THE ECOLOGY OF THE ANTS OF THE WELAKA RESERVE, FLORIDA
(Hymenoptera: Formicidae)

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INTRODUCTION

This dissertation presents the results of a study dealing with ecological relationships of the ants on the University of Florida Conservation Reserve, Welaka, Florida. It is an attempt to expand the knowledge of the nesting habits and behavior of the ants of a limited area. Although similar studies on ants had been undertaken previously in other parts of the United States, especially the middle west, there still remained the opportunity to study comprehensively an area in the southeastern Coastal Plain, with its influences from both the neotropical and nearctic faunae.

In studying the ants of the Reserve, it was desired to 1) ascertain what ant forms occur on the Reserve, and to determine their quantitative relationships in each of the situations in which they are found; 2) classify these different situations from a knowledge of the qualitative and quantitative distribution of the ants in them; 3) gather as much information as possible concerning the life history and habits of the ants.

During the study much interesting information incidental to the main problem was obtained on various aspects of the ants' biology. Observations concerning the speed of movement, feeding habits, guests and parasites in the nests and on the individuals, and the hours during which foraging is done are included in the Annotated List.

The literature bearing on ants of selected regions has been, for the most part, lists or keys, including only notes as to the nesting habits of the ants concerned. Several recent papers have dealt with the ecological relationships between the ants and the environment of

limited areas: Buren (1944) in Iowa; Cole (1940) in the Great Smoky Mountains of Tennessee; Gregg (1944) in the Chicago region; and Talbot (1934) also in the Chicago region. Those papers dealing with Florida ants have been four state lists (Smith, 1930, 1933, 1944, and Wheeler, 1932) and a key to the ants of the Gainesville region (Van Pelt, 1948).

Until recently, the taxonomy of ants has been based on a quadrinomial system. About 1875, Carlo Emery and Auguste Forel first recognized infraspecific units. At that time the taxonomy of the European ants, with which these men dealt, was in a period of stability brought about by the thorough knowledge these men had of their fauna. They therefore felt no hesitation in marking forms as distinct which showed a slight variation. Species were first divided into races by Forel, and were later termed varieties by Emery in 1885. In 1890, Emery recognized the subspecies as a second infraspecific category. Acceptance of this quadrinomial system was not immediate, but through the added influence of W. M. Wheeler, it was in general use by 1910.

Even though Forel in his Fourmis de la Suisse recognized the possibility that subspecies intergrade and exist in separate ranges, the concept was embryonic and he failed to carry through with it. Most other authors disregarded this geographical aspect of subspecies, and named the infraspecific forms on the basis of their concept of the magnitude of the difference between them. Thus subspecies were separated by smaller differences than species, but by larger ones than varieties. Most of the material studied by Emery and Forel consisted of cabinet specimens. Lack of sufficient field observation and data, such as this dissertation presents, led them into making taxonomic errors.

Several authors have made proposals to do away with the cumbersome

quadrinomial system. Wheeler, in 1910, in his book Ants, suggested that the variety in ant nomenclature is very nearly equivalent to the species in other groups, such as birds and mammals, and that for ordinary purposes it would be sufficient to treat the varietal name as if it were specific. In writing generally of an ant, therefore, he used a binomial system, but retained the full terminology for catalogue listings and the like.

The efforts of Wheeler and other authors who were tending away from quadrinomial nomenclature might have produced more general results if it had not been for the publication, from 1901 to 1925, of Emery's section on the Formicidae in the Genera Insectorum, with its concomitant authority. In 1938 Creighton proposed a trinomial system in which all of the varieties were to be raised to subspecific rank, and in 1944 Buren put this idea into practice for the ants of Iowa.

Finally, in 1950, Creighton published a manual on the ants of North America in which he revised his earlier concept by discarding the category "variety", and by designating as subspecies all intergrading forms which replace each other geographically. Actually a great many varieties were relegated to synonymy because the characters, especially color, separating them from their most closely related forms, were found to be invalid. Most of Creighton's changes involved either synonymizing varieties or raising them to subspecific rank. His paper ought to have a wide influence in placing ant nomenclature on a sound basis. Several points in the present study have been simplified, and other obvious mistakes in previous nomenclature rectified by accepting his trinomial system.

Literature references are given at the end of this dissertation only for those papers cited in the text. No references to original

descriptions or to papers dealing with synonomy are listed. The reader will be able to find these references, along with keys to all North American ants, in Creighton (1950).

DESCRIPTION OF THE AREA

Location and Physical Features

The University of Florida Conservation Reserve, where the present study was made, is a 2180 acre tract, located on the east bank of the St. Johns River, about seventeen miles south of Palatka near the town of Welaka in Putnam County, Florida. The Reserve is situated in northeastern peninsular Florida on a portion of the state known as the Coastal Lowlands (Cooke, 1945:8), and is for the most part located on the Pamlico marine terrace, which is designated by its 25 foot elevation above sea level. It is approximately in the center of the rectangle formed by the lines of latitude of 29° and 30°, and those of longitude of 81° and 82°.

The Reserve varies in its topography from flat or very gently rolling lands covered with pine woods to hilly uplands supporting oak and pine, and many areas are pock-marked because of the solution of the underlying limestone. The uplands, with their sand dune appearance, are evidence that the land was once part of a marine shore line. The submergences and emergences of the Coastal Lowlands to form Pleistocene marine terraces, along with the absence of catastrophic movements in the Welaka area, as well as in all Florida, will undoubtedly prove important in consideration of the zoogeographic distribution of the Formicidae. For a complete discussion of the geology of this area, as well as other parts of Florida, see Cooke (1945).

Usually more than half of the annual precipitation falls in thunder showers during the hottest months, June to September, when rainfall averages 5 to 10 inches per month. Least precipitation occurs in late fall and again in early spring, with a monthly average of 1 to 4 inches.

The annual rainfall averages under 50 inches. The weather station at Crescent City[1] recorded the total precipitation per month during the period of the present study as shown in Figure 1. For complete data on the climate of Florida from 1896 to 1926, see Mitchell and Ensign (1928).

The temperature of the area in which the Reserve is located averages about 70° Fahrenheit. Freezing temperatures may occur from November to March, although frost-free winters have been reported. Summer temperatures average 80° to 90°, and are at times recorded above 100°. Temperatures may vary greatly within a small area, for example, from a dense hammock to an open flatwoods. Figure 1 shows the average monthly temperature during the period of the present study. The average length of the growing season is 300 days. The first killing frost in fall may occur in November or December; the last killing frost in spring usually occurs in February or March.

The nearest weather station recording relative humidity is at Jacksonville, where the mean annual relative humidity for 7 A.M. is 83%, while for 7 P.M. it is 76%. Records from here also indicate only the general conditions on the Reserve, since Jacksonville and Welaka are separated by seventy miles. Moreover, relative humidity varies greatly within a small area, depending upon the vegetational conditions encountered. The author has recorded relative humidity below 20% on numerous occasions in open areas on hot, sunny days.

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[1] The records of temperature and rainfall taken from Crescent City, eleven miles to the east, can be used only as general indications of conditions on the Reserve.

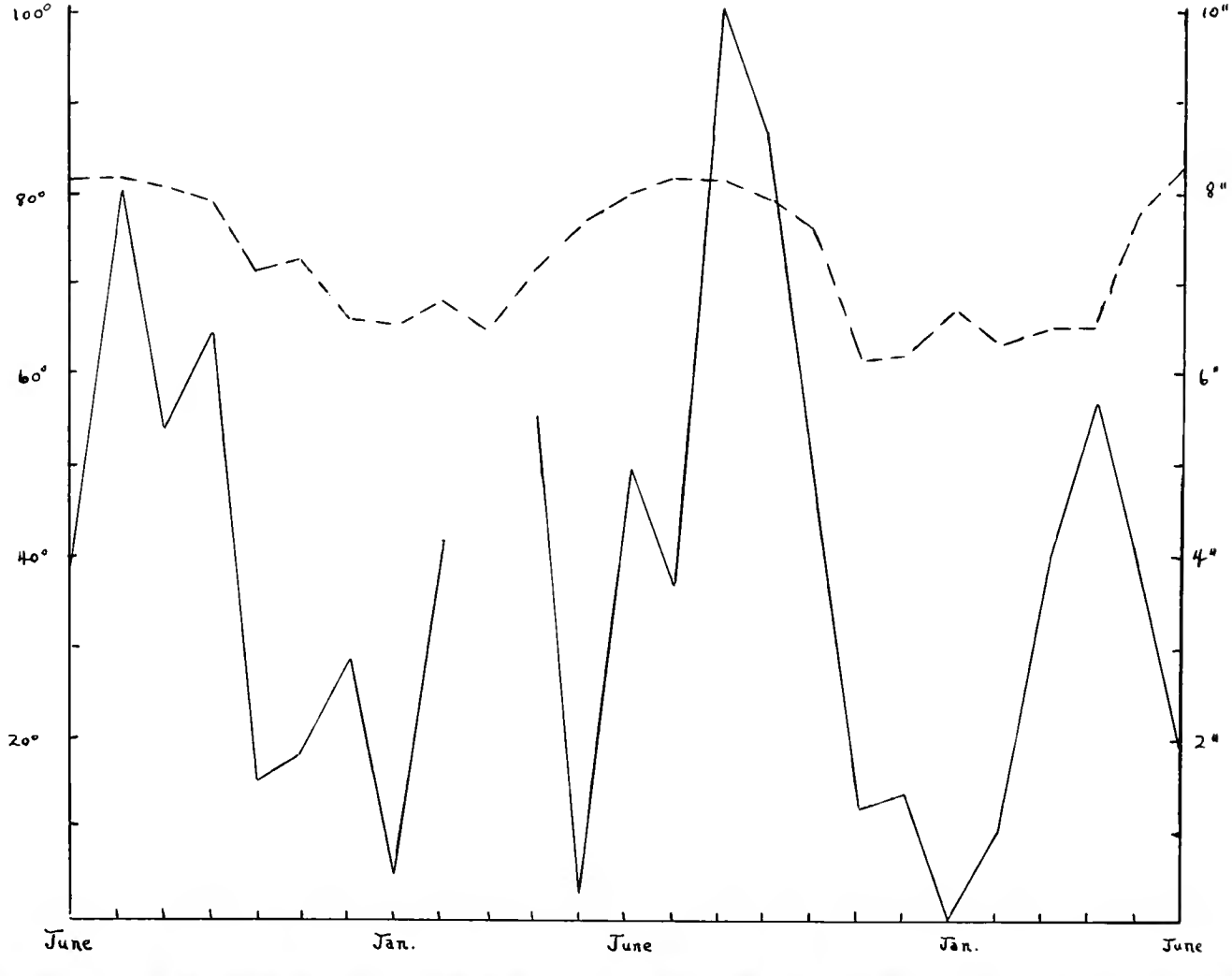


Fig. 1. -- Average monthly temperature in degrees Fahrenheit (— —) and total monthly precipitation in inches (———) at Crescent City weather station from June, 1948, to June, 1950.

The Soils and Vegetation

During the summer of 1948, a soil survey of the Reserve was made in order to become acquainted with the soil types present. This work was based to a great extent on the detailed survey of the area made by Laessle (1942). Where necessary, the soil-type nomenclature was brought up to date (See Map 1). The following discussion of the derivation and texture of parent materials, and of drainage, is based on Laessle's paper.

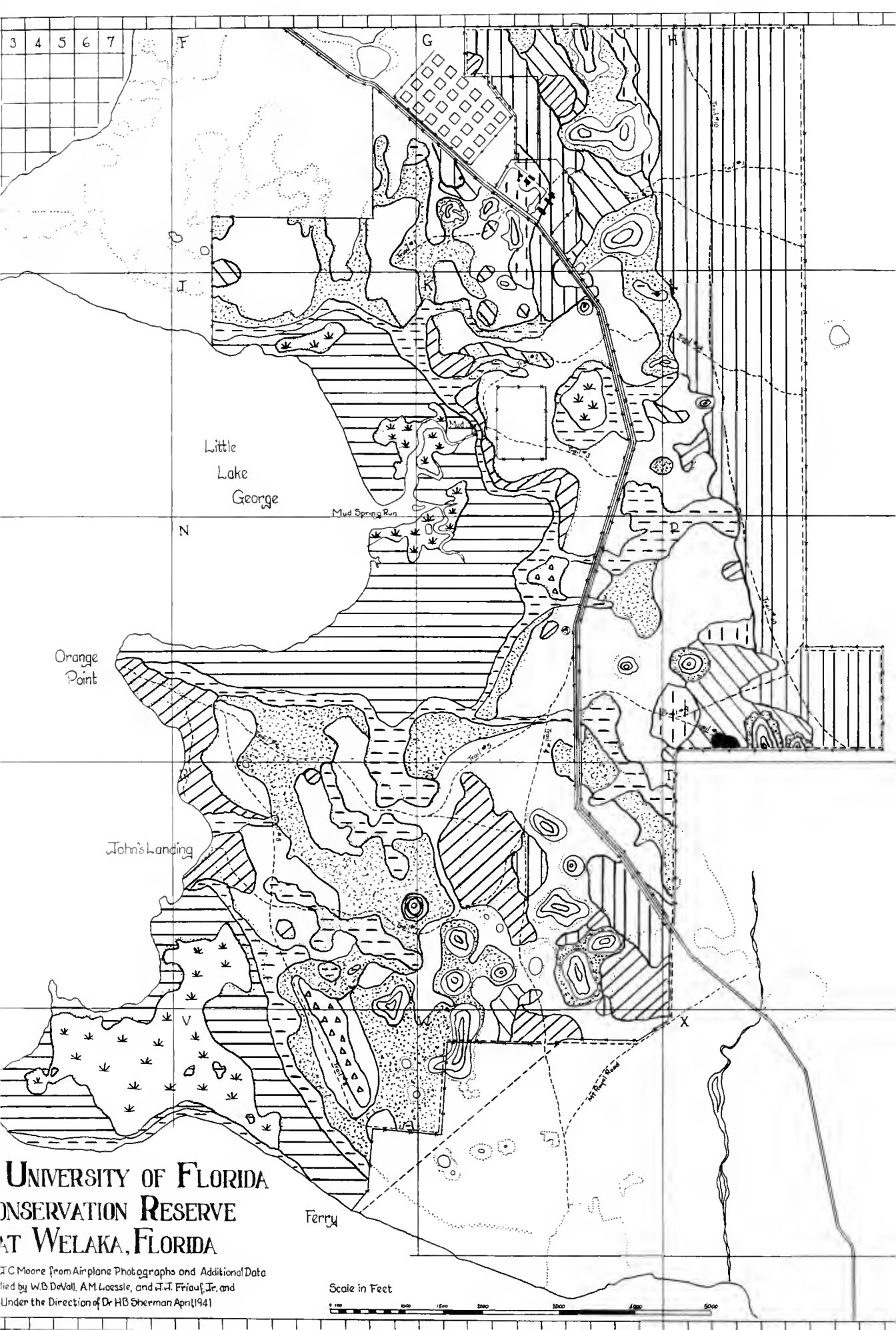
The mineral soils of the area are very probably derived from marine deposits of fine sand. No clays were found within six feet of the surface, with the exception of small areas along the St. Johns River. The organic soil, peaty muck, has been laid down by the accumulation of vegetable matter in two extensive areas along the river.

Chemical analysis of the soils has been carried out only to a minor extent in nearby areas, and not at all on the Reserve.

In the rolling areas, and in other areas where the land is not entirely flat, the very sandy nature of the soil permits excellent drainage. Much of the Reserve, however, is almost completely flat, and in these areas lateral movement of water is slow or negligible and the water table is near the surface. In many of the flat areas, an accumulation of organic matter, called a hardpan, is formed at varying depths beneath the surface, and in such areas during heavy rains the ground becomes supersaturated. In lower positions within the flatwoods, organic matter accumulates as a black or dark gray layer at the surface rather than as a hardpan. In contradistinction to these soils, the soils of the higher areas, with good internal drainage, do not have an organic hardpan within 42 inches of the surface and contain very little organic

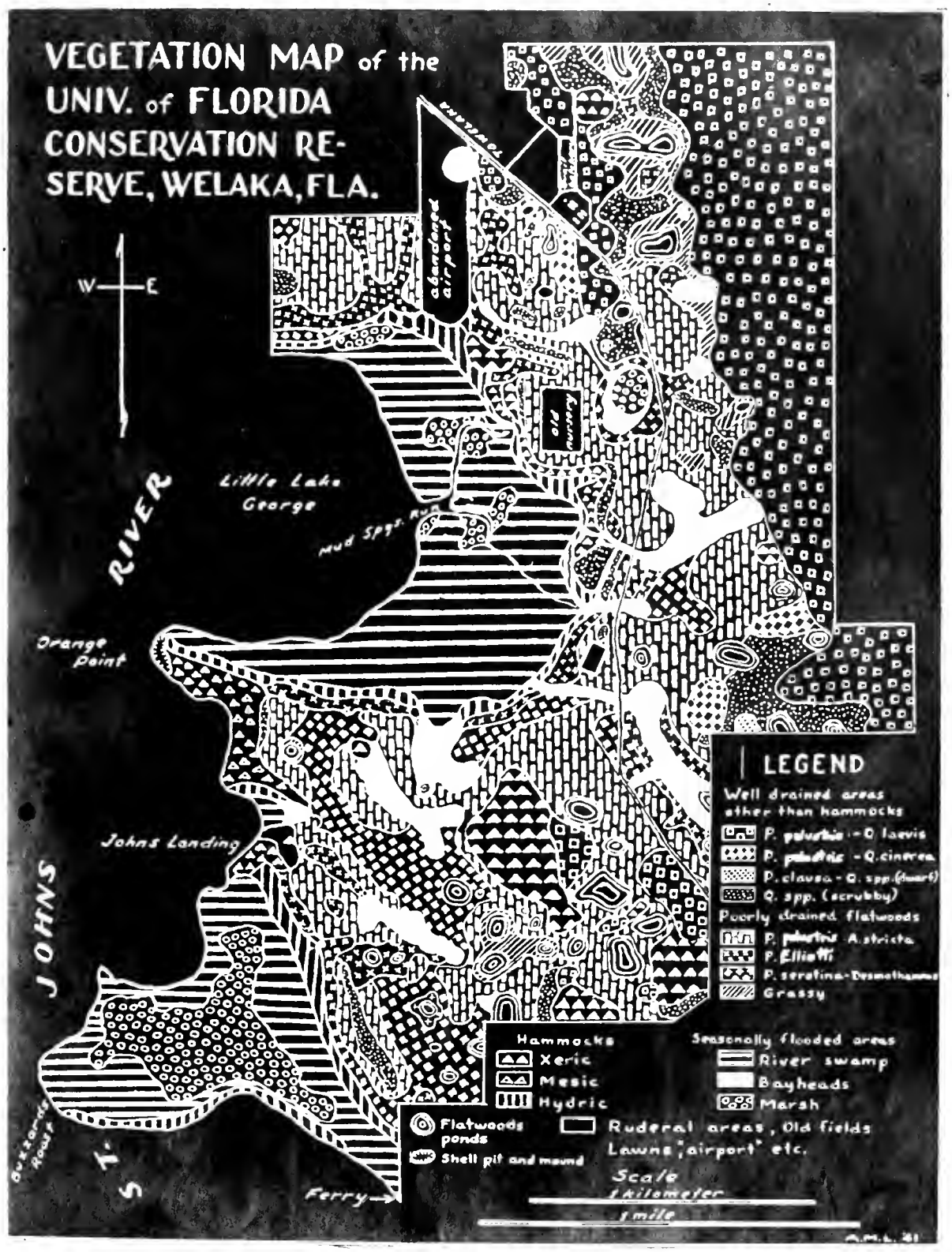
Map 1: Soil Map of the Reserve

St. Lucie fine sand
Lakeland fine sand
Blanton fine sand
Blanton fine sand, hammock phase
Leon fine sand
Leon fine sand, light colored surface phase
Pomello fine sand
Plummer fine sand
Rutlege fine sand
Peaty muck, swamp phase
Peaty muck, marsh phase


3 4 5 6 7
F
G
H
J
K
O
Little
Lake
George
Mud Spring Run
N
P
Orange
Point
T
John's Landing
V
X
Ferry
UNIVERSITY OF FLORIDA
ONSERVATION RESERVE
AT WELAKA, FLORIDA
JC Moore from Airplane Photographs and Additional Data
lied by W.B. DeVall, A.M. Laessle, and J.T. Friauf, Jr. and
Under the Direction of Dr H.B. Sherman April 1941
Scale in Feet
0 1000 2000 3000 4000 5000

matter in the surface soil.

The vegetation of the Reserve (Map 2) may be divided into four main categories, not including the various types of ruderal areas. They are: 1) uplands or sandhills; 2) flatwoods; 3) hammocks; and 4) seasonally flooded areas. On the eastern side of the Reserve there is a large area of uplands supporting longleaf pine and turkey oak, and scattered in the southern portion are similar smaller areas covered with longleaf pine and bluejack oak. Various types of flatwoods form a strip, interrupted by bayheads and higher hammocks, through the center of the Reserve. Low hammocks form a strip adjacent to river swamp and marsh which border the St. Johns River.



Map 2: Vegetation Map of the Reserve

DEFINITIONS

The following definitions of terms are given so that their use in the remainder of the dissertation will be clear:

Form -- Ant form is used to designate any category below subgenus.

Assemblage or species assemblage -- Assemblage is used to designate a characteristic and distinctive aggregate of ant colonies contained in a given plant association, stratum, or nesting site. Such an assemblage can be separated qualitatively and/or quantitatively from any other assemblage. In this dissertation all assemblages contain more than one species, and are consequently species assemblages.

Habitat -- The environment in which an assemblage occurs is its habitat, and consequently the habitat of all the ant forms within the assemblage.

Stratum -- A stratum is one of the vertical levels or layers within plant associations. As used here, it is not delimited by the boundaries of any one plant association or station, but extends through all of them on the Reserve.

Nesting site -- Nest is used to designate the place in which one colony lives, whereas nesting site indicates all nesting places of similar structure and composition, regardless of plant association boundaries. All nests in stumps, for example, are in one nesting site.

Relative abundance -- The term relative abundance is used as a measure to indicate the density or abundance of one form in a collecting station during a particular time relative to the abundance of any form in any station over an equal length of time. It is based on colonies, not individuals.

Station -- An area chosen as representative of a plant association.

Collection -- Applied to each nest observed or collected. In cases where only wandering individuals were seen, they were recorded as a collection on the supposition that a nest was nearby; this applied in most instances to rare ants whose nesting sites were not known.

METHODS OF STUDY

Many authors have found close correlation between the distribution of the animals they studied and plant associations. On this basis they have been able to designate plant associations as the habitats of distinctive species assemblages. On the other hand, there are found to be other assemblages associated with strata. These strata may be confined to only one plant association, or they may extend through several. They have also been considered habitats. Thus an ecological hierarchy was set up with the plant associations as major habitats, and strata as minor habitats.

In order to determine if similar relationships could be expressed for the ants of the Reserve, it was first necessary to make the work on ants as comparable as possible with the work on solitary animals. It must be decided whether the ant individual or its colony will be used as the biotic unit in dealing with distribution and relative abundance. In this study the colony in its nest, and not its individuals or their range of foraging, is considered the unit.

Among the chief reasons for basing the study on the colony rather than on the individual worker ant is that reproduction for the whole colony is generally accomplished by the queen. In this respect the workers and soldiers are not complete individuals, but generally must depend on the reproductive caste to continue the race. Food is brought back to the nest by foragers, not for their benefit alone, but for the benefit of the colony. There is cooperation among the ants of a colony, whereas there is competition among solitary animals of the same and different races, and likewise among ant colonies of the same and of different races. In so far as the processes of living and perpetuating

the race are concerned, the colony is more complete than the individual. It is, for example, more complete than the queen, which might be suggested as the type of individual in the ant nest most closely resembling a solitary animal. Using the colony as a basis, therefore, it was proposed to determine if distinctive ant assemblages existed, and if so, by what means they could be defined.

In order to delimit ant assemblages, it was not only necessary to discover in what situations the ant forms occurred, but it was also necessary to determine as nearly as practicable the relative abundance of each form in each situation. So that this could be accomplished, it was proposed to visit plant associations (as modified in the following section) since, 1) they occur in repeated, rather uniform stands characteristic of the Welaka area, and consequently are more readily recognizable by other workers; and 2) other workers in the Welaka area and elsewhere have found plant associations to be habitats for their groups. If a correlation of plant associations and ant assemblages were found to exist, then the plant associations could be called ant habitats. If ant assemblages were found to exist in strata and in nesting sites, these too could be considered ant habitats.

It could be postulated that soils, as well as vegetation, might be a critical factor in determining where an ant form might nest. In reality, some plant associations occurred on two or more different soil types so that it was to the point to combine soil type with vegetation for the purpose of selecting a collecting site. All such combinations on the Reserve were designated as possible collecting localities. Several combinations were found to occupy an insignificant area and were omitted. Within each of the other soil type-plant association combinations a representative area or station was selected.

Collecting Methods and the Recording of Data in the Field

It was known from previous experience that ants as a family are able to live in a wide variety of nesting places, although certain ant forms are quite specific in their requirements. Without a fairly complete knowledge of the ants to be dealt with, the data, especially as concerns relative abundance, could very well be invalidated. It was imperative, therefore, to become acquainted as quickly as possible with the nesting habits of the ants on the Reserve, and likewise to become familiar with the plants and terrain involved.

In order to facilitate progress along this line, a preliminary survey of the ants of the Reserve was begun in October, 1947, and was carried on during weekend trips from the University in Gainesville. On June 18, 1948, residence was established on the Reserve, and concentrated collecting was begun and continued in the manner described below for somewhat over one year. The data from further collecting, carried on until June, 1950, were used to substantiate the distribution and relative abundance figures already obtained. During the period of concentrated collecting, observations were made on 3576 nests.

Each station was visited 17 times (with additional special trips to collect one particular ant form or one particular nesting site). Visits to each station were made as nearly as possible once every month. They were continued up to (and, in reality, past) the point at which it was felt an accurate sample had been obtained, i.e., the point of diminishing returns. Equal lengths of time, from 2 1/2 to 3 hours, were spent at each station. In order to obtain a representative sample from each station, each type of nesting site was worked for a period of time proportionate to its abundance in that particular station. For example,

in longleaf pine flatwoods there is more opportunity for ants to nest in the bases of trees than in the open sand, and therefore the former was collected proportionately longer than the latter in that association.

Most of the collections were made by forceps, and some were made with an aspirator. The daily collection from each station was supplemented by putting the litter from approximately two square feet of soil surface through a Berlese funnel. The litter was left on the funnel with no external heat for two or three days until dry.

To sample the contents of the litter in the field, several other Berlese-type funnels were built from five-gallon lard cans. The funnel itself consisted of an inverted light reflector which led to a hole in the bottom of the can; over the light reflector different mesh screening or hardware cloth could be placed. To activate the animals a few drops of household ammonia were introduced, and the top placed on the can. Such funnels were left an hour or less.

Another supplementary Berlese-type funnel was made from a household funnel by fastening wire screen over its top and running a rubber tube from its bottom into a vial. Small pieces of wood, pieces of moss, and other similar objects were placed on this funnel, and a light bulb, usually sixty watts, was lowered in a reflector over the funnel. Other special collecting was accomplished by use of molasses traps, and a light trap. The ants from these last two funnels, and from the traps were not figured in the relative abundance.

For each colony collected, the blanks on a field data sheet (Fig. 2) were filled in, except when two or more collections of the same form were made in identical situations. In these cases, only one field data sheet was filled in, but the appropriate relative abundance

University of Florida Conservation Reserve, Welaka
(except as noted) 1948-1950

_____ Coll. No. _____
Det. by AVP _____ Coll. by AVP _____

Station: I1a I2a I3a I4b I4d II1a II2a II2b II3a II1la
III2a III3a IV1a IV2a IV3a
Areas not on Reserve: _____

Forceps Berlese Seen Trap: _____

Nesting sites:
A. Under soil surface
1. Open sand
a. No crater _____
b. Rudimentary crater _____
c. Incomplete crater _____
d. Complete crater _____
2. In and under litter _____
3. Under log (sp.;decay) _____
4. Under and in log (sp.;decay) _____
B. On soil surface
5. In fallen log (sp.;decay) _____
6. In palmetto log on ground (sp.;decay) _____
7. In living palmetto root/trunk (sp.) _____
8. In dead stump (sp.;decay) _____
9. In base of living tree (sp.) _____
10. In litter _____
C. Grass
11. In base of grass clump (sp.) _____
12. Between sawgrass blades _____
13. In tall grass stem (sp.) _____
D. Arboreal
14. Twig (with only center wood absent) (sp.) _____
15. Small branch (with many passageways) (sp.) _____
16. Gall (sp.;sp. tree) _____
E. Other (where found) _____
F. Wandering _____

Characteristics of nest: In shade In sun Diameter of nest: _____
Height of nest: _____ No. openings: _____
Forms present: Males Females Callows Eggs Larvae Pupae:
Queen(s) Male Female Worker
Commensals (sp.) _____
Local abundance: abundant common occasional rare
Amount of activity: very considerable considerable moderate slow
no movement
Physical factors: Day Night: Rainy Overcast Cloudy Clear
Time _____ Temp. _____ Relative humidity _____
Disposition of collection: AVP Not kept Pinned Other _____
Remarks: (over)

Fig. 2. -- Field data sheet.

was checked.

Each collection was recorded on the field data sheet as follows: The blanks in the upper left hand corner of the field data sheet were filled in with the name of the form taken and the determiner. In the other corner, the collection number, which combined the date with the number of a given collection made on that date, was written. The stations were given code numbers (see p. 16) to save space and facilitate recording on this sheet and elsewhere. The I's indicate high areas of sandhills, scrub, or scrubby flatwoods; the II's are the other flatwoods; the III's are the hammocks; and the IV's are the seasonally flooded areas. On each sheet the station collected was encircled. On the next line below the list of stations, the means of collection was indicated. Then the nesting site was checked, and where applicable the species of plant in which the nest was found, its state of decay, and any other peculiarities of the nest were listed. The rest of the sheet is self-explanatory. Remarks of various natures pertaining to the ant in question were written on the back of the sheet.

