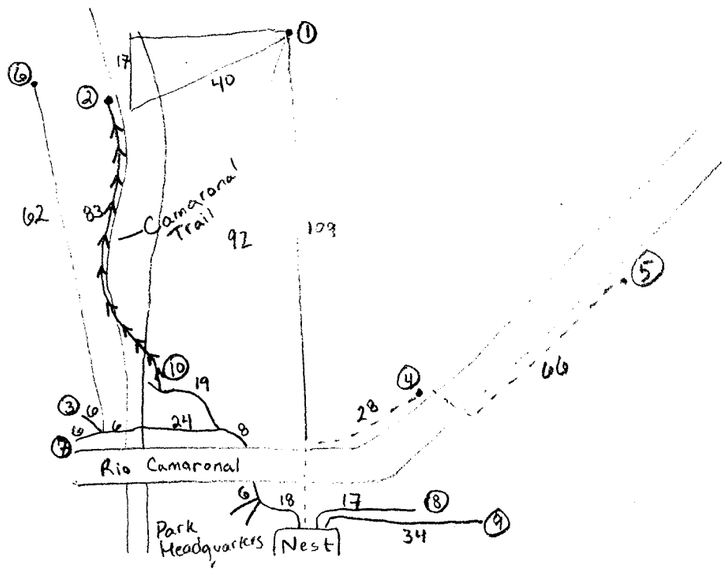
Table 1: Distances of harvested and non-harvested trees from nest.

Tree	Balsa/Non-balsa	Dist. from Nest	Occupied?
1	B	72	No
2	B	81	Yes
3	B	40	Yes
4	B	13	No
5	B	66	Yes
6	NB	54	Yes
7	NB	32	Yes
8	NB	11	Yes
9	NB	22	Yes
10	NB	38	Yes

Figure 1: Map of sampled area.



Literature Cited

Rockwood, L.L. and Hubbell, S.P.; 1987. Host-plant selection, diet diversity, and optimal foraging in a tropical leaf-cutting ant; Oecologia.

DETECTION OF SENSORY CUES LEFT ON LEAF SEGMENTS SELECTED BY ATTA CEPHALOTES

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Abstract (T.G.)

This study showed that leaf-cutting ants (Atta cephalotes) recognized and retrieved leaf segments already selected by nestmates more quickly than comparable segments untouched by nestmates. We concluded that there was some sensory cue left on the previously selected leaf segment which helped the ants to more quickly recognize this piece as acceptable. As the ants withdraw from the tree daily, and often abandon leaf segments in the trail, such a recognition mechanism would make them more efficient foragers since they would not have to waste time searching for acceptable leaves or leaf segments again.

Introduction (T.G.)

Leaf-cutter ants are eusocial insects that nest underground in many parts of the tropics. They clear trails through grass and forest understory litter leading to various source trees. Ants of all three castes in a colony (minima, media and maxima) travel to these source trees, cut off pieces of leaves, and return to the nest with these pieces. They then grow a particular fungi on these leaf pieces as the sole source of food for their larvae (Janzen, 1983). However, ants often abandon source trees and leaf segments which they have already identified as a proper resource and begun processing. Ants withdraw to the nest for several hours each day between early and late morning. Also, ants heading back to the colony with leaf pieces will occasionally abandon them in the trail for reasons unknown to us. The ants would be more efficient foragers if they would quickly recognize suitable leaves in the source trees and abandoned leaf pieces already selected by their nestmates as acceptable to bring back to the nest. Through such a recognition mechanism, they would expend less energy in search time the following day. We predicted that they could identify a previously selected leaf by sensory cues left on the leaf by nestmates which accepted, chewed and carried the leaf already. Therefore, our hypothesis stated that ants would recognize and retrieve leaf segments already selected by nestmates more quickly than comparable segments untouched by nestmates.

Methods (A.M.)

Two separate leaf-cutter ant colonies were studied in Corcovado National Park, Costa Rica. One was located at the North end of the open field in front of the Sirena Station

