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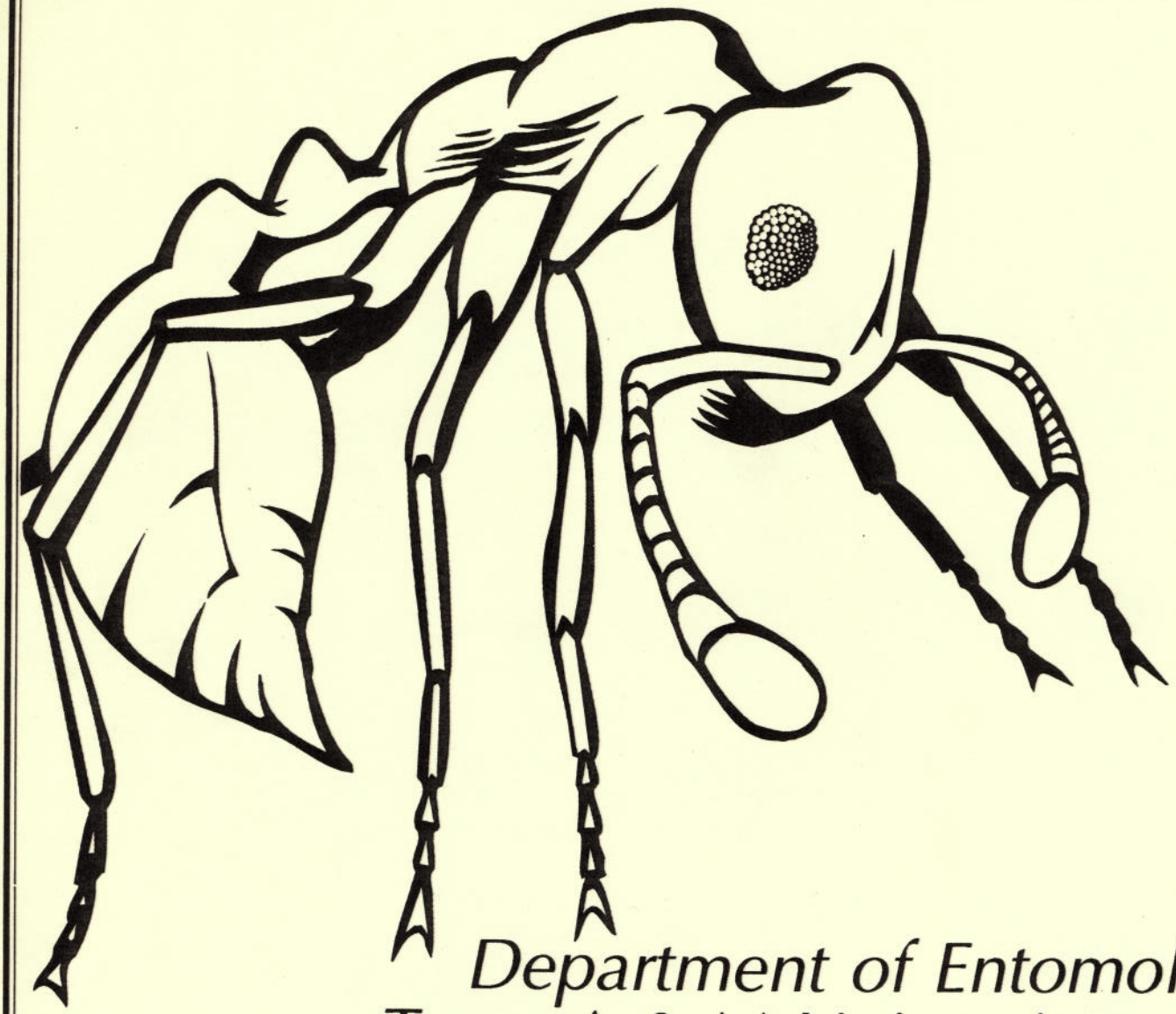

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Modification of the Temporal Foraging Activity of Two Texas Native Ants in Response to the Red Imported Fire Ant

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Abstract

The red imported fire ant (RIFA), Solenopsis invicta Buren, alters the ant community structure in which it is found. The niche characteristics of ant species that remain within the RIFA territory are still unknown. Our objective was to determine if foraging activity of ant species inside the infested localities differ from uninfested localities. Pitfall traps were used to define the S. invicta infested and uninfested localities and bait traps were used to determine the foraging activity of the ant species within each locality. A goodness of fit test (G-test) was used to test for independence of foraging activity between localities. Forelius pruinosus (Roger) and Monomorium minimum (Buckley) showed highly significant differences in foraging activity depending on locality ($P << 0.001$). Modifications of the foraging activity patterns for the ant species tested will be discused.

