2, 4, 15
Trachymyrmex septentrionalis		X	X		X		4, 13, 15, 21, 43
Total Ants per habitat	60	54	43	59	38	19	

[1]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.

Habitat/Ant Species Associations

Pine Forests

The 43 species of ants collected in pine forests represented the lowest species diversity of the natural forested habitats. Pine forests at the Noxubee Refuge are regularly burned, which greatly reduces the understory vegetation and leaf litter. Thus, it is likely that litter dwelling species are adversely affected, although some of these species may survive at the peripheries of burned areas. Our collections appeared to confirm that some litter inhabiting species may be limited in burned areas, as we collected only four of the soil- and litter-dwelling dacetine species (the most speciose group in Mississippi) in pine forests.

In general, pine forests were dominated by relatively common species such as *Aphaenogaster* spp., *Camponotus* spp., *Crematogaster* spp. (especially *C. ashmeadi* Mayr), *Hypoponera opacior* Forel, *Monomorium minimum* Buckley, *Nylanderia faisonensis* Forel, *Pheidole* spp., *Ponera pennsylvanica* Buckley, *Solenopsis 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. and *Camponotus* spp., as well as extremely high numbers of *Crematogaster ashmeadi* in the pine forests, suggests that a plentiful supply of food was available in this preferred habitat of the red-cockaded woodpecker, *Picoides borealis*, which is known to consume large quantities of ants, especially *C. ashmeadi* (Hess and James, 1998). Random sampling on pine trees in pine forests revealed 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. 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 numbers 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), but they have not been reported to have adverse effects on red-cockaded woodpecker populations.

Despite the relatively low diversity of ants in this habitat, three species, *Hypoponera inexorata* (Wheeler), *Myrmica pinetorum* (Wheeler), and *Solenopsis tennesseensis* Smith, were collected only in pine forests. Of these, *S. tennesseensis* was the most surprising, as we typically have collected this species only along the Gulf Coast and inland sand dune habitats. *Myrmica pinetorum* is often associated with open pine forests, although it is also found in other open woodland habitats. *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 comprises only a small fraction of the Noxubee Refuge, the 59 species collected there represent the second highest species total for the different habitats at the refuge. The 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 variation, which in turn may result in higher 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 tribe Dacetini, with 13 species found, followed by 11 species of *Camponotus*. However, the most common ants in pine/hardwoods (ants collected at most sites) were *Aphaenogaster carolinensis* Wheeler, *A. fulva* Roger, *Crematogaster ashmeadi, Hypoponera opacior, Monomorium minimum, Myrmecina americana, Nylanderia faisonensis, Pheidole dentata* Mayr, *P. dentigula* Smith, *Ponera pennsylvanica, Solenopsis carolinensis*, *Solenopsis invicta* x *richteri,* and *Strumigenys louisianae* Roger.

Six species were collected only in pine/hardwood forests, including *Camponotus caryae* Fitch, *Proceratium croceum* Roger, *Pyramica reflexa* (Wesson and Wesson), *Solenopsis abdita* Thompson, *S. picta* Emery,

and *Strumigenys silvestrii* Emery. *Solenopsis abdita* and *Strumigenys silvestrii* represent new state records for Mississippi. *Pyramica reflexa* was only reported for the first time for Mississippi in 2006 (MacGown and Brown, 2006). Although *Solenopsis picta* was collected only in this habitat, it likely occurs in other wooded habitats because it is a common arboreal species that nests in a variety of plants. Only three exotic species were collected in pine/hardwoods, including *Strumigenys silvestrii* (native to South America), *Nylanderia vividula* (Nylander) (thought to be native to Mexico), and *Solenopsis invicta* x *richteri*. *Strumigenys silvestrii* and *N. vividula* were collected at only one locality — an area intermixed with cedars that showed signs of past disturbance. *Solenopsis invicta* x *richteri* was abundant in open areas and along edges of the habitat.

Bottomland Hardwood Forests

It may seem counterintuitive that we found the highest species diversity (60 species) in bottomland forests, because the environmental stresses of periodic flooding would have obvious negative effects on soil-dwelling species. In areas that are repeatedly 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 piled litter, numerous 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.

Despite the improbability of finding soil- and litter-nesting species in flooded areas, 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* Emery 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 forests. Several of the dacetines from this habitat are rarely collected species. *Pyramica abdita* (Wesson and Wesson) and *P. pergandei* (Emery) were reported as new state records for Mississippi in 2010 (MacGown and Hill, 2010), and *Discothyrea testacea* Roger was reported for Mississippi in 2006 (MacGown and Brown, 2006). Workers of an apparently undescribed yellow colored *Brachymyrmex* species were collected at one site. They are similar to other specimens 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.

Not surprisingly, we collected a high percentage of arboreal and rotting wood specialists (27 species). The highest diversity in wood-nesting species was found in *Camponotus* with 10 species. Notable arboreal species included *Aphaenogaster mariae* Forel, which was 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 another new record for the state, *Crematogaster vermiculata* Emery, which nests in cypress trees.

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 1,295 hectares at the Noxubee Refuge, they provide important habitat for many ant species, as illustrated by the 54 species that we collected there. The elevated sloped forests with sandy soils and deep litter layers provide good drainage for soil-nesting species, and unlike ants found in bottomland forests, most of the species collected in upland hardwood forests typically nest in the soil and/or litter.

Based on their 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, *Hypoponera opacior, Myrmecina americana, Nylanderia faisonensis, N. parvula, Pheidole dentata, P. dentigula, Ponera exotica* Smith, *P. pennsylvanica, Prenolepis imparis* (Say), *Pyramica angulata* (Smith), *P. ornata* (Mayr), *Solenopsis carolinensis, Strumigenys louisianae, Temnothorax curvispinosus* (Mayr), and *Trachymyrmex septentrionalis* (McCook).

Three species were collected only in upland hardwood forests: *Proceratium crassicorne* Emery, *Pyramica laevinasis* (Smith), and *Pyramica hyalina* Bolton. *Pyramica hyalina* is a rarely collected species that was described in 2000 (Bolton, 2000) from seven specimens, one of which was collected at the Noxubee Refuge (habitat not recorded). Other rarely collected species were *Aphaenogaster mariae*, *Discothyrea testacea,* and *Pyramica missouriensis* (Smith). Four 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 *N. parvula, Ponera exotica*, *Pyramica angulata,* and *T. septentrionalis*. Only two exotic species, *Cyphomyrmex rimosus* Mayr (native to Neotropics) and *Solenopsis invicta* x *richteri*, were collected. *Cyphomyrmex rimosus* was collected at only one site, which was at the border of the refuge and the Mississippi State University John Starr Memorial Forest. 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

Diversity in disturbed, open, pine/hardwood forests was relatively low, with only 38 species collected, compared with a higher number of species in other wooded habitats at the Noxubee Refuge. Similarly, we have found that other areas in the Southeast that are highly disturbed tend to have less overall diversity but higher numbers and abundance of introduced species (MacGown and Hill, personal observations). 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), *Hypoponera opaciceps*, *Linepithema humile* (Argentine ant), *Nylanderia 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 ornamental plants, and it 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., 2007a). 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 environmental 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 *Nylanderia 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 it also had several uncommon ant species present including the rarely collected *Pyramica metazytes*.

