TRAIL-CLEARING BEHAVIOR IN *ATTA CEPHALOTES*

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Abstract. Atta cephalotes transport leaf tissue on trails from food sources to their fungal colony. We placed organic material of varying sizes and quality on ant trails to test the response of the ants to the different forage. Ants demonstrated a behavior distinctly different from their leaf carrying behavior in response to leaves placed on the trail. Ants frequently moved introduced leaves off the trail, but were never observed dropping leaves cut from trees. Unlike leaves, introduced flowers were always carried down the trail toward the colony. This trail clearing behavior was exhibited at all levels of trail traffic. Our results suggest that trail clearing is an adaptive response to decrease traveling time, and not simply the continuation of standard foraging behavior on trails.

Key Words: Atta cephalotes, *insect behavior, trail clearing,*

INTRODUCTION

Atta cephalotes (leaf-cutter ants) work together as a colony, travel in groups to potential food sources, and then bring back forage along organized trails to the central colony. These leaves are then fed to fungus that is grown as food for the colony. Leaf-carrying behavior, defined as ants returning with their forage along trails back to the central colony, differs from trail clearing behavior in which debris is removed from the trail. Previous studies have demonstrated that ants are able to travel with cut leaves at a faster rate across well-cleared trails (Beadell et al., 1996). We hypothesized that if clearing trails of debris increases foraging efficiency, then ants would have a trail clearing behavior that is distinct from their leaf carrying behavior. For trail clearing to be most efficient, we predicted that ants would dispose of the dead material lateral to the trail, and carry any live plant tissue back to the colony. Due to the initial cost of trail clearing we expected ants to only display this behavior when the benefit outweighs the cost. For a trail of given length, the benefits of a cleared trail increase with the amount of ant traffic, but the costs of clearing are essentially fixed. Therefore, we predicted that ants would only clear trails when they reached a certain traffic density and would not remove introduced leaves on uncleared trails.

METHODS

To determine how *A. cephalotes* clears trails, we performed three experiments near Sirena Station in Corcovado National Park, Costa Rica, on 31 January 1996. First, we placed flower parts, live leaves and dead leaves on 12 leaf-cutter trails, and monitored displacement and final location of the introduced objects. In order to simulate the range of debris which might fall on an ant trail, we used three size classes of leaves: 0.25-0.5 cm2, 4 cm2, and 25 cm2. To determine whether trail-clearing and leaf-cutting behaviors differ, we compared the percentage of ant-cut leaves dropped within a 1.5 m section of trail with the percentage of experimentally-introduced objects dropped in the same distance.

To examine whether clearing behavior varied between cleared and uncleared trails, we placed three dead leaves of 0.5 cm^2 on four of each type of trail, and measured the time required for the ants to move the leaves. We measured ant flow rates for each trail in order to calculate the probability that an individual ant would clear an introduced leaf. Ant traffic and behavior on cleared and uncleared trails were compared with a T-test or a non-parametric Mann-Whitney U test. All other results were analyzed with X^2 tests (or G tests if requirements for a X^2 were not satisfied).

RESULTS

Ants responded differently to different types of debris placed in their path (Fig. 1). They were most likely to move flowers placed in their trails, followed by introduced live leaf fragments and then introduced dead fragments (X^2 = 8.81, df = 2, P < 0.025). Of material they picked up, they carried 100% of flowers toward the colony, but only 37% of live leaves and

