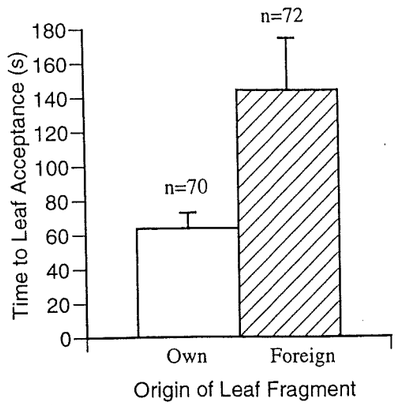

Fig. 1. Time to *A. colombica* leaf acceptance (mean ± 1 SE) for intra- and inter-colony leaf fragments from the same tree species at Corcovado National Park, Costa Rica.

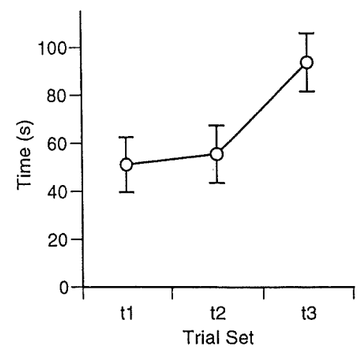

Fig. 2. Time to leaf fragment acceptance (mean ± 1 SE) by *A. colombica* for three sequential sets of intra-colony introductions at Corcovado National Park, Costa Rica.

Discussion

In this experiment, since we controlled for plant species, the *A. colombica* preference for leaf fragments from their own colony is most reasonably attributed to ants marking fragments with a colony-specific recognition signal, probably a chemical pheromone. The trend of increasing time to acceptance of intra-colony fragments with later trial runs suggests that a pheromone could have dissapated after a longer waiting period. This pheromone may not serve as an offensive inter-colony signal, since we observed no ant efforts to remove foreign leaf fragments from the trail.

If the pheromone is only an intra-colony signal, it could serve in the recognition of leaf fragments. Whether this is a specific leaf-marking pheromone or one that is used to mark colony trails and that residual chemicals are left on carried fragments remains to be determined. Either way, it appears that members of a colony recognize their own leaf fragments as compared to those from another colony, even when both are harvesting the same tree species. A future study could reintroduce washed and non-washed leaf fragments to a single trail to look for more evidence of a pheromone marking of leaf fragments.

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Caste distribution and the occurrence of leaf-riding minima in *Atta colombica* foraging trails

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Abstract: Leaf-cutting ants, *Atta colombica*, have a caste system which includes workers, soldiers, and minima. Both soldiers and minima are thought to participate in colony defense. We hypothesized that the pattern of dispersion of ants in these defensive castes along the foraging trail would reflect the greater need for defense in certain areas. Specifically, we predicted that the proportion of soldiers would be greatest near the nest to protect the queen, and that the proportion of leaf-riding minima would be highest in the middle of the trail to defend against parasitic wasps. No difference in the distribution of castes along the trail was detected. This suggests that the colony's need to defend resources is evenly distributed along the trails.

Key Words: colony defense, leaf-cutting ants

Introduction

The caste system of the eusocial leaf-cutting ant, *Atta colombica*, includes soldiers, workers, and minima. Leaf-cutters harvest foliage from trees and lianas to cultivate fungus, which they then eat. Workers (~10 mm in length) do most of the leaf-cutting and are the most commonly observed caste above ground. Soldiers (up to 20 mm in length) defend the colony and clear debris from foraging trails (Stevens 1983). Minima (~2 mm in length) mainly function in underground colony maintenance, but are also seen along trails and on leaf fragments carried by workers, where they may defend against parasitic wasps (Wetterer 1994).

We hypothesized that the distribution of these castes along the foraging trail would vary according to the colony's need to defend and acquire resources. Specifically, we predicted that the proportion of soldiers would be highest near the nest to protect the queen and young and that soldiers would exist in greater numbers in areas with high concentrations of leaf carrying workers. In addition, we predicted that the proportion of leaf-riding minima would be highest in the middle of the trail where foraging ants are not hidden by the nest or the tree, and thus may be more exposed to parasitic wasps.

Methods

We sampled four foraging trails of four separate *A. colombica* colonies on the afternoon of 4 February 1999 on the Naranjo Trail at Corcovado National Park, Costa Rica. For each foraging trail, we located the nest and the tree being harvested. We measured the distribution of the three castes at three positions along the trail: at the nest, 1.5 m up the trunk of the tree, and halfway between the tree and the nest. At each position we counted the number of ants traveling towards the nest during two 1 min trials and then repeated the measurements, counting the number of ants traveling from the nest. Ants were classified as soldiers, workers, minima, or leaf-riding minima.

Results

We found no significant difference in the relative abundance of castes among the three locations (Fig. 1; Kruskal-Wallis, soldiers: X^2= 0.61, df= 2, P= 0.74; workers: X^2= 0.62, df= 2, P= 0.74; minimas: X^2=0.62, df= 2, P= 0.73; leaf-carrying workers: X^2= 3.04, df= 2, P= 0.22). At all locations, workers made up the highest proportion of ants (mean ± SE; 0.93 ± 0.013) followed by minima (0.047 ± 0.01), then soldiers (0.02 ± 0.005).

We observed a total of 26 leaf-riding minima. Contrary to our expectations, the relative abundance of leaf-riding minima did not differ along the trail (Fig. 1; Kruskal-Wallis, X^2= 0.67, df= 2, P= 0.72), nor did the ratio of leaf-riding minima to leaf-carrying workers differ with position along the trail (mean ratios ± SE; nest: 0.015 ± 0.013, middle: 0.01 ± 0.01, tree: 0.004 ± 0.004; Kruskal-Wallis, X^2= 0.67, df= 2, P= 0.72).

Discussion

The distribution of castes in A. *colombica* colonies in our study did not vary along their foraging trails. This implies that the colony's need to defend resources (by soldiers and

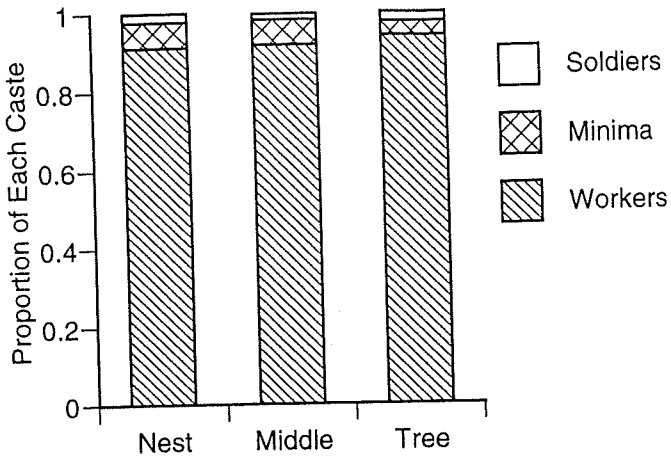

Fig. 1. Proportion of each caste at three positions along the foraging trail. There is no significant difference in the proportions of each caste.

minima) is evenly distributed along the trails. Alternatively, there may be plasticity in the behavior of each class. For example, we observed soldiers clearing trails and carrying leaves, which means that they would patrol the entire length of the trail. Dickinson et al. (1998) also found no difference in the dispersion of soldiers along foraging trails. It is also plausible that there is no mechanism (e.g., caste-specific pheromones) by which *A. colombica* colonies generate single caste aggregations. If this is the case, a constant proportion of castes would be expected along the trail. Minima, however, may be more concentrated in the nest for colony maintenance.

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