Fields, Grasslands, and Sand Pit

Open habitats, especially non-sandy ones, are not known to support high diversity of ant species. This is due in part to the lack of physical structure (i.e., vegetative structure, woody debris, etc.) and because high

temperatures during warm seasons 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 in a revision of the group by Trager et al. (2007). Three exotic species were found in the open habitats including *B. patagonicus, N. 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 (88) and relatively few exotic species (eight) collected at the Noxubee 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 the proportion of native species to exotic ones to be high. Bottomland hardwood forests were the most diverse habitat in which we collected, with 60 species, followed by mixed pine/hardwood forests (59), upland hardwood forests (54), pine forests (43), disturbed mixed forests (38), and fields, grasslands, and mowed roadsides (19). Seventy-one of the species collected at the refuge primarily nest in the soil or leaf litter, whereas 25 species nest either in rotting wood or arboreally.

Similar to Mississippi and the Southeast in general, the highest diversity at the refuge was seen in the tribe Dacetini with 20 species represented (18 *Pyramica,* two *Strumigenys*), which is only nine less than the total known to occur in the entire state (MacGown et al., 2005; MacGown and Hill, 2010b) and almost half of the 42 species known to occur in the entire Southeast (MacGown, 2009b). Because dacetine ants are minute, cryptic, soil- and litter-inhabiting ants, they are uncommonly collected, and additional species that we did not collect may be present 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 three less than the total known from the entire state (MacGown et al., 2007b; MacGown, unpublished data). However, unlike our finding with the dacetines, we feel more confident that all possible species in this region were collected at the refuge. The only three species we did not find have more southern distributions and are only found in areas of deep sand.

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, five 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 in four habitats, and 13 species in five habitats. Only seven species were found in all of the primary habitats that we collected. Species that showed the least habitat preference were *Formica pallidefulva, Hypoponera opacior, Myrmecina americana, Nylanderia faisonensis, Ponera pennsylvanica, Solenopsis 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 (Hill, 2009).

New State Records

Six of the species that we collected at the Noxubee Refuge have not been reported to occur in Mississippi and represent new state records: *Crematogaster vermiculata, 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, but these findings have not yet been published. *Stenamma 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 96 species collected at the Noxubee Refuge, only eight are considered to be exotic, including *Brachymyrmex patagonicus*, *Cyphomyrmex rimosus*, *Hypoponera opaciceps, Linepithema humile*, *Nylanderia 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 near highly to moderately disturbed areas. Of these species, imported 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 they were not found in undisturbed wooded areas. All of the other exotic species were found to be much less abundant. However, both *B. patagonicus* and *L. humile*, both of which are known for their explosive growth potential, should be closely monitored.

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

Pest Species

Fourteen 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), *Nylanderia vividula, Solenopsis invicta* x *richteri,* and *Tapinoma sessile* (odorous house ant). Several other species that were collected are sometimes considered less important nuisance pests.

List of the Ants at the Noxubee Refuge

This list is arranged by subfamily and genus according to Bolton et al. (2006) and Brady et al. (2006). Names follow Fisher and Cover 2007, except for *Nylanderia*, which follows LaPolla et al. (2010). Exotic species, pest species, and new state records are noted, and habitats and collecting sites are given. Habitat types are abbreviated as follows: bottomland hardwood forest (BL), upland hardwood forest (UP), pine forest (PI), mixed pine/hardwood forest (PH), disturbed mixed forest (DF), and field, roadside and sand pit (OA).

SUBFAMILY DOLICHODERINAE
Tribe Dolichoderini

***Dorymyrmex bureni* (Trager). Yellow pyramid ant. (Figure 10).** This medium-sized, fast-moving, yellow species nests in open, somewhat sandy areas, including roadsides, and is active during the day. This species often litters the edges of nest mounds with the bodies of imported fire ants. OA. Site 5.

***Forelius mccooki* (McCook). (Figure 11).** This small, fast-moving, reddish-brown species is active during the day and nests in soil on roadsides, trails (especially on ridges), and other open areas. PH, DF, and OA. Sites 5, 7, 15, 16, 17, 43, and 55.

***Linepithema humile* (Mayr). Argentine ant. (Figure 12).** (Introduced, pest). This dark-brown species, considered to be one of our most serious pests, was found only near the refuge headquarters in a landscaped area. It was likely introduced to the refuge in mulch brought in for landscaping around buildings and flowerbeds. DF. Site 15.

***Tapinoma sessile* (Say). Odorous house ant. (Fig 13)** (Pest). This small brown ant is a common pest species that frequently enters human constructed structures. We found colonies of this species in soil along the banks of the Noxubee River and in open grassland habitat at the Morgan Hill Overlook. BL, UP, and OA. Sites 2, 7, 26, and 40.

SUBFAMILY FORMICINAE
Tribe Lasiini

***Lasius alienus* (Foerster). The cornfield ant. (Figure 14).** This small, dark-brown species occurs in a variety of habitats where it nests in soil and rotting logs and stumps. We found abundant colonies in bottomland forests. In areas of frequent flooding, colonies in the soil were in higher locations or in elevated wood. BL, UP, PI, and PH. Sites 1, 2, 4, 6, 8, 11, 14, 20, 23, 29, 30, 31, 32, 35, 36, 40, 45, 46, 48, 51, 52, and 53.

***Lasius umbratus* (Nylander). (Fig 15).** This yellow-colored species nests in rotting wood, usually in moist forests and swampy areas. It is a temporary parasite of *L. alienus* (Wheeler, 1905). BL and PH. Sites 10, 14, and 26.

***Nylanderia arenivaga* (Wheeler). (Figure 16).** This nocturnal, pale-yellow species nests in areas with sandy soils. We collected this species only at a disturbed open area beneath some hardwood trees near the refuge headquarters, although it may occur in other areas such as sandy areas near creeks. DF. Site 15.

***Nylanderia faisonensis* (Forel). (Figure 17).** This small brown species is very common in wooded areas and is occasionally found beneath grass clumps in open areas. BL, UP, PI, PH, DF, and OA. Sites 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.

***Nylanderia parvula* (Mayr). (Figure 18).** This small, brownish-black species is less common than *N. faisonensis,* and appears to be restricted to higher, more xeric wooded sites where it nests in leaf litter. UP and PI. Sites 4, 13, 25, 26, and 27.

***Nylanderia vividula* (Nylander) (Figure 19).** (Introduced?, pest). This species is thought to be native to Mexico, although some scientists have considered it to be native to the U.S. Colonies can usually be found in the soil in open, disturbed areas. Foraging workers frequently enter structures. PH, DF, and OA. Sites 5, 8, 15, 16, 47, and 55.

***Prenolepis imparis* (Say). False honey ant. (Figure 20).** This long-legged species is most common in wooded areas during the cooler times of year. BL, UP, PI, PH, and DF. Sites 1, 2, 4, 8, 10, 12, 13, 15, 21, 25, 26, 29, 30, 36, 39, 42, 44, 47, 49, 51, 52, 53, and 57.

Tribe Plagiolepidini

***Brachymyrmex depilis* Emery. (Figure 21).** This minute, pale-colored species is a common inhabitant of leaf litter and soil in forested areas, although

it also occurs in open habitats. BL, UP, PN, and DF. Sites 2, 5, 15, 40, 42, and 51.

***Brachymyrmex patagonicus* Mayr. (Fig 22).** (Introduced, pest). This minute, dark-brown ant is an exotic species native to Argentina. In the last 30 years, it has become well established in the Southeast and is now considered a serious nuisance pest (MacGown et al., 2007b). It was likely introduced to the Noxubee Refuge in mulch and dirt/gravel**.** DF and OA. Sites 5, 15, and 16.

***Brachymyrmex* sp. (Figure 23).** This minute, yellow species was only collected in soil and leaf litter in bottomland forest habitat. It is very similar in appearance to *B. depilis*, but it differs in its possession of thickened erect setae on the alitrunk. It does not appear to match other known *Brachymyrmex* species, and it may represent an undescribed species. BL. Site 2.