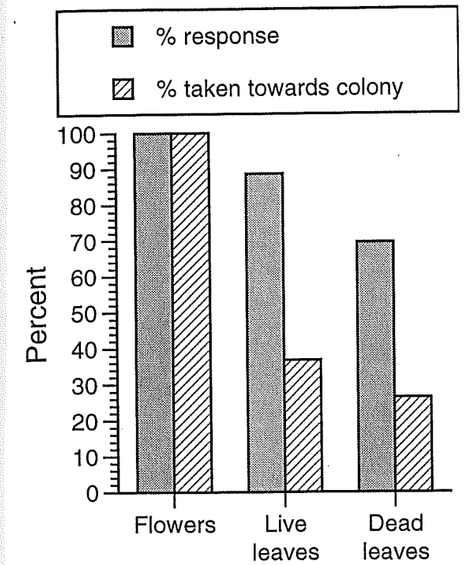

Fig. 1. Leaf-cutter response to foreign material placed in cleared trails at Corcovado National Park, Costa Rica. Any movement of material by ants was scored as a response. Material carried further than 2 m toward the nest by ants was scored as taken to the ant colony.

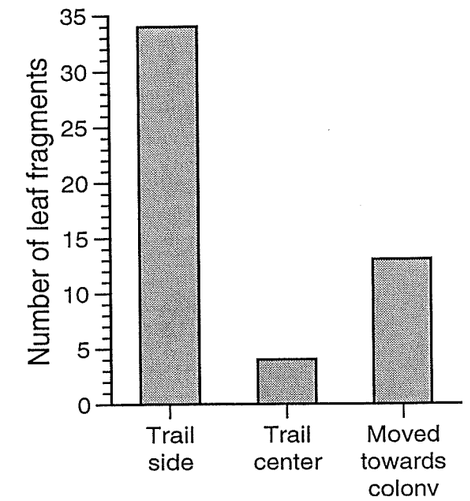

Fig. 2. Final location of 51 leaves <4 cm2 initially placed in the center of leaf-cutter trails at Corcovado National Park, Costa Rica.

41% of dead leaves (Fig. 1; X^2 = 14.85, df = 2, P < 0.005).

When ants moved introduced leaves, they were more likely to move them to the side of the trail than to take them back toward the colony or leave them in the trail (Fig. 2; X^2 = 14.25, df = 1, P < 0.01). Ants were far more likely to drop material they picked up on the trail than material they had cut from a tree (40% of 110 items vs. 0% of 30 items; X^2 = 27.74, df = 1, P < 0.005).

Cleared trails had four times as much traffic as uncleared trails (mean ± SE = 1.5 ± 0.15 vs. 0.43 ± 0.35 ants • s^{-1}; t (unpooled) = 5.74, df = 4.03, P = 0.002). Individual ants on cleared and uncleared trails were equally likely to move introduced leaves (mean ± SE = 0.0033 ± 0.0013 vs. 0.0031 ± 0.0019 leaves moved • ant^{-1}; Mann-Whitney U = 7, P = 0.77).

DISCUSSION

Atta cephalotes cleared trails by moving debris laterally; this was distinctly different from their foraging behavior in which they returned to the colony with cut leaves. In addition, ants selectively collected certain items left on the trail and brought them back to the colony. This selective collection allowed them to efficiently combine foraging and trail clearing. The distinct clearing behavior supports the idea that trail clearing is not merely a byproduct of foraging and other leaf-cutting behaviors. However, trail-clearing behavior did not differ between cleared and uncleared trails; this suggests that clearing behavior is not related to specific foraging strategies. Beadell et. al. (in press) showed that leaf-cutter ants travel faster over cleared trails. Thus, trail-clearing behavior may be an adapative mechanism. By clearing trails, ants are decreasing their travel costs and, as a result, increasing their foraging benefits.

Flowers on the trail were selectively taken to the colony; this suggests that trail clearing also provides additional forage sources. Because the ants tend to forage on live plants, the trail would be a possible source of dead organic matter. Dead leaves and flower parts have different primary and secondary chemistry than live leaves and may be a means for the ants to meet the shifting nutritional needs of their fungal gardens. We observed ants on different paths carrying different percentages of flower parts and live and dead leaves. Further study could look into whether different paths to the same colony have different plant tissue collection responsibilities, and whether ants clear trails as a means of collecting materials, such as dead leaves, that they might not

obtain otherwise.

LITERATURE CITED

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