Foraging activity of *Acromyrmex laticeps nigrosetosus* Forel (Hymenoptera, Formicidae) in *Eucalyptus* stands

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ABSTRACT. This work was conducted from November 1994 to February 1995 in *Eucalyptus camaldulensis* (Myrtaceae) stands in Paraopeba, State of Minas Gerais, Brazil, to study some aspects of foraging habits of *Acromyrmex laticeps nigrosetosus* Forel, during two periods of twenty-four hours each month it was observed that the foraging activity of this leaf-cutter occurred mostly at night and lasted 12 hours. A negative correlation between ant flow in the trail and air temperature was obtained but increases in relative humidity increased workers' flow. Longer trails were observed when there were no secondary trails and the area explored by the colonies averaged 9.24m². The medium length of the main trails was 4.08 m and it varied from 2.10 to 8.83 m.

Key words: leaf-cutting ant, Attini, rhythm of activity.

RESUMO. Atividade forrageadora de *Acromyrmex laticeps nigrosetosus* Forel (Hymenoptera: Formicidae) em povoamento de eucalipto. Observou-se, de novembro de 1994 a fevereiro de 1995, a atividade forrageadora de duas colônias de *Acromyrmex laticeps nigrosetosus* Forel em área reflorestada com eucalipto, *Eucalyptus camaldulensis* (Myrtaceae), em Paraopeba, Minas Gerais, Brasil. Essas colônias foram monitoradas por dois ciclos consecutivos de 24 horas por mês, tendo sido observado que a atividade dessas colônias foi predominantemente noturna, com correlação negativa, entre o fluxo de operárias nas trilhas e a temperatura do ar, e positiva, com a umidade relativa do ar. A área média explorada, durante o forrageamento, foi de 9,24 m². Foram observadas trilhas mais longas quando não havia trilhas secundárias. O comprimento médio de forrageamento foi de 4,08 m, variando de 2,10 a 8,83 m.

Palavras-chave: formigas cortadeiras, Attini, ritmo de atividade.

Introduction

Foraging activity is predominantly nocturnal in some leaf-cutting ants of the genus *Atta* (Cherrett, 1968) but it is not uncommon to observe foraging during the day (Lewis *et al*., 1974; Wetterer, 1990) and a few of the *Acromyrmex* species also show this foraging pattern (Cherrett *et al.*, 1974; Mendes *et al*., 1992; Maciel *et al*., 1995; Araújo *et al.* 1998). This activity usually follows a circadian rhythm that may be modified by hunger and environmental changes (Hölldobler and Wilson, 1990). Temperature (Troppmair, 1974; Cherrett *et al.*, 1974; Mintzer, 1979; Fowler and Robinson, 1979) followed by relative humidity and atmospheric pressure (Fowler and Robinson, 1979) are determinant on daily variation of the foraging rhythm. Other factors, still unknown, may also affect foraging. For example, in *Atta laevigata* this activity may be reduced or absent during the time preceding the nuptial flight (Salzemann and Jaffé, 1990) and also due to the presence of the parasitic phorid flies (Bragança *et al.*, 1998).

Many *Acromyrmex* species are considered important agricultural and forest pests in Latin America but little is known about their ecological aspects. Information is scarce specially for *A. laticeps nigrosetosus*. Gonçalves (1961) described some diagnostic characteristics and nesting habits of this subspecies in some regions of Brazil; Araújo *et al* (1998) worked on this subspecies polymorphism and Antunes and Della Lucia (1999) measured leaf consumption under laboratory conditions. *Acromyrmex laticeps nigrosetosus* is common and density of nests is high in Paraopeba, Minas Gerais (Araújo *et al*., 1997). Therefore, we conducted this research with the following objectives: to determine the foraging rhythm, to evaluate the effect of temperature and relative humidity on the workers'

flow in the trails and to measure foraging areas and trails of *A. laticeps nigrosetosus* in *Eucalyptus* (Myrtaceae) plantations.