Tribe Camponotini

***Camponotus americanus* Mayr. (Figure 24).** (Pest). This large, reddish-brown carpenter ant with a blackish-colored head typically nests in soil and less frequently in rotting logs in somewhat xeric forests. UP, PN, and PH. Sites 4, 13, 25, 27, and 57.

***Camponotus caryae* (Fitch). (Figure 25).** This smallish, dark brown species typically nests arboreally in limbs; consequently, it tends to be undercollected. However, it is likely abundant in most forests containing hardwoods. BL. Site 26.

***Camponotus castaneus* (Latreille). (Figure 26).** (Pest). This large, concolorous, orangish-red species nests in soil and rotting wood. It is considered an occasional pest because it nests in wood of structures. BL, PI, PH, and DF. Sites 13, 26, 42, and 57.

***Camponotus chromaiodes* Bolton. Red carpenter ant. (Figure 27).** (Pest). This large species varies in coloration from almost entirely black to bicolored red and black. This species typically nests in soil or in rotting wood adjacent to soil, but colonies are occasionally found in dry wood. It is active both diurnally and nocturnally in wooded areas. BL, UP, PI, PH, and DF. Sites 2, 9, 13, 14, 26, 43, 51, and 53.

***Camponotus decipiens* Emery. (Figure 28).** (Pest). This small, red and black carpenter ant nests in cavities of trees and branches, in seedpods, and other similar microhabitats. This species was collected at only three localities, but it is probably common in all wooded habitats at the Noxubee Refuge. BL, PH, and OA. Sites 2, 16, and 54.

***Camponotus discolor* (Buckley). (Figure 29).** (Occasional pest). This red-and-black carpenter ant is collected infrequently. It nests in cavities of trees, seedpods, branches, and other microhabitats. PH. Site 54.

***Camponotus impressus* (Roger). (Figure 30).** This small species nests in hollow twigs, galls, and other cavities. Similar to other arboreal species, this one is often undercollected, and it is likely common in wooded habitats. This species and others in the subgenus *Colobopsis* are atypical for the genus in that the heads of major workers and queens are truncate and apparently modified for blocking entrance holes to colonies. BL. Site 1.

***Camponotus mississippiensis* Smith. (Figure 31).** This is a common, small, arboreal species that nests in hollow twigs of live ash trees (*Fraxinus* sp.). A member of the subgenus *Colobopsis*, it also is characterized by the truncate head. BL, UP, and PH. Sites 3, 17, and 53.

***Camponotus nearcticus* Emery. (Figure 32).** A small, dark-brown to black species that nests in hollow twigs and branches. BL, UP, and PH. Sites 11, 25, and 37.

***Camponotus obliquus* Smith. (Figure 33).** This small species is rarely collected, but it is probably more common than indicated by numbers of collected specimens. It nests in hollow twigs, vines, and possibly other similar places, and it has a truncate head, typical of other species of the subgenus *Colobopsis*. PI and PH. Sites 48 and 49.

***Camponotus pennsylvanicus* (DeGeer). The black carpenter ant. (Figure 34).** (Pest). This large, black carpenter ant nests in wood and is considered a serious pest because it may infest man-made structures. It is active both diurnally and nocturnally in wooded areas, and is a frequent visitor in picnic areas. BL, UP, PI, PH, and DF. Sites 2, 4, 13, 15, 17, 26, 29, 30, 40, 46, 47, 57.

***Camponotus snellingi* Bolton. (Figure 35).** This is a common, bicolored species that nests in rotting wood or under bark of dead trees. BL, UP, PI, PH, and DF. Sites 2, 11, 13, 25, 26, 30, 42, 48, 49, and 51.

***Camponotus subbarbatus* Emery. (Figure 36).** This small, bicolored species with a striped gaster nests in rotting wood, twigs, and vines. BL, PI, and PH. Sites 2, 26, 49, 50, 52, and 57.

Tribe Formicini

Formica biophilica **Trager. (Figure 37).** This fast-moving, long-legged, orangish-brown species is usually found in somewhat mesic open habitats such as fields, prairies, lawns, and open woodlands where it nests in the soil. OA. Site 7.

Formica dolosa **Buren. (Figure 38).** This fast-moving, long-legged, orangish-brown species is found in open grassy areas and open mixed forests where it nests in the soil, occasionally with large mounds. This species is the host of the slave-making ant *Polyergus longicornis* Smith, which was not collected at the Noxubee Refuge, but has been collected in the adjacent Tombigbee National Forest and is likely also present at the refuge (MacGown and Brown, 2006). PH and OA. Sites 5 and 17.

Formica pallidefulva **Latreille. (Figure 39).** This is a common woodland species that also strays into open habitats. We collected it in all of the major habitats at the refuge. BL, UP, PI, PH, DF, and OA. Sites 4, 5, 13, 22, 25, 26, 27, 42, and 57.

SUBFAMILY PSEUDOMYRMECINAE
Tribe Pseudomyrmecini

Pseudomyrmex ejectus **(Smith). (Figure 40).** (Pest?). This dark-brown, large-eyed, elongate species nests in hollow twigs, reeds, or other cavities. It becomes less common farther north in the state. BL and PH. Sites 1 and 48.

Pseudomyrmex pallidus **(Smith). (Figure 41).** (Pest?). This elongate, large-eyed, yellow species nests in grass culms, hollow twigs and vines, and other cavities. This species has a large stinger and can inflict a fairly painful sting. BL. Sites 1 and 28.

SUBFAMILY AMBLYOPONINAE
Tribe Amblyoponini

Amblyopone pallipes **(Haldeman). (Figure 42).** This is a relatively common species that nests in and under rotting wood and in leaf litter at bases of trees. This dark-brown, elongate species has large mandibles with bidentate teeth. BL and UP. Sites 4, 19, 26, and 27.

SUBFAMILY PONERINAE
Tribe Ponerini

Cryptopone gilva **(Roger). (Figure 43).** This orangish-brown ant is uncommonly collected. It nests in moist rotting logs and litter at bases of trees in wooded habitats. BL, UP, PI, and PH. Sites 4, 13, 25, 26, 30, and 44.

Hypoponera inexorata **(Wheeler). (Figure 44).** This species is bright orangish-brown and has sinuate mandibles. It nests in soil in open woods or grasslands. PI. Site 13.

Hypoponera opaciceps **(Mayr). (Figure 45).** (Introduced). This dark-brown, introduced species nests in the soil, rotting wood, mulch, or leaf litter in disturbed areas, and it can be found near buildings. BL and DF. Sites 40, 41, and 47.

Hypoponera opacior **(Forel). (Figure 46).** This small, brown species nests in soil, leaf litter, and rotting wood. This is a very common ant that is found in all habitats at the Noxubee Refuge. BL, UP, PI, PH, DF, and OA. Sites 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, and 57.

Ponera exotica **Smith. (Figure 47).** This minute, pale yellowish-brown species nests in leaf litter. This species was especially common in upland sites. BL, UP, and PH. Sites 4, 17, 24, 25, 26, 27, 32, 35, 53, and 57.

Ponera pennsylvanica **Buckley. (Figure 48).** This dark brownish-black species is very common in woodland habitats where it nests in rotting logs and stumps, in acorns, soil, and leaf litter. BL, UP, PI, PH, DF, and OA. 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, and 57.

SUBFAMILY PROCERATIINAE
Tribe Proceratiini

Discothyrea testacea **Roger. (Figure 49).** This minute, yellow ant with clubbed antennae nests in leaf litter, humus, and rotting logs. BL, UP, PH, and DF. Sites 9, 14, 15, 19, 21, 24, 27, 37, 39, and 50.

