ATTA COLUMBICA CASTE DISTRIBUTION ALONG FORAGING TRAILS

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Abstract: Leaf-cutting ants, *Atta columbica* are eusocial and have a caste system with minors tending the colony, workers carrying leaves to the colony, and soldiers performing a defensive function. Along a foraging trail, ants should be distributed according to the need for their caste function. We surveyed the proportion of soldiers near the colony, in the middle of the trail, and near the foraging tree, to assess where defense allocation is greatest. Contrary to our predictions, the percentages of soldiers did not vary among locations along the trail. However, soldiers carried leaves on 75% of our trails and the percentage of soldier ants carrying leaves was higher (45%) in the middle of the trail than at either end. Apparently, caste plasticity allows soldier ants to perform a defensive function where resources are most valued, and perform other functions such as carrying leaves where defense is less important.

Key Words: caste plasticity, resources, soldier ants, trail distance

INTRODUCTION

Leaf-cutting ants, *Atta columbica*, are eusocial insects that live in colonies including at least three castes. The smallest ants, minima (≈ 2 mm in length) stay in the colony, tending the queen, the young and the fungal garden. Media workers (≈ 10 mm) cut and carry leaves to the nest, and soldier ants (up to 20 mm in length) are thought to defend the colony and maintain foraging trails (Stevens 1983). If the soldiers fill a defensive role, they should be distributed where the colony's resources need the most protection. We hypothesized that defense allocation should vary along the trail, with greater proportions of soldiers to total ants near the nest and the food source, and less in the middle of the foraging trail. However, preliminary observations indicated that soldiers occasionally carry leaves to the nest. Perhaps soldier ants defend the colony's resources where trails require the most protection, and perform other functions where defense is less needed.

METHODS

On February 2 1998 we studied eight foraging trails of *Atta columbica* crossing the Senderos Espavales, Pavo and Rio Sirena in Corcovado National Park, Costa Rica. We located the nest and leaf source associated with each foraging trail and sampled from three locations along the trail: ≈ 2 m from the nest, ≈ 2 m from the tree and halfway between the nest and the tree. At each location, we classified and counted the number of ants per minute traveling in either direction. Ants were classified as soldiers carrying leaves, soldiers without leaves, or workers.

We analyzed arcsin transformed ratios of soldier to total ants with a two-way ANOVA that included trail position (fixed effect), colony (random effect), and trail position by colony. To assess caste plasticity, we used a paired t-test to compare the total number of soldiers with leaves to the total number of soldiers across all eight trails. We analyzed arcsin transformed ratios of soldiers with leaves to soldiers without leaves using an ANOVA with a Tukey test for multiple comparisons to determine effects of location on the trail. Figures and tables show untransformed data.

RESULTS

We recorded a total of 1993 ants (n = 8 - 213 ants at each of three locations on each of eight trails). Of these, the percentage soldiers (of total ants) did not vary along trail locations ($F_{9, 14}$ = 1.35, P = 0.29; Fig 1), or between colonies ($F_{7, 14}$ = 1.55, P = 0.23), nor was there an interaction between colony and location ($F_{2, 14}$ = 1.31, P = 0.30). The total number of ants passing per minute, also did not vary with trail position ($F_{2, 21}$ = 0.87, P = 0.43). Overall, there were about thirteen-fold more workers than soldiers (t_{23} = 7.06, P < 0.0001).

Of the 86 soldier ants seen, 16 were carrying leaves. The percentage of soldier ants with leaves (of total soldiers) was higher in the middle of the trail than near the entrance to the colony ($F_{2, 20}$ = 4.21, P = 0.030; Fig. 2). There were always more soldiers without leaves than soldiers with leaves (t_{22} = 5.33, P < 0.0001).

DISCUSSION

Assuming that soldiers perform only a defensive role, the finding that soldier ant distribution did not vary with location suggests that all parts of the trail are equally defended by the ants. However, there may be considerable caste plasticity in *A. columbica*. For example, workers can provide a stronger defensive reaction to intruder ants than soldier ants (Goodwin et al. 1997). In our study, seventy-five percent of the trails surveyed contained soldier ants carrying leaves, and there was a greater percentage of soldiers with leaves in the middle of the trail than elsewhere. Soldier ants may fill defensive roles only as needed. Perhaps soldier ants pick up leaves dropped along the trail as they travel back from the foraging tree to the colony. In this case, soldier ant functional role (as opposed to the simple occurrence of soldier morphs) may be a better indicator of spatial allocation of defense.

Goodwin et al. (1997) found no difference in soldier ant reaction to intruders near or far from the colony. Soldier ants functioning as leaf carriers may be able to drop leaves and defend the trail as necessary or this behavioral plasticity could lessen their capacity for defense. It is unknown whether soldier ants also participate in other behaviors such as leaf cutting.

LITERATURE CITED

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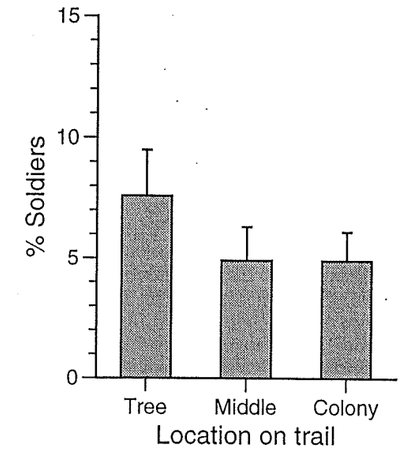

FIG. 1. Percentage soldier ants (of total ants) at three locations on the foraging trails (mean ± SE, n = 8 trails).

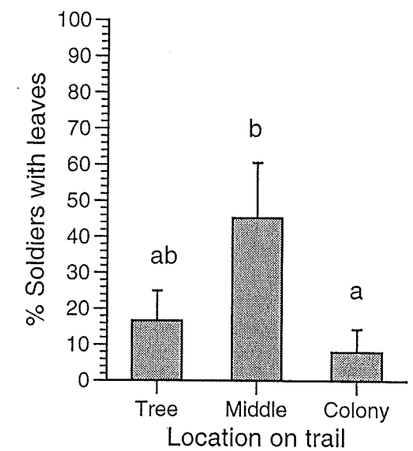

FIG. 2. Percentage of total soldier ants at each location that carried leaves (mean ± SE, n = 8 trails). Bars with different letters were significantly different.