Material and methods

This study was conducted from November 1994 to February 1995 in Paraopeba (19º 17'S; 44º 29'W), State of Minas Gerais, Brazil, in a seven-year old *Eucalyptus camaldulensis* plantation, located at 700 m of altitude. The average annual rainfall is 1353 mm and average minimum and maximum temperatures are 15 and 24ºC, respectively.

Diel foraging activity of *A. laticeps nigrosetosus* was monthly evaluated during two consecutive cycles of 24 hours during four months. The observations were made on two nests with external areas of 0.65 (nest C1) and 0.78 m² (nest C2). Evaluation of the foraging activity consisted of counting the number of laden and unladen workers returning to the nest, during five minutes at each hour (Maciel *et al.*, 1995; Araújo *et al.*, 1998). Nocturnal observations were conducted with the aid of a flashlight covered by red cellophane film to avoid interfering with the ants' activities (Guajará *et al*., 1990).

Temperature and relative humidity were registered during each observation period. The time of foraging peak (highest number of workers in the trail) was determined during the first 24 hours so that it could be used in the second period to estimate trail length and to mark foraging areas of the colonies. These were delimited by ten stakes, after following 10 workers of each colony to their cutting sites. The foraging area was considered to be the surface obtained by linking the nest entrance to the ten stakes (Fowler and Robinson, 1979; Mendes *et al*., 1992). The foraging areas were drawn on square paper and measured. Data were analysed using non-linear regression and Pearson`s correlation.

Results

Foraging activity of the colonies was mostly nocturnal (Figures 1 and 2), except in C1 in January. This nest was active during the day (with a peak) and the night (Figure 1). Foraging frequently begun between 3 and 6 p.m. and usually ended between 6 and 10 a.m., lasting for 12 at least hours. We found variation, between colonies, in the time of peak flow and in the numbers of foragers in the trail at this peak time. The highest numbers of laden workers occurred from 11:00 p.m. to 4:00 a.m. in C1 and from 8:00 p.m. to 3:00 a.m. in C2.

