

## Observations on Fire Ants, *Solenopsis* spp., in Mato Grosso, Brazil

by

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### ABSTRACT

Mounds of the imported fire ant, *Solenopsis invicta*, observed in its native habitat in the state of Mato Grosso, Brazil, were typically smaller than those observed in the southern United States. Mound size varied somewhat with colony size but more so with the moisture level of the soil. The ants were most common in areas disturbed by human activity and were more abundant in areas disturbed within 1-2 years of the survey than in areas undisturbed for longer periods. Most colonies observed were mature.

Arthropods encountered frequently in ant nests included the parasitic wasp, *Orasema* sp. (Eucharitidae), myrmecophilous beetles (Scarabaeidae, Histeridae, Staphylinidae), Thysanura, and millipedes. The socially parasitic ants, *Solenopsis (Labauchena)* spp., common in Uruguay and Argentina, appear to be rare in Mato Grosso.

### INTRODUCTION

The black and red imported fire ants, *Solenopsis richteri* Forel and *Solenopsis invicta* Buren, were introduced into the United States at the port of Mobile, Alabama, ca 1918 and 1940 respectively (Lennartz 1973). Buren (1972) showed that these 2 species in the *Solenopsis saevissima* complex inhabit widely separated areas in South America. *S. richteri* is found in Rio Grande do Sul in southern Brazil, over most of Uruguay, and in parts of Argentina (Buren 1972, Buren et al. 1974). The range of *S. invicta* is primarily in the state of Mato Grosso in west central Brazil, but extends northwestward as far as Porto Velho, Rondonia, Brazil and southward along the Paraguay River through Paraguay and into northern Argentina (Buren et al. 1974). In the United States, the 2 species infest in excess of 10<sup>8</sup> ha (2.5 x 10<sup>8</sup> acres) in nine southern states. *S. invicta* occupies about 95 percent of this area, having displaced *S. richteri* except for a small enclave in northwestern Alabama and northeastern Mississippi. Efforts to control the ants with chemicals have produced serious controversy

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(Lofgren et al. 1975); consequently, several trips have been made to South America to search for potential biocontrol agents. These trips have also given limited opportunity for observations on the biology and ecology of the ants.

Published information on the ecology of the fire ants in their native habitat has dealt primarily with their natural enemies (Williams and Whitcomb 1974, Allen and Knell 1980, Whitcomb 1980, Williams 1980). Allen et al. (1974) reported observations on other aspects of their ecology during a 17-day trip to Brazil. Williams and Whitcomb (1974) made brief mention of mound-building habits of the ants in their paper on parasites. Buren et al. (1974) discussed the known range of fire ants in North and South America and postulated a number of biotic and abiotic factors governing the present and future distribution of the ants. Wojcik (1983) reported limited observations on the biology and population levels of fire ants in Brazil. Our observations extend, and in some cases, modify this published information.

## MATERIAL AND METHODS

Trips were made to west-central Brazil (states of Mato Grosso and Mato Grosso do Sul) in June-July 1974, January 1976, October-November 1979, April-May 1981, March 1983, and February-March 1984.

During each of the trips, fire ant nests were opened with a small spade or hand trowel to a depth of 10 to 20cm, and 0.5 to 1.0 liter of the nest soil with ants was placed in a plastic container for transport to the laboratory. The remainder of the nest was examined to determine the approximate number of workers, the presence or absence of immatures and sexual forms, and the general vigor of the colony.

The containers, with ants and soil, were returned to the laboratory where the ants were separated from the soil by flotation (Jouvenaz et al. 1977). After separation, the ants were examined to confirm or enlarge the field observations on the presence of brood and sexual forms, and to determine the presence of potential parasites or predators. Samples of ants and brood were examined for the presence of pathogens and workers were preserved in alcohol for subsequent confirmation of the species.

Plots were established at several sites near Cuiaba during the 1979 trip to obtain estimates of population density and size of the ant colonies. Seven rectangular (0.096ha) plots were established in the median of a multilane highway on the southeast side of Cuiaba, and similar (0.06ha) plots were established on the shoulders of the Cuiaba-Rondonopolis highway (BR-364) and the Cuiaba-Santo Antonio do Leverger highway. A single rectangular (0.02ha) plot was located on a vacant lot near the Cuiaba airport. Circular plots (0.031ha) were established in cerrado (arid

tropical savanna—see Eiten 1982 for a description of cerrado) ca midway between Cuiaba and Santo Antonio do Leverger. During the 1983 trip, additional plots were established; 2 plots (0.22ha each) on vacant lots adjacent to the Dentel Communications Center between Cuiaba and Santo Antonio do Leverger, 2 plots (0.049 and 0.079ha) in street medians, and one plot (0.074 ha) in a park area in the town of Santo Antonio do Leverger. Every nest on all plots was opened with a spade, the contents examined, and the nest then rated according to the system of Harlan et al. (1981) to obtain an estimate of relative colony size and brood status. The colony counts on these plots were converted to an equivalent number of nests/ha.