Relative Abundance

If on one collecting trip of two and one-half hours to a given station an ant form was collected six times or more, it was considered abundant; if collected four or five times, common; two or three times, occasional; and if collected only once, it was treated as rare in that locality. The relative abundance data for each collecting trip was recorded in the field.

A form collected only once or twice in a given day may have a sporadic occurrence in the area of the station collected, and yet have a relatively high abundance over a period of time in that station.

Because of such possible discrepancies, a relative abundance figure based on the 17 collecting trips was compiled for each form in each station so as to give a truer representation. On this basis, a form is considered abundant if it was collected in a station forty times or more; common, if collected thirteen to thirty-nine times; occasional, if collected two to twelve times; and rare if collected once.

COLLECTING STATIONS ON THE RESERVE

Summary of Recognized Stations

For convenience in referring to the field data sheet, the plant association-soil type combinations, or stations, are expressed by letters and numbers representing the drainage, vegetation, and soil type of the station. For example, IIa represents a well drained station supporting the *Pinus palustris-Quercus laevis* association on Lakeland fine sand. The stations chosen are:

I. Well drained areas other than hammocks

1. *Pinus palustris-Quercus laevis* association

a. Lakeland fine sand (Turkey oak sandhills or uplands)

2. *P. palustris-Q. cinerea* ass.

a. Blanton f. s. (Bluejack oak sandhills)

3. *P. clausa-Q. virginiana* var. *geminata-Q. myrtifolia-Q. chapmanii* ass.

a. St. Lucie f. s. (St. Lucie scrub or scrub)

4. *Q. virginiana* var. *geminata-Q. myrtifolia-Q. chapmanii* ass.

b. Leon f. s., light colored surface phase (Leon scrubby flatwoods)

d. Pomello f. s. (Pomello scrubby flatwoods)

II. Poorly drained flatwoods

1. *P. palustris-Aristida stricta* ass.

a. Leon f. s. (Longleaf pine flatwoods)

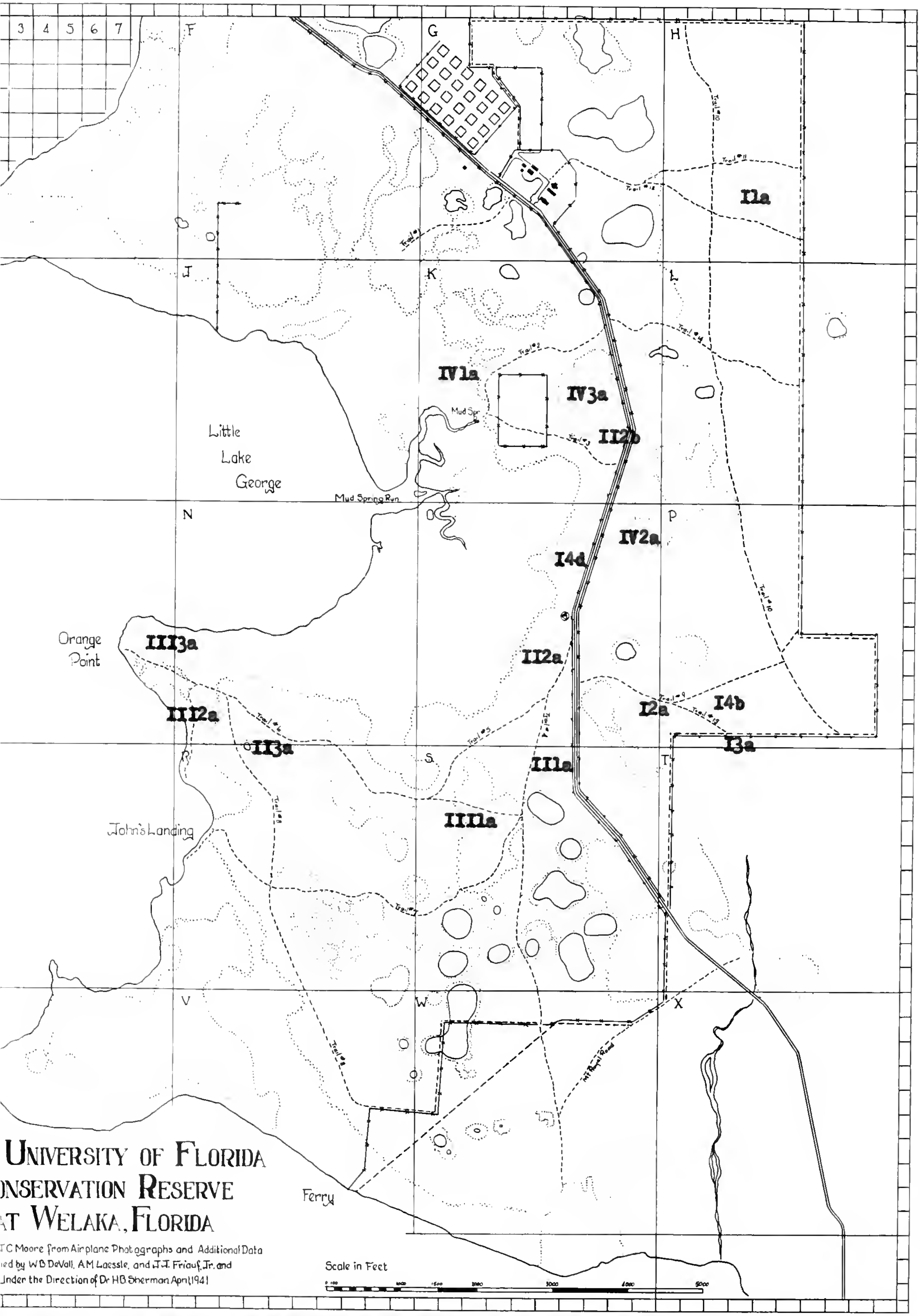
2. *P. elliotti* ass.

a. Plummer f. s. (Plummer slash pine flatwoods)

b. Rutlege f. s. (Rutlege slash pine flatwoods)

Map 3: Distribution of Stations on the Reserve.

I1a.	Turkey oak sandhills or uplands
I2a.	Bluejack oak sandhills
I3a.	St. Lucie scrub or scrub
I4b.	Leon scrubby flatwoods
I4d.	Pomello scrubby flatwoods
II1a.	Longleaf pine flatwoods
II2a.	Plummer slash pine flatwoods
II2b.	Rutlege slash pine flatwoods
II3a.	Black pine-fetterbush flatwoods
III1a.	Xeric hammock
III2a.	Mesic hammock
III3a.	Hydric hammock
IV1a.	River swamp
IV2a.	Bayhead
IV3a.	Marsh



Map 3: Distribution of Stations on the Reserve.

3. P. serotina-Desmothamnus ass.

a. Plummer f. s. (Black pine-fetterbush flatwoods)

III. Hammocks (Well drained to nearly saturated)

1. Q. virginiana ass.

a. Blanton f. s., hammock phase (Xeric hammock)

2. Magnolia grandiflora-Ilex opaca ass.

a. Blanton f. s., hammock phase (Mesic hammock)

3. Q. nigra-Liquidambar-Sabal palmetto ass.

a. Rutlege f. s. (Hydric hammock)

IV. Seasonally flooded areas

1. Taxodium distichum-Nyssa biflora ass.

a. Peaty muck (River swamp)

2. Gordonia-Tamala pubescens-Magnolia virginiana ass.

a. Rutlege f. s. (Bayhead)

3. Mariscus jamaicensis ass.

a. Peaty muck (Marsh)

Descriptions of the Stations[1]

Turkey oak sandhills

(P. palustris-Q. laevis ass.; Lakeland f.s.)

The location of this station (see Map 3) is in the northeast portion of the Reserve, between Trails 10, 11, and 12. Characteristic trees are the longleaf pine (P. palustris[2]) and turkey oak (Quercus laevis).

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[1] For a fuller discussion of the vegetation and soils of the Reserve as a whole, and of the stations mentioned here, the reader should see Laessle (1942).
[2] The scientific names of pines are taken from West and Arnold (1946).

Bluejack oak (Q. cinerea) and live oak (Q. virginiana) are also present, but are not so plentiful. Below the widely spaced trees is a scanty herbaceous vegetation consisting in the main of wiregrasses (Aristida stricta and Sporobolis gracilis). Between these rather dense patches of wiregrass there are areas of bare, pale gray sand.

Lakeland fine sand (Laessle's Norfolk fine sand, deep phase) may occur on level or gently sloping areas of uplands, but on the Reserve it appears chiefly in the rolling turkey oak sandhills. The soil has good drainage, but it is not as excessive as that of St. Lucie fine sand and Lakewood fine sand. It has more organic matter in the surface layer than either of the latter soils.

Bluejack oak sandhills

(P. palustris-Q. cinerea ass.; Blanton f. s.)

This station is located at the junction of Trails 9 and 13 in the middle of the eastern side of the Reserve. The vegetation is similar to that of the turkey oak sandhills, except that bluejack oak (Q. cinerea) is the codominant instead of turkey oak. The pines of this station are larger and more numerous in a given area than in the turkey oak sandhills, and there is consequently more pine needle litter. This litter, along with the wiregrass and the litter added by the oaks, forms a complete and sometimes dense mat.

Blanton fine sand possesses good to fair drainage. Although the soil has no organic hardpan, there is a tendency toward one at a depth of three feet where the soil borders Leon fine sand.

St. Lucie Scrub

(P. clausa-Q. spp. ass.; St. Lucie f. s.)

The area chosen for this station is located just over the Reserve fence at the end of Trail 13. Part of this area of scrub extends onto the Reserve east of Trail 13, but the larger area over the fence was chosen as more typical.

Laessle points out that the patch of scrub in question lacks certain characteristic plants of the Florida scrub in general. Important among these are rosemary (Ceratiola ericoides) and the semaphore cactus (Opuntia austrina). A rather dense growth of sand pine (P. clausa) makes up the upper story of the station, while scrub oaks, along with several other shrubs, comprise a lower layer. Among the oaks may be listed twin live oak (Q. virginiana var. geminata) and Chapman's oak (Q. chapmanii) while staggerbush (Xolisma ferruginea), saw palmetto (Serenoa repens), silk bay (Tamala humilis), and species of Ilex are other shrubs found at the station. A few vines and herbs, along with mosses and lichens are also to be found. It is pointed out by Laessle (1942:29) that "in spite of the xeromorphic nature of the scrub vegetation, with its small, heavily cutinized, often revolute, and hairy leaves.... comparatively mesic conditions are found...." in scrub because of the close, low, and consequently dense growth.

St. Lucie fine sand is characteristic of higher areas where drainage is excessive or nearly so. Organic matter has opportunity to remain only in the first inch of the profile. Below this the rainwater leaches it rapidly through the large particles of what perhaps were ancient dune sands, to give a loose, white sand.

Leon scrubby flatwoods

(Q. spp. ass.; Leon f. s., light colored surface phase)

This station is located between Trails 9 and 13 in the middle portion of the eastern side of the Reserve. The vegetation is like that of the St. Lucie scrub, except that the sand pine and the silk bay, as well as certain other plants, are absent. A few trees of longleaf pine may be present as relics.

Leon fine sand, light colored surface phase (Laessle's Leon fine sand, scrubby phase) holds a position between Pomello fine sand and St. Lucie fine sand on the one hand, and the typical Leon fine sand on the other. It is better drained than the latter and more poorly drained than the former. The hardpan is usually within thirty to forty-two inches of the light gray or almost white surface.

Pomello scrubby flatwoods

(Q. spp. ass.; Pomello f. s.)

The patch of this scrubby flatwoods studied is located one hundred yards west of the highway, and about 1/4 mile northwest of the fire tower. The vegetation is very much like that of the Leon scrubby flatwoods. Laessle (1942:30) sums up the differences between the two as follows: "I am able to detect no fundamental vegetational difference .... except that there is a noticeable difference in the greater height attained by the shrubs [of the Pomello soil] and the longleaf pine always seems lacking there."

Pomello fine sand (Laessle's St. Lucie fine sand, flat phase) is more poorly drained than St. Lucie fine sand, and better drained than Leon fine sand. It differs from Leon fine sand, light colored surface phase, in drainage as noted above, and in possessing no hardpan within forty-two inches of the surface.

Longleaf pine flatwoods

(P. palustris-A. stricta ass.; Leon f. s.)

This station is located between Trail 4 and the highway, about 3/8 mile from the fire tower. The vegetation is dominated by somewhat scattered, large longleaf pines; small longleaf pines are quite abundant. Saw palmetto, gallberry (Ilex glabra), and fetterbush (Desmothamnus lucidus), as well as other shrubs, are found here. The ground cover consists largely of wiregrass (A. stricta), but much indian grass (Sorghastrum secundum) is present. Since fire has been kept out for several years now, the shrubs, especially those mentioned above, are growing profusely, and wiregrass is being forced out.

These flatwoods, which are fire subclimax for this region, grow on Leon fine sand. It is higher than Plummer fine sand and Rutlege fine sand. The soil has a gray or salt-and-pepper surface becoming lighter down to a brownish black hardpan consisting of fine sand particles cemented together with organic matter. Below the hardpan, at twenty-eight to thirty-four inches from the surface, the sand is only partially cemented with organic matter, and becomes lighter brown with depth.

Plummer slash pine flatwoods

(P. elliotti ass.; Plummer f. s.)

The location of this station is a little less than 1/4 mile southwest of the fire tower. It supports the dominant slash pine (P. elliotti) and a few longleaf and black pines. Saw palmetto and other shrubs are present, along with several grasses, among them Andropogon.

Plummer fine sand, found in many cases between longleaf pine flatwoods and the lower hydric hammocks, is a gray to light gray soil. It contains a brown stained fine sand, usually at about three feet.

Rutlege slash pine flatwoods

(P. elliotti ass.; Rutlege f. s.)

This station is north of Trail 3 and just west of the highway. The vegetation, dominated by slash pine (P. elliotti), and composed of scattered trees of longleaf pine (P. palustris) and black pine (P. serotina), is similar to that of Plummer slash pine flatwoods. Its shrubs consist of fetterbush (Desmothamnus lucidus), saw palmetto (Serenoa repens), and others. Because of lack of fire, these shrubs have become dense, and are in many places shading out the ground layer of short grasses.

The surface ten inches of Rutlege fine sand (Laessle's Portsmouth fine sand) contain much organic matter and are dark gray or black. The station is low, and in times of heavy rain the soil may become supersaturated.

Black pine-fetterbush flatwoods

(P. serotina-Desmothamnus ass.; Plummer f. s.)

This station is about 1/4 mile east of the junction of Trails 6 and 8, on the south side of Trail 6, near the middle of the west side of the Reserve. The trees of the area are widely scattered black pine (P. serotina), but thickets of fetterbush are fairly dense between the pines. Among these thickets are open areas with little or no litter in which the most important plants are the broom sedge (Andropogon) and shorter grasses. The thickets themselves are on areas raised a few inches above the lower, open soil, presenting available space for nests when the lower areas become temporarily supersaturated during the summer rains.

Although the soil of this station (designated St. Johns fine sand by Laessle) may not be typical Plummer fine sand, it is placed under that heading. The lack of a hardpan within the eighteen to twenty-four inch level suggests Plummer rather than the best alternative, St. Johns fine sand. Over the surface of the very flat area, the organic matter is tightly packed.

Xeric hammock

(Q. virginiana ass.; Blanton f. s., hammock phase)

Located in the only large area of live oak on the Reserve, this station extends between Trails 6 and 7 from near their junction for about a quarter of a mile. The dominant tree is live oak (Q. virginiana). There are also numbers of bluejack oak (Q. cinerea) and laurel oak (Q. laurifolia), and some cabbage palmetto (Sabal palmetto). A few trees of longleaf pine (P. palustris) and loblolly pine (P. taeda) are present. Chapman's oak, as well as other shrubs, wild grapes (Vitis spp.), virginia creeper (Parthenocissus quinquefolia), and grasses of the genus Panicum make up part of the rest of the flora. Because of the well-spaced large trees, the area is quite open, except in those clumps where scrub oaks, with other lower vegetation, have grown together to form more or less dense thickets.

Blanton fine sand, hammock phase, has a profile much like that of the typical Blanton fine sand. The soil at this station is higher than that of the surrounding Leon fine sand flatwoods.

Mesic hammock

(Magnolia grandiflora-Ilex opaca ass.; Blanton f. s., hammock phase)

This station is next to the river, just south of Orange Point. The area supports a denser growth than the xeric hammock. The top

canopy allows comparatively little sunlight to filter through, and consequently the litter is moist much of the time. While it is not mature enough to represent a typical climax association, it does support bull bay (Magnolia grandiflora) and American holly (Ilex opaca), along with various large oaks and pignut hickory (Hicoria glabra). Saw palmetto and staggerbush (Xolisma ferruginea) are abundant. Among the vines are scuppernong (Muscadina rotundifolia), Smilax bonanox, and virginia creeper. Few herbs are present. As in the xeric hammock, the soil type here is Blanton fine sand, hammock phase.

Hydric hammock

(Q. nigra-Liquidambar-Sabal palmetto ass.; Rutlege f. s.)

The site of this station is 1/8 mile west of the junction of Trails 6 and 8 at Orange Point, between the mesic hammock just described and the lower river swamp. As the name of the association indicates, water oak (Q. nigra), sweetgum (Liquidambar styraciflua), and cabbage palmetto (Sabal palmetto) are common. Also prevalent are swamp red bay (Tamala pubescens) and Florida elm (Ulmus floridana). Large relic slash pines are also to be found infrequently. Poison ivy (Toxicodendron radicans) and blaspheme vine (Smilax laurifolia), and the shrubs wax myrtle (Cerothamnus ceriferus) and saw palmetto are not uncommon. In a lower layer, Osmunda spp. are to be found. The ground, which at times becomes very wet to saturated, supports patches of sphagnum. The Rutlege fine sand is much the same as described under Rutlege slash pine flatwoods. It supports a comparatively dense growth, the top canopy of which is broken in only a few places.

River swamp

(Taxodium distichum-Nyssa biflora ass.; Peaty muck)

This station is located just north of Mud Springs. Dominant among the trees which form a fairly thick canopy are bald cypress (Taxodium distichum), water tupelo (Nyssa biflora), red maple (Rufacer rubrum), and cabbage palmetto. The shrubs buttonbush (Cephalanthus occidentalis), Salix longipes, and wax myrtle are present, along with several vines, and only few herbs. The peaty muck is high in organic material from the decomposition of debris, and is consequently dark brown or black. There is standing water at this station almost all year, except just before the summer rainy season. The water isolates hummocks, formed by the root systems of trees and raised a foot or more above the lowest level of the ground.

Bayhead

(Gordonia-Tamala pubescens-Magnolia virginiana ass.; Rutlege f. s.)

The bayhead used for this station is about 1/4 mile south of the gate to Trail 3 on the east of the highway. Dominant in this station are the broadleaved evergreens, loblolly bay (Gordonia lasianthus), swamp red bay (Tamala pubescens), and white bay (Magnolia virginiana). A few shrubs, chiefly wax myrtle, are supported, as well as blaspheme vine and poison ivy. The dense canopy allows little herbaceous growth, but sphagnum patches occur. This bayhead is formed in a depression of the longleaf pine flatwoods which surrounds it. As its name suggests, bayheads head up incipient streams which find their way to the river, and consequently maintain standing water at almost all seasons, except perhaps just before the summer rainy season. Certain portions, especially toward the edge, remain comparatively dry, but the Rutlege fine sand is always moist.

Marsh

(*Mariscus jamaicensis* ass.; Peaty muck)

The area of this station is between Trails 2 and 3, near Mud Springs. It supports a growth of dominant saw grass (*Mariscus jamaicensis*), scattered buttonbush, and *Sagittaria*, along with several other smaller plants. The saw grass is in most parts of the station so thick that not much, if any, plant life exists besides the saw grass.

The peaty muck of this station is covered with water almost all year. A foot or a foot and a half of water accumulates during the summer rainy season. Unlike the river swamp, the ground here is completely covered with water, and there are no saturated, emergent hummocks.

ECOLOGICAL RELATIONSHIPS

By means of repeated collecting trips to the stations, it was found that each contained a characteristic and distinctive assemblage of ant forms. The stations therefore represent ant habitats. It was also discovered that certain strata and nesting sites (as defined, p. 9) contained distinctive assemblages. These could also then be considered ant habitats.

Description of the Strata and Nesting Sites

The strata found to be significant in designating assemblages in the present study are: 1) subsurface or subterranean; 2) surface or ground; 3) grass or herbaceous; and 4) shrub or arboreal. Included in the first stratum are all those nests which occur in sand, whether they are under logs, litter, or some other cover, or are in the open with no cover. Nests in the surface stratum are those which occur in any of the following: litter, fallen log, palmetto root on ground, under mat of palmetto root or trunk, dead stump, base of living tree, and grass clump. Those nests which are built in and under logs are included in the stratum in which their largest portions were found. For example, if a colony has its largest part in a log rather than in the sand under the log, the nest is recorded in the surface stratum. The herbaceous stratum consists of two nesting sites, namely, in tall grass stems (includes Mariscus), and in and between sawgrass blades. The shrub or arboreal stratum includes small branches, twigs, or galls.

The nesting sites recognized in these four strata are as follows:

A. Subterranean Stratum

1. Open sand -- Those nests which were found in sand with no cover. These were divided into four types: 1) no crater -- any nest built in the open with no crater of sand pellets on the surface around the nest opening; 2) rudimentary crater -- those nests in which a mound or string of several or many openings was built in seemingly unorganized fashion; 3) incomplete crater -- those nests in which the crater of sand pellets was not built in a complete circle; and 4) complete crater -- a nest with a complete circle of sand pellets around the nest opening. Incomplete craters are probably only unfinished complete craters.

2. In and under litter -- indicates situations in which a nest may be either in and under litter or merely under litter. Most of the nests in this category were actually under litter. A majority of the nests which extended from the sand into litter were probably only in litter temporarily.

3. Under log -- those nests in sand with the nest openings under a log.

4. Under and in log -- those nests with portions of the colony both under logs and in logs.

B. Surface Stratum

5. In fallen logs -- includes all logs except those of palmetto.

6. Palmetto logs on ground -- with their scaly structure, offered a distinct nesting site, which even though rarely found was usually inhabited.

7. In living palmetto root or trunk -- on living palmetto roots and on the bases of palmetto trunks, nests occur in the debris

beneath the mat and between the bases left by fallen fronds.

8 and 9. Nests in dead stumps, and in the bark at the bases of living trees -- usually occurred in the moist first four inches above the soil surface.

10. In litter -- those nests built in and on fallen leaves, especially live oak. This type of nest occurred most often in mesic hammock on oak leaves which had fallen so that the convex surface was next to the ground. The ants lived on the inverted, concave surface, and the colony was covered by one or more leaves. This was a favorite nesting site of Paratrechina parvula (Mayr), and although other ants, such as Pheidole dentata Mayr, were found in it, they nested there only seldom. Other nests in this category were taken in the lower areas of the Reserve from piles of pine needles supported by low vegetation.

11. Nests in the bases of grass clumps are built mostly between the appressed blades of grass and in the roots. Various ants occur in this nesting site, usually in low areas such as Rutlege slash pine flatwoods, but again Paratrechina parvula (Mayr) is most abundant. Nests of this kind are especially numerous during the wet season. Although this category was first placed in the herbaceous stratum, its close relation to other nesting sites in the surface stratum makes it necessary to place it in the latter stratum.

C. Herbaceous Stratum

12. Between sawgrass blades -- this category is very much like the last in that the ants nest between appressed blades. Where sawgrass occurs, however, there is standing water most of the year, and nests cannot extend into the roots. Paratrechina parvula (Mayr) is a major inhabitant of the sawgrass too.

13. Tall grass stems -- Most of the tall grass in which ants live is of the genus Andropogon. Other tall grasses do not allow enough room for the ant to move within the stem. One of the few inhabitants of the tall grass stems is Pseudomyrma pallida F. Smith, but it is found there abundantly. Also included within this category are the flower stalks of sawgrass, although the occurrence of ants within them is not great.

D. Arboreal Stratum

14. Twigs -- those branches from which the center core of wood is absent, providing only enough room for the ant to crawl through.

15. Small branches -- those branches which have multiple passageways, or which retain only the bark and a very little of the wood.

16. Galls -- Nests in galls seem to be made only after the gall insect has emerged. The ants always use the opening made by the emerging gall insect as a nest opening, but some galls showed additional openings quite evidently made by the ants.

A miscellaneous category, "other", is used for nests in pine cones, fern roots, under stones, and other such places which are of little consequence for nesting on the Reserve.

Availability of Nesting Sites in Stations

Table I shows the relative abundance of places to nest in the various stations. This abundance is purely subjective, based on the field experience of the author, and is used to indicate the abundance of a given place to nest in a given station relative to that of the same place in another station. The column "Litter" serves a double purpose in designating the availability of nesting places both in litter and in and under litter. Likewise, the column "Broadleaved or pine logs"

TABLE I

AVAILABILITY OF NESTING SITES

Rare -- R; occasional -- O;
common -- C; abundant -- A

	Turkey oak	Bluejack oak	Scrub	Leon fws.	Pomello fws.	Longleaf fws.	Plummer fws.	Rutlege fws.	Black pine fws.	Xeric hammock	Mesic hammock	Hydric hammock	River swamp	Bayhead	Marsh
Sand with no litter	O-C	R-O	R-O	O	O	R	R	-	R	C	R	-	-	-	-
Litter	C	A	A	C	C-A	A	A	A	C-A	O-C	A	A	R-O	A	-
Broadleaved or pine logs	O	C	C	R	R	O	O	R	R	O-C	O	C	A	C	-
Palmetto logs	-	-	R	R	R	R	R	R	R	-	R	R	-	-	-
Palmettos	-	-	C	C	C	C	C	C	C	R	A	O	R	R	-
Broadleaved or pine stumps	O-C	C	R	R	R	O	R	R	R	O	O	C	O	R	-
Living trees and shrubs	C	C	A	A	A	C	C	O	O	C	A	A	A	A	R
Grass clumps	-	R	R	R	R	R-O	C	A	C	O	R	R	-	-	-
Sawgrass plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A
Tall grass plants	-	-	-	-	-	C	O	R	A	R	-	-	-	-	-
Twigs	R	R	O	O-C	R-O	R	R	R	-	O	C	C	C	O	C
Small branches	C	C	O-C	A	A	O	O	R	R	O	A	A	C	C	-
Galls	R	O	O	C-A	A	-	-	-	-	O	R	-	-	-	-

indicates the availability of places to nest in and under logs, under logs, and in fallen logs. The table therefore indicates the availability of the nesting sites in the stations.

In parts of hydric hammock and bayhead, litter not only covers the whole surface area, but it is also thick, sometimes reaching a depth of six inches or more. Ants that lived under litter were found to be at a minimum, being replaced by ants living in litter and in the maze of roots and decaying logs buried in litter. Litter is common or abundant in almost every station except swamp and marsh. Here the availability of nesting sites in litter is cut down by the seasonally standing water. In stations such as xeric hammock and turkey oak, where the tree, shrub, and herb growth is widely spaced, large patches of bare sand are present.

Logs are not abundant on the Reserve, except in hydric hammock and river swamp, because of the logging operations being carried on. In the swamp, however, most of the logs are under water for the best part of the year, and consequently offer no nesting places. The column "Living trees and shrubs" indicates the abundance of the possible nesting places in the bases of trees and shrubs. Nesting sites are found almost always in the bases of pine trees, rather than in the bases of broadleaved trees.

"Grass clumps" shows the abundance of clumps of grass, including the bases of the tall grasses. "Tall grass plants" denotes Andropogon. The stems, in which the ants live, die in the winter, and although some remain suitable for nesting sites throughout the year, there is a tendency for this nesting site to disappear seasonally.

Distribution of Ant Forms in Stations

Table II shows the distribution of ant forms in stations on the Reserve. In general, they preferred the higher and more open areas in which to nest. Xeric hammock and turkey oak contained the largest number of forms with 43 and 42 respectively. The next 11 stations held smaller and smaller numbers of forms, the numbers diminishing by one to three per station. The black pine-fetterbush flatwoods supported only 17 forms, and the number dropped to 11 in marsh. The number of forms per station is as follows:

xeric hammock -- 43
turkey oak -- 42
bluejack oak -- 33
scrub -- 30
mesic hammock -- 30
longleaf pine flatwoods -- 29
hydric hammock -- 27
Leon scrubby flatwoods -- 27
Pomello scrubby flatwoods -- 25
bayhead -- 24
Plummer slash pine flatwoods -- 22
river swamp -- 21
Rutlege slash pine flatwoods -- 20
black pine-fetterbush flatwoods -- 17
marsh -- 11

The mean number of forms collected in one station is 26.7, a figure lying between hydric hammock or Leon scrubby flatwoods and Pomello scrubby flatwoods, near the middle of the list.