Proceratium crassicorne **Emery. (Figure 50).** This reddish-brown species is somewhat uncommon and nests in rotting wood and leaf litter. UP. Sites 4 and 27.

Proceratium croceum **(Roger). (Figure 51).** This reddish-brown species nests in rotting wood and leaf litter. PH. Site 52.

Proceratium pergandei **(Emery). (Fig 52).** This reddish-brown species nests in rotting wood and leaf litter. BL. Sites 2 and 29.

Proceratium silaceum **Roger. (Fig 53).** This relatively small, reddish-brown species is fairly common and nests in rotting wood and leaf litter. BL. Sites 4, 13, 20, 26, and 29.

SUBFAMILY MYRMICINAE
Tribe Dacetini

***Pyramica abdita* (Wesson & Wesson). (Figure 54).** One specimen of this minute species was collected in litter in bottomland hardwood forest habitat. Typically, this is considered to be a more northern species. BL. Site 2.

***Pyramica angulata* (Smith). (Figure 55).** Considered rare in most areas, this species is commonly collected in mixed pine/hardwood and hardwood forests in this region, especially in litter in upland hardwood sites. With its elongate mandibles and squared clypeus, it is very distinctive. BL, UP, and PH. Sites 4, 25, 26, 27, 30, 37, and 46.

***Pyramica clypeata* (Roger). (Figure 56).** This is a relatively common dacetine ant that we find in wooded habitats throughout the state. BL, UP, and PH. Sites 4, 18, 29, 30, and 57.

***Pyramica creightoni* (Smith). (Figure 57).** We collected this species only in litter in relatively xeric woodlands, although it has also been collected in the Black Belt Prairie habitat in this region. BL and PH. Sites 53 and 57.

***Pyramica dietrichi* (Smith). (Figure 58).** This species is fairly common and is found in litter in wooded habitats and grass clumps in open grassy habitats. This species often is found with the related *P. ornata* in leaf litter samples. BL, UP, and OA. Sites 7, 27, and 30.

***Pyramica hyalina* Bolton. (Figure 59).** This species is known from only a few specimens, and the type series included a specimen collected by R.L. Brown from the Noxubee Refuge. Based on the recent collection of this species at the refuge and two other specimens collected in the Mississippi Delta, this species appears to be associated with bottomland hardwood habitat. BL and UP (?). Site 26 and an unnumbered site (where the R.L. Brown specimen was collected).

***Pyramica laevinasis* (Smith). (Figure 60).** This species has been rarely collected in the state, and we found it only at one upland site at the refuge. UP. Site 26.

***Pyramica membranifera* (Emery). (Fig 61).** (Introduced). This exotic species has become well established in disturbed habitats in Mississippi, especially in the southern portion of the state. Similarly, we only collected it in open disturbed forests at the refuge. DF. Sites 15 and 41.

***Pyramica metazytes* Bolton. (Figure 62).** This species was only recently described from few specimens (Bolton, 2000), and it has been rarely collected. PI, PH, and DF. Sites 20, 21, and 24.

***Pyramica missouriensis* (Smith). (Figure 63).** This species occurs in somewhat xeric to mesic forests in soil and leaf litter. UP and PH. Sites 4 and 57.

***Pyramica ohioensis* (Kennedy & Schramm). (Figure 64).** This species is commonly collected in soil and litter in forests in Mississippi. BL, UP, and PH. Sites 6, 8, 14, 18, 29, 46, 53, and 57.

***Pyramica ornata* (Mayr). (Figure 65).** This is one of the most commonly collected dacetine ants in the state. This species is somewhat larger than other congeners and possesses elongate, spoon-like setae that radiate outward from the clypeus. This species is common in leaf litter at bases of hardwoods and under rotting logs. BL, UP, PI, and PH. Sites 9, 32, 28, 45, 52, and 57.

***Pyramica pergandei* (Emery). (Figure 66).** Previously considered to be a northern species, this ant has elongate mandibles similar to its closest relative in this region, *P. angulata*, but it differs in having a more rounded clypeus. We collected only one specimen in bottomland forest. BL. Site 36.

***Pyramica pilinasis* (Forel). (Figure 67).** We collected this species only at one upland site, where we also collected the related *P. laevinasis.* UP. Site 26.

***Pyramica pulchella* (Emery). (Figure 68).** This is a fairly common, litter-inhabiting species in hardwood forests, pine forests, and open grassy habitats in this region, and it is much more frequently collected than the related *P. missouriensis*. BL, UP, and PH. Sites 4, 46, and 57.

***Pyramica reflexa* (Wesson & Wesson). (Figure 69).** This species is found in a variety of wooded habitats in leaf litter, often at tree bases. PH. Sites 9 and 39.

***Pyramica rostrata* (Emery). (Figure 70).** This is one of the most commonly collected dacetine ants and one of the largest species of the genus. It occurs in soil and litter at tree bases and under rotting logs. BL, UP, PI, and PH. Sites 14, 20, 30, 32, 35, 36, 37, 39, 40, 46, 51, 52, 53, and 57.

***Pyramica talpa* (Weber). (Figure 71).** This small species occurs in soil and leaf litter in a variety of forested habitats. BL, PI, and PH. Sites 29, 33, and 57.

***Strumigenys louisianae* Roger. (Figure 72).** This elongate-jawed species is our most commonly collected dacetine in the state, and it occurs in soil, leaf litter, and rotting wood in most wooded habitats, from

xeric to mesic. BL, UP, PI, PH, and DF. Sites 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, and 57.

***Strumigenys silvestrii* Emery. (Figure 73). NEW STATE RECORD.** (Introduced). We collected this minute dacetine ant only in one locality but have been finding it with more frequency throughout the state in recent years. PH. Site 8.

Tribe Attini

***Cyphomyrmex rimosus* (Spinola). (Figure 74).** (Introduced). We collected only a few specimens of this exotic species near a gravel road. This species is common in the southern half of the state, and this is the northernmost record for it. UP. Site 53.

***Trachymyrmex septentrionalis* (McCook). (Figure 75).** This distinctive, reddish-brown species has irregular projections on the alitrunk. It nests in the soil in somewhat xeric forests where it cultivates its own fungus gardens within its galleries. This is a common upland species, where its crescent-shaped mounds can be observed on trails. UP, PI, and DF. Sites 4, 13, 15, 21, and 43.

Tribe Stenammini

***Stenamma impar* Forel. (Figure 76). NEW STATE RECORD.** This slender, yellowish to reddish-brown species is most active during the late fall through early spring in forested habitats. BL, UP, PI, and PH. Sites 4, 8, 11, 12, and 46.

Tribe Solenopsidini

***Monomorium minimum* (Buckley). Little black ant. (Figure 77).** (Pest). This small, brownish-black species is a common nuisance pest that often enters structures, but it is also very common in natural habitats. Somewhat surprisingly, we did not find this species in upland sites. BL, PI, PH, DF, and OA. Sites 2, 7, 8, 13, 15, 16, 17, 18, 30, 33, 34, 42, 43, 45, 47, and 49.

***Solenopsis abdita* Thompson. (Figure 78). NEW STATE RECORD.** This minute, golden-yellow species is very similar to others in the group, but it can be separated by the queens that are blackish in color. PH. Site 37.

***Solenopsis carolinensis* Forel (Figure 79).** *Solenopsis carolinensis* is in a group that is poorly defined taxonomically, but specimens from the Noxubee Refuge appear to be this species. Both workers and queens of this minute species are golden yellow. We collected it in all of the major habitats, but it was especially common in pine forests where we found it nesting under and in bark of *Pinus taeda* (loblolly pine) at the bases of trees. BL, UP, PI, PH, DF, and OA. Sites 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, and 57.