## RESULTS AND DISCUSSION

A total of 1,185 colonies of *Solenopsis* spp. were collected and examined in the laboratory during the six trips. In addition, field observations were made on several hundred other colonies.

Data recorded on the presence of brood (immatures) and alates (winged male and female sexuals) in nests during the 3 earliest trips were as follows:

Time of trip	Number of nests examined	Number (percent) with brood	Number (percent) with alates
June-July 1974	184	130 (70.7)	65 (35.3)
January 1976	184	141 (76.7)	26 (14.4)
Oct.-Nov. 1979	456	444 (97.4)	172 (37.7)

Nests of fire ants were found with ease on all trips, with the exception of 1974. The soil was extremely dry during that trip and our experiences in locating fire ant mounds were similar to those reported by Allen et al. (1974). We found ants in numerous sites where no mound was visible; the colonies were present under stones and logs, in old tree stumps, around the base of trees, and were detected only by probing with a shovel. On some occasions, we observed fire ant workers foraging the soil surface; but even with intense searching, we were unable to locate the colony. When mounds were found, usually in damp areas, they ranged from 8 to 20cm in diameter and from 2 to 20cm in height.

All trips subsequent to 1974 were made during the rainy season; and we had little difficulty in finding nests of fire ants in open areas, such as the campus of the Federal University of Mato Grosso at Cuiaba, in vacant lots, on most road shoulders and highway medians, and in pastures. Table 1 shows the relative incidence of mounds on selected sites. The numbers

Table 1. Colony sizes in a sample of 216 colonies of fire ants from Mato Grosso, Brazil.

Index for Nests		# Colonies	
# Workers	Brood	(total of 216)	% Colonies
<10 <sup>2</sup>	-	4	1.85
10 <sup>2</sup> -10 <sup>3</sup>	-	7	3.24
10 <sup>3</sup> -10 <sup>4</sup>	-	13	6.02
10 <sup>4</sup> -5 · 10 <sup>4</sup>	-	5	2.31
>5 · 10 <sup>4</sup>	-	3	1.39
<10 <sup>2</sup>	+	0	0
10 <sup>2</sup> -10 <sup>3</sup>	+	7	3.24
10 <sup>3</sup> -10 <sup>4</sup>	+	11	5.09
10 <sup>4</sup> -5 · 10 <sup>4</sup>	+	29	13.44
>5 · 10 <sup>4</sup>	+	137	63.43

on nests/ha in 1979 ranged from equivalents of 33.3 and 56.7 on 2 highway shoulders to 165.1 on a highway median, 35 on a vacant lot, and 32.3 on 3 plots in cerrado. In 1983, the nests/ha were equivalent to 27 and 41 on vacant lots, 76 and 81 on 2 street medians, and 215 in the park site.

It must be emphasized that these data cannot be directly extrapolated to estimate fire ant population densities in Mato Grosso. The sites for population counts were selected for accessibility and convenience rather than at random according to a pre-established selection plan. These observations were secondary to the search for natural enemies, and time was limited. Nevertheless, these data demonstrate that, at least locally, fire ants may be abundant in Mato Grosso.

The majority of the colonies on the plots in both years were fairly large; in 1979, 59.4 percent of those examined on the highway median and 61.0 percent of those examined on the road shoulders contained brood and 50,000 or more workers. An additional 20.6 percent of the nests on the median and 13.0 percent of the nests on the road shoulders contained 10,000 to 50,000 workers although only 1 of the 3 examined in cerrado was that large. In 1983, 66.7 percent of the colonies on the vacant lots contained 50,000 or more workers, as did 81.2 percent of those on street medians, and 94.0 percent of those on the park site. Markin et al. (1973) reported that ca 1 year was required for the average colony to reach a size of 10,000 workers and more than 2 years were required to reach a size of 50,000 or more workers. The size of the colonies, the numbers of major workers present, and the presence of numerous sexual forms suggest to us that a large number of the colonies we examined were probably 2 or more years old. Thus, these colonies may have survived one or more dry

seasons in open areas with no open sources of water nearby. Allen and Knell (1980) reported that mounds of *Solenopsis* more than 2 years old are rarely seen in Brazil; however, it would appear that a large percentage of those we examined were that old. A summary of colony size is presented in Table 1.

