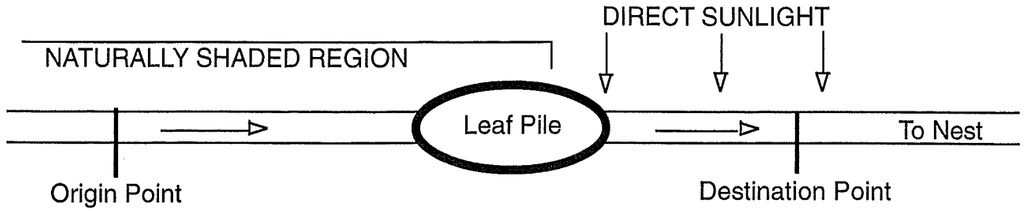


Fig. 1. Schematic of *A. columbica* path with leaf pile. Origin and destination haphazardly selected in a naturally shaded area and in a sunlit area, respectively. Experimental shade was introduced over the leaf pile in the sunlit portion of the path.

resumed their transport of leaves toward the nest. We also observed that ants dropped the fragments almost immediately upon leaving the experimentally shaded area of the path, and returned back along the shaded trail.

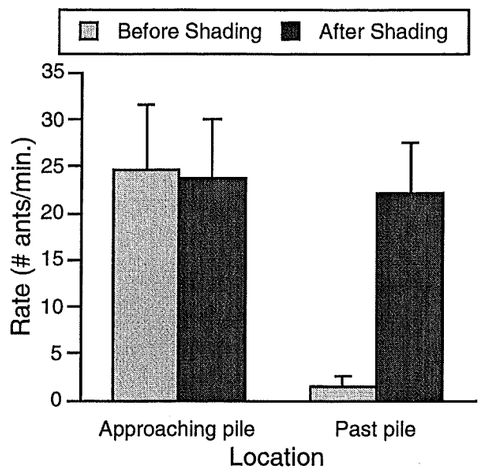


Fig. 2. Number of leaf-carrying ants crossing lines approaching and past leaf piles (heading towards the nest) before and after the experimental introduction of shade across the path (mean ± 1 SE). The path approaching the pile was naturally shaded and the path past the pile was naturally in full sun.

## Discussion

Leaf-cutter ants ceased carrying leaf fragments and formed leaf piles upon moving from shaded areas to areas of high sun exposure, and resumed carrying fragments past the piles when shade was introduced over the paths (Fig. 2). These results suggest that sunlight and/or temperature has a direct effect on the tendency of these ants to carry leaf fragments. We suggest temperature may be the more important factor, as it undoubtedly increases with sun exposure and time of day (Cover et al. 1997) and probably results in increased physical stress on the ants. We propose that it is more energy-efficient or perhaps physically necessary for the ants to stockpile the leaves, and carry them further only when the path is shaded and cooler.

To more accurately determine the stimuli for the stockpiling behavior, further studies might separate the effects of light and temperature, or investigate whether preexisting plant fragments on a trail will cue the ants passing that point to drop their fragments at that site. Further study might also investigate whether ceasing travel across sunny paths affects the overall efficiency of the ants.

## Literature Cited

Cover, W. A., P. T. X. Hang, K. R. Kroenlein, and A. C. Tolonen. 1997. Effects of temperature and light on the distribution of leaf piles in leaf-cutting ant trails. Pp. 73-74 *in* J. R. Shandro and G. S. Chen, editors. Dartmouth Studies in Tropical Ecology 1997. Dartmouth College, Hanover, New Hampshire, USA.

Stevens, G. C. 1983. *Atta cephalotes* (Zompopas, Leaf-cutting Ants). Pp. 688-691 *in* D. H. Janzen, editor. Costa Rican Natural History. The University of Chicago Press, Chicago, IL, USA.