***Solenopsis invicta* x *richteri*. (Figure 80).** The hybrid imported fire ant. (Introduced, pest). The hybrid of *S. invicta* Buren (the red imported fire ant) and *S. richteri* Forel (the black imported fire ant) is an aggressive stinging pest that is common in disturbed open habitats. This hybrid species was collected in openings or edges of forests. BL, PI, PH, DF, and OA. Sites 2, 3, 5, 7, 9, 12, 13, 15, 16, 17, 18, 21, 22, 23, 31, 33, 34, 40, 41, 42, 43, 47, 50, 53, and 57.

***Solenopsis picta* Emery. (Figure 81).** This minute, dark brownish-black species nests in twigs and branches of trees. PH. Site 24.

***Solenopsis tennesseensis* Smith. (Figure 82). NEW STATE RECORD.** This minute, pale-yellow ant is the smallest species known in Mississippi. Previously, we thought this species primarily made nests in sandy soils, such as those found in the southern portion of the state. We found it in the soil in two different open pine forests at the refuge. PI. Sites 13 and 33.

Tribe Myrmicini

***Myrmica pinetorum* Wheeler. (Figure 83).** This yellowish-brown, sculptured species is often found in somewhat dry, open forests, including pine forests. PI. Site 13.

***Myrmica punctiventris* Roger. (Figure 84).** This dark-brown, heavy-sculptured species with long propodeal spines nests in soil in mesic forests. BL, UP, and PH. Sites 11, 26, 30, 36, 46, and 57.

Tribe Pheidolini

***Aphaenogaster carolinensis* Wheeler. (Figure 85).** This slender, reddish to yellowish-brown species with short propodeal spines is a common ant in wooded habitats where it nests in small colonies in the soil. BL, UP, PI, PH, and DF. Sites 11, 26, 30, 36, 46, and 57.

***Aphaenogaster fulva* Roger. (Figure 86).** This long-legged, dark-brown species has long propodeal spines, which are directed upward. It is a very common species in forested habitats where it nests in rotting logs. BL, UP, PI, PH, and DF. Sites 1, 2, 6, 11, 12, 13, 20, 26, 42, 46, 47, 50, 51, 52, and 53.

***Aphaenogaster lamellidens* Mayr. (Figure 87).** This is a relatively large *Aphaenogaster* species that nests in rotting logs and standing dead trees and is very abundant in forested habitats. Colonies may be very large. BL, UP, PI, PH, and DF. Sites 1, 2, 6, 11, 12, 13, 20, 26, 42, 46, 47, 50, 51, 52, and 53.

***Aphaenogaster mariae* Forel. (Figure 88).** This orangish-brown species is heavily sculptured and has propodeal spines directed posteriorly. Queens are thought to be temporary nest parasites of *A. fulva*, which are often found in rotting wood near or in soil; but colonies are found at tops of hardwood trees, especially oaks and hickories. This species is easily collected with peanut butter bait on large oak trees. BL and UP. Sites 2, 4, 10, and 26.

***Aphaenogaster treatae* Forel. (Figure 89).** This large, reddish-brown species has a distinctive flange at the base of the antennal scape. It is a fairly common species that nests in the soil in open, somewhat xeric forests. UP, PI, PH, and DF. Sites 4, 13, 15, and 45.

***Pheidole bicarinata* Mayr. (Figure 90).** This small, yellowish-brown species nests in soil in xeric, open habitats, especially roadsides. DF and OA. Sites 15, 16, and 22.

***Pheidole dentata* Mayr (pest?). (Figure 91).** This average-sized, elongate, reddish-brown species is common in forests and nests in rotting logs, stumps, or in the soil. BL, UP, PI, PH, and DF. Sites 1, 4, 12, 13, 14, 15, 17, 23, 25, 26, 27, 31, 34, 37, 42, 45, 47, 48, 53, and 57.

***Pheidole dentigula* Smith. (Figure 92).** This small, reddish-brown species is very common in forests where it nests in soil and leaf litter. BL, UP, PI, PH, and DF. Sites 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, and 57.

***Pheidole metallescens* Emery. (Figure 93).** This small species nests in sandy soils along stream banks and on ridges in upland habitats. Minor workers are blackish in color and appear to have green or blue reflections when magnified. UP, PI, and DF. Sites 4, 13, 21, and 43.

***Pheidole tysoni* Forel. (Figure 94).** This small, shiny, yellow species nests in the soil in open, usually xeric sites. PH, DF, and OA. Sites 7, 21, 37, 42, 47, and 56.

***Pheidole* sp. (*crassicornis* group). (Figure 95).** This relatively large, dark reddish-brown species has been collected in open forested park-like habitats throughout the Southeast. Although very similar to *P. crassicornis* Emery, it has several key differences and appears to be an undescribed species. DF. Site 15.

Tribe Crematogastrini

***Crematogaster ashmeadi* Mayr. (Figure 96).** (Occasional pest). This small acrobat ant is very common in forests where it nests under bark of trees, in vines, rotting wood, and in various cavities. It is an occasional nuisance pest in structures. BL, UP, PI, PH, and DF. Sites 2, 4, 8, 9, 10, 11, 13, 15, 17, 19, 26, 31, 34, 45, 46, 47, 48, 49, 51, 53, and 57.

***Crematogaster lineolata* (Say). (Figure 97).** (Occasional pest). This dark brownish-black species is very common in forests where it nests in the soil, leaf litter, and in various cavities such as acorns, hickory nuts, or hollow twigs. BL, UP, PI, and PH. Sites 2, 4, 18, 20, 25, 27, 30, 44, 52, and 57.

***Crematogaster minutissima* Mayr. (Figure 98).** This minute, pale-yellow species nests in soil, in cavities, or under bark. It is more common in upland sites. UP and PH. Sites 4, 25, 27, and 57.

***Crematogaster pilosa* Emery. (Figure 99).** (Occasional pest). This is one of our largest species of *Crematogaster*. This species is often bicolored (red and black), and it nests in hollow twigs, grasses, or other cavities. BL and PI. Sites 30, 31, and 33.

***Crematogaster vermiculata* Emery. (Figure 100). NEW STATE RECORD.** This somewhat small species has reticulate sculpture and is almost always collected on live bald cypress trees [*Taxodium distichum* (L.)]. BL. Sites 2 and 11.

Tribe Formicoxenini

***Temnothorax curvispinosus* (Mayr). (Figure 101).** This is a small, yellow species with long, curved propodeal spines. It nests in litter, twigs, nuts, and a variety of other cavities in forested habitats. BL, UP, PI, PH, and DF. Sites 2, 4, 8, 11, 14, 15, 21, 23, 26, 27, 29, 30, 32, 35, 42, 46, 47, 50, 51, 52, 53, and 57.

***Temnothorax longispinosus* (Roger). (Figure 102). NEW STATE RECORD.** This dark brownish-black species has long propodeal spines that are directed posteriorly. We previously considered this to be a northern species. BL. Site 2.

***Temnothorax pergandei* (Emery). (Figure 103).** This is a variable species that ranges from orangish-brown to brownish-black. In upland or other xeric sites, it tends to nest in the soil, but it may also nest in hollow twigs, acorns, or hickory nuts in more mesic forests. BL, UP, PI, and PH. Sites 13, 27, 33, 34, 53, and 57.