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Introduction

Ants are present in almost all terrestrial habitats, occupying a great diversity of niches within ecological communities. Interspecific interactions are important in determining species distribution, abundance, and behavior within habitats and are proportional to the number of ant colonies present within a community. In undisturbed communities different foraging strategies may evolve among species to avoid interspecific competition. Marsh (1988) studied the activity patterns of eight species of ants in the Namib desert in South-western Africa during the summer and winter seasons and before and after rain fall. Seven of the species studied showed a change of their activity pattern between seasons and greater differences among activity patterns were found during summer when the activity of all species was greater.

When an intruder ant species enters the community, the activity patterns already established within the ant community may be disrupted. This disruption may develop into new interspecific relationships within the community. The amount of change in activity patterns will be directly related to the competitive ability of the new intruder, and can become evident in several ways. First, the weaker species could become extinct. Savolainen and Vepsalainen (1988) studied the social organization and behavior of the boreal ants in Finland. They divided the ant fauna into three different categories: territorials, encounterers, and submissives, and found that encounterers and territorials are very competitive and can not coexist; hence, following Gause's principle, the encounterers become extinct when in presence of territorials. Second, displacement from the habitat rather than extinction of weaker species can occur. Ward (1987) showed the

displacement of native ants from the Sacramento Valley by the Argentine ant, Iridomyrmex humilis (Mayr), and Tschinkel (1988) showed the displacement of Solenopsis geminata (Fabricius) from highly disturbed habitats in Florida by the red imported fire ant, Solenopsis invicta Buren. Third, ant species that remain within the habitat can modify their foraging activity to avoid interspecific competition. Savolainen and Vepsalainen (1988) also found that submissives can coexist, but only with a decrease in nest densities and number of foragers. In addition, submissives shifted their diet from a protein to a carbohydrate base.

The red imported fire ant has been shown to be a good competitor. Camilo and Phillips (in press) studied the influence of S. invicta on the ant community structure in central Texas. Their data showed that three species: Conomyrma insana (Buckley), Monomorium minimum (Buckley), and Forelius pruinosus (Roger) decreased their numbers at a slower rate than the other ants present in the community. However, whether these species maintain or modify their foraging activity is unknown. Based on that, our objective was to determine if significant differences exist in the foraging activity (number of ants actively foraging) of the ant species that remain within the red imported fire ant territory.

Materials and Methods

The study was conducted in Taylor County, Texas, during the months of July, August, and September of 1989. The study site is a flooded, disturbed range land habitat bordered on two sides by mesquite trees, at the southeastern edge of Lake Kirby in Abilene.

The study consisted of two stages. First, a survey was made using pitfall traps to determine the distribution of S. invicta. Each pitfall trap consisted of two 16 oz plastic cups containing ethyl glycol (one third of the volume) as a preservative. The pitfall traps were arranged in 23 rows of 4 pitfall traps each. The distance between rows was 20 meters and the distance between pitfall traps within rows was 10 meters. Based on the data obtained, the site was divided into two localities: infested area (presence of S. invicta) and uninfested area (absence of S. invicta), of approximately 6,000 square meters each. Second, a bait trap study was conducted to determine the foraging activity of ant species within the S. invicta infested and uninfested areas. The bait was a gel that consisted of a mixture of grape jelly (carbohydrate source) and albacore fish preserved in oil (protein and oil source) with agar. The gel was cut into cubes of approximately 1 cu cm and placed within a transparent, 1 oz, plastic cup (4.0 cm diameter x 4.5 cm height).

Data were collected twice each month with a week interval between collections. Each collection day consisted of 600 samples collected in groups of 25 bait cups randomly placed in each locality every two hours for a 24 hour period. The cups were left on their side for 15 minutes before collection to record foraging activity and not recruitment. Each collection day began at 1100 hours and ended at 0900 hours of the next day. After collection each sample was placed inside a sandwich plastic bag to maintain the sample integrity. Samples were placed in ice chests, taken to the laboratory, and maintained in a freezer. Ants were identified and counted to determine the frequency of individuals per species at each collection.