Soil moisture seemed to be a very important factor influencing the visibility of fire ant mounds in Mato Grosso. The prolonged dry season (April-late September) and the speed with which the soil dries after rains during the rainy season appear to limit both the number of sites where fire ants can survive and the size of the mound. Our observations indicate that reports of other authors regarding the presence and size of fire ant mounds in Mato Grosso are not universally applicable. Williams and Whitcomb (1974) reported that fire ant mounds in Brazil are low and inconspicuous in the wet season, are difficult to locate in the dry season, and are never as abundant or conspicuous as in the United States. Allen et al. (1974) stated that "characteristic large mounds of *S. invicta*, common in the United States were not observed in Brazil." We have found that, although these situations are often true, there are many exceptions. We have found numerous large nests (40-50 cm in height — Fig. 1) in many areas after vegetation was burned during the dry season. The incidence of large nests is less than in the United States and the reason for this is not understood at present. Wilson (1971) indicates that mound-building is most common in areas subject to wide variations in temperature and humidity. Temperatures in Mato Grosso rarely are below 15°C and do not fluctuate widely (the minimum recorded over 9 years was 10°C with a year-round monthly mean of 24 to 27.7°C — Lennartz 1973, USDA 1941). If the primary purpose of the mound is thermoregulation, there is little need for large mound tumuli in Mato Grosso. On the other hand, moisture varies widely in Mato Grosso through the year, and there the mound structure may be most important in regulating moisture levels. We observed the larger mounds in those areas where moisture control appears to be most difficult (for example, the edges of marshes, areas subject to flooding).

Soil type or quality may also influence mound size. In the cerrado of Mato Grosso (which includes the environs of Cuiaba, where observations have been concentrated), the soil is coarse, rocky, and low in humus. Here mounds are usually quite small, even in the wet season. In the vicinity of Caceres (west of Cuiaba), however, the soil appears to be higher in clay content and richer in humus, and large mounds are much more common. The vegetation is also relatively lush.

Our observations, both in the United States and Mato Grosso, have convinced us that colony size and visible mound size are not necessarily correlated. We have found small colonies with extremely large mounds and large colonies with relatively small mounds. In the sandy soils of Florida, particularly during hot or dry weather, mounds of the fire ant may

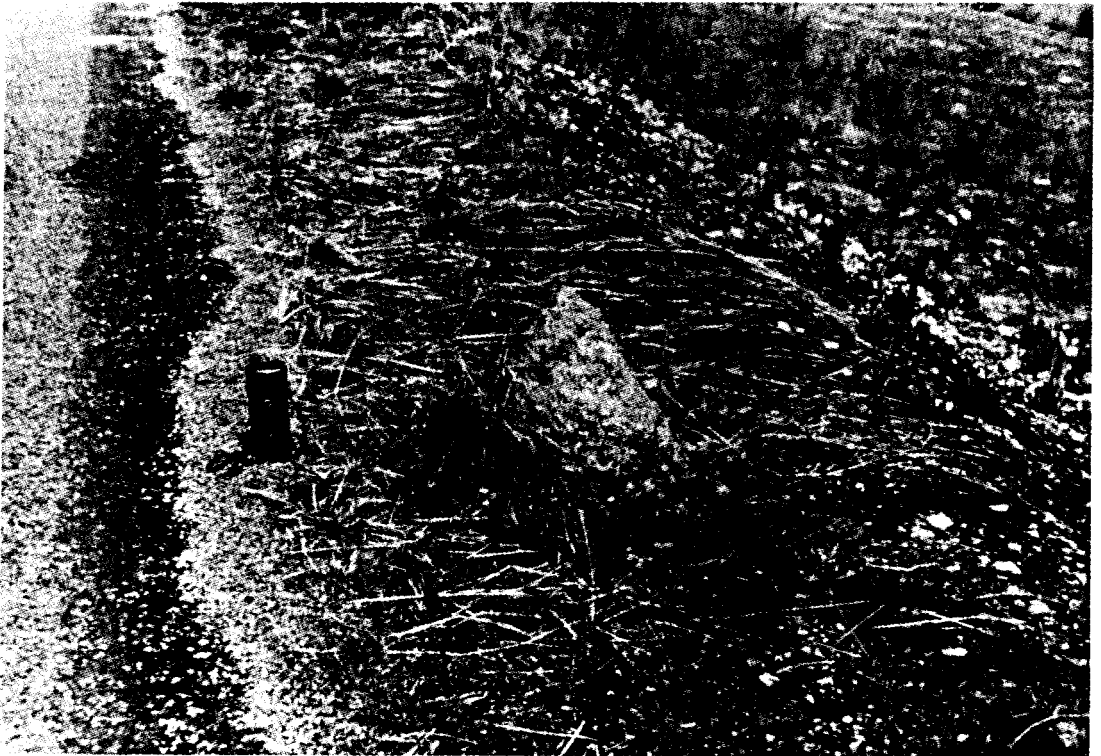


Fig. 1 Large mounds of the red imported fire ant in Mato Grosso, Brazil.