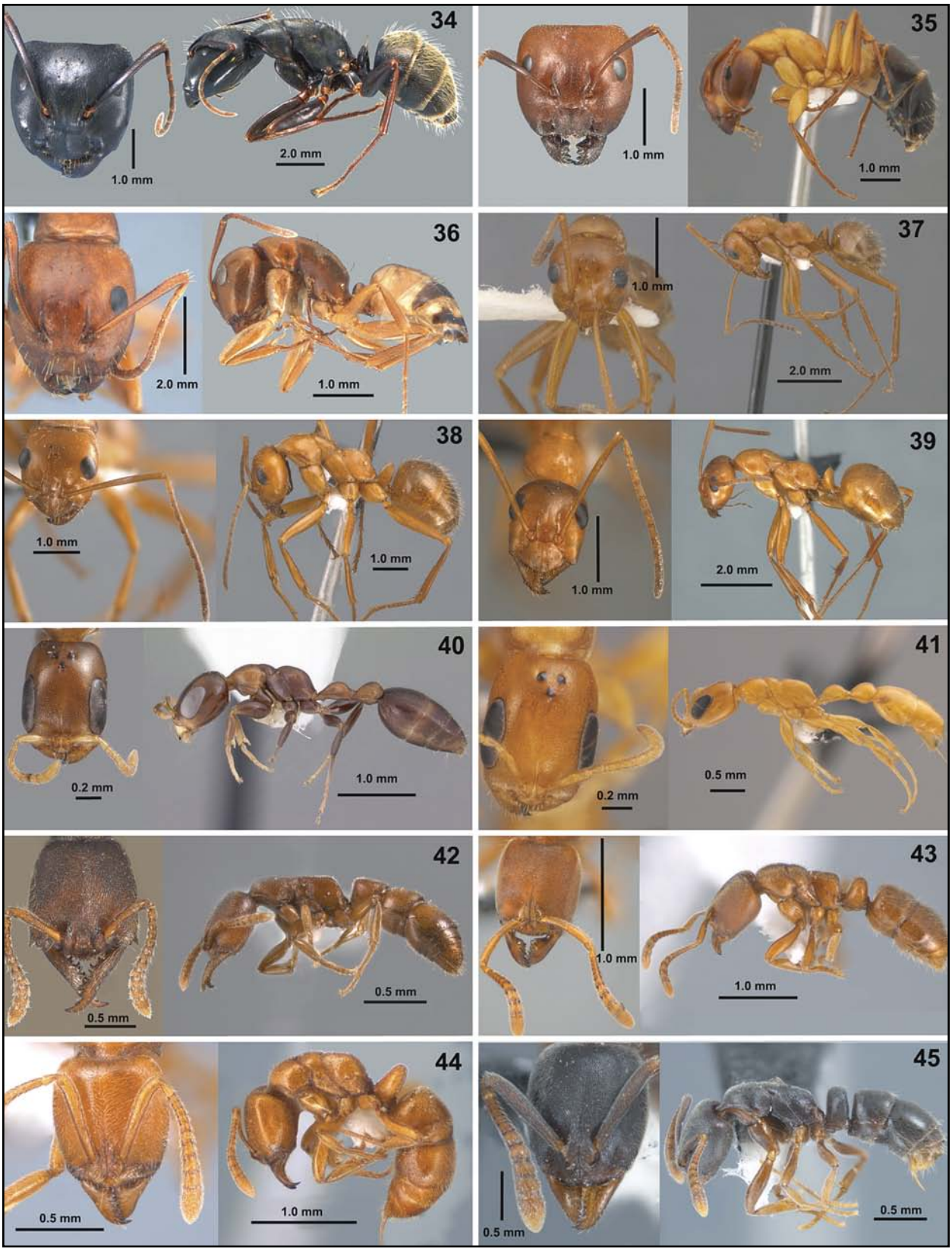
***Temnothorax schaumii* (Roger). (Figure 104).** This small species has reduced propodeal spines and nests under and in bark of live hardwood trees. This is a very common but somewhat cryptic, slow-moving species that is easily undetected because its coloration blends with the bark. However, it is easily collected using peanut butter bait on trees. BL, UP, and DF. Sites 2, 4, and 15.

Tribe Myrmecinini

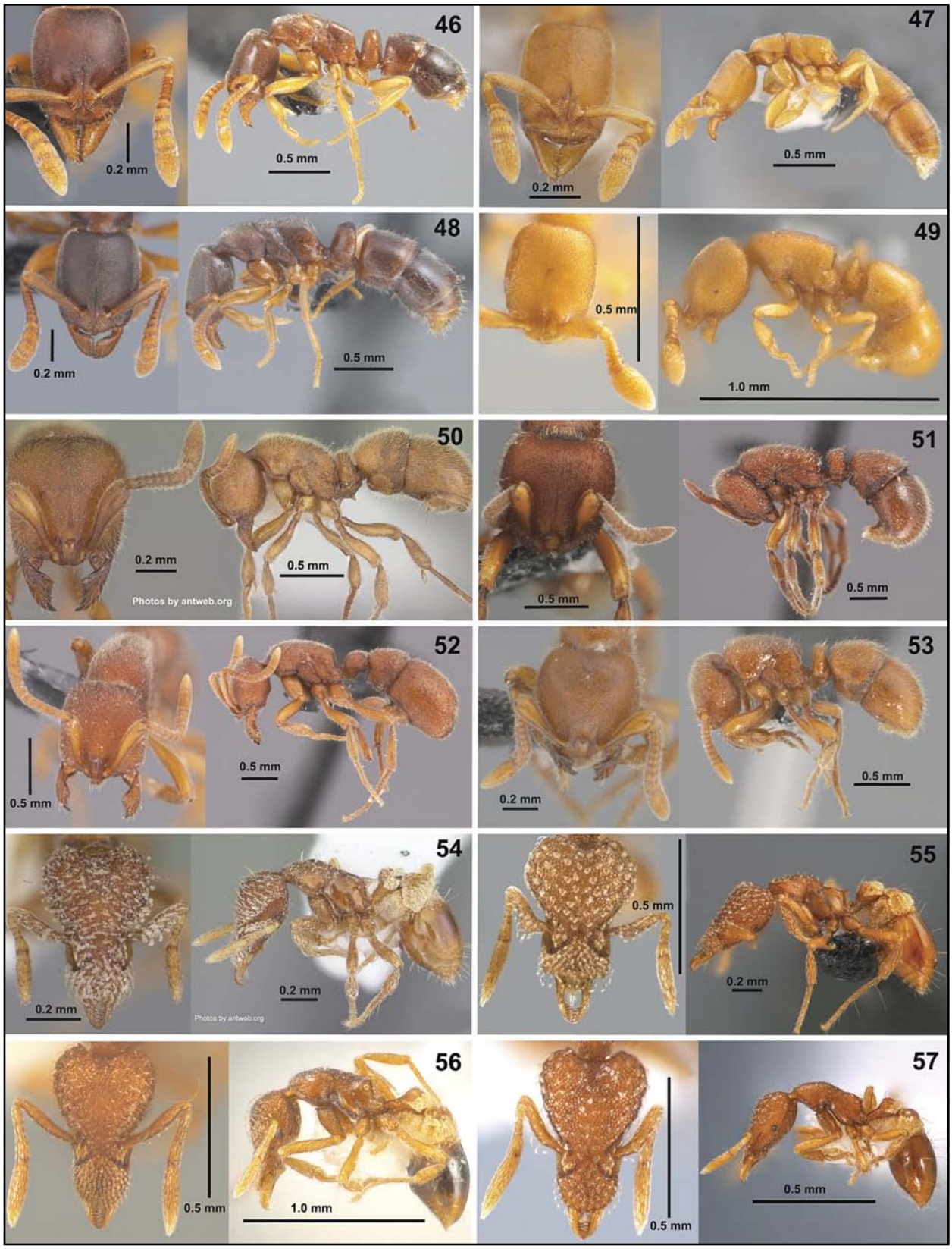
***Myrmecina americana* Emery. (Figure 105).** This is an extremely common woodland species that nests in and under rotting wood and in leaf litter at tree bases. This shiny, black ant often remains motionless when disturbed, making it difficult to detect. BL, UP, PI, PH, DF, and OA. Sites 2, 4, 7, 8, 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, and 57.

