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RESULTS OF THE ARCHBOLD EXPEDITIONS. NO. 51

BEHAVIOR AND ECOLOGICAL NOTES ON SOME ANTS FROM SOUTH-CENTRAL FLORIDA¹

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The present report contains some records of observations made during late August and early September, 1943, at the Archbold Biological Station, Florida, which is situated in the lower portion of the Highlands Ridge area of Florida, about midway between Lake Okeechobee and Arcadia.²

About 65 species of ants were taken, including two new to science which are being described by M. R. Smith (1944), and some others new to the Florida list.³ This paper is concerned with a few of these species for which the notes appear to be of special interest.

Formica pallidefulva archboldi

M. R. Smith

Single foragers of this dark chocolate-brown *Formica* were captured frequently near the border of ponds or swampy areas, usually running on vegetation. (It is notable that the nests of *F. archboldi* are found in low ground, near bodies of water. No cases were observed in the higher sandy terrain frequented by the other *F. pallidefulva* subspecies.) The ant was particularly difficult to capture, not only because of its speed and capacity to spurt and change direction suddenly in running, but also because of the readiness with which it fell or actually jumped from heights when startled.

At length a nest of *F. archboldi* was

found about 6 feet from the edge of a swamp, in an open sandy space surrounded by palmettos and low bushes. The entrance (located by tracing foragers to the nest from various points within a radius of 100 feet from the nest entrance) lay under a clump of grass. Three galleries descended close together from a shallow surface chamber covered by a canopy of detritus supported by plant stems. The nest, which was excavated in its entirety, was restricted to an area not more than 12 inches in diameter and 7 inches deep. Its numerous galleries and chambers were closely arranged within this space and extended nearly to the water level, which was 8 inches below the surface. The entire nest lay closely above a dead palmetto root and around its central portion, in moist sandy loam permeated by fine rootlets.

The colony was isolated by digging a trench around the nest and, after ascertaining the absence of lateral galleries beyond the central area about 1 foot in diameter, the block of earth was removed to the laboratory for examination. During a period of about one hour, while the digging was in progress, 37 ants returned to the nest from various directions, some carrying parts of insects or whole carcasses, others empty or replete with nectar, others evidently unladen. Since numerous others engaged in foraging at the time remained uncaptured, the population count represents merely a rough census. In all, one queen, 1210 adult workers, and 414 brood were taken from this colony. About two-thirds of the brood were in various stages of pupation, only a small proportion of it enclosed in cocoons. There were a few

¹ A contribution of the Department of Animal Behavior, the American Museum of Natural History.

² Mr. Richard Archbold (Research Associate in the Department of Mammals, the American Museum of Natural History), who maintains the station, has made its facilities available to the scientific staff of the American Museum. The writer is grateful to Mr. Archbold for his hospitality and his kindness in facilitating the present study in every possible way.

³ The ants described in the present paper were determined by Dr. Smith.

packets of eggs and numerous immature larvae, not counted.

Around the outskirts of the close system of galleries and chambers which comprised the *Formica* nest, on all sides near the surface, were nests of *Solenopsis pergandei*. Five separate colonies were found, each with numerous queens and a large brood. These evidently were present as "thief ants," for their small galleries could be traced to connections with the larger *Formica* tunnels. When the earth was broken the tiny *Solenopsis* swarmed upon the *Formica* in numbers, biting and stinging the larger ants.

The *F. archboldi* colony was installed in an artificial nest and is still on hand in good condition. Unfortunately the queen was killed by a small group of her own workers when she was placed with them after a month of isolation in a vial.

***Formica pallidefulva* Latreille**

Colonies of this ant were found at points widely apart in upper sandy areas of palmetto scrub and pine. The light-brown workers make their way surprisingly well as individual foragers. Orientation tests showed that solitary ants can pursue direct routes over fairly long distances, dependent upon special cues such as the visual effect of a single tree or group of trees. Thus foragers were able to continue passing directly across an open area 12 yards wide among palmettos, even after the sand was thoroughly stirred around or removed to a depth of 4 to 6 inches, but in various tests they circled about, obviously disoriented, when a large black sheet was placed so that it masked a pine tree standing at one side of the distant nest. The movements of these ants in foraging are strikingly speedy and vivacious. At times their progress across an area covered by pine needles is so rapid that it can be followed only very uncertainly, and often appears to involve a series of small leaps or skips from needle to needle. When attempts are made to capture an ant by hand the ability to spring from an elevated surface is clearly in evidence, and together with exceedingly rapid running makes the foragers very elusive. When a series of

them was placed in a quart glass jar and the ants were permitted to escape successively as an orientation test, most of the subjects were able to leave the top of the jar on the side toward which they were progressing when captured, and almost all of them reached the ground by leaping out from the rim or shoulder of the container to a landing spot a few inches from the base. There can be little doubt that these ants are capable of "jumping."