The difference of 9 forms between the first two stations and the next highest probably indicates an aspect of the unnaturalness of the Reserve. Where there should be logs under what are natural conditions in other portions of the state, the timber has been removed on the Reserve before it fell. Longleaf pine flatwoods and mesic hammock should contain more fallen logs than they do, with a correspondingly greater number of log-inhabiting forms. In Gainesville, a more typical mesic hammock,

TABLE II

RELATIVE ABUNDANCE OF ANT FORMS IN STATIONS

Rare -- R; occasional -- O;
common -- C; abundant -- A

	Turkey oak	Bluejack oak	Scrub	Leon fws.	Pomello fws.	Longleaf fws.	Plummer fws.	Rutlege fws.	Black pine fws.	Xeric hammock	Mesic hammock	Hydric hammock	River swamp	Bayhead	Marsh
1. Eciton nigrescens.....	-	-	-	-	-	-	-	-	-	-	R	-	-	-	-
2. E. opacithorax.....	-	-	-	-	-	O	-	-	-	-	-	-	-	-	-
3. Amblyopone pallipes.....	-	-	-	-	-	-	-	-	-	-	-	-	-	R	-
4. Proceratium croceum.....	-	R	-	-	-	O	-	-	-	-	-	-	-	-	-
5. P., near silaceum.....	-	-	-	-	-	-	R	-	-	-	-	-	-	-	-
6. Euponera gilva.....	-	-	-	-	-	-	-	-	-	-	R	O	-	-	-
7. Ponera ergatandria.....	R	R	-	-	-	-	-	-	R	-	O	O	-	-	-
8. P. opaciceps.....	-	-	-	-	-	-	-	R	-	R	-	C	C	R	A
9. P. trigona opacior.....	O	O	O	O	-	R	O	R	R	C	O	O	-	O	-
10. Odontomachus haematoda insularis	C	O	O	C	O	C	C	O	A	C	A	C	C	C	-
11. Pseudomyrma brunnea.....	O	-	R	O	O	-	-	R	-	R	O	O	O	R	O
12. Ps. pallida.....	O	O	-	C	-	C	O	O	A	R	-	-	-	-	-
13. Pogonomyrmex badius.....	O	O	-	-	-	-	-	-	-	C	-	-	-	-	-
14. Aphaenogaster ashmeadi.....	R	O	O	O	-	-	-	-	-	C	O	-	-	R	-
15. A. floridana.....	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16. A. fulva.....	-	-	O	-	-	O	-	R	-	R	-	O	C	O	R
17. A. lamellidens.....	-	-	-	-	-	-	-	-	-	R	-	-	-	-	-
18. A. macrospina.....	-	O	-	-	-	O	-	O	-	-	-	-	-	-	-
19. A. texana.....	-	-	O	-	-	R	-	-	-	R	R	-	-	-	-
20. A. treatae.....	-	-	R	O	-	-	-	-	-	-	-	-	-	-	-

TABLE II (cont.)

	Turkey oak	Bluejack oak	Scrub	Leon fws.	Pomello fws.	Longleaf fws.	Plummer fws.	Rutlege fws.	Black pine fws.	Xeric hammock	Mesic hammock	Hydric hammock	River swamp	Bayhead	Marsh
21. Pheidole dentata.....	C	A	A	A	A	C	C	C	C	C	A	C	A	O	R
22. Ph. dentigula.....	-	-	O	-	O	-	O	?	-	O	O	O	-	O	-
23. Ph., near floridana.....	C	C	R	R	C	O	O	O	R	R	O	R	O	-	-
24. Ph. metallescens.....	C	C	C	C	-	R	-	-	-	A	O	-	-	-	-
25. Ph. morrisi.....	O	O	-	O	O	-	-	-	-	C	-	-	-	-	-
26. Ph. pilifera.....	Orange grove														
27. Cardiocondyla emeryi.....	-	R	-	-	-	-	-	-	-	O	-	-	-	-	-
28. C. nuda minutior.....	-	-	-	-	-	R	-	-	-	?	-	-	-	?	-
29. C. wroughtoni bimaculata.....	C	-	-	R	-	R	-	-	-	-	-	-	-	-	-
30. Crematogaster minutissima missouriensis.....	-	O	O	-	R	-	C	O	-	O	C	C	R	C	-
31. Cr. ashmeadi.....	O	O	C	C	A	C	R	-	R	O	O	R	O	-	-
32. Cr. coarotata vermiculata.....	-	-	-	-	-	-	-	-	-	-	-	O	O	-	-
33. Cr. laeviuscula.....	R	O	-	-	-	C	C	A	-	R	O	C	-	C	A
34. Cr. lineolata.....	-	-	-	O	C	-	-	-	-	O	-	-	-	-	-
35. Monomorium floricola.....	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36. M. minimum.....	O	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37. Solenopsis geminata.....	O	O	R	C	O	O	-	-	-	O	-	O	O	-	-
38. S. rufa.....	R	-	-	-	-	R	O	-	-	-	-	-	-	-	-
39. S. globularia littoralis.....	-	-	-	-	-	-	-	-	O	-	-	-	-	-	-
40. S. minutissima ?.....	O	O	O	-	O	-	O	-	-	R	O	O	R	O	-
41. S. molesta.....	O	O	C	O	O	O	C	O	O	O	A	C	-	O	-
42. S. pergandei.....	O	-	-	R	-	-	-	-	-	O	R	-	-	-	-
43. S. picta.....	O	O	O	O	O	O	O	O	R	R	O	O	R	C	-
44. Myrmecina americana.....	-	-	R	-	-	-	-	-	-	-	-	-	-	-	-
45. Leptothorax pergandei floridanus	C	C	C	C	O	C	R	-	C	C	O	R	-	-	-

TABLE II (cont.)

	Turkey oak	Bluejack oak	Scrub	Leon fws.	Pomello fws.	Longleaf fws.	Plummer fws.	Rutlege fws.	Black pine fws.	Xeric hammock	Mesic hammock	Hydric hammock	River swamp	Bayhead	Marsh
46. Leptothorax texanus davisi.....	O	R	-	O	-	-	-	-	R	R	-	-	-	-	-
47. Tetramorium guineense.....	R	-	-	-	-	-	-	-	-	-	-	O	R	-	O
48. Strumigenys louisianae.....	R	R	-	-	-	-	-	-	-	R	R	-	R	-	-
49. Smithistruma bunki.....	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50. Sm. clypeata.....	-	-	-	-	-	-	-	-	-	O	-	-	-	-	-
51. Sm. creightoni.....	-	-	-	-	-	-	-	-	-	O	-	-	-	R	-
52. Sm. dietrichi.....	O	R	-	-	-	-	-	-	-	-	-	-	-	-	-
53. Sm. ornata.....	-	-	R	-	-	-	-	-	-	-	R	-	-	-	-
54. Sm. pulchella.....	-	-	-	-	-	-	-	-	-	R	-	-	R	-	-
55. Sm. talpa.....	-	-	-	-	R	-	-	-	-	-	R	R	-	R	-
56. Trachymyrmex septentrionalis seminole.....	C	O	O	O	O	-	-	-	-	C	R	-	-	-	-
57. Dolichoderus pustulatus.....	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O
58. Iridomyrmex humilis.....	Palatka, ruderal														
59. I. pruinosus.....	C	O	O	C	O	C	-	-	C	O	-	-	-	-	-
60. Dorymyrmex pyramicus flavopectus.	Welaka, ruderal														
61. D. pyramicus.....	O	R	-	-	-	-	-	-	-	O	-	-	-	-	-
62. Tapinoma sessile.....	-	-	-	-	-	-	-	-	-	-	-	-	-	-	R
63. Brachymyrmex depilis.....	O	O	O	O	O	C	C	O	C	-	O	O	-	O	-
64. Camponotus castaneus.....	-	-	O	O	O	R	R	O	-	O	O	R	O	O	-
65. C. socius.....	C	O	-	O	-	-	-	-	-	C	-	-	-	-	-
66. C. nearcticus.....	O	O	R	-	O	O	-	-	-	-	O	-	O	R	-
67. C. (Colobopsis) spp.....	-	-	O	-	O	-	R	R	-	O	O	O	O	O	C
68. C. abdominalis floridanus.....	C	C	C	C	O	C	C	O	C	C	C	C	O	O	O
69. Paratrechina longicornis.....	Crescent City, ruderal														
70. P. arenivaga.....	A	R	-	O	R	R	R	-	-	A	-	-	-	-	-

TABLE II (cont.)

	Turkey oak	Bluejack oak	Scrub	Leon fws.	Pomello fws.	Longleaf fws.	Plummer fws.	Rutledge fws.	Black pine fws.	Xeric hammock	Mesic hammock	Hydric hammock	River swamp	Bayhead	Marsh
71. Paratrechina parvula.....	C	O	O	C	O	C	C	C	A	C	A	C	O	C	A
72. Prenolepis imparis.....	R	:	O	:	:	O	O	R	O	R	:	:	:	:	:
73. Formica archboldi.....	O	:	:	:	R	O	:	:	:	O	:	:	:	:	:
74. F. pallidefulva.....	O	:	:	:	O	R	:	:	:	:	:	:	:	:	:
75. F. schaufussi.....	R	:	:	:	:	R	:	:	:	:	:	:	:	:	:

with 39 forms, contained the highest number of ants collected in any plant association worked.

Turkey oak and xeric hammock offer the greatest opportunity for nesting in open sand. They are therefore able to attract those ants which prefer or must have nesting sites in open areas. At the same time they offer dry or moist litter, a few logs, and arboreal sites.

Two factors should be mentioned in regard to longleaf pine flatwoods. First, the logging operations remove many logs which would provide nesting sites, and perhaps attract a greater number of species to the area. Second, fire is conscientiously kept out of the Reserve. As a consequence, there is a dense growth of shrubs in the flatwoods and litter is becoming deeper over the whole area.

Only 17 forms were taken from black pine-fetterbush flatwoods. Since the station offers very little diversity of nesting sites, it excludes most of the other ants found on the Reserve. During the summer months it has standing water after every heavy rain; this tends to limit the ants to those which can withstand periodic submergence.

The low number of forms in marsh can also be traced to the small number of available nesting sites in that plant association. For all but a few months of the year there is standing water. There are no trees, but only scattered shrubs to offer small branches and twigs. The great majority of the nesting sites are between the appressed blades of sawgrass.

The number of collections made (the number of nests collected) in each station is as follows:

turkey oak -- 425
xeric hammock -- 373
black pine-fetterbush flatwoods -- 307
mesic hammock -- 295
Leon scrubby flatwoods -- 280
hydric hammock -- 245
scrub -- 226
bluejack oak -- 224
longleaf pine flatwoods -- 219
Pomello scrubby flatwoods -- 218
marsh -- 184
Plummer slash pine flatwoods -- 166
river swamp -- 166
bayhead -- 128
Rutlege slash pine flatwoods -- 120

The mean number of collections made in one station is 238.4, a figure lying between hydric hammock and scrub.

It will be noted that turkey oak and xeric hammock are at the top of the list with the greatest number of collections, as well as with the greatest number of forms. This emphasizes that these two stations are best suited to the ants for nesting situations. In this chart also, the higher and more open areas are at the top of the list. In this connection, the open black pine-fetterbush flatwoods was next to lowest in the number of forms taken from it, but it is third when the number of collections is considered. This indicates that black pine-fetterbush flatwoods is particularly favorable for the few ant forms occurring there. The opposite trend is shown by bluejack oak, which is relatively low in number of collections, but high in number of ant forms; such a trend indicates that suitable nesting sites are diverse, but scarce.

In general, those places in which the moisture and litter are intermediate are in the middle of the list. Last on the list are the seasonally flooded areas and the slash pine flatwoods. Marsh, which has the fewest number of forms, is more toward the middle of the list in numbers of collections. Bayhead and the slash pine flatwoods, on the other hand, are lower on the present list.

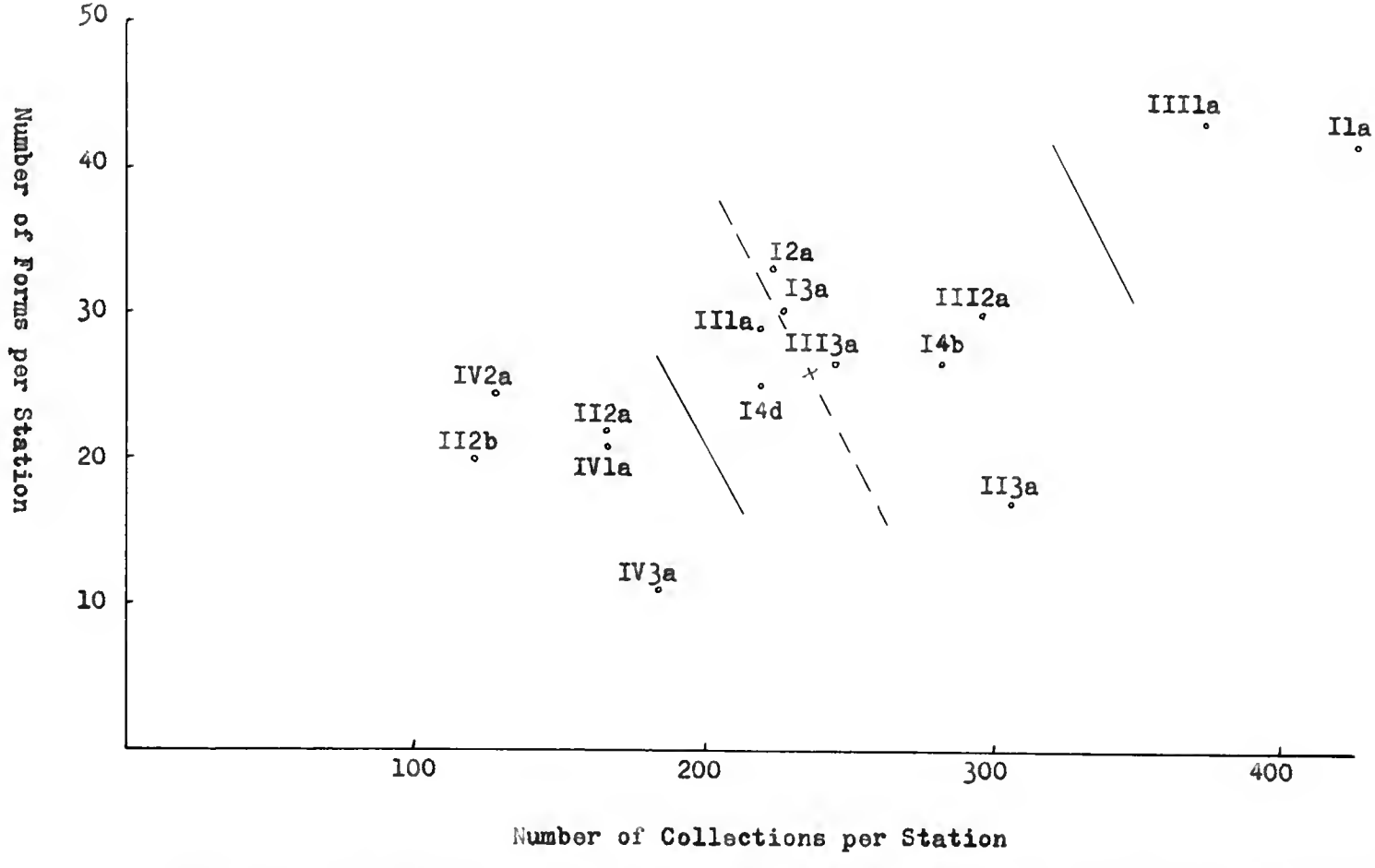

Fig. 3. -- Suitability of the stations for ants, based on the number of ant forms per station weighted against the number of collections per station. Ila, turkey oak; I2a, bluejack oak; I3a, scrub; I4b, Leon flatwoods; I4d, Pomello flatwoods; IIla, longleaf pine flatwoods; II2a, Plummer flatwoods; II2b, Rutlege flatwoods; II3a, black pine flatwoods; IIIla, xeric hammock; III2a, mesic hammock; III3a, hydric hammock; IVla, river swamp; IV2a, bayhead; IV3a, marsh.

Fig. 3. -- Suitability of the stations for ants, based on the number of ant forms per station weighted against the number of collections per station. The stations fall into three groups separated by the solid black lines. In general, the higher, more open areas are highest in number of forms and number of collections per station; the lower, wetter areas have the least of each; and the more mesic situations occur in the middle group on the graph.

The "x" represents the intersection of the average number of forms and the average number of collections per station. Those stations to the right of the dashed line are more suitable than average for ants, while those on the left are less suitable.

Since some of the stations differ in their positions on the lists more or less considerably, the number of forms per station and the number of collections per station are weighted in Figure 3 to obtain the over-all suitability of each station as a nesting situation. The numbers and letters near each point on the graph indicate the station which that point represents. It will be noted that three major groups are shown, separated on the graph by the solid black lines. The group lowest in the number of species and the number of collections per station contains all of the seasonally flooded areas plus the slash pine flatwoods. Plummer slash pine flatwoods is higher than Rutlege slash pine flatwoods in number of species and in number of collections, bearing out its closer resemblance in the field to longleaf pine flatwoods.

The middle group contains mesic and hydric hammock, bluejack oak, scrub, and all of the flatwoods, including scrubby flatwoods. It is possible that the thick stand of pine in the bluejack oak area is responsible for its relation to the longleaf pine flatwoods on the graph. The last group, xeric hammock and turkey oak, is outstanding for the large number of species and collections made in its two stations.

The "x" in Figure 3 represents the point at which the mean number of collections per station intersects the mean number of forms per station. Those stations to the right of the dashed line are more suitable than average for ants, while those on the left are less suitable than average.

Plant succession as depicted by Laessle for the Reserve (1942:95) is shown in Figure 4. Three psammoseres are recognized: 1) active dunes or strongly wave-washed sands, leading eventually to scrub; 2) residual sands neither strongly wind-sorted nor wave-sorted, with rolling

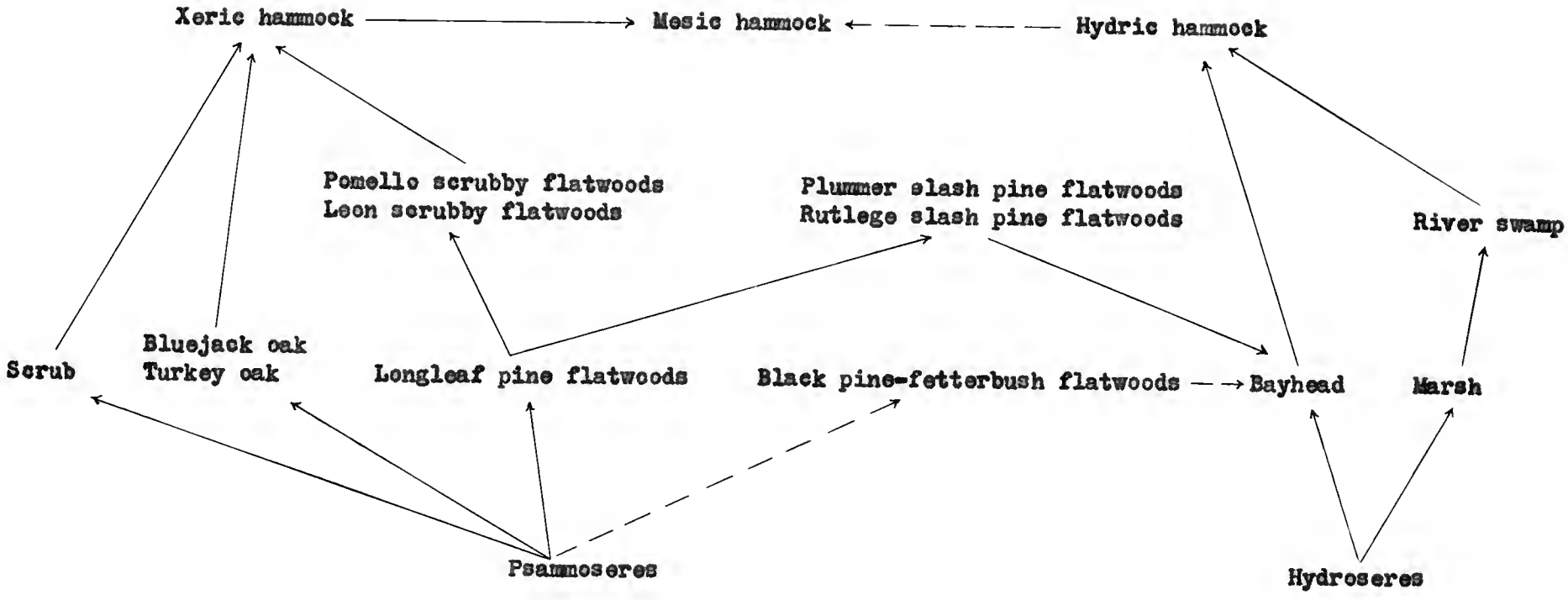

Fig. 4. -- Plant succession on the Reserve. (After Laessle.)

topography, leading to the sandhills of turkey oak and bluejack oak; and 3) washed and sorted marine sands, with flat topography, leading to longleaf pine flatwoods. The hydroseres lead, on the one hand, through successive stages to bayhead, and on the other, through similar stages to marsh. The relationships of the black pine-fetterbush flatwoods are obscure, but it is possible that they originate in much the same way as the longleaf pine flatwoods, and that bayhead vegetation replaces the flatwoods from the lower portions. The transition from hydric hammock to mesic hammock is also possible, but Laessle had not observed such a replacement on the Reserve. It will be noted that longleaf pine flatwoods may be replaced by either scrubby flatwoods or slash pine flatwoods, depending upon whether succession takes place in the higher or the lower portions. Laessle recognizes three fire subclimaxes: 1) scrub; 2) the sandhills; and 3) longleaf pine flatwoods. The climax is mesic hammock.

In general, those stations near each other in succession are found near each other on the graph (Fig. 3). This situation is probably a reflection of the moisture conditions in the various associations. The groups on the graph could be called xeric, mesic, and hydric, with little overlap. The graph shows that the hydric situations have the least number of species and collections per station, while the xeric situations have the most.

Another important relation is plotted in Figure 5. The solid black line shows the number of ant forms occupying one station, the number occupying two stations, etc. The dashed line shows the number of forms per given number of stations for those forms collected more than once; and the line of dashes and dots, for those collected more than twice.

Note that only in the first case is there a large number of

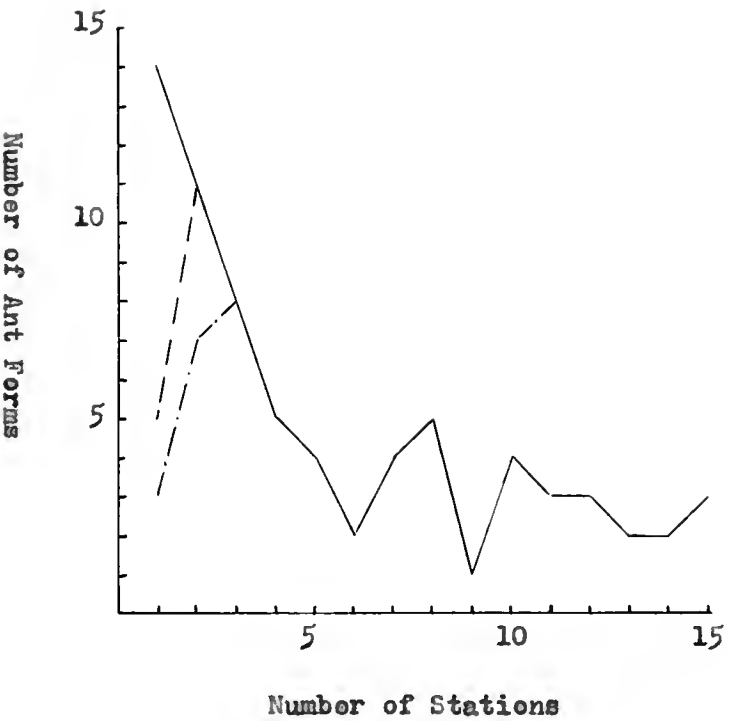

Fig. 5. -- Number of ant forms confined to a given number of stations. The figure shows that 14 forms, or 19%, were confined to one station when all forms collected are considered (———) (N = 71). This number drops to 5 forms, or 8%, when those forms collected only once are not included (— — —) (N = 62), and to 3 forms, or 5%, when only those forms collected more than twice are considered (— · — ·) (N = 56). The graph tends to become level at 2 or 3 forms for the higher number of stations.

forms (about 19%) taken in one station. In the case of those ants which were collected more than once, only 5, or 8%, are confined to one station. Of those forms collected more than twice, only 3 ants, or about 5%, are limited to one station. As this procedure is continued, the number of ants in only one station tends to become smaller and will finally reach zero at eleven collections.

The dashed line graph has a peak where the number of stations equals two. In graphs excluding ant forms collected two times or less, three times or less, etc., the peak moves over to three stations. The cause of this peak is obscure, but it may indicate that the ants of the Reserve will, in most cases, be found to occupy at least three stations when enough collections are made.

It can be pointed out that the graphs do not dip strongly as the number of stations is increased. They tend toward a straight line at two to three forms per given number of stations.

The 19% of the ant forms taken in only one station is comparable to the 20% of the ant forms of the Chicago region that Talbot (1934) took in one plant association. Likewise, Gregg (1944) showed about 24% of the ant forms of the same region confined to one plant association, but Cole (1940), in the Great Smoky Mountains, found about 48% of the ants confined to one plant association. His high percentage may in part have been caused by the differing altitudinal levels of his plant associations.

Neither Talbot nor Cole mentions the number of times each ant form was collected. Even though Gregg gives relative abundance figures for each species, these apply to the whole area worked, rather than to his plant associations. On the basis of the figures he presents, however, none of the ants collected in only one plant association was common or

abundant. When his ants were found to be common or abundant they were always collected in more than one plant association. This also holds true for the Reserve. Only those collected rarely or occasionally were confined to one station. This fact makes it plausible to suggest that in their distribution, ants do not show as much dependence upon stations based on plant associations as other animals.

It is interesting to note that only three of the forms listed by Talbot as confined to one plant association were found in but one plant association by Gregg ten years later. In view of this fact and in consideration of the observations made during the present study, it becomes quite clear that even after a thorough investigation of a given area has been completed, continued collecting in that area will increase the number of stations in which certain of the ants are found. This can also be used in support of the contention that ants are not as restricted by factors in plant association-soil type combinations as are other animals.

Distribution in the Strata and Nesting Sites

The ant forms collected on or near the Reserve were found to have the following distribution as to strata:

subterranean stratum -- 38
surface stratum -- 38
herbaceous stratum -- 11
arboreal stratum -- 16

The subterranean and surface strata contained a majority of the ant forms on the Reserve with a total of 58 in the two. Only 19 forms nested in the herbaceous and arboreal strata.

Table III shows this relationship. Of the total of 75 ants, 1 form was found only in buildings, while for 10 others no definite nesting site data were gathered. A few collections were made which may

T A B L E III

DISTRIBUTION OF ANT FORMS IN STRATA

Found only in one stratum -- *
Preferred stratum -- P
Additional strata -- x
N = 64

SPECIES	Subterranean	Surface	Herbaceous	Arboreal
1. Eciton nigrescens.....	x	?	-	-
2. E. opacithorax.....	x	?	-	-
3. Amblyopone pallipes.....	-	x	-	-
4. Proceratium croceum.....	-	*	-	-
5. P., near silaceum.....	-	x	-	-
6. Euponera gilva.....	-	*	-	-
7. Ponera ergatandria.....	-	x	-	-
8. P. opaciceps.....	-	P	x	-
9. P. trigona opacior.....	x	P	-	-
10. Odontomachus haematoda insularis.....	P	x	-	-
11. Pseudomyrma brunnea.....	-	-	x	P
12. Ps. pallida.....	-	-	P	x
13. Pogonomyrmex badius.....	*	-	-	-
14. Aphaenogaster ashmeadi.....	*	-	-	-
15. A. floridana.....	*	-	-	-
16. A. fulva.....	x	P	-	-
17. A. lamellidens.....	-	-	-	x
18. A. macrospina.....	*	-	-	-
19. A. texana.....	-	*	-	-
20. A. treatae.....	*	-	-	-
21. Pheidole dentata.....	x	P	-	x
22. Ph. dentigula.....	x	P	-	-
23. Ph., near floridana.....	x	P	-	-
24. Ph. metallescens.....	P	x	-	-
25. Ph. morrisi.....	*	-	-	-
26. Ph. pilifera.....	*	-	-	-
27. Cardiocondyla emeryi.....	?	-	-	-
28. C. nuda minutior.....	-	x	-	-
29. C. wroughtoni bimaculata.....	-	P	x	-
30. Crematogaster minutissima missouriensis.....	x	P	-	x
31. Cr. ashmeadi.....	-	x	-	P
32. Cr. coarctata vermiculata.....	-	-	-	*
33. Cr. laeviuscula.....	-	x	x	P
34. Cr. lineolata.....	x	P	-	x
35. Monomorium floricola.....	-	-	-	?
36. M. minimum.....	*	-	-	-
37. Solenopsis geminata.....	P	x	-	-

TABLE III (cont.)

SPECIES	Subter-anean	Surface	Her-baceous	Arbore-al
38. Solenopsis rufa.....	P	x	-	-
39. S. globularia littoralis.....	-	*	-	-
40. S. minutissima ?.....	-	*	-	-
41. S. molesta.....	x	P	-	-
42. S. pergandei.....	P	x	-	-
43. S. picta.....	?	x	-	P
44. Myrmecina americana.....	?	?	-	-
45. Leptothorax pergandei floridanus	x	P	x	x
46. L. texanus davisi.....	*	-	-	-
47. Tetramorium guineense.....	-	P	x	-
48. Strumigenys louisianae.....	-	x	-	-
49. Smithistruma bunki.....	-	?	-	-
50. Sm. clypeata.....	?	?	-	-
51. Sm. creightoni.....	-	?	-	-
52. Sm. dietrichi.....	-	x	-	-
53. Sm. ornata.....	-	?	-	-
54. Sm. pulchella.....	-	?	-	-
55. Sm. talpa.....	-	x	-	-
56. Trachymyrmex septentrionalis seminole.....	*	-	-	-
57. Dolichoderus pustulatus.....	-	-	x	P
58. Iridomyrmex humilis.....	x	-	-	-
59. I. pruinosus.....	P	x	-	-
60. Dorymyrmex pyramicus flavopectus	*	-	-	-
61. D. pyramicus.....	*	-	-	-
62. Tapinoma sessile.....	?	-	-	-
63. Brachymyrmex depilis.....	x	P	-	-
64. Camponotus castaneus.....	-	*	-	-
65. C. socius.....	*	-	-	-
66. C. nearcticus.....	-	x	-	P
67. C. (Colobopsis) spp.....	-	-	x	P
68. C. abdominalis floridanus.....	x	P	x	x
69. Paratrechina longicornis.....	In buildings			
70. P. arenivaga.....	*	-	-	-
71. P. parvula.....	x	P	x	x
72. Prenolepis imparis.....	*	-	-	-
73. Formica archboldi.....	*	-	-	-
74. F. pallidefulva.....	*	-	-	-
75. F. schaufussi.....	?	-	-	-

or may not have been colonies; they are indicated with a question mark. The 10 ants for which no data were obtained and the ruderal form, along with the questionable collections, were not included in arriving at the distributional data on page 38. The number of ants concerned was therefore 64. A single "x" indicates that the form was collected too few times for a preference to be recognized in Table III.