A goodness of fit test (G-test) was used to analyze the foraging activity for each species. This test is a test for independence which compares the frequency of foragers for each time between both localities (infested and

uninfested areas) with a null hypothesis that foraging activity of each species is independent of locality and an alternate hypothesis that foraging activity of each species is dependent on locality. The data were analyzed in three steps. The first consisted of testing for independence among localities of foraging activity within each collection day. Second, we tested for independence among localities within each month. The data used for the G-test in the second step was new foraging activity frequencies obtained from adding the number of foragers within each month from each locality. For the third step, in which we tested for independence among localities for the whole study period, we used new foraging activity frequencies obtained from adding all the number of foragers from each locality.

Results

A total of 18 ant species was collected from the bait traps. These species were divided into four groups depending on locality and consistency of occurrence. The first group consisted of species that only occurred within the infested area. These species were: Formica gnava Buckley, Camponotus festinatus (Buckley), and Pheidole lamia Wheeler. These species were collected in very low numbers (13, 2, and 14 individuals, respectively). The second group, consisted of three species collected exclusively from the uninfested area. They were Pogonomyrmex barbatus (F. Smith), Pheidole metallescens Emery, and Prenolepis imparis (Say). From this group only P. metallescens and P. imparis were collected in low numbers (41 and 1 individuals, respectively), and for P. barbatus a total of 355 individuals were collected. The third group consisted of nine species obtained from both

localities (infested and uninfested areas), but were collected inconsistently throughout the study (Table 1). This inconsistency was defined as absence of species individuals in one or more of the collection days or in one of the localities within one or more of the collection days. This inconsistency is important because the G-test requires data from each locality for every collection day. Of the nine species of this group, three were collected in greater numbers from the infested area: Conomyrma flava (McCook), Conomyrma insana (Buckley), and Crematogaster laeviuscula Emery. The fourth group, consisted of the two ant species collected consistently throughout the study and were used for the statistical analysis. They were Monomorium minimum (Buckley) and Forelius pruinosus (Roger).

Solenopsis invicta was also collected in both localities, but only within the edge of the uninfested area (91 individuals) nearest to the infested area and at night when the other species were not foraging compared to the 86,268 individuals collected from the infested area. This situation might be due to the capability of S. invicta to further expand its foraging at night until it reaches the boundaries of the uninfested area due to the lack of interference from foragers of the other ant species.

Both localities were significantly difference (d.f. = 11; $P << 0.001$) for foraging activity of the species tested. This difference indicates that the foraging activity for the species is dependent on locality. For M. minimum the value of G_{adj} was 2108.747 compared to a table value of $X^2 = 31.264$. The foraging activity for M. minimum began at 0500 hrs for both localities (Figure 1). Within the uninfested area the number of foragers was relatively constant during the whole period of foraging with two foraging activity peaks at 1100 hrs and 1700 hrs. For the infested area the number of foragers was erratic throughout the period of foraging with three distinct activity

Table 1. Species collected from both sites but not used for the G-test.

Species	Number of Ants	
	Infested	Uninfested
Forelius foetidus (Buckley)	1,244	1,402
Conomyrma flava (McCook)	918	195
Conomyrma insana (Buckley)	451	13
Formica schaufussi Mayr	71	39
Paratrechina terricola (Buckley)	1,593	3,469
Crematogaster laeviuscula Emery	7,730	4,918
Crematogaster punctulata Emery	25	35
Leptothorax pergandei Emery	1	2
Pheidole dentata Mayr	75	1,289

peaks at 0700 hrs, 1100 hrs, and 1700 hrs. The number of foragers increased and decreased very rapidly before and after each activity peak. Within the uninfested area the foraging activity ended at 2300 hrs whereas the foraging activity in the uninfested area ended at 0300 hrs. This difference of four hours indicate that to obtain the same kind of resources M. minimum needs to expand their temporal foraging activity within the infested area. For F. pruinosus the value of G_{adj} was 349.899 compared to a table value of X^2 = 31.264 (d.f. =11; P << 0.001). The foraging activity for F. pruinosus began at the same time (0700 hrs) for both localities (Figure 1). Within the uninfested area the species showed more foraging activity in the morning and reached a peak at 1300 hrs. In the infested area the species showed more foraging activity during the afternoon with a foraging activity peak at 1500 hrs. For both localities the foraging activity ended at 2300 hrs.