Furthermore, at times the foragers were observed *dropping* to the ground from grass blades or even from the stems of bushes. To test this behavior, a laboratory set-up was prepared in which the *Formica* could reach a food card only by dropping to it from a point about 10 inches overhead. After an introductory feeding on the floor, the ants appeared in numbers, many of them soon reached the ceiling of the glass cage, and shortly some of them were dropping. At first they dropped rather randomly, from remote places as frequently as from places directly above the food card. However, a distinct improvement was observed, even in the course of an hour or two during the first session. Although the first falls seemed to occur accidentally, as a result of losing hold while running upside down on the glass, within 10 or more trips a more definite pattern of behavior appeared in certain individuals. These ants typically ran in increasingly narrower circles on the ceiling, with occasional stops to extend downward by releasing the anterior pairs of legs, at length hanging down with only the rear legs holding. From the last vertically extended position the ant might pull back abruptly and resume its running, to repeat the act somewhere else or, after swaying briefly, might fall to the food card or floor. Some of them improved in the ability to hit the food card, so that their misses decreased noticeably within a series of 30 or more trips. In various tests evidence was obtained suggesting that the ants dropped more readily the more the stimulus card (a disk hiding the food) contrasted visually with the white floor, also that a discrimination somehow depending upon the "area" (or bright-

ness, etc.) of the stimulus disk could develop. These preliminary findings suggest the development of a specialized dropping response related to a visual discrimination, an apparent learned adjustment which merits further investigation.

Two nests of *F. pallidefulva* were excavated in their entirety, from points about one-third of a mile apart in a sandy palmetto scrub area containing pines. One nest lay well within the area of a "dry pond," in a dense growth of grass and reeds, the other in light sandy loam among palmettos. Each nest was restricted to a small space not more than 10 inches in diameter, and both had their excavations entirely in an upper area of sandy loam topsoil without entering the pure sand be-

vegetation. This canopy covered a shallow entrance chamber, above which it was supported by numerous grass and plant stems. This feature of nest building resembles the canopies formed by other camponotine ants such as *Lasius* in Europe (e.g., Pickles, 1942).

A census was made of the two colonies mentioned above. Colony A was isolated in the early morning before foraging had begun, hence the count may be considered complete; colony B was isolated in the late afternoon when foraging was in progress, hence was not completely counted. The results are given in table 1. In both cases unhatched and newly hatched eggs were present, but since many were lost in removing the ants no counts are given.

TABLE 1

POPULATION OF TWO COLONIES OF *F. pallidefulva* EXCAVATED AT THE ARCHBOLD BIOLOGICAL STATION, FLORIDA

	Adult individuals		Pupae		Larvae	
	Queens	Workers	Advanced	Immature	Advanced	Immature
Colony A (Aug. 17)	1	507 (14 callows)	71 (30 enclosed, 41 naked)	105	13	20
Total	508 adult individuals; 209 brood.					
Colony B (Sept. 5)	1	647	87 (22 enclosed, 65 naked)	83	17	21
Total	648 adult individuals; 208 brood.					

low. Within this relatively small nesting space the numerous galleries and chambers of the nest were confined very closely, without any trace of the ramifications which characterize the nests of *F. pallidefulva* in northern areas. The same fact held for two other *F. pallidefulva* nests excavated in part, and for the *F. archboldi* nest which was completely excavated.

All four of the *F. pallidefulva* nests examined were hidden below clumps of grass, reeds, or surface rubble. The actual entrances were difficult to locate because of the variety of ways in which foraging ants departed from and reentered the immediate environs of the nest. Characteristically, the two or three entrance holes of a given nest lay within a 3 to 4 inch wide area which was covered by a thin canopy composed of particles of earth and bits of

It is a notable fact that, although the three *Formica* colonies studied were all fairly large, their nests were located only with difficulty by a slow process of tracing back foragers from food cards placed in the vicinity. Attempts were made to find other nests by tracking foragers but without success, a testimonial to the inconspicuous nest sites of the species in this area.

