

THE ROLES OF SOLDIERS ON LEAF CUTTER ANT FORAGING TRAILS

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Abstract. We observed leaf cutter ant soldiers both carrying leaf fragments and removing obstacles from ant trails in Corcovado National Park, Costa Rica. The proportion of soldiers carrying leaves on a trail did not significantly differ from the proportion of workers carrying leaves. However, a significantly higher proportion of available soldiers helped move an obstruction on the path than did available workers. Contrary to reports in the literature, we believe that leaf cutter ant soldiers do more than just defend the nest. Not only do soldiers aid in collecting leaves, they also appear to be primarily responsible for removing obstacles from the trail. (JVK)

INTRODUCTION (JAR)

Social insect societies are organized in caste systems, in which different groups of individuals perform specific tasks. Leaf-cutter ants (*Atta cephalotes*) have three morphologically distinct castes. Minima workers are primarily concerned with the internal functions of the nest, while media workers usually cut and carry leaves (Stevens 1983). Soldiers, the largest ants in a colony, have been described primarily as guards of the nest, rarely leaving the vicinity of the queen and the brood (Weber 1966).

In personal observations at Corcovado National Park, however, we noted a substantial number of soldiers on the foraging trails, apparently fulfilling some function other than guarding the nest. Although they could be guarding the workers, we propose that the soldiers could also be both carrying leaves to the nest and removing obstructions from the trail.

We hypothesized that the proportion of soldiers carrying leaves on the trails would be less than the proportion of workers carrying leaves, but that the proportion of available soldiers aiding in the removal of trail obstructions would be larger than the proportion of available workers.

METHODS (JAR)

We observed ants on seven different foraging trails (each presumably from a different colony) in the vicinity of the Naranjo Trail at Corcovado National Park, Costa Rica. Ants passing a point on each trail were counted and classified as either workers with leaves, workers without leaves, soldiers with leaves, or soldiers without leaves. Soldiers were distinguished from workers on the basis of size, soldiers being consistently larger than workers. To determine passage rates for each class of ant, ants were counted during three 2min periods per trail, with ~2min between successive periods.

Since different speeds for each class of ant could affect the census, speeds were determined for each class of ant. Fifteen ants of each of the four classes were timed over a 30cm section of trail. Mean speeds were then used to transform the rates into densities (ants/10m) for each class of ant.

Tests for differences in the proportions of soldiers and workers removing trail obstructions were conducted on six of seven trails used in the first part of the experiment. One

trail was not used because at the time of the obstacle testing, the trail was in direct sunlight and ant activity was minimal. Obstacles were constructed out of single pieces of white paper. We blocked 100% of the cleared trail in an attempt to stop the flow of leaves into the nest. Since the sizes of the trails varied, the sizes of the obstructions also varied. New obstructions were used for each sample.

Obstructions were left in place for 10min, or until they were removed, whichever came first. At the end of the observation period, we counted the numbers of soldiers and workers attempting to remove the obstruction. No distinction was made between those ants attempting to cut the obstruction and those attempting to pull it off the trail. During the entire observation period, we counted the number of soldiers and workers without leaves coming into contact with the obstruction from either direction. Ants with leaves were not counted, as previous observations indicated that ants with leaves will not drop them to assist in obstruction removal. Each trail was blocked twice, with a minimum of 30min between trials to allow the trails to return to normal activity.

RESULTS (JJB)

Leaf collection data from each replicate were summed for analysis. By dividing rates for each class (ants/sec) by the average speed of ants (cm/sec) in each of the four categories, we obtained an unbiased estimate of density (ants/cm; Table 1). These values were multiplied by 100 to facilitate use in a chi-square test. Based on these

densities, no significant difference between proportions of workers and soldiers carrying leaves was found ($p > 0.1$; Table 2). However, soldiers were found to be more involved than workers in moving obstacles, relative to the numbers of each caste arriving at each obstacle ($p < 0.005$; Table 3).

Table 1. Calculations of densities of ants from raw data.

	Workers		Soldiers	
	w/ leaves	w/o leaves	w/ leaves	w/o leaves
actual totals	983	576	68	32
ants/sec	.390	.229	.027	.013
speed cm/sec	3.23	2.31	3.41	4.57
ants/cm	.121	.095	.008	.003
ants/cm	121	95	8	3

Table 2. Proportions of each caste involved in leaf collections.

	with leaves	w/o leaves
workers	121*	95*
soldiers	8*	3*

$\chi^2 = 1.54, p > 0.1$

*Numbers represent estimated densities of ants per 10m (from Table 1).

Table 3. Proportions of available ants from each caste involved in obstacle movement

	Did not help	Helped
workers	4,443	23
soldiers	486	39
$\chi^2 = 184.25, p < 0.005$		

DISCUSSION (JJB, JVK, JAR)

Our findings seem to indicate that the role of the soldier caste within leaf cutter ant colonies includes more than protecting the nest and entering the foraging trails at times of disturbance. The lack of a significant difference between the proportion of soldiers and the proportion of workers on

trails that carry leaves showed that soldiers do contribute to leaf collection. While the workers moved more leaves overall because they were more abundant, the soldiers were the dominant ants involved in moving obstacles. These findings suggest that the function of clearing obstructions is assigned primarily to the soldiers.

Perhaps in times of relative safety for the nest, a certain number of soldiers may be allocated to other functions, such as collecting leaves or moving obstacles. The additional help on the foraging trails would increase the productivity of the nest and thus increase fungal growth for food. Further testing by presenting a danger to the nest and measuring changes in soldier behavior or leaf biomass col-

lected could address this idea. Why our findings differ from those of Weber (1966) is not yet clear. It's possible that the nests he observed were already in a state of emergency, either from disturbances created by himself or by other unknown factors.

LITERATURE CITED

- Stevens, G. C. 1983. *Atta cephalotes*. In *Costa Rican Natural History*, ed. D. H. Janzen, 688-91. Chicago: The University of Chicago Press.
- Weber, Neal A. 1966. Fungus-Growing Ants. *Science*. Aug. 5. 587-599. D