Distribution according to nesting sites was as follows:

Subterranean stratum

open sand -- 21
no craters -- 12
rudimentary craters -- 7
incomplete craters -- 6
complete craters -- 13
under logs -- 10
in and/or under litter -- 31

There were 34 forms which lived under cover of either logs or litter. Nests of 9 forms were found under and in logs.

Surface stratum

in litter -- 13
in fallen log -- 32
in palmetto log on ground -- 9
in living palmetto root/trunk -- 16
in dead stump -- 22
in base of living tree -- 19
in base of grass clump -- 7

Herbaceous stratum

between sawgrass blades -- 4
in tall grass stems -- 9

Arboreal stratum

twig -- 11
small branch -- 14
gall -- 3

Only 11 ant forms were found in over 6 of the possible 16 nesting sites. The highest number of nesting sites (14) was occupied by Camponotus abdominalis floridanus. Next highest was 12 nesting sites occupied by Pheidole dentata and Paratrechina parvula. It will be noted that these three ants are the same that occupy all of the stations. With the exception of Pheidole dentata, which occupies only 3 strata, they occupy all 4 strata also. Leptothorax pergandei floridanus, which occupies 11 nesting sites, is the other ant found in all strata. The distribution of these ants in stations, strata, and nesting sites points to a direct correlation between the number of stations occupied and the number of strata and nesting sites occupied.

Figure 6 shows the relation between the number of stations occupied and the number of nesting sites occupied for each ant collected more than three times. It is a scatter diagram in which the number of stations any given ant form occupies is plotted against the number of nesting sites that form occupies. An examination of this figure shows that a large number of forms are limited to from 2 to 5 stations and from 1 to 3 nesting sites. The diagram shows that the number of stations occupied by any form increases faster than the number of nesting sites occupied, indicating that the ants are more likely to be confined by nesting sites than by stations. However, the diagram goes to substantiate the premise of the preceding paragraph, in that as more stations are occupied, more nesting sites are also occupied.

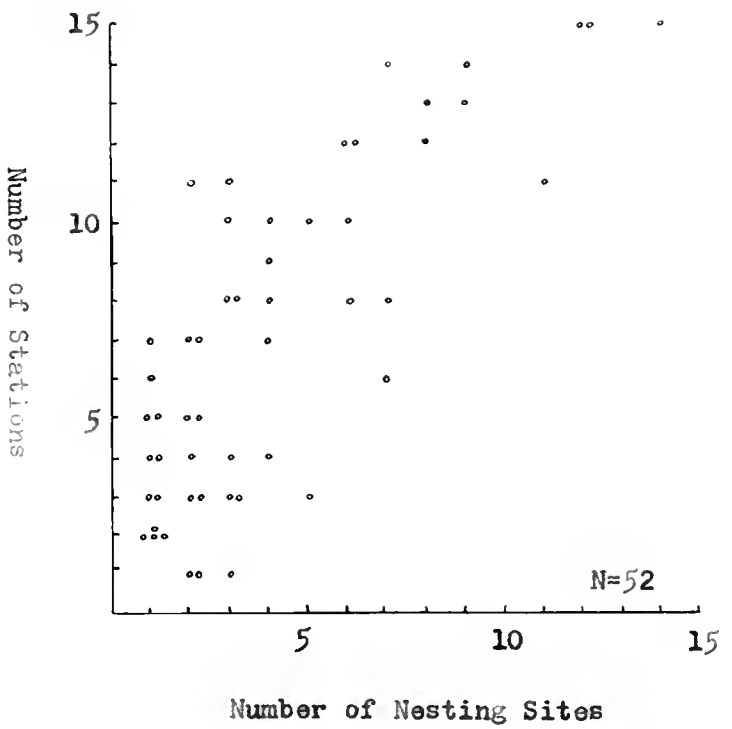

Fig. 6. -- Scatter diagram to show the relationship between the number of stations occupied and the number of nesting sites occupied for each ant form collected more than three times. The number of forms involved is 52.

Activity Relationships

The speed of movement of each ant form varies to some extent with changes of temperature and relative humidity. During the course of the present study, this "amount of activity" was estimated subjectively for individuals. The speed was then correlated with temperature and relative humidity readings taken at the ground surface.

The data on this subject collected during the field work proved to be complex when all of the ant forms were studied together, and in many cases when merely one form was considered. Some ants chose one extreme in physical factors in which to forage, whereas other forms chose the opposite extreme. In general, the diurnal foragers displayed a moderate amount of activity in their above-ground activities when the temperature was above 20°C. If, on the previous night, relative humidity was high and the temperature low (below 10°C.), the ants were slower to resume activity the subsequent day. At the other extreme, activity has been observed from nests of Camponotus abdominalis floridanus at 53°C., and most of the ants have been seen foraging at temperatures above 30°-35°C.

Seasonal variation in the foraging habits of several forms has also been observed. Many ant forms remain in their nests during periods of cold. On the other hand, during the winter months many forms will remain idle for a short period even though the temperature remains mild, and no frost appears at night. A notable exception is Pheidole dentata, which can be seen foraging even on chilly days.

ANNOTATED LIST

In the following annotated list, the discussion of every ant form has been arranged so that topics appear in the same order. Any points of taxonomy which are felt to be important are discussed first. The distribution through plant associations, strata, and nesting sites, are listed next. Comparisons are made with the ant's distribution in Gainesville or other regions, or with another ant on the Reserve which may replace it in some of the plant associations, if such a discussion is felt necessary for a better understanding of the habits of the ant. Notes as to its life history are followed by others on its activity. Miscellaneous remarks are added in a final paragraph.

As indicated in the introduction, the taxonomy of the ants in the present study is based on Creighton's recent work (1950) in which he reduced the quadrinomial system, prevalent until 1950 in the family Formicidae, to the trinomial system used in the dynamic view of nomenclature. Any departure from the names which Creighton uses is explained in the text of the Annotated List under the ant concerned. Some forms were found during the study which could not be definitely identified. Such forms that were recognizably different are listed, and comments are made concerning their taxonomic status.

In presenting the life history data, an attempt was made to determine an average number of workers present in a flourishing colony of each ant form. In some cases this has been impossible, or has been derived from the counting of only one nest. In addition, the seasonal appearance of immatures, males and females is indicated for each form.

Measurements have all been made from the lateral view. Total length is the sum of the distances from the base of the mandibles to the

back of the head, from the most anterior part of the pronotum to the base of the propodeum through the abdominal pedicels, and from the anterior to the posterior of the abdomen. All measurements were the shortest straight lines covering the given distances.

Fourteen ant forms were taken during the present study which had not been recorded from Florida. They are as follows:

Proceratium, near silaceum
Aphaenogaster treatae
Pheidole pilifera
Crematogaster coarctata vermiculata
Solenopsis minutissima ? (see annotated list)
Myrmecina americana
Leptothorax texanus davisi
Smithistruma bunki
Smithistruma clypeata
Smithistruma creightoni
Smithistruma ornata
Smithistruma pulchella
Smithistruma talpa
Paratrechina arenivaga

Several ant forms taken in the Gainesville Region were not found during the present study on the Reserve. These are as follows:

Eciton carolinense
Sysphincta pergandei
Ponera coarctata pennsylvanicus (lit.)
Leptogenys elongata manni
Crematogaster minutissima minutissima (det. ?)
Monomorium pharaonis
Xenomyrmex stolli floridanus
Leptothorax bradleyi
Leptothorax wheeleri
Tetramorium simillimum (lit. from Sanford, Jacksonville)
Lasius alienus americanus
Formica schaufussi dolosa (lit.)

Other ants taken in Welaka, but not in Gainesville are:

Amblyopone pallipes
Proceratium, near silaceum
Proceratium croceum
Ponera ergatandria
Aphaenogaster macrospina
Aphaenogaster treatae

Pheidole dentigula
Pheidole pilifera
Cardiocondyla wroughtoni bimaculata
Solenopsis minutissima ?
Myrmecina americana
Leptothorax texanus davisi
Smithistruma bunki
Smithistruma clypeata
Smithistruma dietrichi
Smithistruma ornata
Smithistruma pulchella
Smithistruma talpa
Formica archboldi

The following ants, taken within seventy miles of the Reserve, have been cited in the literature:

Pheidole megacephala (St. Aug.) (not listed by Creighton, 1950)
Pheidole anastasii (Sanford)
Leptothorax curvispinosus (Jacksonville; pinned specimen)
Tetramorium simillimum (Sanford; Jacksonville)

FAMILY FORMICIDAE

Subfamily Dorylinae

Eciton nigrescens (Cresson)

On July 5, 1948, the single collection of nigrescens made on the Reserve was recorded for mesic hammock. The nest was under litter which had gathered in the center of the base of a stump rotted so that only the rim was left standing. The nest extended into the stump, but the major portion was in and under the moist litter in the stump and in the nearby chambered sand.

All of the workers were huddled in a tight ball. No activity was observed until the workers were disturbed, but then the workers ran hurriedly in all directions. No individuals of the reproductive caste were seen, even though the nest was dug into, and returned to later.

Cole (1940:38) made some observations concerning the nesting habits of this ant in the Great Smoky Mountains. Two colonies he found there "were beneath large, flat stones, loosely applied to the soil, in open grassy areas.... Deep within the soil the ants occupied large brood-filled chambers constructed around imbedded and partially decayed tree roots....The soil, even at chamber level, was dry and firm."

Eciton opacithorax Emery

E. opacithorax was found occasionally in longleaf pine flatwoods. All nests were under the bark and loose wood of stumps or logs, and extended into nearby litter. All logs from which this ant was taken were longleaf pine (Pinus palustris). In stumps the ant occupied all available space under the bark and all suitable crevices; in logs the ant nested in a

length of several feet of wood.

One nest in a stump was estimated to contain between 40,000 and 50,000 workers. These numbers were obtained by placing all of the ants in vials, counting the number in one vial, and measuring this vial against all the others.

Numerous individuals of Eciton were taken at the openings of a nest of Solenopsis geminata in the sand one and one-half feet from a stump in which the colony of opacithorax was located. The Eciton nest abutted a nest of Brachymyrmex depilis, and partially occupied a nest of Crematogaster laeviuscula in the stump. Groups of Eciton were also taken from termite galleries in the stump. Leptothorax pergandei floridanus and Aphaenogaster macrospina were found wandering near the stump. The following animals were taken through the Berlese funnel from the litter of the Eciton nest:

beetle larvae
round worms
heads and thoraces of Odontomachus haematoda insularis
Solenopsis molesta
Proceratium croceum
dealated female of a species of Solenopsis (Diplorhoptrum)
wasp of the family Bethylidae ?

From another nest the following were taken:

Brachymyrmex depilis
Paratrechina parvula
diplopods

A large portion of a colony with its nest litter was placed in a large lard can and brought into the laboratory. To prevent the escape of the individuals, the lard can was placed on a platform surrounded by water. Very few workers, however, were observed wandering on the platform, although workers carefully placed the dead or injured individuals in a pile outside of the lard can on the platform.

Subfamily Ponerinae

Amblyopone pallipes (Haldeman)

Previous to Brown's paper (1949), pallipes was considered a species of Stigmatomma. Brown, however, has given reason to place Stigmatomma as a subgenus of Amblyopone. It is treated as such in this paper.

One collection of Amblyopone was made during April in bayhead. Several ants were gathered in moist litter near and in fern roots. A careful examination of the roots and litter nearby revealed no additional specimens.

Cole (1940;36) has the following to say concerning this species in the Great Smoky Mountains: "The nest consists of one or two openings beneath or beside a stone or under the topmost forest litter. Almost perpendicular galleries connect with small subterranean chambers never far beneath the surface....These ants are nowhere abundant in the Park but seem to occupy rather circumscribed areas where environmental conditions, particularly moisture and deep shade, are favorable. Colonies were most numerous in second-growth pine woods."

The collection on the Reserve, made on April 22, 1949, yielded one male. The workers are very reclusive, and quickly find crevices in which to hide. Their color blends with that of the soil and duff. Haskins (1928) has reported on the behavior and habits of this ant.

Proceratium croceum (Roger)

P. croceum was collected occasionally in longleaf pine flatwoods, and rarely in bluejack oak. All of its nests were taken in the surface stratum from fallen longleaf pine logs. These logs were either moist or wet, with the wood pulpy or soft and separable between the annual rings. The nests extended toward the center of the log.

Two colonies were counted. One contained 24 workers, 12 gallows, and 1 male. The other, seemingly complete, had only 3 workers. There was a queen in each of these nests and no immatures were noted. The male was taken on November 23, 1949. It was found about two feet from the nest, and since no other males were taken, it is possible that a flight had recently taken place. Workers of croceum were sluggish in their movements, while the male was alert and moved quickly.

Cole (1940:36) indicates that his single collection of this species in the Great Smoky Mountains was made in a wet, dense area of mixed cove hardwoods. He adds that the log in which the ants were found was easily broken apart into firm, wet pieces. The nest was "well toward the center of the log, in the more firm core wood" and had "small galleries and chambers chiefly with longitudinal penetration. In all the nest covered a length of [only] about 4 inches....The colony was rather small, being composed of about 30 workers." In the Chicago area, Gregg (1944:460) records the presence of this species beneath dung.

Proceratium, near silaceum Roger

From Emery's redescription of Proceratium silaceum, the form dealt with here seems to be close to this latter species. However, M. R. Smith, to whom specimens were sent, would not place the form

beyond genus. In an attempt to revise the genus he found (in litt.) that "The previously mentioned characters for separating the two species did not appear dependable and I could not discover any new characters that were any good either." Thus the form is given an uncertain taxonomic status.

One collection of this form was made on October 17, 1948, from the base of a slash pine. The colony was nesting in bark buried under the soil surface. Six individuals were taken. As in P. croceum, the workers are sluggish in their movements.

Euponera gilva (Roger)

Euponera gilva was confined in its distribution to the moist or wet hammock areas. It was taken once in mesic hammock, and occasionally in hydric hammock.

Its nesting sites were in fallen logs. A typical nest extended for two and one-half inches in debris under the bark of a log. Specimens have also been taken from litter, and from the debris decomposing between the rootlets in and under the litter.

A nest from hydric hammock contained 26 workers and one queen. The eggs, larvae (which are well equipped with body spikes), and pupae were observed in separate places in the nests, with the pupae usually more toward the surface, or toward the outside in log nests. Since so few nests were seen, no further life history data were obtained.

Although the ants are slow in their movements most of the time, they are quick to find concealment. Their elusiveness is increased by their color which is similar to that of the wood where they live, and by their ability to hide motionless in every narrow crevice.

Smith (1934:562) records E. gilva from Mississippi, Alabama, and Tennessee. His observations on the nesting sites coincide with the above. He states that its nests "in some instances contain as many as from one to several hundred workers and often as many as ten or more dealated queens". He remarks further that Creighton has found fully developed males and a winged female on June 20 in southern Alabama.

Ponera ergatandria Forel

Mention needs to be made of a number of small specimens of P. ergatandria collected on the Reserve. These workers are in all measurements more diminutive than specimens taken in Dade County, Florida, and are likewise smaller than other ergatandria taken on the Reserve. While the latter specimens fit the description of P. ergatandria which Smith gives (1936:425), the smaller workers from the Reserve differ in total body length. Smith lists the body length as 2.3-2.9 mm.; the smaller workers on the Reserve measure only 2.0-2.1 mm. Moreover, the ventral portion of the petiolar tooth is smooth in the larger specimens, and serrate in the smaller specimens. Smith (in litt.) says that he has noted much variation in the workers of ergatandria, and considers all of the specimens from the Reserve as of that species. The smaller specimens have been found only in mesic and hydric hammocks, whereas the larger specimens were spread mainly over drier areas. Both variants will be treated together in the following discussion.

P. ergatandria colonies were taken occasionally in hydric hammock and mesic hammock; and rarely in turkey oak, bluejack oak, and black pine-fetterbush flatwoods. A typical nest was taken from under the moss near the base of a living oak tree in hydric hammock. No life history data were obtained.

Ponera opaciceps Mayr

A discussion concerning the variation in the shape of the petiolar scale in Ponera trigona opacior and in this form can be found under P. trigona opacior. Many of the nests of opaciceps, especially in marsh, contained one to several individuals which are evidently aberrant workers. These insects have large, compound eyes, comparable to those of the queen, and the petiole is more slender than that of the normal worker. It is perhaps significant that queens were not found in nests which contained these aberrant forms.

This species prefers the wet or flooded areas of the Reserve. It has been taken abundantly in marsh; commonly in hydric hammock and river swamp; and rarely in Rutlege slash pine flatwoods, bayhead, and xeric hammock. If the characters now used to separate P. opaciceps from P. trigona opacior prove to be misleading, as some workers believe, the specimens taken in xeric hammock and assigned to P. opaciceps may be extreme variations of P. trigona opacior, a form which prefers high, dry areas. P. opaciceps occurs almost exclusively in the wetter portions of the Reserve, and tends to replace P. trigona opacior there. In the Gainesville region, P. opaciceps was taken in longleaf pine flatwoods where there are more fallen logs than in the same plant association on the Reserve. Because of its preference for wet areas, it ought to occur also in at least the lower portions of mesic hammock.

Most often this ant nests in the bases of sawgrass plants between the appressed leaves. Many times the ant can be found in the wet or saturated moss-covered stumps of the plants where there is an intermingling of roots in the decomposing, appressed leaves and wet debris. The other nesting sites, in order of preference, are:

1. fallen logs
2. dead stumps
3. bases of living trees (under moss and litter at water surface)
4. in litter (wet)
5. palmetto roots on ground
6. under mat of palmetto roots
7. under mat of palmetto trunks

In general, the nests are wet to saturated and built in debris. Most of the nests, especially those in sawgrass, are at the water surface, or just above or below it. (In this latter case, the tight growth of the plant parts seems to keep the water from the nest.) In situations which are less wet, the insect continues to simulate the above-mentioned nesting conditions in its choice of wet, pulpy wood of logs, or the debris found under the bark of logs or stumps.

Of 5 nests counted, the number of workers varied from 15 to 84, with an average of 40 per nest. Each of these nests contained from one to three of the aberrant workers described above, and none contained a queen. Immature forms probably occur in all months, but from September through November very few were noticed in the nests. Females are produced from September to November, and males from October to November.

This is a fast moving and evasive ant which blends with the color of its surroundings. It is much less active in winter months, although this is the period winged forms are in the nest.

Ponera trigona opacior Forel

From an examination of the specimens of this form and of P. opaciceps in the Museum of Comparative Zoology, there appears to be a great deal of overlapping variation in the two forms. It seems clear that, in the museum collection, the character of the shape of the

petiolar scale, which is used by Smith (1936) to separate the two forms, is not distinctive. Many of the specimens labelled as one form are more like the description of the other form. The specimens of opaciceps and of trigona opacior collected from the Reserve, however, fall into two distinct classes on the basis of the petiolar scale. Perhaps the shape of the petiolar scale will be shown to be dependent on the environment of the nest, and therefore of no use as a key character. On the other hand, it is possible that the specimens in the M. C. Z. have been misidentified.

In all respects except total length, the Welaka specimens agree with Smith's description (1936) in which he cites the length of workers of opacior as 2-2.3 mm. Workers from the Reserve measure 2.4-2.7 mm. in total length.

P. trigona opacior tends to prefer the higher, drier plant associations. It was taken commonly in xeric hammock; occasionally to commonly in turkey oak; occasionally in bayhead and Plummer slash pine flatwoods, in all well-drained areas except Pomello scrubby flatwoods, and in the hammocks; and rarely in the other flatwoods stations. No collections have been made from Pomello scrubby flatwoods or the seasonally flooded areas of the river swamp and marsh. Cole (1940:37) points out that in the Great Smoky Mountains the ant does not nest in dense wet woods, but prefers rather open areas where the soil is able to contain an appreciable amount of moisture.

A majority of the nests of this ant occupied the surface stratum. The several nests recorded from sand, moreover, did not extend more than a few inches into the sand, but were mostly under litter. The nests in the surface stratum were usually associated with debris, although some nests

were found with little or no debris. Several of the nests taken in fallen logs were found under the bark against fairly hard wood. The order of preference of nests in the surface stratum is as follows:

1. fallen logs
2. dead stumps
3. bases of living trees
4. litter
5. palmetto roots on ground
6. under mat of palmetto roots
7. under mat of palmetto trunks

Of four nests taken from wood, the number of workers varied from 7 to 21, with an average of 13. None of these nests contained queens. Immature forms have been found in all months. Males have been observed in flight in December and February. No information has been obtained concerning females.

P. trigona opacior is relatively fast moving, and characteristically evasive. Individuals are difficult to see because they are very nearly the color of the wood or litter surrounding their nests. They immediately seek the first available crevice in which to hide.

Nests are occasionally found in the same logs and stumps as nests of Odontomachus haematoda insularis.

Odontomachus haematoda insularis Guerin

O. haematoda insularis is a widespread ant on the Reserve, and is well represented in nearly all of the stations except marsh, where it has not been found. It occurs abundantly in black pine-fetterbush flatwoods and mesic hammock; commonly to abundantly in turkey oak and hydric hammock; commonly in Leon scrubby flatwoods, longleaf pine flatwoods, Plummer slash pine flatwoods, xeric hammock, river swamp and bayhead; and occasionally in bluejack oak, scrub, Pomello scrubby flatwoods, and Rutlege slash pine flatwoods.

A majority of its nests have been found in sand, almost always under litter or logs. The remainder of the nests were taken in the surface stratum. Where there are suitable logs or stumps present, this ant shows no preference between wood and sand. However, on the Reserve, because of the existence of relatively few suitable logs or stumps, the most favored nesting site was in sand under litter. In the Gainesville region most of the nests of O. haematoda insularis were taken in logs.

In order of preference to the ant the nesting sites in which O. haematoda insularis was found in Welaka are:

1. under litter
2. under logs
3. in and under logs
4. in dead stumps
5. in fallen logs
6. under mat of palmetto trunk
7. in litter
8. in bases of living trees
9. open sand or with very light litter

Most nests in logs and stumps were in wood of an advanced stage of decay, although nests were found in wood in all stages. There was no preference between pine and broadleaved wood, but all nests were wet or moist. Charred wood was not rejected. Many of the nests in logs and stumps, and under logs, ramified into chambers in the nearby sand. In the black pine-fetterbush association, several nests were found among the roots of fetterbush.

On several occasions O. haematoda insularis has been found in the same stump or log with Camponotus abdominalis floridanus, but the association probably depends on a common suitable nesting site. Both of these ants sometimes extend their nests into sand near the wood which contains the major portion of their colonies. Both, moreover, live under logs, but O. haematoda insularis sometimes lives in sand alone. The

chambers of these large ants are never very deep, and usually appear to be ready-made cavities into which the ants moved. They have not specialized in excavating to the degree that the true crater forms have. Many of the passageways, too, seem to have been constructed by some other agent than the workers, since they are in most cases much too large for the size of the ant. The portions of the nests in sand, moreover, are commonly supported by humus and leaf litter.

Large nests of O. haematoda insularis have not been seen on the Reserve. One nest, perhaps slightly smaller than average, contained 20 workers and 3 callow workers. Immatures have been observed in the nests in all months, but not during cold periods. On numerous occasions males have been taken in flight and in the nests from May through early August, but no information has been gathered concerning the females.

When the soil is saturated during the summer rainy season, the workers often bring their immatures to the surface and place them under leaves. Single workers also can be seen resting under the cover of a leaf during these periods, as well as during the colder months of the year.

This ant is one of the most conspicuous in a majority of the plant associations on the Reserve. It is quite active above ground, especially during the warmer months, and large workers, foraging alone, are commonly seen. In the cold periods, however, activity, both above ground and in the nest, is reduced to a minimum, and its absence above ground is quite noticeable.

O. haematoda insularis is known to feed on insects. When large insects are caught, several workers cooperate in carrying the intact bodies to the nest opening. Workers have been attracted to the peanut butter and oatmeal bait used in mammal traps.

Insects which have been found living near O. haematoda insularis in the same log or stump are:

Camponotus abdominalis floridanus
Paratrechina parvula
Reticulitermes (flavipes?) (Isoptera)

In several instances mites have been found clinging to workers. They have been found on all parts of the body, but especially on the head, gaster, and propodeum.

Foraging workers have been found in association with several other species of ants. Neither the Odontomachus nor the other ants were much disturbed. In one instance an Odontomachus worker was very inquisitive concerning the activities going on within the crater of a nest of Trachymyrmex septentrionalis seminole. The worker repeatedly ran to the nest opening with waving antennae, but neither the visitor nor the Trachymyrmex gave much attention to the other.

Subfamily Pseudomyrminae

Pseudomyrma brunnea F. Smith

P. brunnea nests were taken occasionally in turkey oak, Leon scrubby flatwoods, Pomello scrubby flatwoods, mesic hammock, hydric hammock, river swamp, and marsh; and rarely in scrub, Rutlege slash pine flatwoods, xeric hammock, and bayhead. The ant shows a preference for river swamp, hydric hammock, and the dense Pomello scrubby flatwoods. On the other hand, it has been collected only once in any type flatwoods other than the scrubby flatwoods. P. brunnea thus replaces P. pallida in the wet or seasonally flooded areas, whereas P. pallida replaces

brunnea in the flatwoods areas. The difference can be attributed to the fact that pallida is able to live in tall grass stems, whereas brunnea is not. Moreover, brunnea prefers the more dense, wet woods, and pallida the more open areas.

Almost all of the colonies of brunnea have been collected in the arboreal stratum. Nests have been equally divided between true twigs and small branches. A single collection from the herbaceous stratum was made six feet above the ground in a flower stalk of a sawgrass plant.

Two large nests of this species were taken, one with 79 workers and 1 queen, the other with 79 workers and 8 queens. Other nests contained 18 workers and 1 queen; 9 workers and no queen; and 7 workers and no queen. A mating flight occurred on June 17, 1950, and winged forms were observed in previous years from June through September. Immature forms occur in the nests almost all year, and usually there are a large number of larvae, i.e., 30 to 65 large larvae and many more small ones.

P. brunnea is agile and is able to disappear easily on the other side of a branch. It seems to prefer foraging when temperatures and humidity are high.

Pseudomyrma pallida F. Smith

Until Creighton's paper (1950), P. pallida and P. flavidula were recognized as separate species on the basis of the presence or absence of black spots on the base of the abdomen in flavidula. Creighton has synonymized flavidula, since he has found that a nest series of sufficient length will contain individuals with and without black spots on their gasters. Nest series from the Reserve also have shown these characteristics.

P. pallida was found in eight stations. The black pine-fetterbush association affords a great many Andropogon stems which are suitable nesting places for pallida. As a consequence, the ant is found abundantly in this station. It occurs commonly in longleaf pine flatwoods and Leon scrubby flatwoods; occasionally in the sandhill areas and the slash pine flatwoods; and rarely in xeric hammock.

Because of its preference for tall grass stems as nests, P. pallida was found most often in the herbaceous stratum, but was also taken arboreally. It was absent from the other strata.

The nesting sites of pallida were almost always true twigs or were twig-like. All but a few collections were made from tall grass; a few others were made from the twigs of pine and scrub oaks; and the ant can often be found nesting in the stems of planted bamboo. Several collections were made from twig-like small branches.

Of 12 colonies taken, the number of workers varied from 5 to 25, averaging 11. Of these colonies 7 contained no queens. (These small, queenless aggregates may really be sections of a larger group centered around a queen. See Crematogaster ashmeadi and C. minutissima missouriensis). Eggs, larvae, and pupae are present in all months, with a peak of abundance indicated in August. Winged forms were taken from the nests from August through November. No nest contained both males and females.

This agile ant has a knack of disappearing behind a grass stem or a twig when disturbed. When a nest is broken open, many of the ants will remain perfectly still until touched. Normally they exhibit a moderate to considerable above-ground activity. Several workers were found, evidently foraging, within a cocoon of a dead bagworm (Thyridopteryx ephemeraeformis Haworth) hanging from a fetterbush.

The eggs, larvae, and pupae of this ant are usually more or less segregated. A typical nest contained eggs and some larvae in the base of a grass stem, other larger larvae near the middle, and pupae and a few eggs near the top of the stem. Many times the queen is found near or at the top of the stalk.

As the Andropogon dies in the fall and the stems become drier and less habitable, the ants are forced down near or into the base of the stems, or into portions of stems that have been broken from the plant but which are still supported by vegetation. Their abundance becomes somewhat less until the spring growth of grass creates new nesting sites. In this respect these ants, like Paratrechina parvula in marsh, show a seasonal variation in occurrence which is dependent on the seasonal variation in occurrence of the nesting site plant.

It might well be pointed out that the nature of the Pinus serotina-Desmothamnus association, which this ant occupies in the most abundance, gives an advantage to these grass stem ants in the summer, just as it creates a disadvantage for the ant when the Andropogon dies in the winter. During the height of the rainy season from early July into August, the water level may reach within inches of the soil surface, or even exceed it. Deep burrowing forms which cannot withstand prolonged periods of submergence will be kept at a minimum or eliminated. A few forms, such as Iridomyrmex pruinosus and Formica archboldi, can withstand the submergence of their lower galleries, and undoubtedly fluctuate the depth of their galleries with the rise and fall of the water table. The grass stem ants, on the other hand, remain relatively unaffected by the water level change, are free of competition for their nesting site, and at the same time are adapted to procure the above-ground food supply.

Subfamily Myrmicinae

Pogonomyrmex badius (Latr.)

P. badius is one of the most restricted ants of the Reserve as far as occurrence in plant associations is concerned. It requires open areas in which to build its dome-shaped mound, and only a few situations suitable in this respect occur in the stations studied in the present problem. Xeric hammock is preferred and nests are found there commonly. P. badius nests were taken occasionally to commonly in turkey oak, and occasionally in bluejack oak. Many nests are found on lawns, around gardens, and in firelanes. All of its nests were complete, domed craters. Characteristically, the areas around the openings of the nests are always bare of vegetation in well-established colonies. Many of these areas are edged with charred pieces of wood, seeds, twigs, and other debris. The charcoal rim of many of these mounds is a conspicuous feature of the nests. Wray (1938), giving an account of the ant in North Carolina, mentions that nests in that region have the same features. He also gives a description of the internal structure of the nests.