# Effects of Tree Size and Distance from Nest on *Atta colombica* Harvesting Activity

Daniel M. Braden, P. Bjorn Erickson, Ryan M. Owens, and Dominic Stanculescu

*Abstract:* Why leaf-cutter ants, *Atta colombica*, travel long distances from their nests to forage for leaves is unknown. We hypothesized that *A. colombica* foraging activity would be greatest on trees of intermediate size and distance from the ant nest, in order to maximize harvest per unit time and energy while preserving leaf cover close to the nest. We found a broad range of ant foraging activity, tree size and distance, yet found no non-random pattern of ant effort allocation over these ranges. Further study should sample more colonies as well as more variables, such as tree species and trail age, in determining the harvesting effort of *A. colombica*.

*Key Words: leaf-cutter ants, optimal foraging, tree preference*

## Introduction

Leaf-cutter ants, *Atta colombica*, harvest leaves, flowers, and seeds from rainforest trees and use them to cultivate edible fungal gardens in their nests. We observed variation in the number of *A. colombica* ants harvesting leaves from trees of varying sizes at varying distances from their nests, yet it did not seem that ants were harvesting extensively in trees in the immediate vicinity of the nests. We hypothesized that ant activity on a given tree depends on the tree's size and its distance from the nest. Although harvesting in trees near the nest may conserve time and energy through shorter travel distances, it may also result in a local depletion of resources. Alternatively, harvesting in very distant trees may carry time and energy costs greater than the benefits provided by the leaves. Similarly, smaller trees may require less time and energy to climb to leaf height, but may not provide a large leaf harvest. Large trees, however, may provide ample leaf harvest, but take more time and energy to climb. We therefore predicted that *A. colombica* ant colonies would invest the greatest harvesting effort in trees of intermediate sizes and at intermediate distances from the nest.

## Methods

We sampled the active trails of three *A. colombica* colonies in primary growth forest along the Senderos Rio Claro and Espavales at Sirena Biological Station, Corcovado National Park, Costa Rica, on 1 February 2001. Two colonies had five main trails, and one colony had three, for a total of 13 trails. For each trail, we measured the DBH (Diameter at Breast Height) of the tree to which it lead, the distance of that tree from the colony's nest, and took five counts of the number of ants passing down the tree within a 1 min time interval. We took the mean of these five counts as an indicator of harvesting activity (i.e. effort) for each tree. We log-transformed the activity level to normalize the data. We found no significant effect of trail length or DBH on ant activity within each nest, and therefore plotted ant activity as a function of tree size and distance over all 13 trees, regardless of nest. To compare colony harvesting effort between the two colonies with five active trails each, we performed ANOVAs comparing ant activity versus trail length and tree size.

## Results

We found large variation in ant foraging activity, DBH, and trail length. Amongst the 13 trees sampled ant activity ranged from 3.2 ants/min to 57.6 ants/min. DBH of trees being harvested ranged from 18 to 75 cm, and

trail lengths ranged from 0.4 to 63.4 m. Ant activity for these 13 trees, however, did not vary significantly with either trail length ($r^2$ = -0.013, df = 1,11, P = 0.377) or DBH ($r^2$ = -0.021, df = 1,11, P = 0.406).

Comparing the two colonies with five trails each, average trail length to trees was over twice as great for one as for the other (mean ± 1 SE: 1665 ± 170.0 vs. 4516 ± 353.2; ANOVA, F = 8.82, df = 1, 8, P = 0.018), yet there was no significant difference in average ant activity between these two colonies (ANOVA, F = 0.91, df = 1, 8, P = 0.368).

## Discussion

*Atta colombica* ants seem to invest similar effort in harvesting trees regardless of their size and distance from the nest. This indicates that other factors, such as tree species, leaf accessibility and nutritional quality, time since harvesting began at a tree (newly discovered trees may have less activity than more established routes) and tree distribution in relation to ant nests, may be more important than simply size and distance in determining ant foraging activity. Our limited number of replicates may account for the lack of measurable patterns and therefore we cannot exclude distance and DBH of trees as possible factors influencing levels of ant activity. Furthermore, our measure of ant activity (# ants/min) may not be an accurate indicator of harvesting effort, i.e., if the number of ants going up and down the tree varies throughout the day. In addition to sampling more colonies and trees, further study could examine other factors that may influence the amount of effort (time and energy) placed into harvesting by *A. colombica*.