In conclusion, the foraging activity differences found between both sites suggest an adaptation that enables these species to survive within the red imported fire ant territory. Perhaps this difference in foraging patterns together with the slower decrease in forager numbers, demostrates that some ant species that remain within the red imported fire ant territory are rapidly adapting to it presence and are thus avoiding interspecific competition.

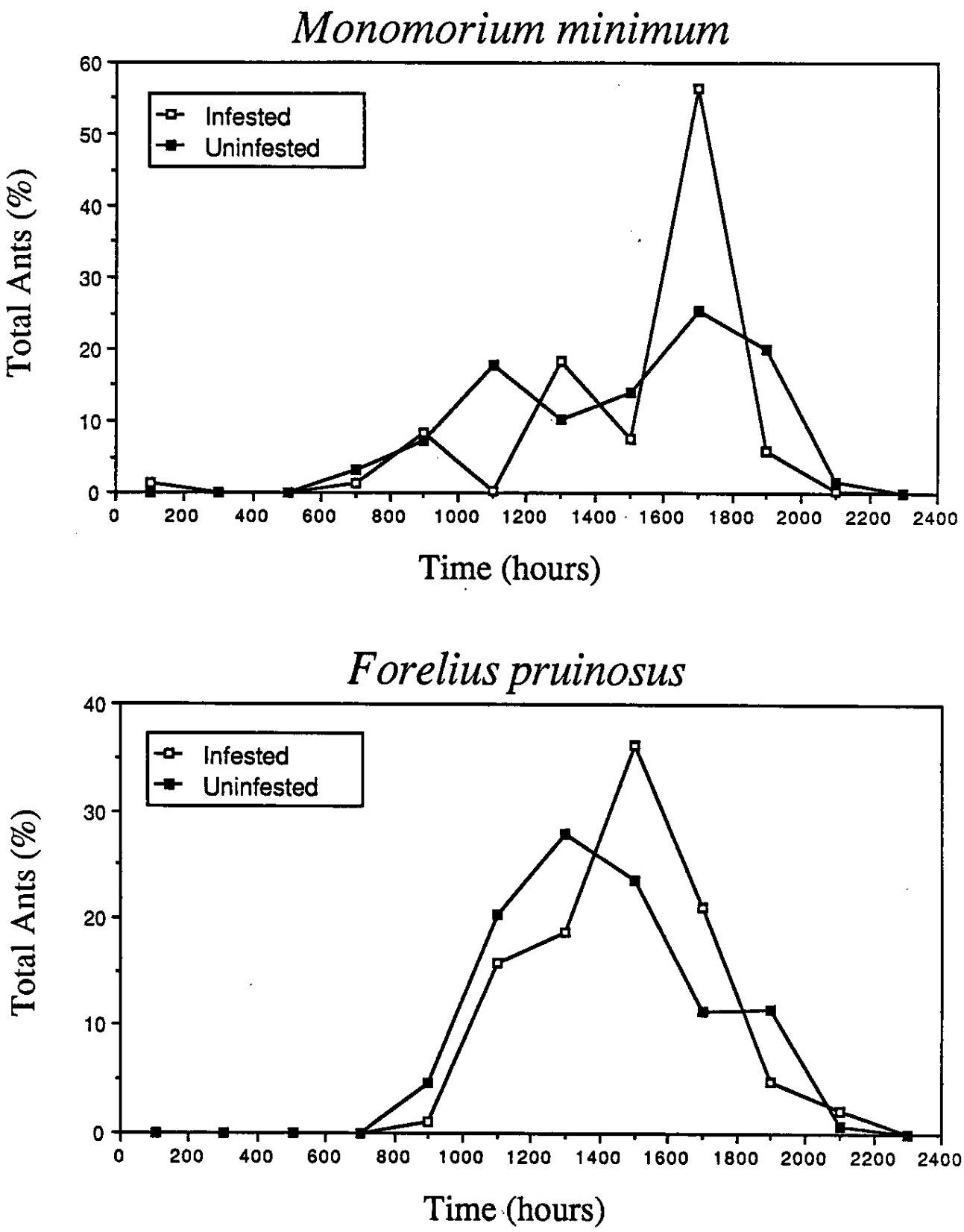

Fig. 1 Temporal foraging frequencies based on total number of ants collected.

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