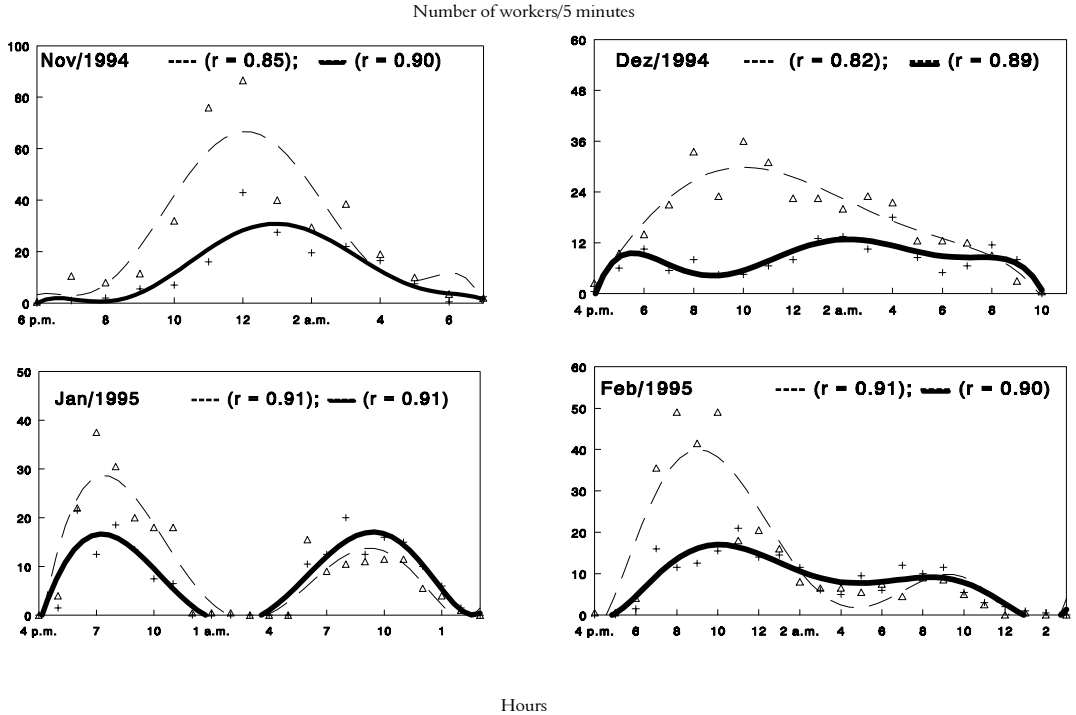

Figure 1. Daily foraging rhythm of colony C1 of *Acromyrmex laticeps nigrosetosus* in Paraopeba, State of Minas Gerais, Brazil, November of 1994 to February of 1995. Solid lines represent laden workers; dotted lines represent unladen workers. The non-linear regressions were significant ($p<0.05$). The hours not represented in the illustration did not have foraging activity

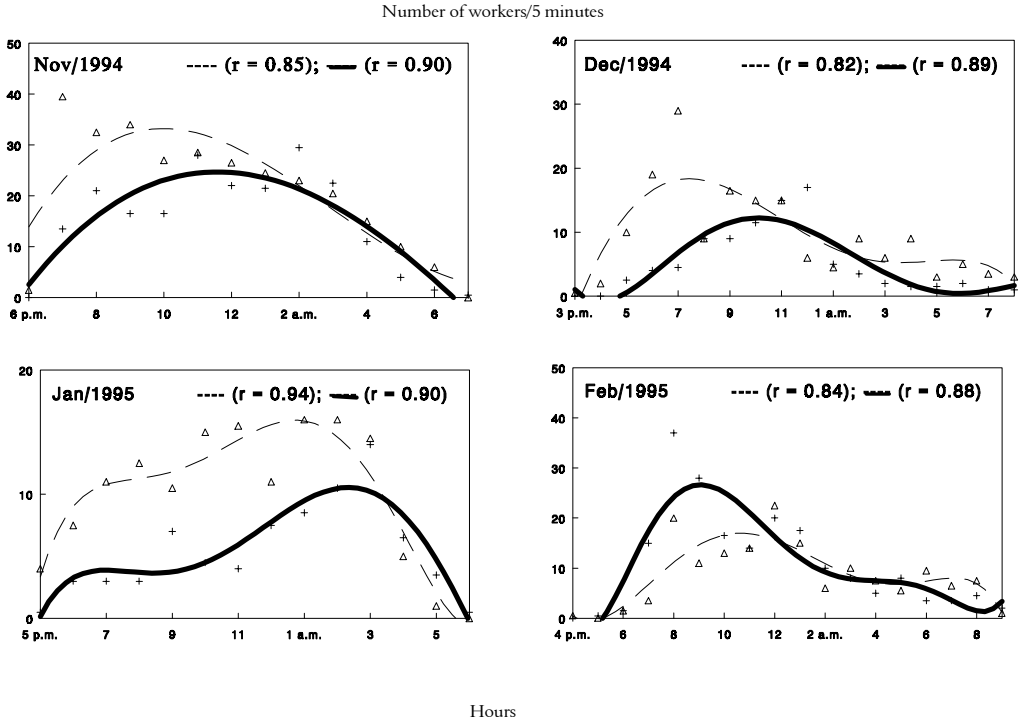

Figure 2. Daily foraging rhythm of colony C2 of *Acromyrmex laticeps nigrosetosus* in Paraopeba, State of Minas Gerais, Brazil. November of 1994 to February of 1995. Solid lines represent laden workers; dotted lines represent unladen workers. The non-linear regressions were significant ($p<0.05$). The hours not represented in the illustration did not have foraging activity

A negative correlation between ant flow in the trail and air temperature (Table 1) was found, but ant flow was higher during periods of high relative humidity. Both colonies showed no significant correlation between the size of areas explored by workers and total trail length (Table 2). Foraging areas ranged from 2.07 to 23.04 m² in C1 and 3.60 to 11.88 m² in C2.