Figures 10–21. Head and profile views of (10) *Dorymyrmex bureni,* (11) *Forelius mccooki,* (12) *Linepithema humile,* (13) *Tapinoma sessile,* (14) *Lasius alienus,* (15) *L. umbratus,* (16) *Nylanderia arenivaga,* (17) *N. faisonensis,* (18) *N. parvula,* (19) *N. vividula,* (20) *Prenolepis imparis,* and (21) *Brachymyrmex depilis.*

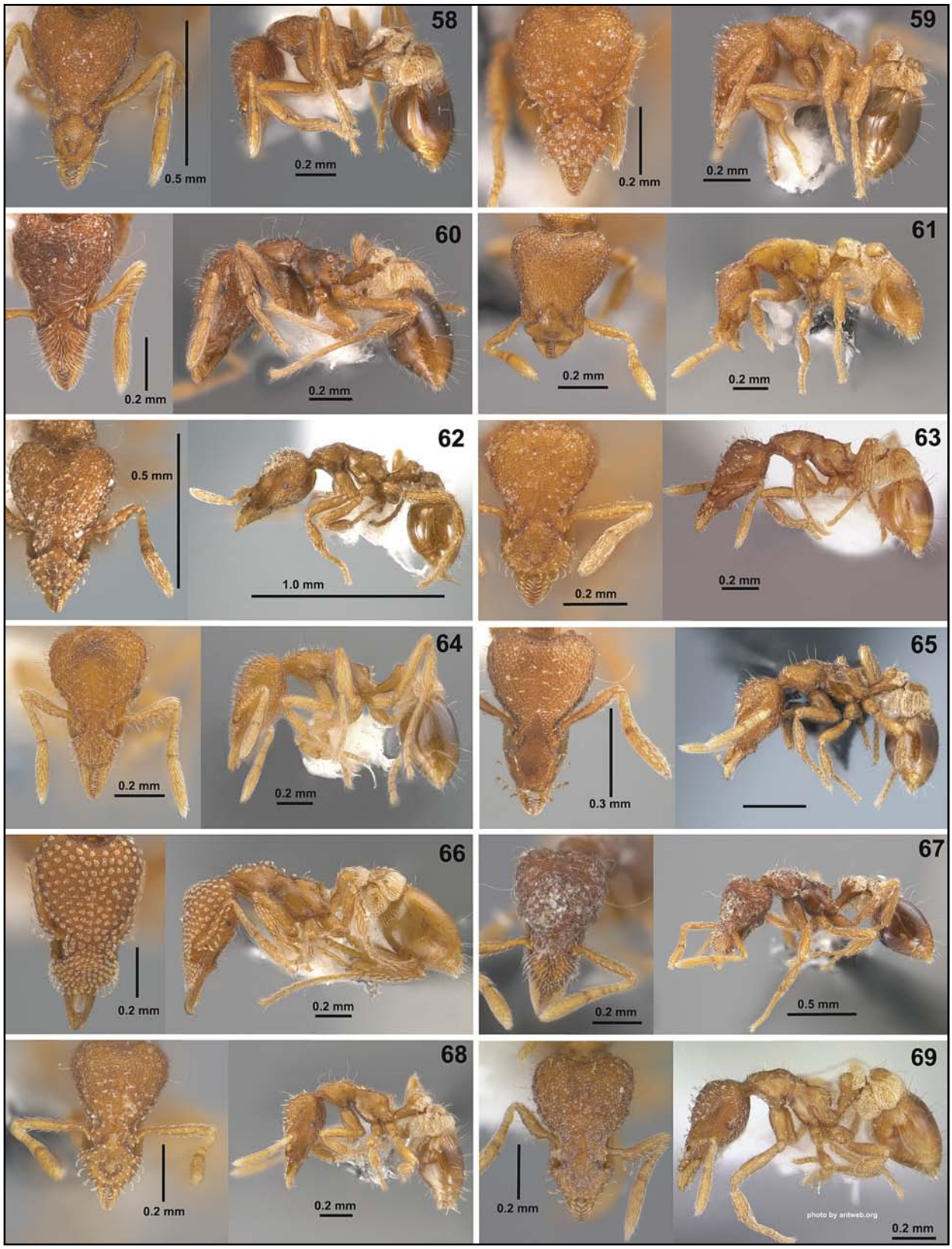
Figures 22–33. Head and profile views of (22) *Brachymyrmex patagonicus,* (23) *B.* sp, (24) *Camponotus americanus,* (25) *C. caryae,* (26) *C. castaneus,* (27) *C. chromaiodes,* (28) *C. decipiens,* (29) *C. discolor,* (30) *C. impressus,* (31) *C. mississippiensis,* (32) *C. nearcticus,* and (33) *C. obliquus.*



Figures 34–45. Head and profile views of (34) *Camponotus pennsylvanica,* (35) *C. snellingi,* (36) *C. subbarbatus,* (37) *Formica biophilica,* (38) *F. dolosa,* (39) *F. pallidefulva,* (40) *Pseudomyrmex ejectus,* (41) *P. pallidus,* (42) *Amblyopone pallipes,* (43) *Cryptopone gilva,* (44) *Hypoponera inexorata,* and (45) *H. opaciceps.*