administration building and the other was located behind the administration building. Our studies were done between 1000 and 1400 on a hot sunny day when the ant colonies were active. For each colony, a distinct path was found where ants could be seen coming and going from a specific source. For each trial a piece of leaf being carried by a media ant was removed from the tree with a pair of tweezers. The ant that was carrying the leaf was then blown off the leaf. After collecting an ant-cut leaf piece, a piece of leaf, of similar size and shape was cut with scissors from whole leaves that had been collected from the same source tree. The human-cut leaves were handled with separate tweezers and were also blow upon to control any effect human breath may have on the nature of the leaf segment. Once both segments were ready, they were placed approximately 1.0cm apart on the center of the active ant path. For every trial we alternated which side of the path the leaf segments were placed on. Timing began when the segments were placed on the path. When an ant came, picked up the segment, and carried it 12cm in the direction of the nest, it was counted as a retrieval and the time was noted. Twenty trials were performed for each ant colony and tree. In a few trials, leaf segments were picked up by an ant and deposited on the side of the path. In such cases the trial was counted as a rejection and was not included in analysis. If a trial went over three minutes the trial was ended. Successive trials were performed at the same location on the ant path and approximately five minutes apart; thereby allowing enough time for path flow to return to the pretrial level. Results were analyzed with Wilcoxon Statistical tests.

Results (L.T.)

Our hypothesis was that there would be less time required for the leaf cutter ants to pick up and carry off leaves cut by a nestmate than time required for them to pick up the leaves cut by us. We used a Wilcoxon paired test on the data from each colony separately and found a significant difference in these times for each colony (Colony I: $T = 225.5$, $p < 0.05$; Colony II: $T = 157$, $p < 0.05$). As can be seen on Table I, the means show that the ants were faster at locating and picking up leaves cut by nest mates.

Discussion (T.Y., E.G.)

We conclude that there is a recognition mechanism used by leaf-cutter ants to identify leaves previously selected and cut by another nestmate. This mechanism allows ants to pick up and move ant-cut fragments more quickly than fragments of comparable size not previously encountered by nestmates. It is likely that this same sensory cue enables ants to more quickly recognize partially harvested leaves still on trees.

This recognition capability could confer significant advantage to those colonies which possess it. Acceptance times for abandoned leaf fragments previously accepted by a former nest

mate were shorter than acceptance times for human-cut leaves on which the first ever assessments of leaves were being done. Through reducing repetitive energy expenditure by avoiding lengthy assessments of previously accepted leaves, ants improve their foraging efficiency. Because ants frequently abandon leaf fragments and partially harvested leaves, due to daily foraging patterns not fully understood, these recognition events occur frequently. By increasing foraging efficiency in a frequently encountered situation, this recognition cue may likely increase the fitness of those colonies which possess it.

Our results show that more than one colony possesses a similar mechanism of leaf recognition. Though our sample size was small (2 colonies) we believe that the presence of such a sensory cue indicating previous leaf acceptance is a trait characteristic of this species. We attempted to identify the specific nature of the recognition mechanism. Two possible sensory related factors considered were chemical recognition of saliva deposited during the original cut, and visual recognition from serrations along the cut. Our experimental design was not effective enough to carry out a full experiment but a few trends were demonstrated.

To test if the leaf preference was due to chemosensory cues from saliva, we performed procedures almost identical to our primary experiment. But, we washed both leaf fragments in tap water, then dried them before placing them on the trail. We performed five trials. Instead of carting all leaf fragments back towards the colony, eight of the ten pieces were deposited just off the trail edge and left there. Unwashed leaves cut by ants and humans continued to be taken to the colony. We interpreted these results as an indication that the water was leaving a residue on the leaves, or removed a natural coating, which made the leaves undesirable.

We condensed some water on the outside of a cold glass of water to get relatively pure water. We washed some more leaf fragments in this water. All leaves were carried back to the colony. We suspect that if we had ample amounts of distilled water, we could successfully run the experiment on relative importance of salivary and serration cues.

One aspect of the recognition mechanism which would be an appropriate subject for a follow up study is the following. More ants attempted to remove out-cut fragments than human cut. This struggle over the ant-cut fragments slowed the removal of them. How effectively ants can recognize acceptable leaves due to a sensory cue might better be measured by recording time to initial acceptance of the fragment as worth removing, rather than time to actual removal.

Table 1: The time taken for Atta cephalotes to carry the two leaf treatments from the study site. (Corcovado, Costa Rica)

	Colony I		Colony II	
Trial #	Leaves cut by ants	Leaves Cut by humans	Leaves Cut by ants	Leaves Cut by humans
1	7	40	22	27
2	72	81	50	45
3	42	77	40	30
4	29	92	35	23
5	45	100	80	70
6	27	49	41	150
7	14	34	20	19
8	14	54	11	25
9	16	110	18	60
10	25	128	27	75
11	21	28	18	20
12	68	30	60	75
13	67	137	17	110
14	27	132	26	15
15	18	57	20	23
16	23	20	60	160
17	42	23	45	57
18	15	30	165	70
19	33	40	20	138
20	80	30	25	40
Means	34.25	67.10	40.00	61.60