Table 2 Frequency of selected plant community attributes in mesic and dry areas.

Trees (thin/med/thick)	Mean Surface Area (cm^2)	Morph-ology (simple/ compound)	Shape narrow to wide	Ventitures Presence with/w/o	Cuticle Thickness
Xeric	29.9	10/3	1/9/2/1	8/5	3/7/4
Mesic	163.0	4/7	2/4/5/0	2/9	2/4/4
Shrubs					
Xeric	43.1	16/1	9/4/4	4/14	5/12/0
Mesic	35.3	6/0	0/5/1	1/5	2/3/1

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Janzen, D.H. Costa Rican Natural History, p. 127-129. Univ. of Chicago Press, Chicago, 1983.

VARIATION IN ACTIVITY OF LEAF CUTTER ANTS (ATTA CEPHALOTES)

Jon Kohl, Christy Goodale, Dan Gavin, Ann Schrot, and Greg York

Abstract (G.Y.)

We measured rate of removal of leaf fragment per unit time by Atta Cephalotes and its relationship to light intensity and canopy air temperature from 0800 to 1230. Foraging activity increased with increasing temperature and with increasing light intensity. Because light intensity increased with ambient air temperature, foraging activity was not necessarily influenced directly by both.

Introduction (A.S.)

The ant species Atta cephalotes cuts pieces of vegetation which are transported back to their subterranean nests. The ants grow fungus on the fragments as a food source. The ants forage together using well maintained trails leading from their nests to the vegetation.

We observed that activity on the trails varied throughout the day. We hypothesized that later in the day, with increased temperature and light intensity, the ant activity would also increase.

Since ants are ectothermic, the ambient temperature would be expected to influence ant activity levels. At very high or low temperatures the ants would be much less efficient in their energy use due to respiration costs. The ants therefore must adjust their schedule of activities to ambient temperature to maximize efficiency. We found, as expected, that temperature was related to time of day and light intensity. We collected data only in the morning, and therefore examined only the effect of rising and relatively low temperatures.

Method (C.G.)

This study was designed to be run over a full daily cycle. Due to time limitations, we were restricted to observing only between 0800 and 1230. Sunrise on the day of the experiment, Jan. 21, 1991 was approximately 0645, and the sky remained mostly cloud-free.

We studied the media ants' leaf-cutting activity on nine trees within 100 meters of the Rio Claro Trail at Corcovado National Park, Costa Rica. All activity observed occurred on second-growth canopy trees. We counted the number of ants carrying leaves that passed a fixed point during five-minute trials. Trials were repeated every hour on the same trees. The data for the nine trees were pooled for analysis.

We recorded hourly both the light and temperature in the sun in an open field approx. 1m above the ground vegetation in an effort to estimate these values for the canopy, since we expected leaf-cutting to occur in the canopy.

Results (J.K.)

The number of leaf fragments returning to the nest increased with temperature from 0800 to 12:30 (Figure 1: $r^2 = 0.32$, $n = 45$, $p < 0.01$). The number of leaf fragments returning to the nest also increased with light intensity from 0800 to 12:30 (Figure 2: $r^2 = 0.27$, $n = 45$, $p < 0.01$). Finally, the number of leaf fragments returning to the nest increased with time from 0800 to 12:30 (Figure 3: $r^2 = 0.29$, $n = 45$, $p < 0.01$).

Discussion (D.G.)

Approximately 30 percent of the variation in A. cephalotes leaf-cutting activity was accounted for by either time of day, light intensity, and temperature. Causes for activity differences between trees are variations in the distance from the nest to the tree, and/or differences in tree species preferences. Past studies have detailed leaf preference of the ants and leaf defense mechanisms (Howard, 1988). Because certain individual trees are exploited more than others, then a certain amount of variation in leaf cutting activity between trees is expected.

Because the independent variables of light intensity, time of day, and temperature are themselves highly correlated we can only speculate which, if any, is the influencing factor on leaf cutting activity. Testing for one independent variable, while controlling the others, might identify the causal factor. However, the large vertical and horizontal range of the colony subject it to variables that are difficult to control in the field. We cannot conclude whether the level of leaf cutting is a physiological response to temperature, a response to light, a response only dependent on circadian rhythms, or a response to other factors such as humidity or photosynthate concentration in leaves. However, because ants are ectothermic, and temperature increased from 24 to 34°C on a four-hour period, and media leaf cutting activity measured over the same period temperature changes are likely to be important for the ants. Unfortunately, we could not monitor leaf cutting activity for an entire 24-hour period, but we did observe that A. cephalotes continues herbivore activity until midnight and discontinues sometime in the cooler morning hours. Because the subterranean nest is at a relatively stable temperature and the canopy conditions vary widely, it is logical that the ants prefer the nest during times of day when canopy temperatures are physiologically suboptimal.

There may be a minimum temperature that triggers A. cephalotes to start leaf cutting or there may be a continuum of temperatures in which leaf cutting activity increases. The trends we found are not proof of a cause and effect relationship. However, the results do reveal that certain times of the day are more favorable for leaf cutting activity, and that their foraging time is limited by physical conditions.