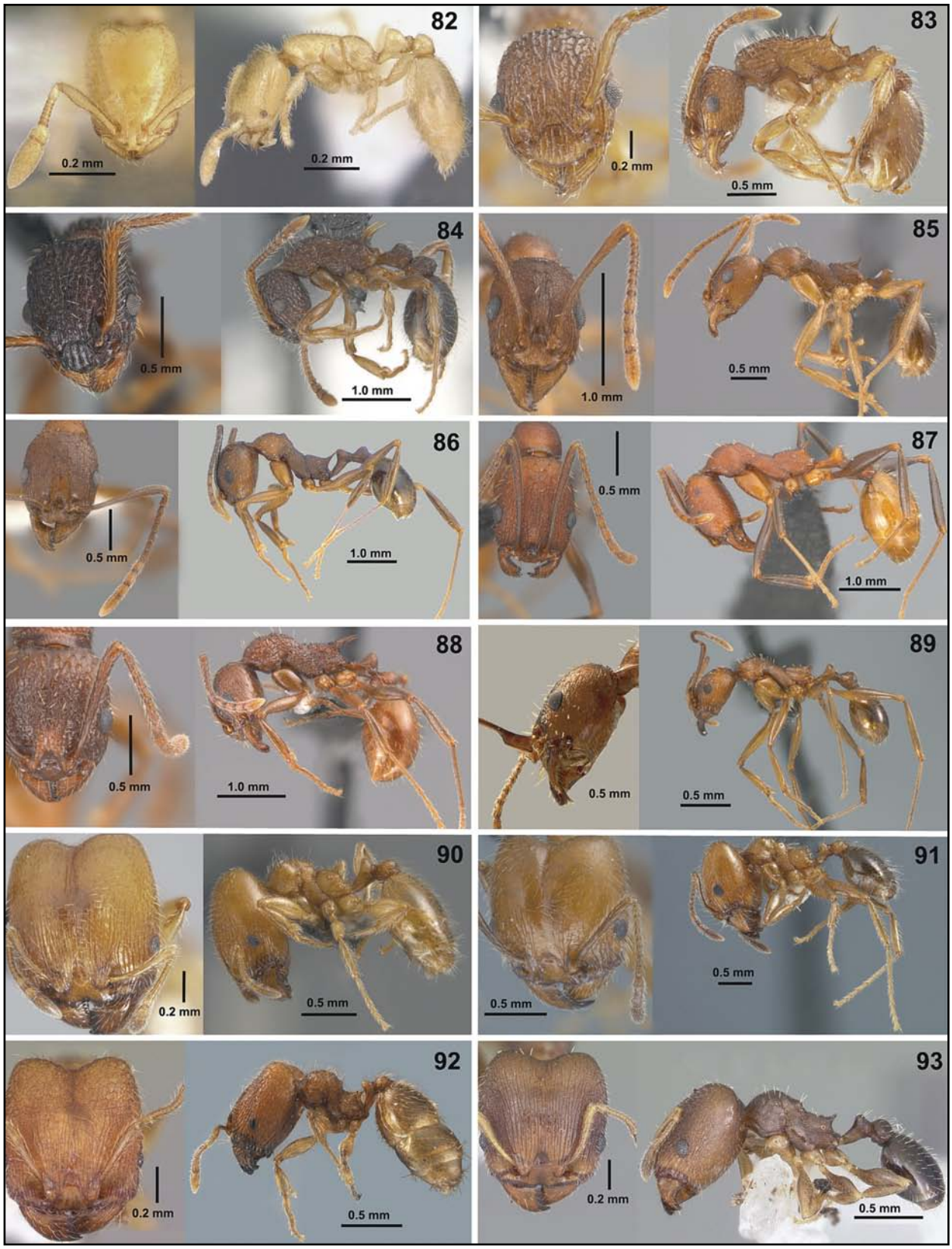


Figures 46–57. Head and profile views of (46) *Hypoponera opacior,* (47) *Ponera exotica,* (48) *P. pennsylvanica,* (49) *Discothyrea testacea,* (50) *Proceratium crassicorne,* (51) *P. croceum,* (52) *P. pergandei,* (53) *P. silaceum,* (54) *Pyramica abdita,* (55) *P. angulata,* (56) *P. clypeata,* and (57) *P. creightoni.*

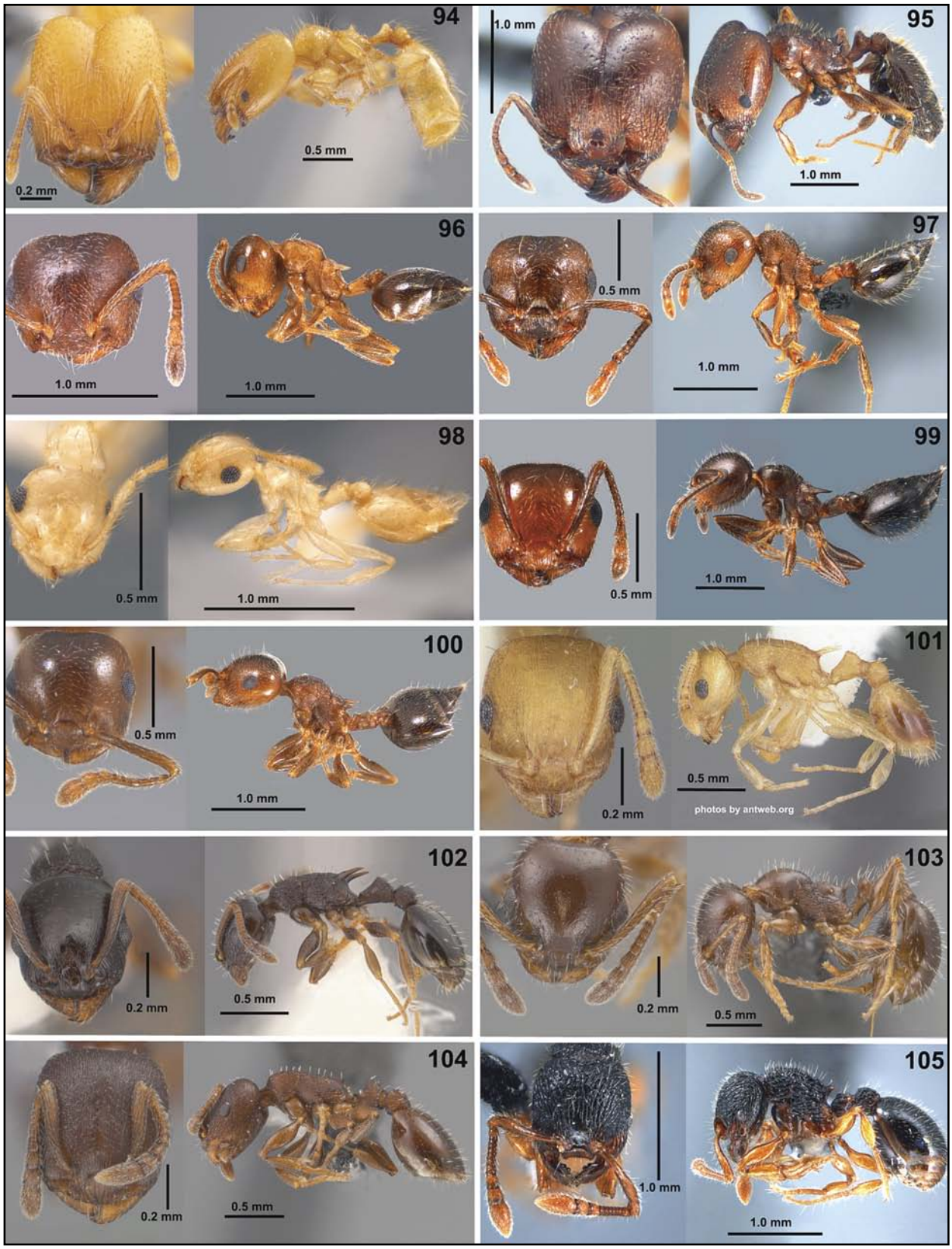


Figures 58–69. Head and profile views of (58) *Pyramica dietrichi,* (59) *P. hyalina,* (60) *laevinasis,* (61) *P. membranifera,* (62) *P. metazytes,* (63) *P. missouriensis,* (64) *P. ohioensis,* (65) *P. ornata,* (66) *P. pergandei,* (67) *P. pilinasis,* (68) *P. pulchella,* and (69) *P. reflexa.*

Figures 70–81. Head and profile views of (70) *Pyramica rostrata,* (71) *P. talpa,* (72) *Strumigenys louisianae,* (73) *S. silvestrii,* (74) *Cyphomyrmex rimosus,* (75) *Trachymyrmex septentrionalis,* (76) *Stenamma impar,* (77) *Monomorium minimum,* (78) *Solenopsis abdita,* (79) *S. carolinensis,* (80) *S. invicta* x *richteri,* and (81) *S. picta.*



Figures 82–93. Head and profile views of (82) *Solenopsis tennesseensis,* (83) *Myrmica pinetorum,* (84) *M. punctiventris,* (85) *Aphaenogaster carolinensis,* (86) *A. fulva,* (87) *A. lamellidens,* (88) *A. mariae,* (89) *A. treatae,* (90) *Pheidole bicarinata,* (91) *P. dentata,* (92) *P. dentigula,* and (93) *P. metallescens.*



Figures 94–105. Head and profile views of (94) *Pheidole tysoni,* (95) *P.* sp, (96) *Crematogaster ashmeadi,* (97) *C. lineolata,* (98) *C. minutissima,* (99) *C. pilosa,* (100) *C. vermiculata,* (101) *Temnothorax curvispinosus,* (102) *T. longispinosus,* (103) *T. pergandei,* (104) *T. schaumii,* and (105) *Myrmecina americana.*

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