Table 1. Effect of temperature and relative humidity on flow of laden and unladen workers in two colonies of *Acromyrmex laticeps nigrosetosus* in Paraopeba, State of Minas Gerais, Brazil

Climatic factor	Colony	Foragers		
		Laden workers	Unladen workers	Laden + Unladen workers
Temperature	C1	- 0.211	- 0.369	- 0.349
	C2	- 0.369	- 0.279	- 0.372
Relative humidity	C1	0.254	0.389	0.379
	C2	0.449	0.292	0.409

Upper values correspond to Pearson's correlation coefficients at 99% probability

Discussion

Daily and monthly variation in the workers' flow in the trails were observed. Foraging activity in *A. laticeps nigrosetosus* was predominantly nocturnal, probably following a circadian rhythm. This is the usual in ants (Hölldobler and Wilson, 1990). The diurnal foraging observed in only one colony could be the result of resource partitioning during that period, since we did not eliminate other existing nests of the same species which were closer to that colony in the vicinities of the study area. This resource division during foraging was observed previously in another *Acromyrmex* subspecies by Maciel *et al.* (1995). Diurnal foraging may also be due to internal nest necessities. It was interesting to verify that the number of unladen workers was, in general, higher than that of laden ants (Figures 1 and 2). No trail fidelity was observed during foraging. It has been suggested that the task of these workers is related to trail maintenance. This, in turn, could be associated to colony size, trail length or territory delimitation (Lewis *et al*., 1974; Fowler, 1979). These workers could also be involved in sap transportation to the nest as suggested for *Atta* species (Littledyke and Cherrett, 1976; Stradling, 1978).

Temperature is probably a limiting factor in foraging of *A. laticeps nigrosetosus* much the same as it is with other species of leaf-cutters (Moser, 1967; Gamboa, 1976; Farji Brener, 1993; Maciel *et al*., 1995). It was observed that the increase in relative humidity increases workers flow along the trails. It is possible that fluctuations in temperature and relative

humidity could promote physiological modification not only in the ants but also in the plant material and this, according to Fowler (1979), makes the meaning of these correlations still unclear.

Table 2. Monthly variation on lenght of main and secondary foraging trails of two colonies of *Acromyrmex laticeps nigrosetosus* in *Eucalyptus camaldulensis* stand in Paraopeba, State of Minas Gerais, Brazil. No significant correlation ($p<0.05$) was found between size of the area explored by workers and total length (T) of trails for colony 1 and colony 2

Month/Year	Size of the area explored by workers (m^2)		Trail length (m)					
			Colony 1			Colony 2		
	Colony 1	Colony 2	M	S	T	M	S	T
November/1994	2.07	3.06	3.00	1.50	4.50	2.30	2.00	4.30
December/1994	17.46	4.13	8.83	0	8.83	2.10	1.40	3.50
January/1995	23.04	4.77	4.85	0	4.85	5.40	0	5.40
February/1995	6.93	11.88	2.70	3.00	5.70	3.50	4.40	7.90

M- Main trail (where the majority of ant flow was observed); S- Secondary trail (small and sporadic ant flow); T- Total

Trail numbers and length fluctuated during the four months. Longest trails were observed when there were no secondary trails. If a single eucalypt plant was attacked, the workers built only one trail. Reported values of trail lengths of two grass cutters ranged from 1.0 m (*Acromyrmex landolti fracticornis*, Fowler, 1977) to 62 m (*Acromyrmex lobicornis*, Juruena and Meyer-Cachapuz, 1985).

The area explored by the colonies averaged 9.24 m^2. This is larger than areas reported by Mendes *et al*. (1992) for *Acromyrmex balzani* (values from 0.1 to 0.6 m^2). In contrast, one nest of *Atta sexdens* may infest an area ranging from 2,000 to 6,700 m^2 (Fowler and Robinson, 1979). Therefore, one can presume that the number of nests of *A. laticeps nigrosetosus* in a given area should be much higher. In fact, Araújo *et al.* (1997) surveyed this subspecies under *Eucalyptus* plantations and reported a density of 8.15 nests/ha in the regrowth area. This should be considered in leaf-cutting ant programs, especially during forest implantation.

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