Observations were made on a nest of this active ant beginning in August, 1949. The nest, which was situated in a lawn, had been moved perhaps three feet immediately prior to the first observation. Surface temperature, temperature at three inches, relative humidity, and the number of workers emerging from the nest within a period of two minutes were recorded daily for 8:30 A.M., 11:30 A.M., 2:30 P.M., and 5:30 P.M. Activity of the colony above ground never began before 8:30 A.M. and was usually completed within a few minutes of 5:30 P.M. In February, 1950,

the nest opening was again moved, this time only a foot. In each of these instances of changing the site of the nest opening, it is possible that some of the old chambers and galleries were continued in use.

Table IV shows the number of Pogonomyrmex badius that emerged from the nest during a warm period in August on four successive days, and during four days of a cold period in November. On August 12, no ants were seen above ground. Although the temperature this day was mild, the relative humidity remained at 100% and most of the day was rainy. Other colonies have been noted to continue excavation during very light rain, but when the drops became constant, activity stopped. The ants show a tendency to avoid high humidity, although as can be seen on August 14, activity continued during 100% humidity. Conversely, lower humidities are correlated with the greatest activity. However, when the humidity becomes very low and temperature very high (50°C. or more) in June and July in midday, a cessation of above-ground activity occurs.

The temperature at three inches below the surface was first recorded on August 14. During the rest of August, while these temperatures were being taken, the ants opened and closed their nest at a three inch temperature of about 27°C., as indicated in the table. In November, however, most of the temperatures were below 27°C., and opening began at a three inch temperature of about 10°C., whereas closing started at about 16°C. Thresholds of surface temperatures were more obscure.

Besides the effect of the temperature on the opening and closing of the nest, high humidity, as indicated above, seems to retard the opening and speed the closing. The ants are slow to start work on mornings with a good deal of moisture in the air. In the evenings, when the humidity rises, they are usually well along in their closing operations when it

TABLE IV

NUMBER OF POGONOMYRMEX ACTIVE DURING A WARM AND DURING A COLD PERIOD

date	time	temp. at 3"	temp. at sur.	rel. hum.	no. in 2 min.	remarks
8/12/49	0830		21°C.	100%	0	overcast
	1130		19	100	0	rainy
	1430		20	100	0	rainy
	1730		19	100	0	rainy
8/13/49	0830		24.5	87	0	cloudy
	1130		39	57	118	windy, clear
	1430		41	42	152	clear
	1730		22	94	0	windy, clear
8/14/49	0830	25°C.	38	46	0	clear
	1130	30	39	50	180	opened 0945
	1430	35	40	51	235	clear
	1730	31	24	100	204	rainy
	1800	30	23	100	180	clear
	1830	29	23	100	68	
	1900	27	23	100	4	
	1920	27	23	100	0	sunset
8/15/49	0830	27	36	35	128	activity starts at 0830
	1130	33	49	25-	288	clear
	1430	35	37	35	150	clear
	1730	32	30	62	136	closing starts at 1730
11/17/49	0830	10	18	45	48	clear, activity sluggish
	1130	16	25	35	50	moderately active
	1430	20	27	37	52	moderately active
	1730	18	10	75	1	sluggish
	1735	18	9	83	0	
11/18/49	0830	8	10	55	0	
	1130	13	18	25-	44	clear, sunny
	1430	19	24	25-	51	
	1715	16	8	65	0	sundown, clear
11/19/49	0830	7	10	75	0	clear
	1130	11	17	25-	25	sunny
	1430	18	21	25-	57	activity moderate
	1730	16	6	89	3	closing starts at 1715
	1750	15	5	100	0	sunset
11/20/49	0830	8	12	65	0	clear, sunny
	1130	13	27	25-	100	quite active
	1430	19	30	25-	49	
	1730	17	11	97	28	closing starts at 1730
	1745	15	9	100	0	

reaches 100%. In addition, closing seems to be influenced by the increasing darkness, and the nest was usually closed by sunset. Controlled laboratory experiments would have to be carried out to determine the importance of each of these physical factors on colony activity.

A typical closing operation was carried out as follows: Certain of the workers started the procedure by picking up pellets of sand lying on the mound, and carrying them to the nest opening. Some carried this sand between their mandibles, and others pushed the pellets between their hind legs. Once at the opening, the workers packed the sand into the orifice wall. The whole procedure was not concentrated, and many individuals lost interest in their work. Little by little, however, the opening was made smaller. Some of the ants brought pieces of grass and small twigs instead of sand, and these acted as supports. During this whole activity, other ants were bringing pellets to the surface. When the opening was finally closed, there remained a small area (two inches in diameter) cleared of sand pellets which surrounded the pile of sand at the opening. Although the outside was closed, movement of the sand at the place of the opening indicated that the ants were still packing sand into the passageway from the inside. The pile of sand over the opening sometimes became very large, reaching on one occasion a height of one-half inch, and a diameter of one-half inch. This turret contained no passageway. The nest was closed in a similar fashion every night, and in rainy weather sometimes remained closed all day.

In early December, the ants broke through the mound, over a period of days, in nine places. Within a few days all of the holes were plugged and the ants were emerging from the original opening. However, as has been noted, in February the ants closed their original opening,

and used a new one approximately a foot from the former. Since the latter opening was in lawn, the ants went about their characteristic habit of cutting the grass around the opening and covering the shoots left standing with sand.

A mating of the males and females from the same nest took place at about 10:00 A.M. on June 20, 1950. While some workers were carrying on the normal nest activities of bringing seed husks and sand pellets to the surface and carrying seeds below, others were attending the mating individuals. These males and females were two feet to one side of the nest opening, in an area about two feet in diameter. The males ran very speedily over the ground, or else flew for short periods six inches to a foot above the mating area. They were probably equal in abundance to the combined numbers of females and workers within the area.

Three or four males approached a given female at one time. Within a matter of seconds one of the males had entered into copulation with the female. The period of copulation lasted up to one and one-half minutes. Each female mated with three or four different males. Because the males were so very quick in their movements, it was difficult to tell whether a given male mated more than once.

During the matings, the fast moving workers could be observed pulling at the males wherever they happened onto one. They pulled them away from the females, even during mating, and when a male wandered back toward the nest opening, he was carried or pulled away. Probably the same stimulus was involved in all of these activities.

After each mating, each female stroked her antennae with her forelegs, and examined the tip of her abdomen with her mouthparts. When several matings had taken place, each female began a slow flight upward.

The males, which had been flying swiftly around the mating area, gradually flew away also.

The following seeds have been taken from nests of Pogonomyrmex badius: Ampelopsis arborea[1], Phytolacca rigida, Pinus sp., Conchrus gracillimus (sandspur), Sabal palmetto (cabbage palm), Diodella teres (buttonweed), and centipede grass.

The ants were able to carry all of these seeds, except those of the cabbage palm. One of the latter seeds presented somewhat of a problem, although the ants were able to carry it for short distances in their mandibles. When they had transported it to the mound, however, several ants began digging under it with their forelegs until a crater was formed with the seed in the center. When the seed was removed for identification, the crater was becoming deeper and the ants were making no progress. It was observed that ants can carry seeds for at least 100 feet. Cole (1932:144), however, noted that Pogonomyrmex occidentalis in the western United States carries seeds for as much as 0.7, 0.4, 1.35, and 0.25 miles.

Aphaenogaster ashmeadi Emery

A. ashmeadi prefers the areas of the Reserve which offer xeromesic conditions in the subterranean stratum. It is found occasionally to commonly in xeric hammock and Leon scrubby flatwoods; occasionally in bluejack oak, scrub, and mesic hammock; and rarely in turkey oak and bayhead.

A. ashmeadi is confined to the subterranean stratum. In all

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[1] Determinations of all seeds were made by A. M. Laessle, Department of Biology, University of Florida.

cases it nested in sand, and most of its nests were under litter. One nest, situated where there was no litter, had no recognizable crater and two nest openings.

The size of the nest is approximately the same as the closely related A. treatae. One nest contained 326 workers, 7 callows, 250 pupae, plus eggs, larvae, and a queen. Winged forms have been found in the nests in June.

The above-ground activity of this ant is moderate to considerable on clear, sunny days when the relative humidity is below 70%. It has not been taken foraging when the temperature was below 20°C. Along with other ants, A. ashmeadi shows a tendency to become very inactive above ground during the winter. The form is carnivorous, and is attracted to raw liver; it has been seen carrying dead ants of other species, especially Odontomachus haematoda insularis.

Aphaenogaster floridana M. R. Smith

A. floridana was taken occasionally in turkey oak on the Reserve. In the Gainesville region, it was also taken in ruderal situations, such as open, sandy roadsides. Nests are either complete craters or rudimentary craters around small clumps of grass.

A. floridana is a fairly fast moving insect. Most of its foraging is done at night, but it is sometimes active during the day, especially during overcast weather. It is attracted to molasses traps.

Aphaenogaster fulva Roger

Within a given nest of fulva there is great variation in character proportions of the workers from the incipient to the mature

colony. Of the specimens sent him from the Reserve, Dr. Smith (in litt.) says, "The smaller workers with more posteriorly rounded heads and longer antennae probably belong to young colonies. As the colonies increase in size the later workers acquire shorter antennae and less rounded heads." Because of this change in characteristics, it is important to recognize workers of an incipient colony, so that they will not be misidentified as a closely related form.

It can be mentioned here that individuals with shorter spines, keying to rudis in Creighton's paper (1950), have been found on the Reserve, but are not included because of their small number and uncertain taxonomic position.

A. fulva prefers the lower areas of the Reserve. They have been taken commonly in river swamp; occasionally in scrub, longleaf pine flatwoods, hydric hammock, and bayhead; and rarely in Rutlege slash pine flatwoods, xeric hammock, and marsh. It tends to replace A. ashmeadi in the wetter areas.

Ants of this group have been found in both the subterranean and surface strata. Nests were equally abundant under logs, in litter, in fallen logs, under the mat of palmetto roots and trunks, and in dead stumps. They also have been found in and under logs and in the bases of living trees. Logs which contain nests are usually in the last stages of decay. One nest was between the bases of palm fronds and the trunk of the palm in the debris gathered there.

Of the 2 nests counted, the one from scrub contained 46 workers, 10 worker pupae, and 1 queen, while the other from river swamp contained 65 workers, 3 callows, 15 worker pupae, and 1 queen. Immatures were in almost every nest collected. Males were found in the nests in May through

July; no information was obtained concerning the females

The ants of this group are quite active. The workers are attracted to a mixture of peanut butter and oatmeal. They have been noted living next to nests of termites (Reticulitermes flavipes), and have been seen carrying live termites in their mandibles.

Aphaenogaster lamellidens Mayr

Only one collection of A. lamellidens was made on the Welaka Reserve. This nest, in xeric hammock, occurred in the base of a broken limb which had decayed differentially. In the Gainesville area, the author has collected the species in mesic hammock in fallen logs. In the Great Smoky Mountains, Cole (1940:52) has found a few colonies "in wet rotting logs in a deeply shaded forest".

Although collections in other regions indicate that lamellidens occurs usually in the surface stratum, its collection on the Reserve from the stump of a limb 5 feet above the ground places it in the arboreal stratum.

Aphaenogaster macrospina M. R. Smith

A. macrospina was taken occasionally in bluejack oak, longleaf pine and Rutlege slash pine flatwoods. All of its nests were in the subterranean stratum under litter. Its distribution on the Reserve shows a preference for pine growths.

This is a moderately active ant. On a number of occasions, it has been attracted to molasses. One nest counted contained 65 workers, 10 worker pupae, and 1 queen. Attention was drawn to the nest by the capture of individuals of this species in a molasses trap. Part or all

of the 44 ants caught in the molasses trap may have belonged to this colony.

Aphaenogaster texana Emery

A. texana nests occasionally in scrub, and rarely in longleaf pine flatwoods, xeric hammock, and mesic hammock. Nests have been taken only from the surface stratum in wet to saturated logs in the last stages of decay. The habits of this species are much the same as those of fulva.

Aphaenogaster treatae Forel

Nests of A. treatae have been found occasionally in Leon scrubby flatwoods, and rarely in scrub. Although it has been found in only these two plant associations, there is no apparent reason why it should not occur in other areas with relatively light leaf litter, as does A. ashmeadi.

All of its nests have been found in the subterranean stratum under litter. One nest contained eggs, 20 larvae, 81 pupae, 20 callows, 292 workers, and 1 queen. Two diplopods were removed from the dirt surrounding the nest.

A. treatae is a moderately fast moving, timid insect. Workers have been noted carrying larvae of various kinds into the nests. A grasshopper nymph was readily eaten when introduced into a nest transplanted into the laboratory.

This laboratory nest consisted of the queen and three workers. The queen laid eggs within three days of the time that she was placed in the nest. All of these eggs were kept near a damp sponge in the nest,

and were cared for by the workers. The queen rested on the sponge, and paid little attention to the clump of eggs.

A. treatae has been taken from the Chicago area (Gregg, 1944) and from Iowa (Buren, 1943), and Cole (1940:50) has the following to say concerning nests in the Great Smoky Mountains: "Invariably, it was found colonizing open woods (usually pine) or less frequently grassy fields and slopes. All nests were beneath stones of varying size, and each nest possessed a single entrance, either beneath or beside the stone, leading by a gallery to a series of large interconnected chambers deep in the soil.... In all cases, however, the soil was rather moist." It is probable that the "open woods" and "grassy fields and slopes" of the Great Smoky Mountains offer conditions similar to the open areas of the Reserve. Since there are few stones on the Reserve, the ant here must be satisfied to use leaf litter to cover its nest opening.

Pheidole dentata Mayr

P. dentata nests are well represented in all of the stations on the Reserve except marsh. It was taken most often in the better drained areas, as well as the hammocks, river swamp, and black pine-fetterbush flatwoods. Colonies occur abundantly in scrub, Leon scrubby flatwoods, Pomello scrubby flatwoods, and river swamp; commonly to abundantly in bluejack oak, xeric hammock, mesic hammock, and black pine-fetterbush flatwoods; commonly in turkey oak, longleaf pine flatwoods, Plummer and Rutlege slash pine flatwoods, and hydric hammock; occasionally in bayhead; and rarely in marsh.

Over two-thirds of the dentata nests taken were on the soil surface, and, with the exception of one collection from a small branch,

all others were taken from sand, mostly under litter. Nests under litter, and nests in logs and stumps are preferred by P. dentata. The other nesting sites in which it was found, in order of importance for the ant, are:

1. in litter
2. under mat of palmetto root and stump
3. in bases of living trees
4. under logs
5. in and under logs
6. in grass clumps
7. open sand (rudimentary craters)
8. palmetto root on ground
9. in small branch

Other collections were made under moss on a saw palmetto root, and several records were made of nests in fern roots.

In Gainesville, P. dentata was found to nest equally often in logs and in rudimentary craters. On the Reserve, probably due to the presence of litter and at least some wood in almost all situations, craters of this ant were seldom found. Even though other ants, such as Pogonomyrmex badius were able to build crater nests only, P. dentata showed its preference for nests in wood or under cover of wood or litter, by avoiding the open areas.

Nests were recorded in wood in all stages of decay, and in wood that varied from wet to dry. Most of the nests in logs or stumps were in pine, although a number were found in broadleaved wood. Often these nests were under the bark, but a few nests in stumps extended down into the root systems. During the wet seasons, nests have been found several feet high in dead tree trunks.

Nests of this ant usually contain a large number of individuals. One rather small nest comprised 162 workers, 9 soldiers, and 1 queen. Immature forms are present all year except during cold periods. Winged

forms have been taken in flight in May and June, and a dealate female was recorded wandering in February. Reproductive form pupae were seen in the nests in April.

Many times, especially during the rainy season when the ground becomes very wet, the immatures are brought to the surface and laid on or between leaves. On other occasions, in log nests, the immatures were scattered throughout the log without any seeming order. Similar nests, however, proved to have all the eggs, larvae, and pupae in one spot.

During several periods of cold weather, workers of dentata were the only ants carrying on conspicuous above-ground activity. A point which further indicates its adaptability to adverse conditions is that dentata is one of the few ants which regularly forages in swamp during the periods of high water, when very little soil is above water, and all of the soil is saturated.

The feeding habits of this energetic Pheidole are diverse. It is attracted to a mixture of peanut butter and oatmeal used in mammal traps, to liver, and to molasses. These ants have been seen carrying collembola and termites. When a nest of Reticulitermes flavipes was chopped into, they were almost immediately on the scene, carrying termites away. As time passed, more ants entered into the activity. The termites were either paralyzed into stillness or killed, or were able to move only slightly while being carried. Most seemed fatally injured after they had been carried by an ant.

The following have been taken in the nests with P. dentata:

Isoptera, various spp.
Corrodentia
Orasema, possibly robertsoni (det. A. B. Gahan, U. S. N. M.) (Gainesville) (Hym.)
Orasema robertsoni Gahan (det. A. B. Gahan, U. S. N. M.) (Hym.)

Orasema pupae were in the nests in September and October.

Pheidole dentigula M. R. Smith

P. dentigula is not a common ant on the Reserve although it was taken in 8 of the 15 stations. Its nests were found commonly to occasionally in mesic and hydric hammock; occasionally in scrub, Pomello scrubby flatwoods, Plummer slash pine flatwoods, xeric hammock, and bayhead; and a questionable record was made on the basis of workers alone from Rutlege slash pine flatwoods.

All except one nest, taken under litter, were found in the surface stratum. P. dentigula preferred nests in logs and in the bark at the bases of living trees, but it was also found in stumps, under litter, and one collection was made from fern roots. Nests in wood were almost equally divided between pine and broadleaved logs or stumps which ranged from moist to wet. Most of the nests were in soft or well-decayed wood, but many nests were backed by hard wood.

The number of individuals in the nests varied widely, although none were large. An average nest contained 85 workers and 17 soldiers (including callows), and 43 worker pupae and 7 soldier pupae. Most, but not all of the nests had a queen. Immatures were present all year. Females were found on the wing in July and in the nests in September, and males were taken in the nests in August. One nest contained only two workers, but had eggs and larvae.

P. dentigula is one of the species with which Solenopsis molesta has been found associated. In addition to the Solenopsis, Paratrechina parvula was taken with Pheidole dentigula from under litter.

Pheidole, near floridana Emery

Smith has compared specimens of this ant from Welaka with those of floridana in the U. S. National Museum. He says (in litt.) that the Welaka specimens "have been compared with specimens from the original series and although close to floridana they are not typical. Floridana has much more of the posterior part and side of the head, and thorax less heavily sculptured than your specimens. The postpetiole is also larger and less angulate on the side". The sculpturing and shape of the postpetiole have been found to vary to only a negligible degree on the Reserve. No specimens have been taken on the Reserve which approach individuals of floridana collected by the author in southern Florida.

This Pheidole replaces Monomorium pharaonis, prevalent in the Gainesville region, in and around the houses of the Reserve. In non-ruderal areas, it shows a preference for turkey oak and bluejack oak, where its nests occur commonly. Nests are also common in Pomello scrubby flatwoods. This ant is occasional to common in mesic hammock, and has been found rarely or occasionally in scrub, Leon scrubby flatwoods, longleaf pine flatwoods, Plummer and Rutlege slash pine flatwoods, black pine-fetterbush flatwoods, xeric and hydric hammocks, and river swamp.

Nests of this form have been found most often in the surface stratum, but almost as many have been taken in sand. It occupies a variety of nesting sites. In order of preference they are:

1. in dead stumps
2. under litter
3. in fallen logs
4. under logs
5. in litter
6. open sand (rudimentary craters, complete craters)
7. in and under logs
8. in bases of living trees

One collection was made from under the mat of a palmetto root.

Nests in sand have all showed a tendency to be under cover of some sort. Although some nests had well-formed craters, all were covered with one or several leaves. The rudimentary craters were all found against the foundations of buildings, and it is possible that the ants here lived in crevices in cement or under pieces of cement. Those nests in wood were usually in wet logs or stumps, and although nests occurred in wood in all stages of decay, more were in the later stages. Many collections were made under bark, and neither broadleaved nor pine wood was preferred.

Nests of this form are not populous, and seem to be smaller than P. dentigula. A nest, perhaps slightly smaller than average, contained 35 workers and 6 soldiers along with immatures. Immatures probably occur all year, and winged forms are present during the summer months. In some nests in wood it is difficult to delimit the boundaries of the colony. Individuals in these cases are found throughout the log, and there is no single, compact nest group.

This moderately active Pheidole is attracted to grease in kitchens. On several occasions it was taken eating the peanut butter and oatmeal bait of mammal traps, and in other instances it was found between the septa of large mushrooms. Mr. J. C. Moore found this ant on the Reserve in several fox squirrel nests. It continues its foraging activities into the night.

In one nest a beetle of the family Lethriidae was found associated with the ant in a stump in turkey oak.

Pheidole metallescens Emery

P. metallescens prefers the higher, drier areas. It occurs abundantly to commonly in turkey oak, Leon scrubby flatwoods, and xeric hammock; commonly in bluejack oak and scrub; occasionally in mesic hammock; and has been found only rarely in longleaf pine flatwoods, but may occur more abundantly there. It is often found in firelanes.

Approximately equal numbers of nests have been found in the subterranean stratum and in the surface stratum. Often, especially in turkey oak, nests have no crater, and the nest opening is entirely or partially covered by a single leaf. Some nests can be found in and around the root systems of herbs. The complete crater is characteristic of open ground, and in this situation incomplete craters can also be found. Nests of this latter kind vary in outside diameter of the crater from 2 to 3 inches, and in height from 1/8 to 1/2 inch; all of these nests have one opening. Many other nests occur in sand under leaf litter, and some of them maintain elementary craters.

The locations of nests in fallen logs vary from near or on hard wood to wood merging with the substratum; either the bark may still be intact or it may be absent. The wood may be dry, or moist, or wet.

A nest taken from a log in scrub contained 505 workers and 29 soldiers with 1 queen. Immatures occur the whole year. No information concerning the time of appearance of winged forms was obtained. One nest, taken in the middle of January, 1950, from a firelane, contained large chambers of workers within six inches of the surface.

This fairly fast moving ant has a varied diet. It is attracted to liver and to molasses. Foraging activities extend into the night.

Pheidole morrisi Forel

P. morrisi is another of the ants which prefers the higher, more open areas of the Reserve. It occurs occasionally to commonly in turkey oak and xeric hammock, and occasionally in bluejack oak and Pomello and Leon scrubby flatwoods. Characteristically its nests appear along the dirt shoulders of roads, in firelanes, and in the areas around houses.

All of the nests of this species were in the subterranean stratum. Most of the nests were built in open sand, but some were constructed under leaf litter. Half of the nests had no crater, and the other half were built around a grass tuft or in lawn, where a rudimentary crater was thrown up beside the plants. Sometimes these craters were built beside a fallen log under which the colony could be found. Craters of morrisi built in the open were about 4 to 5 inches in diameter, and 1 1/2 to 2 inches in height. A majority of nests had only one opening, but there were several with two, and a few with three, openings.

An unusually large nest of morrisi contained 3500 workers and 350 soldiers. An average nest probably contains 1000 individuals. The immature forms are absent from the nests from late December to February. Winged forms have been taken in July.

P. morrisi is an active ant, and each colony employs numerous speedy workers for foraging. Foraging activities are carried on at night. It seems, however, to show a seasonal relationship in its above-ground activity. In the winter months foraging ceases almost altogether, and the ants remain in the nest, about three feet below the ground surface.

Molasses attracts P. morrisi. It has been seen to pick up eggs and larvae, and even workers of Crematogaster ashmeadi, but no interpretation of this activity is attempted here.

Solenopsis pergandei and Paratrechina arenivaga, as well as a species of Diptera, have been found in nests of P. morrisi.

Pheidole pilifera (Roger)

Smith (in litt.) feels that this is not the typical form of P. pilifera. The name is therefore used here only in the broad sense.

Nests of pilifera have been found only in ruderal areas, namely in lawns and in orange groves, where its occurrence was frequent. All nests were complete craters which varied in diameter from 3 to 4 inches, and in height from 1/4 to 3/8 inches. All of the craters had only one nest opening.

P. pilifera, with its extremely large-headed workers, was recorded nesting with Paratrechina arenivaga and Solenopsis pergandei.

Cardiocondyla emeryi Forel

Foraging workers of C. emeryi were taken occasionally in xeric hammock and rarely in bluejack oak. Its nests in these situations have probably all been under litter, or perhaps in open sand. Smith (1944:36) states that the ants in Puerto Rico nest most commonly in sandy soil, but also in clay soil. Besides the above-mentioned stations, C. emeryi has been taken in the sand roads of the Reserve.

This small, slow-moving ant is attracted in great numbers to molasses traps. It continues its foraging activities into the night. Females were taken in flight in early December of 1949. Nests may be approximately the same size as those of C. nuda minutior.

Cardiocondyla nuda minutior Forel

On the basis of the few collections made of C. nuda minutior, firelanes and dirt roads, especially in high areas such as xeric hammock, seem to be its preferred nesting situations. On several occasions the grillwork of an automobile which had just passed through the high grass that grows in the xeric hammock roads was covered with workers of this form. It has been collected rarely in longleaf pine flatwoods, and it was found foraging along the edge of a bayhead where it abutted a sand road.

Like Solenopsis globularia littoralis, C. nuda minutior has been found only in uprooted palmetto roots. These nests are on the under side of the root, rather deep in the fine scalings of the wood.

The ant nests in small colonies of about 20 individuals. Females were taken on the wing in August, and female pupae were observed in the nest in the same month.

Cardiocondyla wroughtoni bimaculata Wheeler

C. wroughtoni bimaculata has been collected commonly in turkey oak, and only rarely in Leon scrubby flatwoods and longleaf pine flatwoods. Since it is common in turkey oak, there is no apparent reason why it should not be found in other of the high areas such as xeric hammock. Numerous nests can be found abundantly in clumps of bamboo planted near the buildings of the Reserve.

In turkey oak, nests of this ant are found most often in stumps of longleaf pine (Pinus palustris) or turkey oak (Quercus laevis). All of these nests have been in or next to hard wood, with a little debris or softer wood near the nest. The species has also been taken from logs

of longleaf pine, either dry or moist; from the moist base of an Andropogon stem; and from an oleander twig in which the nest was partly in the center of the stem, partly in the wood at the nodes, and partly under the thin bark in debris. It nests in a very similar way in and around the nodes of bamboo. Nests can thus be found in both the surface and herbaceous strata.

Of 3 nests taken in turkey oak and 1 in bamboo, that in the bamboo was the largest. These counted nests varied in number of workers from 21 to 43, and averaged about 32 workers. The number of queens increased with the size of the nest. The smallest nest contained 1 queen, while the others had 2, 4, and 5 queens respectively. All of the workers and queens were in one or two central chambers, and were not difficult to collect. Immature forms occur in all months. Females have been found in the nests in October, and a flight is recorded on October 7, 1949. What seemed to be an incipient nest without workers was observed in May, indicating that perhaps the females fly again in April or May, or that the workers are not hatched out during the winter.

This ant is moderately fast moving, and somewhat deliberate in its motions. Most of its foraging is done on days when the temperature is high (above 28°C.) and the relative humidity is relatively low (below 40%).

Crematogaster minutissima missouriensis Emery

Creighton (1950) lists the range of this ant from Texas to Missouri. C. minutissima minutissima is presented as replacing it from South Carolina to Florida and westward through the Gulf States to Texas. However, specimens from the Gainesville region and from Welaka have been

consistently identified by Dr. M. R. Smith of the U. S. N. M. as missouriensis. These locality records make it doubtful that minutissima and missouriensis are subspecies of minutissima. Until it can be proved, however, that they are variations of the same form, missouriensis will be recognized as a subspecies of minutissima.

During the course of the present investigation, it was found that missouriensis prefers the more hydric situations, although it has also been taken in the higher areas. It nested commonly in Plummer slash pine flatwoods, mesic hammock, hydric hammock, and bayhead, preferring hydric hammock; occasionally in bluejack oak, scrub, Rutlege slash pine flatwoods, and xeric hammock; and rarely in Pomello scrubby flatwoods and river swamp. In the Gainesville region, the ant was found in very similar situations.

C. minutissima missouriensis preferred nests on the soil surface, but many nests were found arboreally. Several nests were also taken in the subterranean stratum. The ant nested most often in fallen logs, bases of living trees, in small branches, in dead stumps, and under the mat of palmetto roots and trunks. It was also taken in the following places:

under logs
in and under moss on a palmetto root
in a debris-filled and well decayed Pinus clausa cone
under litter
under the outer sheath of a dead flower stalk of
Serenoa repens
under moss at the base of an oak tree

Nesting conditions varied from dry, in small branches, to wet in logs buried under litter. Other authors (Buren, 1943:289, and Cole, 1940: 46) have found the majority of nests in sand under stones.

A colony from a small branch in hydric hammock contained 208

workers (including callows), 102 worker pupae, and 8 queens. This colony was a unit, but many colonies appear to occupy several different levels in a nesting place such as a log or the base of a living tree. A typical nest, arranged among debris-filled regions along 10 inches of a log, occupied cavities on the hard wood near the outside.

In a situation of this sort it is difficult, and perhaps really unnecessary for the present purposes, to be sure that one is dealing with only one colony. One may ask what is the criterion which will distinguish a section of a colony from a whole colony. The presence of supernumerary queens in some colonies of missouriensis makes it impossible to be sure one is dealing with a whole colony when one queen is observed. Likewise, here and in the subgenus Acrocoelia, if a queen is observed, there may be other, queenless parts of the colony in other places. Groups of workers have been observed in Crematogaster, especially in Acrocoelia, (and in other genera to some extent) with an abundance of immatures and no queen. Unless intercourse between a queenless group and a group with a queen is observed, it would not be clear whether the queenless group carries its eggs from a mother queen in another nesting place, or whether the workers are independent and lay their own eggs. In treating this situation throughout this study, each physically distinct aggregation is called a nest.