Table 2. Fire ant population (colony) densities on selected sites in Mato Grosso, Brazil.

Habitat	# Sites	Size Sites (ha)	#Colonies/ha Mean $\pm$ SE (Range)
Hwy Median	7	0.096	165.1 $\pm$ 19.5 (83-240)
Hwy Shoulder (BR-364)	10	0.06	56.7 $\pm$ 10.5 (0-150)
Hwy Shoulder (S. Antonio)	10	0.06	33.3 $\pm$ 6.4 (0-83)
Street Median	2	0.049; 0.079	79 (76,82)
Park	1	0.073	219
Vacant Lot	3	0.20-0.22	34.3 (27-41)
Cerrado	3	0.031	32.3 (0-65)

essentially disappear although colonies are present and thriving. We have observed areas in Mato Grosso where no mounds or only very small mounds were apparent until rain fell for several days, after which large mounds were visible. Subsequent examination of these colonies revealed them to be much larger than the initial mound size indicated.

*S. invicta* has been reported as less abundant in Mato Grosso than in most of its range in the southern United States (Buren et al. 1978, Williams and Whitcomb 1974). Whether this is indeed true is still uncertain. Comparison of population levels is very difficult because of the great ecological differences in the United States and Mato Grosso. Cerrado comprises a large part of Mato Grosso (Santos et al. 1977) and does not seem to be a suitable habitat for *S. invicta*. Allen et al. (1974) did not find the species in cerrado, and only 2 of the nests we found in cerrado were *S. invicta* although other fire ants were found. Our limited data (Table 2) indicate that in disturbed areas, densities of fire ant nests may approach levels noted on similar habitat in the United States. Buren et al. (1978) suggested that fire ant problems in both North and South America are largely man-made. Our observations confirm this; in Mato Grosso, fire ants occur most often and in greatest abundance on areas disturbed by man. The large numbers of queens produced by the fire ants give them a decided advantage over other ant species in invading and exploiting such areas. If adequate moisture and food are available, large numbers of colonies become established on these sites; the number of colonies then gradually diminishes to the carrying capacity of the area. This is the pattern in the southern United States (Green 1962, Rhoades and Davis 1967, Lofgren and Williams 1985, Banks et al. unpublished), and our observations suggest it also is the pattern in Mato Grosso. More nests of

fire ants were found on areas disturbed within 1 to 3 years than on similar areas that were undisturbed for longer periods.

Little is known about mating activity and colony-founding by fire ants in Mato Grosso. We have observed winged sexuals in many colonies in every month except August, September, and December; however, sexuals have been seen in the months preceding and after. We have observed flights of fire ants in January, February, April, May, and November in the Cuiaba area, and in the Campo Grande area in June. Allen et al. (1974) reported flights in August. The success of mated queens in founding colonies in Mato Grosso has not been studied.

A number of arthropods were encountered frequently in nests of fire ants in Mato Grosso; these included a parasitic wasp, *Orasema* sp. (Chalcidoidea: Eucharitidae), several myrmecophilous beetles (Scarabaeidae, Histeridae, and Staphylinidae), Thysanura, and millipedes. Silveira-Guido et al. (1973) found a large number of arthropods associated with fire ants in Uruguay and Argentina; however, the relationships to the fire ants have not been studied. Considerable study has been devoted to socially parasitic ants, *Solenopsis* (formerly *Labachena* spp.) (Silveira-Guido et al. 1967, 1968, 1973), as potential biocontrol agents. These ants appear to be extremely rare in Mato Grosso; we have encountered them in only 2 nests of fire ants in Mato Grosso do Sul. In Uruguay and Argentina, however, *Solenopsis* (*Labachena*) *daguerrei* Santschi infested from 2.2 to 70.1 percent of nests of fire ants in the *S. saevissima* complex (Silveira-Guido et al. 1973). The incidence of pathogens in fire ants in Mato Grosso has been reported by Jouvenaz et al. (1980).

The need for additional studies of the fire ants in South America is obvious. A better understanding of the ecology of fire ants in their native habitat may enable us to more effectively manage these pests in the United States.

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