***Camponotus abdominalis floridanus* (Buckley)**

This ant is one of the most successfully and widely adapted of all in the region, with very numerous nests in a variety of situations ranging from pine stands on the sand hills to low open areas near bogs and ponds. During August and September, I found many flourishing colonies of thou-

sands of workers and large broods under empty "dust sacks" which had been thrown away by orange growers, in orchards, on roads, and in a variety of other situations. Perhaps more than three-fourths of these heavy paper sacks covered ant colonies, virtually always *C. floridanus*, and most of them were in the vicinity of orange groves. It is very possible that the insect prey of these ants includes species which are injurious to orange trees or fruit, and that the inadvertent encouragement of *C. floridanus* thus may be quite incidentally a great source of benefit to the orange crop. If that is the case, the abandon with which the orchardists scatter their dust sacks about the countryside offers another illustration of the bizarre relationships (in this instance a favorable one) frequently noticed between planter's behavior and crop ecology.

A striking peculiarity of behavior characterizes the responses of this ant to sudden environmental change. When disturbed, as by the sudden uncovering of their nest, *floridanus* workers typically begin an erratic, spastic activity marked by irregular or circular running, frequent stops and short jerky advances, and a "nervous" trembling of the entire body. This "jittery" behavior continues even while the brood is being carried away, when masses of workers are involved and details are indistinguishable amid a seemingly hopeless confusion. This behavior is not to be confused with the rapid erratic type of locomotion which characterizes the regular field behavior of *Dorymyrmex pyramicus*, *Iridomyrmex pruinosus*, and numerous other Florida (and tropical) ants, a pattern which may be attributed mainly to temperature (since it is largely absent when the temperature falls to about 80° F.). In the laboratory at 75° F., "heat activity" is greatly reduced, but the "nervous" response of *C. floridanus* workers to disturbances continues. It may be elicited readily at almost any time in each of several small colonies which I have raised in the laboratory as the progeny of queens taken after marriage flights in September. The "jittery" behavior appears almost invariably when the glass

covers of the small nests are raised, even after daily repetition of the test during several months in the laboratory. If a worker chances to begin feeding during a seizure, the activity is reduced to a general trembling of the body with or without a rapid beating of raised front legs, but at such times feeding is likely to be discontinuous. Similarly the amplitude of the movements is reduced when larvae or eggs are picked up during a "seizure," although trembling continues and locomotion is erratic. An interesting fact is that among eight *floridanus* queens (which have raised young colonies in the laboratory), six have not exhibited the above pattern of behavior under any conditions during several months of daily observation, one shows it occasionally and partially, and only one queen regularly and definitely exhibits the characteristic excitatory pattern of the worker.

ASSOCIATED COLONIES

In low marshy or boggy ground the partially decayed standing stumps or hulks of pines frequently contain interesting associations of numerous colonies of various ant species, together with termites. As an example, one variegated assemblage of this kind was found within a pine hulk standing inside the border of a shallow pond, surrounded by water but only a few feet from the bank. Within this one dead tree trunk, in very close proximity to one another or with galleries actually interdigitating, nests of the following species of ants were found:

- Solenopsis geminata rufa* (Jerdon)
- Iridomyrmex pruinosus* (Roger)
- Euponera* (*Trachymesopus*) *stigma* (Fabricius)
- Solenopsis globularia littoralis* (Creighton)
- Campanotus abdominalis floridanus* (Buckley)

In addition, there were termites (sp. ?). The *Iridomyrmex* and *Solenopsis* colonies were large but more or less localized; the *Euponera* colony was very large and extended widely around the trunk; the *Campanotus* colony, also large, was confined to one side. In a similar heterogeneous association of species in another stump, the tiny *Brachymyrmex heeri depilis* was found, evidently in a clepto-

biotic relationship (Wheeler, 1901) with a large colony of *Euponera stigma*. In other instances, in addition to those already described, other species were discovered in stump associations, including, for example, *Aphaenogaster macrospina* M. R. Smith and *Paratrechina* (*Nylanderia*) spp.

These associations of colonies of numerous species were regularly found, as described, in tree hulks surrounded by, or close to, water. The concentrically juxtaposed or commingled galleries of the various colonies usually were well developed, and the large populations had the appearance of having been established for some time. It would be interesting to know how such a vast heterogeneous assemblage of ants is able to get the necessary food to

weather the long summer period of rains during which the dead stumps housing them are cut off from dry land. The extent to which they may have become adjusted biologically or behaviorally to one another also is a matter of interest.

The described multi-species aggregations seem to fall largely under the Wasmann (1891) heading of accidental (i.e., occasional) forms of "compound nests," a condition termed by Wheeler (1901) "plesibiosis." However, until live colonies can be collected and their inter-colony relationships can be studied under laboratory conditions, the degree to which an accidental or a regular (i.e., incipient) symbiosis may be involved in these interesting assemblages is a matter of speculation.

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