Cole (1940:46), in his report on the ants of the Great Smoky Mountains, mentions a nest of missouriensis with only 47 workers, but 56 supernumerary queens. On the Reserve, immatures in the nest are usually absent during periods of cold weather, but a few are present in most nests all year. Winged form pupae have been found in the nests in May, and winged forms have been taken through August. One instance of

female pupae in October was observed, and in January males were taken on one occasion wandering about during the day.

This is a slow to moderately fast moving ant. It is attracted to molasses traps.

Crematogaster ashmeadi Mayr

C. ashmeadi nests occur very commonly in all of the well drained areas of the Reserve, and occasionally in the hammock areas and river swamp. Except for their occasional to common occurrence in longleaf pine flatwoods, they are found only rarely in poorly drained flatwoods. C. laeviuscula Mayr tends strongly to replace ashmeadi in the flatwoods areas and in bayhead and marsh.

C. ashmeadi has been taken abundantly in Pomello scrubby flatwoods; commonly in scrub, Leon scrubby flatwoods, and longleaf pine flatwoods; occasionally to commonly in turkey oak, bluejack oak, and xeric hammock; occasionally in mesic hammock, and river swamp; and rarely in Plummer slash pine flatwoods, black pine-fetterbush flatwoods, and hydric hammock.

By far the majority of collections were made arboreally, but other nests were taken in the surface stratum. Most often, the ant was found in small branches. The other nesting sites in order of importance to the ant are as follows: twigs, galls, fallen logs, dead stumps, and one collection was made in the base of a living tree. Most of the nests in small branches were found in either scrub oaks or in Pinus clausa. Nests were also taken from the logs of fallen sand pine, usually from under bark on the top side. Although the ant seemed to prefer nesting sites in scrubby oaks, its presence in pine logs and branches indicates

that its exclusion from poorly drained flatwoods is not due to an inability to live in pine.

The nests in twigs were on scrubby oaks, or else in grape vines. Those in scrubby oak galls were usually in pendant, spherical galls. Some were in other, variously shaped galls, especially the type around stems; in these the ant occupied the several different compartments from which the gall wasps had emerged. Nests were in either broadleaved or pine logs or stumps, but were in all cases dry or moist. This preference for dry or moist conditions in nesting sites supports the contention that this ant prefers the drier situations.

In the Gainesville region, drier situations, among them ruderal areas, were also preferred. In the same manner Cole (1940:46) has found ashmeadi nesting in dry situations.

In the discussion of the life history of C. minutissima missouriensis, it was brought out that on many occasions what may seem to be a colony of Acrocoelia may be merely a section of a larger aggregate, the true colony. It was pointed out that each of these sections is here recognized as a nest.

The number of workers contained in 18 nests ranged from 4 to 425, averaging 137. In none of these nests was a queen found. These nests had an average of 23 callow workers. The nest with the largest number of workers, taken in a small branch in Pomello scrubby flatwoods, contained 51 females and 11 males, while another nest of 185 workers contained no females and 38 males. Of those that contained winged forms, 12 were sex specific, while the others contained at least three times as many individuals of one sex as of another. The largest nest contained 220 worker pupae, whereas the other nests averaged about 25 worker pupae.

Winged forms were found in the nests in July through December. Single males have been taken in January.

In times of excitement, C. ashmeadi extends its heart-shaped gaster above its head, and runs quickly over the ground or the vegetation. Under normal circumstances, this is a slow to moderately fast moving ant. Many times when a nest is opened during a cold period when the nest is inactive, the workers do not move, but lie with their bodies pressed flat against the surface to which they are clinging. Such is also true of the other members of the subgenus.

In September, 1948, collections in Pomello scrubby flatwoods showed a remarkable abundance of C. ashmeadi, especially in galls, but also in small branches. This large population was within a circumscribed area of the station, and may have been coincidental with the galls and the small branches becoming suitable for the ants. A seasonal high was also noticed in Leon scrubby flatwoods in December. During 1949 no such high was observed in either station.

Although this subgenus is noted for its attendance of honeydew-excreting insects, they have been observed carrying various kinds of dead insects into their nests. On one occasion an aggregate of C. ashmeadi was noted in a crotch of a saw palmetto (Serenoa repens) frond; workers were carrying away parts of a dead grasshopper nymph. The workers have repeatedly ventured into the cyanide jar of a light trap in order to carry away insects. They have also been found, probably as casuals, in fox squirrel nests by Mr. J. C. Moore.

Nests have been observed adjacent to those of the termites Kalotermes (jouteli?). In one nest containing winged forms, a Diptera, resembling quite closely the males of ashmeadi, was found.

Some of the workers found on the Reserve have a somewhat opaque and slightly punctate thorax, differing from the usual shiny, smooth thorax. One colony, the only one taken from under the bark of a living tree (Pinus palustris), contained workers with a lighter appearance than usual. The head and thorax are light brown, while the gaster is dark. The queen is all light brown, and measures 1.8 mm. along the dorsum of the alinotum; other queens of C. ashmeadi measure 2.0 mm. along the dorsum, and are all dark brown or black.

Crematogaster coarctata vermiculata Emery

The specimens listed here were assigned to Crematogaster vermiculata by Dr. M. R. Smith. The collections of this ant, which has its type locality in Los Angeles, are the first Florida records.

Nests of this subspecies have been confined to two stations. C. coarctata vermiculata was collected occasionally in hydric hammock and river swamp. In all cases it was nesting arboreally, in most cases in twigs of sweetgum (Liquidambar styraciflua) or some one of the bay trees. Such twigs may have a half dozen openings to accomodate a colony. On one occasion it was found nesting in the crotch along the midrib of a Sabal palmetto frond under the debris gathered there. Other ants, especially Crematogaster ashmeadi and Paratrechina parvula, are also found nesting on palmetto fronds.

The distribution of vermiculata in stations and nesting sites on the Reserve indicates rather strongly that it will always be found in moist or hydric situations, and probably always above ground. In Gainesville, this form was taken in scrubby flatwoods, in an area where the plant association offered mesic conditions.

It is possible that the nests of this ant extend into two or more twigs. If this is the case, each twig of such a colony contains only a section of the whole colony. As explained before, each section is treated as a nest here. One very long twig seemed to contain a whole colony. A count of this colony yielded 1085 workers, 162 worker callows, 7 reproductive and 710 worker pupae, 25 reproductive and 221 worker larvae, and numerous eggs. The presence of reproductive pupae and larvae in the nest, taken in July, indicates that winged forms would soon be present. Winged forms were taken in another nest in early October.

The habits of vermiculata are much like those of ashmeadi.

Crematogaster laeviuscula Mayr

C. laeviuscula prefers to nest in the poorly drained flatwoods areas of the Reserve, and in the wetter areas of hammock and of seasonally flooded plant associations. In this way it tends to replace C. ashmeadi, although there are areas of overlap in the distribution of the two species, especially in longleaf pine flatwoods, and in mesic hammock.

C. laeviuscula was found abundantly in Rutlege slash pine flatwoods and in marsh; commonly in longleaf pine flatwoods, Plummer slash pine flatwoods, hydric hammock, and bayhead; occasionally in blucjack oak, and mesic hammock; and rarely in turkey oak and xeric hammock. Its absence from black pine-fetterbush flatwoods may be due to the scarcity of logs in that station, but it may also depend on the relative openness and consequent high rate of evaporation and prolonged dryness of the area.

Nests of laeviuscula were found in all strata except the subterranean, most often arboreally, and least often in the herbaceous stratum. Small branches and fallen logs are the most preferred nesting sites.

C. laeviuscula, however, uses small branches less than half as many times as ashmeadi, whereas it nests in fallen logs much more often than ashmeadi. In order of preference other nesting sites in which laeviuscula has been found are: twigs, dead stumps, carton, sawgrass flower stems. Single collections have been made from an Andropogon stem, a dried leaf of Sagittaria between septa, a flower stalk of Sabal palmetto on ground, and from under pine needle litter on saw palmetto frond two feet above ground.

In a majority of the cases, the nests in logs were in or against hard wood, but some nests were in softer wood. Nests were in logs of all stages of decay, from those merging with the soil to those in which the wood was in the first stage of decay. Some nests were under the bark of fallen logs. Nests of carton were observed on occasion in the sawgrass (Mariscus jamaicensis) marsh, but always on a flower stalk of sawgrass; in these cases the nests occupied both the carton and the flower stalk. Never was the carton portion of such a nest far above the water surface.

In the marsh grass (Spartina bakeri) marsh on Buzzard's Roost, carton nests were abundant. Except for a few laeviuscula in twigs, no other nesting site was observed to be occupied by ants in this marsh. Nests are usually one or two feet above the base of the Spartina clump, shaded by the tops of the grass blades. Each nest in marsh grass binds together a number of grass blades, usually the middle dozen or so of each grass clump, and is held up by them. Nests are quite large, measuring, on an average, 12 inches vertically and 4 inches horizontally. One nest measured 20 inches vertically and 6 inches horizontally. They are constructed of plant material, usually bits of leaves, together with large sections or whole leaves of maple or wax myrtle curled around the

supporting grass. The nests are quite moist on the inside, but are always dry on the outside. Several nests, built in the crotches of shrubs, extended from the carton into the adjoining hollow stems.

Nests of C. laeviuscula are numerically about the same size as those of C. ashmeadi. The range in numbers of workers in the 7 nests counted was from 16 to 300, averaging 128. None of these nests contained queens. Nests and sections of nests are considered synonymous here in the manner discussed under C. ashmeadi. The cold spells on the Reserve seem to be coincidental with the absence of immature forms in the nests. Reproductive pupae appear in the nests in April, and winged forms have been taken in June through July, and again in October through December. Only 2 out of the 10 nests from which winged forms were taken, contained both males and females.

On June 27, 1948, a nest was observed in Rutlege slash pine flatwoods from which excited workers were emerging and hastily running along the low shrubs surrounding the twig nesting site. Along with the excited workers were males, evidently ready to make a flight, although no male was seen to fly. A nest brought into the laboratory on November 26, 1949 contained males which immediately attempted to wander from the nest, although no flight was observed. The males and attendant workers aggregated under the bucket in which the carton nest had been placed. Perhaps this restlessness was preflight activity, or was merely due to overexposure of the nest to sun with a consequent change in temperature and relative humidity in the nest. (It is possible that in natural conditions a sharp enough change in the physical conditions of the nest may evoke flight.) The next day the nest was placed over water in an attempt to keep the ants in their nest. On November 29, the males were

noted investigating the ends of the cut marsh grass, but no flight took place. Because of their restlessness, a large number of males had fallen into the water and drowned by the next day, and observations were discontinued.

The habits of movement and feeding are much like those discussed under C. ashmeadi. Dead insects have been found in nests of C. laeviuscula, and the ant is attracted to molasses traps. On one occasion workers were seemingly attending scale insects on a palm frond. Nests have been noted near nests of termites, the workers of each freely intermingling. They were seen to stroke the termites with their antennae and palpi on all parts of the termite's body, but mainly in the head and thorax regions. Small mites have been found on the antennae of several workers. The size of many individuals in marsh is strikingly larger than that of those in other plant associations. Total body length ranged in one nest from 3.0 mm. to 4.8 mm., whereas workers from other stations range from 2.5 mm. to 3.3 mm. in total body length.

Crematogaster lineolata (Say)

Creighton (1950:213) notes that C. lineolata is found the farthest south in the Appalachian Highlands of northern Georgia, and that an altitudinal difference separates lineolata from the subspecies subopaca. C. lineolata is reported to have its range at low to moderate elevations in the South Atlantic States, as well as to the west and north.

Specimens which are labelled C. lineolata, sent to the author by Dr. Smith, key out to C. lineolata subopaca in Creighton's key. On the other hand, those specimens which were taken on the Reserve can be assigned to lineolata on the basis of his key. According to the

distribution Creighton cites, subopaca, and not lineolata, should occur here. Since it will not be clear what form of the species lineolata occurs on the Reserve until specimens of lineolata and subopaca have been examined, the name lineolata will be used here in the broad sense.

C. lineolata was taken in only three stations. It occurs commonly in Pomello scrubby flatwoods, and occasionally in Leon scrubby flatwoods and xeric hammock. Nests have been found in almost equal abundance in the surface stratum and in the subterranean stratum under litter.

Its nesting sites have been approximately evenly divided between nests under litter, in litter, in fallen logs, in dead stumps, and in small branches. The nests in logs and stumps were in oak for the most part, but some were found in pine. The relatively few nests in pine sets lineolata apart from the other members of the subgenus on the Reserve, but the difference may be due to the distribution of the species in stations where the main trees forming logs and stumps are oak rather than pine. In this respect it can be noted that lineolata follows the distribution trend of ashmeadi rather than that of laeviuscula, occurring in the better drained areas of the Reserve. Cole (1940:47) indicates, as do the above observations, that this species lives as often in the soil as in wood. He mentions that nests under stones loosely resting on the soil were a favorable nesting site.

One nest from Pomello scrubby flatwoods contained 184 workers, 3 callow workers, and 35 worker pupae. No queen was taken. Cold weather, as it does with the other species of the subgenus on the Reserve, seems to inhibit the production of eggs. Pupae of males and females were seen in nests at the end of March, and males were taken in the nest in May.

No information concerning winged females was obtained.

C. lineolata has much the same habits as the others of the subgenus on the Reserve. It is a moderately fast moving ant. Because of its distribution on the Reserve, it was taken in most cases when the temperatures were high and the relative humidity low. It was observed attending aphids, and probably also uses insects as food.

Monomorium floricola (Jerdon)

One specimen of this species was collected wandering on a sawdust pile in turkey oak. This introduced species is well distributed over Central America and the West Indies. Wheeler (1908:128), writing of the ants of Puerto Rico and the Virgin Islands, states that these ants are "Common in Tillandsias, under bark-scales of trees and in hollow twigs. All the females were apterous...."

Monomorium minimum (Buckley)

M. minimum was taken occasionally in only one station, namely turkey oak. It was, however, found also in firelanes, and was one of the more common occupants of the latter areas. In most cases this ant nested in craters, either incomplete or complete, but some nests were found under very light litter. The craters, all with one nest opening, varied in diameter from 2 1/2 to 4 inches, and in height from 1/2 to 1 3/4 inches.

In the Gainesville region, minimum was found nesting for the most part in logs, or under logs or other cover. It seems to be well distributed throughout the United States.

During the work of bringing pellets of sand to the surface,

this moderately fast moving, diligent ant employs many workers, and thereby gives the nest the appearance of bustling activity. By comparing a vial filled with a known number of ants and another filled with an unknown number, a total of about 3000 workers was estimated for one nest. Several termites were taken with this colony.

Solenopsis geminata (Fabricius)

The close morphological resemblance of this ant and S. rufa is discussed under the latter ant. Since the lack of the mesosternal spine in this form seems to be an untrustworthy character to differentiate it from rufa, the darker color of geminata has been used here to distinguish the two forms.

S. geminata was found in nine stations, but it was taken commonly only in Leon scrubby flatwoods. Occasional collections were made from turkey oak, bluejack oak, Pomello scrubby flatwoods, longleaf pine flatwoods, xeric hammock, hydric hammock, and river swamp; and one nest was found in scrub. Firelanes also afford a favorable nesting site. In the Gainesville region it was found more commonly, and was also taken in mesic hammock.

On the Reserve, geminata has for the most part occupied the subterranean stratum, but has also been found in the surface stratum. Most of its nests are asymmetrical, rudimentary craters, or are in sand under litter. Other nests were found in incomplete craters, complete craters, in a palmetto root on the ground, and under a longleaf pine log. This last colony had produced a crater at the side of the log.

The nests with incomplete and complete craters were very likely incipient nests, or nests with small numbers of individuals. As these

nests grow in size, the several grouped craters fuse to form a large, rudimentary crater. Many of the rudimentary craters, on the other hand, are begun around a clump of grass which soon becomes buried under the sand of the crater. Some rudimentary craters are built in the form of a string of craters, sometimes up to eight feet in length. One rudimentary crater was begun around the base of a scrub oak, and was composed of sand, leaves, and small pieces of rootlets. Rudimentary craters have been observed ranging from 4 inches to over 1 1/2 feet in diameter; from 1 inch to almost 1/2 foot in height; and in number of nest openings from 1 to 20 or more.

This "fire ant" is moderately agile, much like rufa. It has been attracted to mammal traps baited with peanut butter and oatmeal. Small seeds, such as alyceclover and carpetgrass, make up part of its food, but the ant's small size makes larger seeds too difficult to carry. The workers also derive honeydew from aphids on the roots of plants near their nest.

Winged forms have been observed in June and July. Immatures appear most numerous in the summer.

Solenopsis rufa (Jerdon)

This form has been listed by Creighton (1950) and previous authors as S. geminata rufa. Creighton, however, points out that the characters used to separate geminata from rufa may have been given more prominence than they deserve, and that the character of the mesosternal spine in rufa is more valid for the Asiatic specimens than for those from the United States. In America rufa and geminata are found in practically the same areas, making it impossible to treat rufa as a

geographical subspecies. On the other hand, rufa and geminata are found to intergrade, making it difficult to treat them as separate species. Creighton (1950:232) says: "In this country rufa behaves as a color variety and shows no geographical distinctions. I have retained it as a subspecies because this behavior may be a result of introduction." Evidently there is material which has come to Creighton's attention that makes him believe that rufa and geminata are not synonymous. With doubt still existing as to the taxonomic status of rufa, it is here believed wiser to treat it as a separate species and not involve the geographic connotation of a subspecies.

Specimens of rufa were found rarely in turkey oak and longleaf pine flatwoods, and occasionally in Plummer slash pine flatwoods. Colonies have been taken from both the surface and subterranean strata. Nests are found most often with rudimentary craters or under litter in sand. One nest was found in the under side of a turkey oak (Quercus laevis) log. Part of this last colony was in the log and a lesser part in the sand under the log. The rudimentary craters or mounds may reach a diameter of 2 feet and a height of 1 foot, with numerous nest openings. To build these nests S. rufa seeks the more open areas. For example, the nest in longleaf pine flatwoods was partly in the flatwoods proper and partly in a firelane which was cut through the flatwoods. S. rufa has also been taken nesting in ruderal bamboo.

In the Gainesville region the hammocks provided nesting sites for this ant. Its abundance around Gainesville was higher than on the Reserve, probably because of the more open nature of the ground. There is also the possibility that, because it is a "tramp" form, it has spread more widely in the residential districts and their surrounding areas,

than in the less commercial area of the Reserve. In the Gainesville region, small craters were often seen built around grass clumps. As the nest grew and more sand was brought to the surface, the grass was buried.

S. rufa is a moderately fast moving ant. Sweeping with an insect net across low vegetation has, on several occasions, yielded specimens of this form. Flights of winged forms have been observed in May and October.

Solenopsis globularia littcralis Creighton

S. globularia littoralis is one of the few ants collected more than once which occur in only one plant association of the Reserve. It was found occasionally in black pine-fetterbush flatwoods. In Gainesville, the ant was confined to the open, almost shrubless flatwoods which are commonly used as pastureland in that area.

The nests on the Reserve were found to be only in the surface stratum. Typical nests were in palmetto roots thrown up on the soil surface. In the palmetto root the nest was built between the overlapping flakes of the bases of fronds, and was on the under side near the soil. One nest was found in a grass clump, part of the nest being in the roots of the plant, where the queen was located, and the rest being in the lower stems. In Gainesville, the ants were taken from under the bark of newly cut pine logs, and from nests built in sand and covered by small shavings of wood and pine needles.

One nest, taken in the black pine-fetterbush association of the Reserve, contained 46 workers and 1 queen, along with immature forms. No information as to when the sexual forms appear in the nests was obtained.

S. globularia littoralis is a moderately fast moving ant. It extends its above-ground activities into the night.

Solenopsis minutissima Emery ?

The taxonomy of this small, insignificant ant has been one of the most confused of the ants of the Reserve. Smith (in litt.) said specimens "agree very well with specimens collected in Haiti and recorded by Wheeler and Mann....as pollux Forel....Please do not consider the determination final as your specimens have not been checked with types or with the original description." Other specimens were sent to Creighton, who was cognizant of Smith's determination. He wrote that in his opinion the specimens, which were the same that had been determined pollux by Smith, were minutissima Emery. He says (in litt.): "Although I have not been able to compare your specimens with type material of minutissima, they agree so perfectly with Emery's figure and description of that species that there is little room for doubt on this point. The head of minutissima is more elongate than that of pollux and is narrowed behind. There are several other differences which distinguish the two species. Your specimens agree on every count with minutissima rather than with pollux....S. minutissima was originally described from material taken in Buenos Aires, Argentina. The species would, therefore, be much more likely to establish itself in northern Florida than would a strictly tropical form." In another letter Creighton indicates that there is some doubt in his mind as to whether minutissima should have been synonymized with laeviceps. He says specimens from the Reserve may possibly be laeviceps, but he thinks it very likely that they are minutissima. From still another aspect, Brown, from a comparison of worker types, believes

that minutissima and Smith's longiceps are synonymous.

This ant seems to prefer the mesic and hydric areas of the Reserve, although it has been taken in the better drained stations. Nests were occasional in turkey oak, bluejack oak, scrub, Pomello scrubby flatwoods, Plummer slash pine flatwoods, mesic hammock, hydric hammock, and bayhead; and rare in xeric hammock and river swamp.

All nests occurred in the surface stratum, mostly in the bases of living trees. The trees most preferred were slash pine (Pinus elliotti), probably because of the high relative humidity and low rate of evaporation usually around them. The ant was found also in longleaf pine (Pinus palustris) in xeric hammock and bluejack oak, and once in water oak (Quercus nigra). All of these nests were at the base of the tree in the bark below the soil or litter surface; all were wet, and usually contained some debris. These nests were in "sections" as discussed under Crematogaster minutissima missouriensis. Other nests were found in fallen logs and under the mat of a palmetto root.

A count of 3 nests yielded a range in the number of workers from 22 to 39, averaging 29. These numbers are, in all likelihood, smaller than is characteristic of an average nest or section. Immatures were present in the nest in all parts of the year. What are believed to be reproductive form larvae were found in the nest in April. No further information concerning the winged forms was obtained.

The movements of this ant are even slower than those of S. molesta. Whenever a nest was broken into, the workers always remained motionless for a few seconds, perhaps long enough for the student to overlook them. As in the case of the Ponerine ants, which blend with their nesting sites, these ants are many times given away by the presence

of their white immatures.

Solenopsis molesta (Say)

Certain of the specimens included under this heading differ somewhat from the measurements given by Smith (1942) and Hayes (1920). These specimens are proportionately smaller than those described by these authors; they are also smaller than other specimens determined as molesta taken from the Reserve. Smith lists the worker length of molesta as 1.8 mm.; Hayes gives the length of the worker as 1.5 mm. to 1.8 mm. This last measurement is much closer to that of the range found on the Reserve, where workers varied from 1.45 mm. to 1.8 mm. If these specimens all represent the same species, it is possible that the difference in length can be attributed to differences in the technique of measurement, but it would be evident that molesta workers have a wide range in total length.

S. molesta finds its most preferred nesting sites in mesic or somewhat hydric stations. It was taken abundantly in mesic hammock; commonly in scrub, Plummer slash pine flatwoods, and hydric hammock; occasionally to commonly in Pomello scrubby flatwoods, longleaf pine flatwoods, and bayhead; occasionally in turkey oak, bluejack oak, Leon scrubby flatwoods, Rutlege slash pine flatwoods, black pine-fetterbush flatwoods, and xeric hammock. It is possible that it will also occur in marsh and swamp.

Nesting sites of molesta are preponderantly in the surface stratum of the Reserve. Only one nest was found in sand. In the Gainesville region, however, approximately half the nests were constructed in sand, either in the open around grass clumps, or under some sort of

cover. Cole (1940:41) mentions only nests in sand for molesta in the Great Smoky Mountains: "The independent nests consisted of a very few tiny chambers and galleries lying very near the soil surface just beneath the cover of stone or wood." In seeming contradiction to the observations on the Reserve, Cole found molesta nests only in dry grassy areas. It is likely, however, that the ant makes use of the nesting places available in those areas in which it finds itself. Where there are no logs in the right stage of decomposition, it lives under stones or other material, and where there are favorable nesting sites in wood, it makes use of them.

In order of importance to the ant, the nesting sites in which molesta has been found on the Reserve are as follows: bases of living trees, under mat of palmetto root, in dead stump, in fallen log, in palmetto root on ground, in and under litter. It has also been found in the base of a grass clump, under sphagnum at base of live oak, and under sphagnum on saw palmetto root. Cases of lestobiosis have also been observed.

The majority of S. molesta nests in wood on the Reserve were in soft, wet wood which was decayed to fine debris. Those nests in saw palmetto roots were usually between the root and the bases of sloughed-off fronds where there was quite a bit of debris; as a rule, moss covered the roots. Nests in the bases of living trees were all in the bark below the soil surface, in a position where there was a great deal of moisture. Nests in fallen logs and stumps were found equally in pine and broadleaved (especially oak) wood.

Of the three nests counted, the number of workers ranged from 60 to 100, averaging 78. None of these had a queen. Nests which seemed

to have at least 200 individuals have been seen. S. molesta seems to nest in "sections" as discussed under Crematogaster minutissima missouriensis. It offers somewhat the same problem as missouriensis, since it is small in size, and on many occasions can be found in the bases of living trees, especially pine. Sections of a nest in the bark at the base of a tree may range almost the whole distance around the circumference. Hayes (1920: 28), writing on the queen of S. molesta says: "It is an unusual thing to find a queen in out-door nests, and the number of queens in a colony, when found, vary from one to many. In a single instance 26 fertile, or at least wingless queens were taken in a colony containing a large number of workers and immature forms." In an attempt to explain the absence of queens from nests in the field, Hayes states further that "The life of a queen under artificial conditions is very short. None were able to live for an entire summer, or even be carried over the winter.... [but] Queens were found early in May in outdoor nests, indicating that they will live over an entire winter at least." Hayes makes no mention of the point that his nests may be only sections of complete colonies, and consequently have no queen. It is certain, however, that queens of S. molesta are not as easily obtainable as queens of certain other species.

The workers of this ant are small and move slowly, and, with their pale color, are difficult to see against light backgrounds. Winged forms have been observed in the nests in July and August, and immatures are present in every month.

Following is a list of the ants with which S. molesta has been found nesting:

Paratrechina arenivaga, with Solenopsis pergandei
Crematogaster ashmeadi
Aphaenogaster fulva
Pheidole dentigula

On February 22, 1947, in the Gainesville region, a nest taken from around a grass clump in turkey oak, in which the ants were perhaps attending aphids, contained a nymph of the family Miridae (det. R. I. Sailor, U. S. N. M.) (Hemiptera).

Solenopsis pergandei Forel

S. pergandei is the least common of the ants of the subgenus Diplorhoptrum on the Reserve. It was taken occasionally in turkey oak and xeric hammock, and rarely in Leon scrubby flatwoods and mesic hammock. This distribution indicates a preference for the better drained areas of the Reserve.

Most of the nests of S. pergandei were taken in the subterranean stratum, but the ant was also found in the surface stratum. It was found most often in nests of other ants. Other nests were taken under litter, under reindeer moss, and under the bark and in the wood of wet, fairly soft laurel oak logs. Nests of this ant in the Gainesville region were more numerous than in Welaka, and were built around small plants, clumps of grass, and one was found around the base of a mushroom. These rudimentary nests all contained four or five openings.

S. pergandei, as mentioned above, has been noted to exhibit lestobiosis in nests of Paratrechina arenivaga and Pheidole morrisi. Groups of the Solenopsis were found about a foot below the soil surface in the dirt of these nests. In several instances, S. molesta was taken along with pergandei in Paratrechina nests.

S. pergandei is slow moving, and pale in color. These attributes make it difficult to detect, since it lives on pale colored sand in most cases. What are thought to be females of this species have been taken in August.

Solenopsis picta Emery

The distribution of S. picta in the Welaka Reserve is peculiar in that it occurs in 14 of the 15 stations worked, but in none does it occur with a high degree of relative abundance. It was found occasionally to commonly in bayhead; occasionally in all other stations except black pine-fetterbush flatwoods, xeric hammock, river swamp, and marsh. It was absent in marsh, and occurred rarely in the other three stations. Its distribution is more closely allied with the arboreal stratum than with any station or group of stations.

The greatest number of collections were made in the arboreal stratum, but several were also made in the surface stratum. The most common nesting sites, in order of preference, are as follows: small branches, twigs, galls, and fallen logs. The ants were also found under the mat of a palmetto root and in the base of a living tree, and what may have been a nest was recorded from under litter. Although more collections were made of nests in wood of broadleaved trees, many collections were also made in pine, and the margin is not enough to indicate a preference.

Nests of S. picta are at times constructed in such a way that they might be interpreted as being "sections" as discussed under Crematogaster minutissima missouriensis. One such nest in a small branch contained 13 workers and no queen, while another in a gall contained 10

workers and no queen. In the case of the latter nest, it is possible that the rest of the colony was in a nearby gall which contained a queen with 48 workers. All other nests counted contained one queen each. In two small nests, there were 7 and 8 workers, respectively from a grass stem and from a shrub twig. One nest from a twig in mesic hammock contained 215 workers, while another from a twig in scrub contained 555 workers. Winged forms have been taken in July.

S. picta is rather slow in its movements. It has been taken nesting very close to Paratrechina parvula in a saw palmetto root, perhaps giving an example of lestobiosis. The Solenopsis has also been taken with termites. Mr. J. C. Moore, working on the fox squirrels of the Reserve, has found it in the mammal nests. He records that one such fox squirrel nest in which ants were found was 90% Spanish moss and well-soaked by frequent rains at the time of the collection. He states (in litt.) that "Certain beetles, lepidopteras, and stratiomyid fly larvae were much more abundant than the ants in the rotting interior."

Myrmecina americana Emery

Only one specimen of this ant, from leaf litter in scrub, was taken during the study. Further search failed to discover the nesting site.