Figure 1 Effect of temperature change on leaf cutter ants, as observed 0800-1230 on January 21, 1991, Corcovado, Costa Rica.

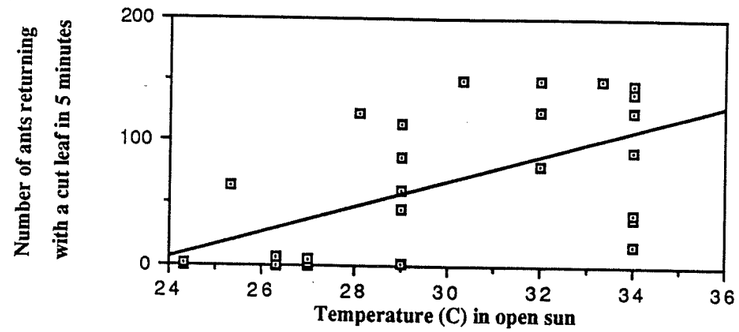


Figure 2 Effect of light intensity on leaf cutter ant leaf cutting activity, as observed 0800-1230 on January 21, 1991, Cocovado, Costa Rica.

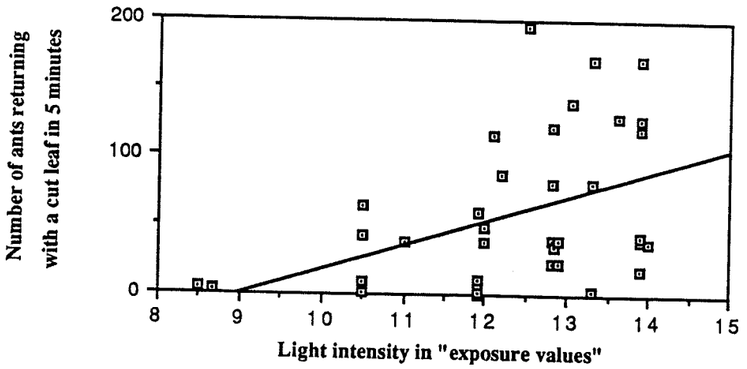
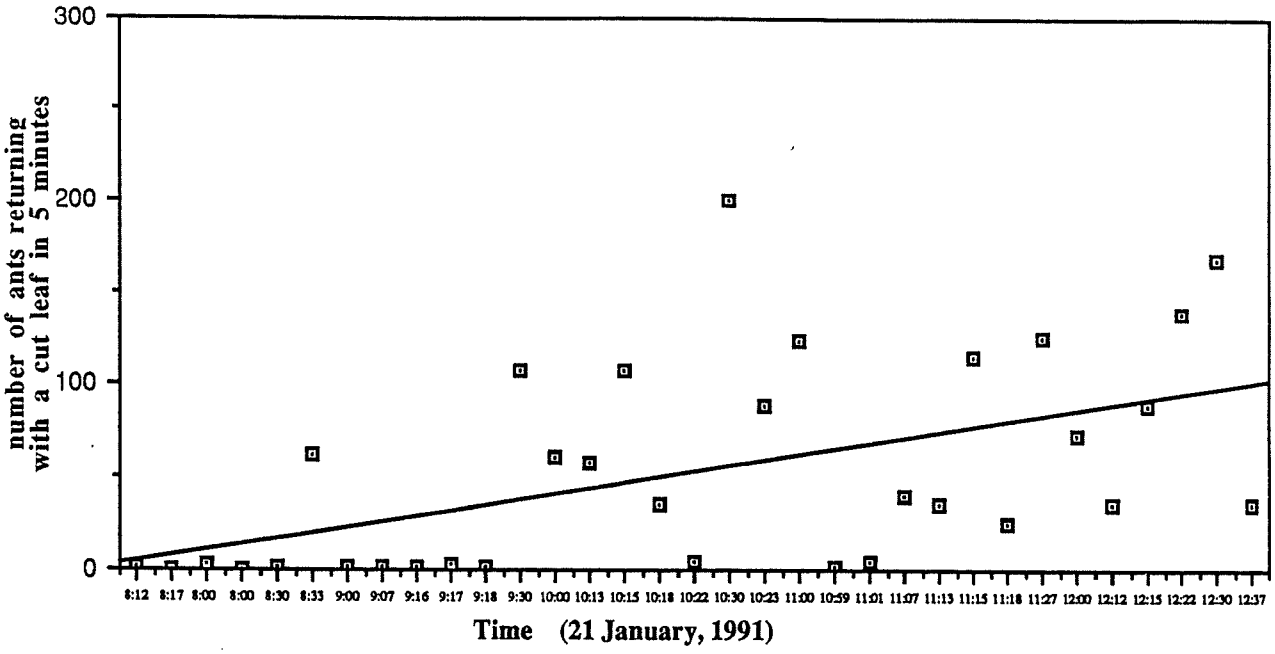


Figure 3 Effect of time of day on leaf cutter ant leaf cutting activity, as observed 0800-1230 on Janurary 21, 1991, Covcovado, Costa Rica.



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Howard, J.J. 1988. Leafcutting ant diet selection relative influence of leaf chemistry and physical features. Ecology 69: 250-260.