Gregg (1944:462) has found americana rare in the Chicago region, and Buren (1943:290) lists it from Iowa. Cole (1940:40) sums up its habits in the Great Smoky Mountains in the following sentences: "It has been found only in very moist habitats, where it lives in small colonies and constructs little nests in wet rotted hollow twigs, under dense masses of moss on logs on stones and beneath small stones. It was

found to be a rather common representative of the meager ant fauna of the buckeye-basswood forest. Many of the colonies consisted of only 12 to 20 workers. The nests are of a very superficial nature and the chambers are generally those natural crevices which may be accessible. The workers are extremely slow of movement."

Leptothorax pergandei floridanus Emery

L. pergandei floridanus occupied eleven stations. Although it prefers the higher, drier plant associations, it was taken several times in low flatwoods and low hammocks. Nests were, however, found to be excluded from the seasonally flooded areas. It is interesting to note that the subspecies has been collected most commonly in the low black pine-fetterbush flatwoods. Portions of this area occasionally contain standing water for a day or so at a time during the period of the hard summer rains. The ground, however, soon becomes dry, and the open terrain affords a habitat similar to a higher area. The other stations in which floridanus occurs commonly are turkey oak, bluejack oak, and Leon scrubby flatwoods. Nests were found occasionally to commonly in scrub, longleaf pine flatwoods, and xeric hammock; occasionally in Pomello scrubby flatwoods and mesic hammock; and rarely in Plummer slash pine flatwoods and hydric hammock.

Colonies were found, for the most part, in the surface stratum. Perhaps half as many nests were found in sand, but a majority of these were associated with wood such as the root system of living and dead fetterbush in the P. serotina-Desmothamnus association. One nest was taken from an Andropogon stem in the herbaceous stratum, and two colonies were collected from the arboreal stratum.

L. pergandei floridanus was collected most often from logs. In order of preference, other places from which nests have been collected are:

1. under leaf litter
2. in dead stumps
3. under mat on palmetto roots and trunks
4. under and in logs
5. in small branches
6. in palmetto root
7. in base of living tree
8. in grass clump
9. in Andropogon stem
10. in rotting pine cone
11. inside stem of rotting palmetto frond

Nests in debris were common, although some contained a minimum of debris.

Of five colonies collected from the surface stratum and counted, the number of workers varied from 21 to 58, and averaged 36. Another nest was taken from a small branch and contained 2 callows and 111 workers. Each of these nests contained one queen. Still another nest was taken from a fallen log which contained only 18 workers and no queen; but perhaps this was only a section of the whole colony. Eggs, larvae, and pupae were found in all months, although not in all nests. Winged forms begin to appear in the nests in May and are absent again by August.

Usually this ant can be seen in moderate above-ground activity in all months of the year. Its mannerisms and appearance in the field are much like those of Pheidole dentata, and it is sometimes necessary to examine closely a wandering individual before a determination can be made.

Leptothorax texanus davisi Wheeler

The collection of this ant in Florida extends the known range considerably, since the subspecies was known previously only from New Jersey and New York. Dr. M. R. Smith writes that the Florida specimens do not differ from the specimens collected in these northern localities.

L. texanus davisi was found occasionally in turkey oak and Leon scrubby flatwoods, and rarely in bluejack oak, black pine-fetterbush flatwoods, and xeric hammock. It thus shows a preference for the higher, drier areas.

Its nesting sites have all been in the subterranean stratum, either under litter or with litter or no crater in the open sand. One nest was discovered which had no apparent opening to the surface; the entire nest was within 1/4 inch of the surface.

A nest collected in turkey oak contained 18 workers and a queen, but no immature forms. No further information was obtained concerning the life history of this ant.

It is shy, and moves only moderately fast over the sand while foraging. Like L. pergandei floridanus, it moves about in somewhat the same manner as the much more common ant Pheidole dentata. It has been taken foraging with Solenopsis geminata, and a lone queen of Camponotus socius was taken with a davisi colony.

Tetramorium guineense (F.)

This introduced species was found in four plant associations. However, only the single collection in turkey oak was taken from a station. Since the other collections were not made in stations, the relative abundance must be based solely on the few collecting trips made to the

areas in question. These three remaining plant associations in which the ant was observed are similar to the descriptions of the respective stations given in a previous portion of this paper. They all had in common their distribution along the St. Johns River, a fact which seems to support the idea that the form is introduced. Map 3 shows Buzzard's Roost in the southwest corner of the Reserve where the ant was taken rarely in river swamp and occasionally in hydric hammock. At Mud Springs, near the swamp station, the ant was taken occasionally in marsh. There is a possibility that it had only recently been introduced into turkey oak.

T. guineense was represented in the surface and the herbaceous strata. Here the herbaceous strata is extended to include the flower stalks of sawgrass. These vertical stalks, which become hollow inside with a usual bore of 1/4 to 3/8 inch, cannot be considered true twigs because of the large diameter of the bore, and because ants representative of twig-inhabiting forms, such as species of Pseudomyrma, are not found here. One nest, taken from a flower stalk, was between two nodes of the sawgrass stem. Part of the segment was broken through, and this had been replaced with black debris, probably from rotting sawgrass blades.

In hydric hammock its nesting sites were under the mat of a Sabal palmetto trunk, in the top of the atrophied root system, and in a stump. In swamp, the ant was found in a fallen log. The nest ramified into many passageways, and occupied three feet of the log which had a diameter of two to two and one-half inches. A dealated queen was taken while it was wandering in one of the buildings of the Reserve.

One colony taken in marsh was found to contain 290 workers, 3 queens, eggs, 218 larvae, and 22 pupae. The arrangement of the castes

in this colony, taken in a sawgrass flower stem, is of interest. All of the nest was contained between two nodes of the vertical stem. An estimated one-half of the colony was in the upper half of the segment. Larvae, attached by their anterior ends, were jutting out into the hollow of the stem. At the top of the section, clinging upside down to the nodal membrane, were many workers and a queen, along with many eggs.

Immature forms have been found in the nests from July through November, but probably occur in all months of the year. Alate and dealated females have been taken in August and September. No information has been obtained for the males.

Strumigenys louisianae Roger

S. louisianae has been found rarely in turkey oak, bluejack oak, xeric hammock, mesic hammock, and river swamp. It is more common on the Reserve than most species of the closely related Smithistruma. As with Smithistruma, the most successful means of collecting it has proven to be by use of a Berlese funnel. It has, however, been taken from nests in fallen sweetgum (Liquidambar styraciflua) logs in which the wood was fairly dry, and in a differential state of decay. It was taken also from the moist wood debris inside a Magnolia grandiflora log. Berlese collections were made between temperatures of 24° - 30°C. and relative humidities of 50% to 95%. As in the case of Smithistruma on the Reserve, the relative humidity was always above 50% at the time of collection.

In the Gainesville region all of the collections of this species were made in logs of Magnolia grandiflora well along in the process of decay. The frequent collections in magnolia may indicate a

preference for the moist debris found in these logs.

The ants of this species, like those of the species of Smithistruma, are difficult to locate in the field. Their color, which is like that of the wood in which they nest, and their habit of remaining very still in their nest after it is opened greatly enhance the chances of overlooking a nest. Like Smithistruma also, they move with a slow, deliberate gait.

Smithistruma Brown

In 1948, Brown erected the genus Smithistruma to receive most of the forms which had previously formed the subgenus Cephaloxys of Strumigenys. Cephaloxys, however, has been shown to be preoccupied, and Trichoscapa is the next available name for the group. Brown, however, recognizes that the type species of Trichoscapa, membranifera, is distinct from the rest of the group. He has therefore raised Trichoscapa to the rank of genus, and has introduced Smithistruma as a new genus. Creighton (1950), although he was undoubtedly aware of the revisionary measures undertaken for Strumigenys, makes no note of them. This dissertation will follow Brown's treatment of the group.

Ants of the genus Smithistruma build nests only one or two inches in diameter, sometimes deep in the wood. Careful searching is usually necessary in order to find their nests. The color of the ants, which is very much like that of the material in which they live, and their habit of remaining very still when their nests are broken open, make it necessary to look at a nest for several seconds before the ants are seen.

It will be noted that, although the temperatures varied widely at the time of collection, the relative humidity was in all cases above

50%. In most cases too few collections were made to draw any conclusions concerning preference of stations.

Smithistruma bunki Brown

The single collection of bunki was made from turkey oak. The collection was made by use of a Berlese funnel from litter gathered on an overcast day when the temperature was 37°C. and the humidity 66%.

Smithistruma clypeata (Roger)

S. clypeata was taken occasionally in xeric hammock from Berlese samples. Two dealated females were taken with workers in one sample. It is possible, therefore, that the nest was in the leaf litter, or on the soil under the litter. This collection was made at 18°C. and 54% relative humidity.

Smithistruma creightoni (M. R. Smith)

S. creightoni has been found occasionally in xeric hammock and rarely in bayhead. All collections were made by means of a Berlese funnel from litter taken at temperatures ranging from 21° to 30°C. and relative humidity ranging from 50% to 80%. The litter sample from bayhead yielded the following ants along with the Smithistruma: Solenopsis molesta, Brachymyrmex depilis, and Pheidole dentigula.

Smithistruma dietrichi (M. R. Smith)

S. dietrichi was taken occasionally in turkey oak and rarely in bluejack oak. In turkey oak, one collection was made of several individuals in a log of Quercus laevis which was in an advanced stage of wet

rot decay. Other collections were made by means of a Berlese funnel at temperatures between 30° and 40°C. and relative humidity between 50% and 70%.

Smithistruma ornata (Mayr)

Two collections of this ant were made, one from scrub and one from mesic hammock. The collections were made at temperatures of 28° and 33°C., with humidity of 80% and 98%. Although two collections probably do not indicate the habitat preference of this ant, it can be noted that they were both made under more or less mesic conditions.

Smithistruma pulchella (Emery)

This species was found rarely in both xeric hammock and river swamp. One collection was made from a Berlese sample with a temperature of 14°C. and 75% relative humidity on an overcast day. Specimens were also taken from a mammal trap baited with oatmeal and peanut butter when the temperature was 25°C. and the relative humidity was 87%.

Smithistruma talpa (Weber)

S. talpa was taken rarely in Pomello scrubby flatwoods, mesic hammock, hydric hammock, and bayhead. In bayhead a nest was found in slash pine (Pinus elliotti) bark at the base of the living tree under litter and just below the soil surface. There was some debris in the nest, and the bark was moist. Other collections were made from Berlese samples between temperatures of 19° and 27°C. and between 60% and 65% relative humidity.

Trachymyrmex septentrionalis seminole (Wheeler)

This fungus-growing ant was found to prefer the higher, drier areas. It was taken commonly in turkey oak and xeric hammock; occasionally to commonly in bluejack oak; occasionally in scrub, Leon scrubby flatwoods, and Pomello scrubby flatwoods; and rarely in mesic hammock.

Areas with little or no litter are preferred by seminole, although it has been taken in sand beneath litter, and Cole, in the Great Smoky Mountains, found it beneath stones. Characteristically the colonies build an incomplete crater around the nest openings. Some nests, however, were found with complete craters, and others with no craters. Even in light litter the ants built craters, piling the sand pellets on the surrounding leaves; in heavy litter the craters became obscure.

Incomplete craters faced no common direction. An average crater is 6 to 8 inches in outside diameter, and about 2 inches at the highest point. Nests always have only one opening. No records of the ant were made other than in the subterranean stratum.

A nest of this form, collected in December, 1949, contained 382 workers and 1 queen. All of the workers, except a very few, were clustered about the queen in a deep chamber 4 feet below the surface. The passageways went down to about 6 feet, but no immature forms were seen. The deeper, vertical passageways (3 to 6 feet) were widened at places for several inches so that it would have been possible to place a 2-dram vial within the gallery. Other nests were opened during the same week, and in all of the nests the majority of the individuals remained well below the surface; only a few were seen excavating. The top galleries and chambers of most colonies were empty. In the nests which were active, workers were bringing to the surface organic substances which might have been used

fungus substratum. Some nest openings, and other nest passageways were closed, and in three nests small rod-shaped particles which resembled in size the nettles of Opuntia were seen clogging the nest openings. These particles were fragments of sedge or grass (probably Aristida stricta). Mixed with these, were many more unidentified plant fragments. Only very poor evidence of fungus was visible.

Immature forms occur during all except the winter months. Winged forms have been collected in April through July. At 5 P.M. on July 8, 1948, an overcast day, females were seen coming from a nest in turkey oak. Both the attendant workers and the females were very excited. At about 5 minute intervals the females flew off from slightly raised objects near the nest; they showed a special preference for a raised twig near the nest opening. Each female rose almost straight up into the air in a zigzag fashion, until she was out of sight above the treetops.

T. septentrionalis seminole moves only moderately fast while foraging, but it is deliberate in its movements. It usually does not attempt to hide when disturbed, but becomes immobile, and depends on its rough integument and tubercles to protect it. Foraging is almost completely stopped during late December and January.

The ants characteristically carry leaves slung over their heads. Workers have also been observed taking seeds back to their nests. On several occasions they were observed carrying away seeds which had been discarded from Pogonomyrmex badius mounds; this activity always took place at night when the Pogonomyrmex nest opening was closed. Hymenomycetes fungi growing in a lawn also attracted them, and they carried pieces of them back to their nests.

On one occasion this form was found associated with a nest of

Solenopsis geminata which was under a log. Species of Corrodentia have also been picked up with collections of seminole.

Subfamily Dolichoderinae

Dolichoderus pustulatus Mayr

D. pustulatus is one of the few ants taken more than three times that occur in only one station. It was found occasionally to commonly in marsh. Perhaps more collections around the margins of low, wet places, such as flatwoods ponds, will reveal its existence there also. The species has been recorded northward to New Jersey.

Collections were made most often in various aspects of the herbaceous stratum, while others were made from shrubs:

nest between septa of rotting Sagittaria stem
sawgrass flower stem
twigs of buttonbush (Cephalanthus occidentalis)

Winged forms are present in the nest from September to February. Immature forms were found in the nests in all months.

The speed of movement of the workers is moderate to considerable and their size and behavior is somewhat like that of the subgenus Colobopsis of Camponotus, living in similar nesting sites in marsh.

Iridomyrmex humilis Mayr

This, the Argentine ant, has not been collected from the Reserve, but was collected from Palatka, 17 miles to the north of the Reserve. Dr. Smith informs me that the ant was found at Palatka about 1932 when the Bureau of Entomology was scouting for the ant there. It has been

reported from there at other times since then, and was taken there by the author in July, 1948, and on February 17, 1950. It appears commonly along the sidewalks of the town, and nests can be taken from under many stones. Probably it makes nests also under the sidewalks.

The ease with which the dispersal of humilis takes place is indicated by the numerous individuals in the following set of circumstances. A station wagon with a wooden body had been left in Palatka for several days in the same spot. When the automobile was driven back to the Reserve, it was noticed that many ants had piled sand between the door and the door casing, and had established themselves there, as well as in other places in the station wagon. In all likelihood, the adaptiveness of this ant allows it to move in this way into ships, trains, and other means of transportation, and thus extend its distribution.

Iridomyrmex pruinosus (Roger)

Eight stations were occupied by this ant. I. pruinosus occurred commonly in turkey oak, Leon scrubby flatwoods, longleaf pine flatwoods, and black pine-fetterbush flatwoods; commonly to occasionally in xeric hammock; and occasionally in bluejack oak, scrub, and Pomello scrubby flatwoods. It seems to prefer areas where its nests are almost never in shadow, whether in the high turkey oak or low black pine-fetterbush flatwoods. The highest numbers of nests occur in stations where there are open areas almost or entirely devoid of litter.

This ant can be found most often in the subterranean stratum, but also in the surface stratum. Most of its nests in sand are either rudimentary or incomplete craters, but there are instances when the nests are found with no crater or with complete craters. Some of these nests

occur under litter, while others are built around the bases and root systems of shrubs. It occurs about equally often under the bark of fallen logs and dead stumps, and is also found in litter. The nests under bark are most often built in the debris which occurs between the bark and the rest of the wood; the immature forms, as well as workers, are found in this debris. Several nests were constructed both in logs and in sand.

Immature forms can be found in the nests in all months. Winged forms have been taken in May through July.

When the ants become active in the summer and fall months, or in the other seasons of the year, they form characteristic trails across the sand, extending them sometimes into the vegetation. Each individual is energetically keeping up with the ant ahead, making a more or less straight and lengthy column. Such trails are exemplified by an instance in bluejack oak. Two columns, at an angle of 180° to each other, originated from the same nest. Both columns seemed to have worn a path through the litter. One column was followed for six yards, where it split, sending one branch at least twenty feet up into a bluejack oak, and the other up into another bluejack oak. The other column was followed into litter where it dispersed. When the ants are moving very fast under the influence of the sun, they follow a zigzag pattern, especially on vertical surfaces.

Some of the nests in wood have been associated with termites. The significance of the association is unknown.

Dorymyrmex pyramicus flavopectus M. R. Smith

The confusion which has resulted from recognizing color variants in Dorymyrmex has been discussed under the section dealing with the subspecies pyramicus. Since two subspecies of the same species have been found in the same area and in identical nesting situations, it is probable that this region is an area of intergradation. In fact, specimens have been found which appear on morphological grounds to be intergrades between pyramicus and flavopectus. More exact identification of intergrades cannot be made until types of both pyramicus and flavopectus are seen.

Although no specimens of this form have been found on the Reserve, nests have been collected in Salt Springs, Marion County, across the St. Johns River from the Reserve, and in the town of Welaka. A typical nest was taken in an orange grove from a crater 4 inches in diameter; 1/4 to 1/2 inch in height; and with one opening 1/8 to 1/4 inch in diameter.

Dorymyrmex pyramicus (Roger)

The material listed under this heading was determined D. pyramicus var. flavus by Dr. M. R. Smith. Creighton (1950:346), however, in dealing with the species pyramicus, has discarded color as a separatory character, and has found certain structural characteristics, such as the shape of the mesonotum, to be clear-cut and constant. Because color was proved to be inconstant, he has synonymized all color varieties.

However, all of the specimens that have the color which is supposedly characteristic of flavus cannot be grouped together on morphological grounds. Some of them are the lighter color phase of pyramicus, while others are Smith's flavopectus. In determinations for the author, Smith, stressing color, evidently recognized a different aggregate of

specimens as his subspecies flavopectus than Creighton recognizes as flavopectus in his 1950 paper. This dissertation will follow Creighton by using structural differences as separatory characters.

These ants prefer open sand, and nests have been taken occasionally to commonly in turkey oak and xeric hammock, and rarely in bluejack oak. The great majority of nests were complete craters in open areas. Colonies were also found in a few rudimentary craters, one nest under a log, and another craterless nest with a leaf over the opening. Complete craters of these ants vary from 2 1/2 to 4 inches in diameter; from 1/4 to 3/4 inch in height; and always have one opening to each nest.

Winged forms of this group have been seen May through August. A flight was observed on July 28, 1949.

Ants of this group are very agile and are able to climb vegetation. Their foraging sometimes extends into the night. One colony was found in association with a queen of Camponotus socius, taken with the nest only 4 inches below the ground surface.

Tapinoma sessile (Say)

The distribution of T. sessile indicates that it is influenced by man. Although in other parts of the country it is widespread, on the Reserve it was taken in only one plant association. This one collection was made in marsh along the St. Johns River, where it is possible that it became established after being transported by man. In this connection, T. sessile was recorded from floating islands in the Gainesville region. Several males and females were attracted to light in the buildings on the Reserve. Females were taken in March and July, and males in April.

Cole (1940:64) gives a good account of the nesting habits of

T. sessile in the Great Smoky Mountains: "It was confined for the most part to rather open situations, although nests have been observed in dense moist woods. The ants nest in the soil beneath stones, logs, stumps and strips of bark. The nests are shallow affairs extending no more than an inch or two beneath the soil surface. Most of those in the Park were under rather large flat stones loosely appressed to the soil. Beneath such a cover the orange colored brood was confined to pockets in the soil, or to superficial chambers made by the workers, or very frequently scattered along one inner margin of the stone and mingled with detritus. The colonies were generally populous."

Subfamily Formicinae

Brachymyrmex depilis Emery

In its distribution in plant associations, B. depilis shows a preference for all types of flatwoods, although its occurrence was high in other associations. It occurs most often in longleaf pine flatwoods, Plummer slash pine flatwoods, and black pine-fetterbush flatwoods, where nests were recorded commonly. B. depilis was found occasionally in turkey oak, bluejack oak, scrub, Leon scrubby flatwoods, Pomello scrubby flatwoods, Rutlege slash pine flatwoods, mesic hammock, hydric hammock, and bayhead. There seems to be no reason why it should not also be found in xeric hammock and river swamp.

Most of the nesting sites of B. depilis were in the surface stratum. Those nests in sand were associated with wood. Many nests, recorded from logs were taken partly from sand although their major portions

were in buried wood. Other nests associated with sand were in the roots of shrubs or other plants. It is probable that these ants were attending aphids.

The most important nesting sites for B. depilis on the Reserve are in the bases of living trees and in fallen logs. Other nesting sites in order of preference are:

1. in stumps
2. in palmetto roots on the surface
3. in living palmetto roots
4. under logs
5. under litter

They have also been found in sand among the roots of living shrubs, and in sand among fern roots. Nests can be found in wood in a variety of stages of decay, but they occur mostly in or near hard wood. B. depilis was taken commonly from burned or charred wood. In most cases the wood was wet or moist.

Many of the nests of B. depilis, especially those in the bases of living trees, are in sections as explained under Crematogaster minutissima missouriensis. They contain about the same number of individuals as do nests of the latter ant. Immatures of B. depilis can be found in all months. Winged forms have been recorded from May to July.

Molasses traps attract this usually slow moving ant. As mentioned above, it attends aphids. It has been found nesting in close proximity to Ponera trigona opacior.

Camponotus castaneus (Latreille)

This species has been taken in eleven stations, but never with more than occasional relative abundance. It may yet be found in one or two more plant associations, but it is unlikely that it will occur in marsh. C. castaneus shows a preference for mesic and hydric conditions. It has been taken occasionally in scrub, Leon scrubby flatwoods, Pomello scrubby flatwoods, Rutlege slash pine flatwoods, xeric hammock, mesic hammock, river swamp, and bayhead; and rarely in longleaf pine and Plummer slash pine flatwoods, and in hydric hammock. In xeric associations, its nests are only in the more moist situations. There is reason to suppose that further collecting will show a higher relative abundance in hydric hammock.

Nests of C. castaneus have in all cases been in the surface stratum, in logs or dead stumps. It prefers the last, moist stages of decay, and has been found only in logs of broadleaved trees. Nests will probably also be found partly in the soil, associated with a log or other cover.

The largest colony counted contained only 22 workers and a queen, along with eggs and larvae. This nest was in all likelihood young; other nests have been seen which were estimated to contain between 100 and 200 individuals. Females have been observed in the nest in February and March, and males in February through May. A mating flight was observed on March 22. Females have been caught on the wing in February also, and males have been caught at light traps in March through May. Immature forms occur in all months.

C. castaneus is an energetic forager. When the temperature drops and the relative humidity rises, it increases its speed of movement,

indicating its nocturnal tendencies. It often forages in open areas, such as firelanes, near the mesic or hydric site of its nest. It is one of the ants which temporarily ceases activity during winter months.

Observations on five workers and a number of cocoons of both worker and reproductive castes, brought into the laboratory from a well-decayed log in bayhead, have yielded miscellaneous data concerning the habits of the ants. The ants were kept in a glass and plaster of Paris nest, and for the first month no food was given them. When the cocoons were placed in the nest they were mixed with debris from the original nest in the field. Within a few hours, however, the cocoons had been moved from the debris into the open at one side of the nest, indicating no desire to avoid light. On the second day the cocoons were more disseminated; some were placed by the workers near the sponge; some were under debris; but most were still in the original pile.

On the third day callows began to emerge. In the cases of the several watched, an attendant worker broke open each cocoon, pulling little by little at the cocoon, at the same time dragging the pupa over debris and around the nest. In several cases there were more than one worker attending a cocoon at one time. In the process of removing the insect from the cocoon, the cuticle fitting tightly to the pupa was eaten away by the nurse. The procedure took an hour or more. When the callows first emerged, they were very uncoordinated, and remained bunched together in one portion of the nest.

What were evidently acts of regurgitation were carried on between the newly arrived callows and the workers. In this operation the heads were set at an angle so that one mandible of each ant could be placed on the clypeus of the other, while the other mandible was placed under

the head of the other ant. One antenna of each ant intermittently stroked the clypeus of her partner, and the other stroked the under side of the head. Pairs of ants remained in this pose for extended times. Four days after their emergence, the callows assumed the coloration of the other workers.

One week after the ants had been brought into the nest, several callows, partially emerged, had been eaten. All of the discarded cocoons, as well as the partially eaten callows were piled near the sponge.

When food was introduced a month after the workers and immatures were first put into the nest, the workers undertook to feed a winged female callow. This female was much less violent in receiving her food than was a queen of Camponotus abdominalis floridanus. The female used her antennae only slowly and inconsistently, and while she did make use of her forelegs, they were more for support on the worker. In distinction, the female of C. abdominalis floridanus stroked the worker partner hurriedly, especially with her forelegs. The heads of the castaneus female and worker were in much the same position as that described above for worker and callow. The female would, however, at times invert her head under the head of the worker.

Camponotus socius Roger

In 1932 Wheeler described Camponotus socius var. osceola from Florida. He separated it from socius by reason of three yellow stripes on the gaster as compared with two in socius. During the present work, it has been found that individuals from the same nest appear with the third yellow band either almost or quite indistinguishable or else strongly evident. Creighton (1950) is therefore followed in synonymizing

C. socius var. osceola with C. socius.

This ant prefers the high, dry areas to the exclusion of the wetter environments. It was taken commonly in turkey oak and xeric hammock; and occasionally in Leon scrubby flatwoods and bluejack oak. Like Aphaenogaster ashmeadi, socius can be found almost always in situations where the litter is relatively light.

All nests of socius were taken in the subterranean stratum. A majority of them were in the open where there was no litter. None of the colonies maintained a recognizable crater, although around some nest openings there were rings of sand pellets in what were the beginnings of craters. Nest openings are often found at the bases of turkey oak (Quercus laevis); these nests go down into the root systems of the oaks where the rootlets may offer support to the nest chambers and honeydew from associated aphids.

In turkey oak and xeric hammock, socius is, on hot summer days, the most conspicuous ant on account of its constant and excited above-ground activity. Its large size and quick movement, along with its habit of moving on top of the litter, make it much more conspicuous than a relatively reclusive ant such as Odontomachus haematoda insularis. During the winter months, even though both day and night remained warm, and often became very hot, the above-ground activity of the ant ceased almost entirely.

The feeding activities of the ant are varied. Specimens were taken in November, 1946, by Mr. J. C. Moore from a fox squirrel nest, 26 feet above the ground in a turkey oak tree, where the ants were probably feeding on other arthropods. The species is always attracted to molasses traps in favorable plant associations.

A queen of C. socius was taken into the laboratory and placed

in an artificial nest on October 19, 1949. She was given nothing but water. During the time she spent in the nest she repeatedly laid eggs, but none of them developed beyond small larvae. On February 2, 1950, two Camponotus abdominalis floridanus larvae were placed in the nest, and were accepted by the queen. On the next day, a pupa and larva of Aphaenogaster macrospina were put in the nest, and although the queen did not accept these, she did not appear to reject them. However, on the following day, the introduced pupa was destroyed or eaten. The larvae were cared for until March 15, when they also disappeared. On June 30, after 8 1/2 months without food other than the sustenance the larvae and pupa may have provided, the queen died.

Leptothorax texanus davisi was found associated with this species on October 19, 1949, in turkey oak. A nest of the Leptothorax, including a queen, was taken along with a lone queen of Camponotus. No crater or nest opening to the sand nest was visible. C. socius has also been reported as a casual in the burrows of the Florida pocket gopher (Geomys floridanus) (Hubbell and Goff, 1939).

Camponotus nearcticus Emery

It is not entirely clear from the work of the present study whether or not Wheeler's C. carvae rasilis pavidus ought to be synonymized with nearcticus. The two variants have been quite distinguishable on the basis of their color, and have occurred in entirely different stations, the black variant nesting in open situations, the lighter variant, pavidus, nesting in the shaded mesic or hydric situations.

The problem as to what the relation of the two variants is, would then present itself. It would perhaps be possible for pavidus and

nearcticus to be ecological subspecies, or along the same line, it would be possible for the two variants to have undergone ecological isolation and already be species. However, ecological subspecies and speciation are not well founded in formicid systematics.

In addition, Creighton (1950:388) brings out the point that there exist several named varieties of caryae [fallax] which are based on slight color differences. "Each is admittedly transitional in this respect. In each the definitive color characteristic was known to vary in the type series." If this be true, there seems little reason for recognizing pavidus and nearcticus as separate forms on the basis of color distinctions. In this dissertation pavidus is synonymized with nearcticus.

C. nearcticus was taken occasionally in turkey oak, bluejack oak, Pomello scrubby flatwoods, longleaf pine flatwoods, mesic hammock, and river swamp; and rarely in scrub and bayhead. It may also be found in other stations where the trees provide branches as arboreal nesting sites.

Nests in the arboreal stratum are characteristic, but on one occasion a nest was taken in an oak log which had been caught in an oak branch and was supported by the ground at an 80° angle. The black variants of nearcticus prefer small branches of pine in open areas, although some were taken in twigs; the wood was usually in the first stages of decay. The lighter variant, on the other hand, was found nesting in small branches of hardwood trees, generally in shaded mesic and hydric areas. It is possible that in the more intense light of open areas the ants take on a darker appearance than in the more shaded hammock areas.

The number of workers in 4 nests of nearcticus varied from 28 to 91, averaging about 69 workers per nest. Another, probably incipient

nest, contained 12 workers. In only this last was the queen taken. Immature forms have been observed in the nests in both summer and winter. Winged forms have been found in the nests and on the wing from March through July.

C. nearcticus is not a conspicuous forager, but it can at times be seen climbing hurriedly on the trunks of pines or oaks. Workers were discovered by Mr. J. C. Moore in a fox squirrel nest 45 feet above the ground in a turkey oak stand. Mr. Moore states (in litt.): "Certain beetles, lepidopters, and stratiomyid fly larvae were much more abundant than the ants in the wet, rotting interior, 90% of which was Spanish moss." The workers in this case were probably foraging for food in the squirrel nest.

The ant has a tendency to become active on cloudy days. Foraging continues into the night, and workers have been attracted to light traps.

The spider, Europsis funebris Hentz (det. W. J. Gertsch), of the family Theridiidae, was taken in a nest of nearcticus.

Camponotus, subgenus Colobopsis Mayr

Most of the Colobopsis on the Reserve seem to be more closely allied to either pylartes Wheeler or to impressus Roger than to any others of the known species from the United States. As Wheeler (1904:149) admits, pylartes is very close morphologically to impressus Roger. Wheeler distinguishes the two forms of Colobopsis on the basis of the shape of the thorax in the soldier and worker, and in the coloration of the gaster which is banded basally with yellow in pylartes. Comparisons of soldiers and workers from the same nest with the descriptions of impressus and pylartes given by Wheeler (1904:144 and 147) show that individuals from

the same nest seem to vary between the two species in regard to the conformations of the thorax and the coloration of the gaster. The intra-nest variation is such that the Colobopsis found on the Reserve could not be unmistakingly identified; they are treated under one heading.

A third form which shows variation in a different manner was found on the Reserve, but because only a few specimens were taken, it is not included here. Although this third form has a resemblance to the other Colobopsis, the major worker or soldier measures only 3.1 mm. in total body length, in comparison to 4.3 - 4.6 mm. for impressus and 4.5 - 5.0 mm. for pylartes (Wheeler, loc. cit.).

Ants of the subgenus Colobopsis on the Reserve prefer mesic and hydric situations in which there are vines or other suitable broadleaved twig vegetation. Ants closely resembling pylartes occur commonly to abundantly in marsh; occasionally to commonly in mesic hammock; occasionally in scrub, Pomello scrubby flatwoods, xeric hammock, hydric hammock, river swamp, and bayhead; and rarely in Plummer slash pine flatwoods and Rutlege slash pine flatwoods. Nests were arboreal in a great majority of cases, but two nests were found in sawgrass flower stalks, and several were in planted bamboo stalks. Nests were found in greatest abundance in twigs, much less often in galls, and only once in a small branch. Nesting sites of all Colobopsis on the Reserve are similar.

These ants, as well as some Crematogaster and Solenopsis, subgenus Diplorhoptrum, nest in "sections", defined under C. minutissima missouriensis. A good example of this type of nesting was observed in a planted patch of bamboo. Although the several nodes in the middle of the stalk had been permeated by the ants, many of the other nodes which the nest included were intact, and the nest was thus split into sections.

A count of 10 nests reveals a range in number of workers from 15 to 269; in soldiers from 1 to 72; in totals of workers plus soldiers from 16 to 341. The average of the total numbers of workers and soldiers was about 108. Queens were absent from all but one of the nests counted. Female pupae were observed in the nests in April through June, and adult females were taken over the same period. Males were found in the nests in April and May, and again in November. Immatures occur in all months, except during cold spells. All forms of Colobopsis on the Reserve seem to follow this general outline of life history.

When this agile ant makes a nest of a bamboo stalk, as explained above, it cuts a circular nest opening through the internodes of the stalk somewhere near the center. The planted bamboo thickets are a favorite haunt of the downy woodpecker (Dendrocopus pubescens). In seeking ants these birds made a characteristic hole in the bamboo stalk. Each hole was about 1/4 inch in vertical length and 1/8 inch in width. Most of the woodpecker holes were near the nodes, in contradistinction to the position of the ant-made holes. Two theories for the position of these holes were advanced by Mr. W. M. McLane who observed the actions of a bird eating the ants from a stalk: 1) the bird may find more support in gripping the node; and 2) the stalk nearer the node will be more resistant to bending and will be more easily broken through. If the last is the sole reason for the position of the holes, it would show a great deal of keenness on the part of the bird in selecting a spot to peck.

An interesting record was made of an ant which more closely resembled impressus than pylartes. All pupae observed in pylartes nests were naked. But pupae taken from the former nests were in cocoons. One cocoon contained five individuals.

Camponotus abdominalis floridanus (Buckley)

C. abdominalis floridanus prefers the better drained areas of the Reserve, especially turkey oak and xeric hammock, as well as black pine-fetterbush flatwoods, but it is one of the three ants which have been found in all plant associations studied. Nests occur commonly in all stations except Pomello scrubby flatwoods, Rutlege slash pine flatwoods, river swamp, bayhead, and marsh in which they appear occasionally. This even distribution in stations is matched by its occurrence in all strata and in a large number of nesting sites.

Within the strata the ant shows a definite preference for the surface stratum, although it has been found over a third as many times in sand, in a majority of cases under some sort of cover. Relatively few records were made of nests in grass, trees, and shrubs.

The most strongly preferred nesting sites are in logs and stumps. Well preferred also are situations under logs, and under litter. Nests are found often:

in and under logs
in litter
in palmetto roots on the soil surface
under the mat of palmetto roots and trunks
in the bases of living trees
around roots of grass clumps
in small branches

Other nests have been recorded:

from open sand with rudimentary or no crater
from between sawgrass blades
from sawgrass flower stalk
in the wall of a building behind cement
under a dead frond resting against a cabbage palm three feet above the ground surface
in the stub of a live oak limb ten feet above the ground

The types of wood in which C. abdominalis floridanus nests vary considerably. Records have been made from logs and stumps of pine and

broadleaved trees, with or without bark, and either charred or unburned. The wood ranges, moreover, from the first stage of decay to the later stages, although the latter seem to be preferred. In many cases the wood is moist, but nests occur in dry as well as wet wood. Most colonies permeate a whole section of log or stump and occupy both the area under the bark as well as most of the wood itself, but nests have been found solely in one position or the other. Records show that the ant is characteristically taken from chambers in the wood, especially in stumps, where a part of the nest will occupy the root system, and another part, chambers in the sand; many colonies extend to higher levels in the wood. Likewise, nests recorded from sand are usually taken from chambers in the sand, a majority of which, however, are associated with roots or wood sunken into the soil, and most do not seem to have been built by the ant.

Mr. J. C. Moore took specimens of this ant on several occasions from fox squirrel (Sciurus niger niger) nests in turkey oak. He indicates that in at least one nest, 21 feet high in a turkey oak, the ants were evidently permanently occupying the chamber of a squirrel nest made of twigs and leaves. As he broke open the nest, the ants were seen to pick up their immatures and carry them to safety.

A typical nest of this ant, counted in February, contained 726 workers, as well as immatures. Immatures seem to be present in all months, although an absence of some forms seems to reflect cold weather. Flights of males have been observed in June through August, and in March. Flights of females were recorded for June through August, and in May. Reproductive caste pupae were observed in the nests in October. Nests with a lone queen have been found as early as February.

A group of females were observed in the process of making

a flight at 7:40 P.M., during dusk, on July 13, 1948. No males were observed. The sky was overcast, the temperature was 27°C. and the relative humidity was 88%. When observed there were perhaps fifty females to be seen, but the flight had probably been going on for some time. They chose the highest possible places to start their independent flights, crawling onto a tin can on the steps of the building in which the nest was located. Each female made a very short preliminary spreading of wings before the flight. A few attempted flight, but fell over backwards, only to make a second successful attempt. Within a space of ten minutes or so, most of the females had left the steps in flight. They took to the air at a rate of from three a minute to ten or twelve a minute. Each ant ascended at approximately a forty-five degree angle to the ground. Most flights proceeded in the direction in which the ant was headed at the taking-off point, but some swerved in one direction or another, perhaps being caught in a wind current; they always, however, maintained somewhat the same angle to the ground. When the last of the queens had left it was dark. During the whole ceremony, many excited workers were in attendance.

On June 29, 1948, an aggregation of males above ground was first noticed because of the excitement of workers traveling in file some distance from the nest. These workers were followed to the nest in a stump in turkey oak where the males were wandering about the nest site with workers in constant, excited attendance. The males seemed to wander farther from the nest than the workers would permit, for the latter were constantly carrying winged forms back toward the nest opening. Most workers carried the males by grasping them by the head, with their body straight out in front of the worker. Although the nest was watched until

it became impossible to see the ants, no flight was observed. The temperature at the time of observation was 25°C., and the relative humidity was 40%.

On July 3 a dealated female of C. abdominalis floridanus was brought into the laboratory in the twig in which she was found. When placed in a container, the twig was open at both ends, but the queen soon shut off the ends with fragments of wood. During her confinement only water was given her.

On the 12th the twig was removed from the container, and the queen was separated from a clutch of eggs first noted that day. During several frantic searchings of the container, she explored under the remaining slivers of wood with her antennae. Several times she paused a few seconds in her search, and bent her abdomen under her legs so that it was facing forward, and examined it with her antennae and mouthparts. Between her sorties, she remained at the top of the jar in the shadow of the lid.

The morning of the 13th found the queen characteristically posed over the ten or twelve eggs which appeared in an unsymmetrical sphere. The queen stood with her head slightly in front of the clutch which rested on the nest floor, seemingly with her palpi on them. From time to time she would rub her antennae over the eggs and then along her forelegs. She was very excitable when disturbed.

On the 14th the remaining fragments of wood had been placed on the sponge. The eggs had increased in number. When disturbed, the queen picked them up in her mandibles and posed with them, or carried them to some other portion of the jar. The eggs were always kept in a cleared portion of the jar. After moving the eggs, the queen repeated her actions

of moving her antennae over the eggs and then under her forelegs. She consistently avoided the sponge.

It was difficult to tell exactly the length of time immatures required to develop from one stage to the next. There was evidence that at least some larvae and pupae had died or been killed, and new eggs were being laid constantly. Approximate times, under the conditions imposed for the development, were as follows: egg to larva, 21 days; larva to pupa, 20 days; and pupa to worker adult, 8 days. It became apparent after observing another ant queen under conditions of low temperature that the length of the developmental period for any of the immature forms is lengthened by adverse conditions. It can be noted here that pupae of another queen, placed under identical environmental circumstances except for the absence of adult forms, did not hatch.

The first offspring of the former queen were all very small workers. These measured only 5.5 mm. in total body length. No insects this small were observed in large, thriving colonies in the field.

The feeding habits of the queen of C. abdominalis floridanus are compared with those of a C. castaneus winged female under the latter ant. The small workers mentioned above took water from the sponge and went to the queen. When she encouraged a worker with her antennae, the two ants would assume positions in which the axes of their heads were at right angles, one mandible of each above, and one below the partner's head. The queen stroked violently with her antennae during the regurgitation, and made frequent use of her forelegs. The worker returned the antennal strokes much more slowly, and made no use of the forelegs.

On several occasions, best exemplified in roots of saw palmetto, the immature forms of C. abdominalis floridanus have been found at different

levels in the nests. In all cases the pupae were at the top, with the eggs and larvae together below, or the larvae placed between the pupae and the eggs.

Most of the year this is a fast moving, excitable ant which finds no difficulty in negotiating the trunks of trees and the stems of herbs. However, in November, especially in 1948, there was a noticeable cessation in its above-ground activity. During most of the year, it is active both in the day and at night, except during rain, when it and most of the other ants seek cover.

The feeding habits of C. abdominalis floridanus are rather diversified. It is attracted to liver as well as molasses. On several occasions it has been recorded taking insects to its nest. Workers have been observed actively dissecting insects before carrying them to their nest. Termites, colonizing in many instances the same type of wood as C. abdominalis floridanus, perhaps supply food for the ant. When a log which contains both termites and this carpenter ant is broken open, the excited worker ants pick up termites between their mandibles and carry them as if they were their own immatures. This habit has been noted in other ant forms.

C. abdominalis floridanus has been found associated with the following animals:

Odontomachus haematoda insularis
Paratrechina parvula
Myrmecophila ? (Orthoptera)
termites (Isoptera)
several beetles and beetle larvae (Coleoptera)
chilopods
Hypoaspis ? (Acarina)

In this connection it might also be mentioned that on several occasions, dead workers of this ant were found tightly clinging to vertical grass

stems, or to strands of hanging Spanish moss. The head of each worker was upward, and from the head or the anterior portion of the thorax a fungus, tentatively determined as Cordyceps sp., was protruding. The worker, being attacked by the fungus, and climbing to die above the ground suggests an excellent medium for the dispersal of the spores of the fungus.

When logs which contained this pugnacious Camponotus and Odontomachus haematoda insularis were broken open, the workers of both species usually became excited and attacked each other. In the field, the Camponotus were much superior in battle, killing the Odontomachus each time an observed combat took place. In the laboratory, ants of this Camponotus introduced into a common container with Odontomachus lost as many battles as they won. The sting of the Odontomachus seemed to be fatal, but they were less pugnacious than the carpenter ant, using their mandibles to spring away from their adversaries. The Camponotus, quicker in the attack, were adept at severing legs and gasters from the bodies of their opponents.

Paratrechina longicornis (Latr.)

The nesting places of P. longicornis are very closely associated with the structures made by man, especially in places where trade through seaports is conducted. Its distribution shows that it is a cosmopolitan species.

It was taken in Gainesville, and in Crescent City, 11 miles to the southeast of the Welaka Reserve. In both of these places nests were found in crevices in the cement of walls of buildings, or beneath the cement in the soil at the base of the buildings. Unlike the imported Iridomyrmex humilis, nests were always found in buildings, rather than,

as in the case of I. humilis, outside the buildings in the ruderal sections. Although it was not found in Welaka, it probably occurs there in some sections.

The long, spidery legs of this ant, and the fast, seemingly aimless movements, are the basis for its being termed the "crazy ant" in some regions. It has been observed to carry spiders to its nest, and to be attracted to candy, and sweets of other kinds.

Paratrechina arenivaga (Wheeler)

Creighton (1950:408) lists arenivaga as a subspecies of melanderi. All the male specimens in his collection taken in the type locality of arenivaga have had genitalia more like Wheeler's figure of melanderi than like his figure of arenivaga (1905). Moreover, he states that "I believe that I have fairly conclusive evidence, from specimens taken in southern Alabama, to show that melanderi and arenivaga intergrade in that area." On this basis he has made arenivaga a subspecies of melanderi.

Specimens collected during the present study, however, have had genitalia which agree with cotype material of arenivaga from the Museum of Comparative Zoology. The genitalia of these males are very similar to the genitalia of arenivaga as pictured by Wheeler. Therefore, until it can be certain that Creighton collected arenivaga, and not another form, in the type locality of arenivaga, and until the intergradation between melanderi and arenivaga can be established without doubt, it seems best to use arenivaga as a distinct species.

Although Paratrechina parvula becomes very light in color in the higher and more open areas of the Reserve, it can almost always be distinguished from the deep yellow P. arenivaga. P. arenivaga is slightly

larger than parvula in most measurements of the workers, and is definitely larger in the winged forms. Two of the best characters for the separation of these two species are the venation of the wings in both the male and female, and the shape of the male genitalia. In the females the venational difference is most striking. Here the crossvein m-cu in parvula is less than half the length of the same vein in arenivaga. The crossvein m-cu in parvula is one-half the length of Rsfl, while in arenivaga both the crossvein and the longitudinal vein are approximately the same length. In arenivaga the processes of the median genital valve are both long and slender, whereas in parvula only the inner process of this valve is lengthened, and the outer process is curved.

Even though arenivaga is abundant here, it was not listed by those who have made state lists. Wheeler (1905) remarks that it occurs in New Jersey and near Austin, Texas. Buren (1943) notes that the ant has been taken from the Missouri River bluff, but from no other part of Iowa. This spotty distribution and its occurrence near ports and rivers may indicate that the distribution of the species is affected by commerce. In all instances it builds craters similar to those on the Reserve.

On the Reserve P. arenivaga was found in 7 plant associations. It nested abundantly in the high and open areas of turkey oak and xeric hammock, where it was able to find suitable areas for its crater nests. Nests were found occasionally in Leon scrubby flatwoods, and rarely in bluejack oak, Pomello scrubby flatwoods, longleaf pine flatwoods, and Plummer slash pine flatwoods. Colonies were also found often in firelanes and on lawns.

Without exception it was found in the subterranean stratum where it built complete craters. These craters ranged from 1 to 3 inches in diameter and from 1/8 to 1/2 inch in height of the crater. All nests had

one central opening. Most of the nests were built in light colored sand which matched the light color of the ant.

The immature forms probably occur in the nests all year. Winged forms appear in January and remain until February or March when the mating flights take place. Activity that seemed to be preparatory to one such flight was observed on February 12, 1950, at 4 P.M., just after a rain when the temperature was 21°C. and the relative humidity was 100%. Although there were many males in the upper chambers of the nests, none were noted taking off from eight nests observed. There was an indication that the nests are sex specific, or nearly so, since all or a large majority of the winged forms in a nest were of one sex. Many of the workers were in a replete state.

This is a moderately fast moving ant, but on warm, overcast days it tends to increase its speed of movement. It is active during both the day and night. During the winter months its above-ground activity becomes limited.

Many animals have been found in association with this ant. In the nests mentioned above from which the winged forms were emerging, a black cricket with red markings on its head was observed, but not taken. P. arenivaga has been found on quite a few occasions with the following:

Solenopsis molesta
Solenopsis pergandei
Reticulitermes spp. (Isoptera)

The termites were always in small pieces of wood buried in the sand, and the arenivaga nests passed through or close by the wood. The Solenopsis occupied chambers of the Paratrechina nest about one-half to one foot below the surface. On occasion both Solenopsis were found in the same nest. One worker of Pheidole morrisi was found in a nest of this Paratrechina,

and several workers of arenivaga were found in a nest of Pheidole morrisi. Since these ants usually live independently, it is likely that the workers had merely wandered into the foreign nests.

Paratrechina parvula (Mayr)

P. parvula and Pheidole dentata are perhaps the most common ants on the Reserve. However, the ants listed under P. parvula in this paper show variation in the worker caste. Some are of very pale coloration and smaller size, while others are darker and of larger size. A majority of workers are small in size and of lighter coloration; but some small, dark workers, and large, light workers were found. Moreover, the color of workers within the same colony may be either pale straw with light brown bands on each segment of the gaster and with a dark head, or the gaster and head may be dark brown with the thorax and legs only slightly lighter.

Some of the variation in color is due to the change from the callow condition to the full color condition. Some of the dark workers, as well as some callows, have a distended gaster. Under both of these circumstances the workers have a lighter appearance than they would in their mature, undistended condition.

The male genitalia of the lighter colored form are insignificantly different from the darker form (the former are slightly smaller, but have the same configuration). Wesson and Wesson (1940:100) have found similar variation in parvula in southcentral Ohio. "Our material shows considerable variation which we have been unable to refer to any but this species on comparison with material in the Wheeler collection at the Museum of Comparative Zoology, Harvard University. Specimens from wooded places are usually dark brown or black and have few or no hairs on the antennal

scapes. They agree with the typical parvula. Specimens from dry or exposed situations, on the other hand, are usually paler and have a variable number of hairs on the antennal scapes....we have occasionally found colonies in which some of the workers bore a variable number of hairs on the antennal scapes while others bore none, suggesting that this character may not be entirely reliable." Specimens from the Reserve agree with those from Ohio in that the number of hairs on the antennal scape is variable. If all of the forms represent one species, it is possible, as the above quotation suggests, that the drier nesting sites will contain lighter forms. But both light and dark forms have been taken from almost every station on the Reserve, although the lighter forms are more prevalent in the higher, drier areas. Conversely, the larger sized workers are found in the wet areas.

In general P. parvula seems to prefer the wetter areas, although nests have been found in all of the stations. It was taken abundantly in black pine-fetterbush flatwoods, mesic hammock, and marsh; commonly to abundantly in Plummer slash pine flatwoods; commonly in turkey oak, Leon scrubby flatwoods, longleaf pine flatwoods, Rutlege slash pine flatwoods, xeric hammock, hydric hammock, and bayhead; occasionally to commonly in scrub, Pomello scrubby flatwoods, and river swamp; and occasionally in bluejack oak.

Three-fourths of the records of parvula were made from the surface stratum. Approximately equal numbers of collections were made from under cover in sand and from nests in the grass stratum. A few nests were taken arboreally.

Nesting sites of parvula, in order of preference, are:

1. in litter
2. in fallen log
3. in grass clump
4. under litter
5. in bases of living trees
6. between sawgrass blades
7. in dead stumps
8. in palmetto roots
9. in small branches
10. in twigs
11. in and under logs
12. under logs

Nests have been in wood varying from wet to dry, and from the first stages to the last stages of decay. They have been found under bark, in both broadleaved and pine wood.

Most of the nests in sawgrass are between the growing, appressed blades, although some are in the dark stumps of sawgrass which are wet or saturated. In the living sawgrass, the ants are able to live at or near the water surface. Several nests were found slightly below the water surface, within the plant parts which excluded the water. No nests were found very far from the water level, since the blades diverge leaving no place to nest at a height of a few inches; these higher portions of the plants are also exposed to much greater evaporation than the partially shaded areas near the water. In January, the sawgrass is for the most part dead, except for the inside blades, and the outer blades fall slightly apart. During this period, even though the temperature is clement, the ants are relatively scarce in marsh.

A similar shifting is noted for nests in grass clumps. Beginning in October the grass clumps in which the ants have lived during the summer become dry and completely dead above the soil surface. With the drying out of the grass above the surface, the density of the population in this nesting site decreases. Those ants that remain inhabit the root systems

of the grass; the others find litter or logs with suitable moisture. It is possible that during the rainy summer the ants move their nests into the above-ground, higher portions of the grass to avoid supersaturation, and that with the onset of winter and dry weather, with the consequent drying of the grass, the ants move down into the moist lower stems and roots.

The number of individuals in the nests of parvula ranged, in the 4 nests counted, from 25 to 72, averaging 45. Females have been taken in nests as early as late July, and as late as the latter part of January. Males were found in September through the last part of February. Winged forms are most abundant in the nests in October, November, and December. The presence of winged forms during most months is noteworthy.

This moderately fast moving ant is attracted to liver and molasses. Workers of parvula forage actively at night. It has been found associated with the following insects:

Atelura (?) (Coleoptera)
Corrodentia: Psocidae
Diptera: fam.?
Pheidole dentigula
Solenopsis picta
Crematogaster minutissima missouriensis
Camponotus abdominalis floridanus
Odontomachus haematoda insularis

Prenolepis imparis (Say)

P. imparis has been taken in only two plant associations. These are turkey oak, in which it was found rarely, and scrub, in which it was found occasionally. Occasional nests can be found on lawns in ruderal areas, and suggest that this may be an important nesting situation for the ant. In the Gainesville region, P. imparis was found occasionally

in mesic hammock and ruderal areas, and was also taken in turkey oak and flatwoods.

All of the nests on the Reserve were under litter, even those in the ruderal areas. Those in Gainesville, however, nearly all formed complete craters in open areas. Both Gregg (1944:470) and Cole (1940:67) note that the ant builds craters and that it lives in clay. Cole states that "The ants nest in shaded, moist, compact soil, particularly clay, occasionally beneath wood or stones; but more often construct obscure crater mounds consisting of pellets of soil scattered around the single nest entrance." This last type of nest is found under light litter on the Reserve. A nest was observed in which all of the ants were dumping sand pellets at least a foot from the nest opening, in the process of excavation.

P. imparis moves with only a moderate degree of speed. It becomes most active during cloudy or overcast days. Molasses and corn bait for mammal traps will attract it. Talbot (1943a and 1943b) and Wheeler (1930) have made extensive studies on P. imparis, in regard to population and response to environment.

Formica archboldi M. R. Smith

F. archboldi was found in six plant associations. It was taken occasionally to commonly in turkey oak and black pine fetterbush flatwoods; occasionally in longleaf and Plummer slash pine flatwoods, and rarely in Rutlege slash pine flatwoods and xeric hammock. This distribution indicates that F. archboldi is attracted to areas of pine growth, more, it would seem, because of the lack of heavy leaf litter than because of the pines. It has been found to be the most common Formica on the Reserve.

It has always been found in the subterranean stratum, and either in the sand under a log or under litter. Of the 2 nests counted, one under a log in black pine-fetterbush flatwoods contained 63 workers, and 4 callows, in addition to eggs, 21 larvae, 18 pupae, and 20 pupal cocoons. The other nest in turkey oak, taken under litter, contained 222 workers, with eggs, 25 larvae, 6 worker pupae, and 21 pupal cocoons. This last nest also had 7 female pupae, 3 female callows, and 20 females. Each nest had a queen.

The first nest was within one foot of the surface, just above the water table. It contained many heads of Odontomachus haematoda insularis, indicating that the Formica may take over Odontomachus nests, or that the Odontomachus is used as food. The second nest was 8 to 12 inches below the surface of the soil with a 1/4 inch passageway leading to the chambers. The castes and immature forms seemed to be arranged in order from top to bottom of the nest in the following order: winged females; larvae and eggs; pupae; cocoons of workers; and cocoons of winged forms. It should be noted that pupae are both nude and covered with cocoons.

F. archboldi usually moves with considerable speed in most of the months of the year, but collections indicate that there is a period of inactivity in the winter months. Specimens have been taken with a species of small mite (Hypoaspis ?) on the gaster directly behind the petiole. In one nest the cricket Myrmecophila pergandei Bruner (det. Cantrall) was found.

Formica pallidefulva Latreille

F. pallidefulva was found on the Reserve in only three plant associations. It was taken occasionally in turkey oak and xeric hammock, and rarely in Pomello scrubby flatwoods. These situations have in common their openness, and absence of thick litter.

All nests of this species were found in the subterranean stratum, all under cover of litter. It has also been collected in Gainesville in this same sort of nesting site.

One nest of F. pallidefulva in turkey oak had two openings, one of which led for only a short distance. The main opening led laterally, at a depth of about 1/2 inch, for about 3 inches where there was a chamber, then straight down to where the passageway stopped at 3 feet. Blind passageways, and chambers were spaced along the downward passage. At 3 feet workers of Camponotus socius were encountered, and were seen carrying cocoons. No eggs, larvae, or pupae, other than those carried by the Camponotus were observed.

Like the other Formica of the Reserve, this ant could usually be seen moving with considerable speed in its foraging activities.

Formica schaufussi Mayr

On the Reserve F. schaufussi was found rarely in turkey oak and longleaf pine flatwoods. In Gainesville it was found in xeric hammock and an open ruderal area.

Nests on the Reserve were all in the subterranean stratum and under litter. About this ant, Cole (1940:79) writes: "The ants live in the ground, as a rule beneath stones in open, warm, rather dry grassy areas. A few obscure crater mounds were found, and a number of colonies

which nested beneath stones had adjoining earthen craters. The stones were loosely banked along their margins with soil particles. Underneath was a number of large, irregular superficial chambers, but the main part of the nest was at a depth of 1 1/2 to 2 feet underground. The colonies are as a rule, populous, and the workers are agile and timid when disturbed." These remarks agree with, and add to, the observations made on the Welaka Reserve.

Addenda

Leptogenys elongata manni Wheeler

On July 26, 1950, a specimen of this Ponerine ant was collected in river swamp. The swamp at the time of collection was extremely dry, and the ant was crawling over litter that contained very little moisture. In the Gainesville region it was taken in mesic hammock from rotting stumps.

The occurrence of this Leptogenys on the Reserve will affect Figures 3 and 5, but these figures will be altered to only a slight extent.

SUMMARY

The present study deals with ecological relationships of the ants of the University of Florida Conservation Reserve, a 2180 acre tract in northeastern peninsular Florida. Field work was carried on from October, 1947, until June, 1950. Seventeen collecting trips were made to each of fifteen areas or stations (plant association-soil type combinations) chosen to represent the major vegetational and soil variations of the Reserve.

Seventy-one species and subspecies of ants were taken on the Reserve, and four others were collected in nearby towns. Fourteen ant forms were recorded for the first time from the state.

Quantitative relationships were determined for the ant forms within the stations, by using the colony, and not the individual ant, as the biological unit. Assemblages of ants which were characteristic and distinctive qualitatively and/or quantitatively were found to exist in the stations, and in four strata and sixteen nesting sites within the stations. The environments of each of these assemblages were therefore designated ant habitats.

For the Reserve, Pheidole dentata showed the greatest abundance; the next four forms in order are:

Paratrechina parvula
Camponotus abdominalis floridanus
Odontomachus haematoda insularis
Solenopsis molesta

In both variety of ant forms and number of nests, the turkey oak and xeric hammock stations rank well above all others, whereas the slash pine flatwoods, river swamp, and marsh stations rank at the bottom. This indicates that the higher, drier stations are more suitable for

ants than the lower, wetter areas.

There were 14 forms none of which were collected from more than one station, while each of 3 forms were found in all 15 stations. Figure 5 shows the relationship between the number of ant forms and the numbers of stations. When the ants which were collected only once are omitted, then there were only 5 forms none of which were collected from more than one station. From this and other evidence it seems probable that ants do not show as much dependence on plant association-soil type combinations as do other animals.

Distribution in strata and nesting sites showed that ants preferred the subterranean and surface strata, and within these strata, nests in sand, fallen logs, or stumps. Only nineteen forms nested in the herbaceous and arboreal strata.

A correlation is shown between the number of nesting sites a form occupies and the number of stations it occupies. In general, however, the number of stations occupied increases faster than the number of nesting sites occupied. From this it would seem that many ants are more restricted by nesting sites than by plant association-soil type combinations.

Data concerning the life histories, activity, food, and habits in general have been brought together under the appropriate ant form in the Annotated List. Indications of variations in seasonal occurrence have been apparent for only a few forms, and in all cases have been due to the seasonal variability in abundance of the suitable nesting sites. The ant forms on the Reserve vary greatly in the time and physical conditions under which they forage. Several forms have a wide range in this respect.

It was also observed that the individuals of certain ant forms appear darker in color when they nest in the open areas of the Reserve, whereas other ants are darker in the shaded areas; and that the individuals of certain forms are larger in the wetter areas than in the higher, drier areas.

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This dissertation was prepared under the direction of the Chairman of the candidate's Supervisory Committee and has been approved by all members of the Committee. It was submitted to the Graduate Council and was approved as partial fulfilment of the requirements for the degree of Doctor of Philosophy.

September 2, 1950

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