RESPONSE OF *PSEUDOMYRMEX NIGROCINCTA* TO A FOREIGN FOOD SOURCE

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Abstract. The ant species *Pseudomyrmex nigrocincta* has a mutualistic relationship with the acacia tree *Acacia collinsii*, in which the acacia tree provides the ant nutrition and a habitat in return for protection. *P. nigrocincta* may place feeding necessities above acacia defense in some cases. We examined whether *P. nigrocincta* will accept a foreign object, a sugared sponge, as a food source. These food sources were placed on the five acacia trees and ant activity level and response were measured. No significant differences were found between the number of ants arriving at the foreign object with food versus the foreign object without food. Neither were there significant differences between the time spent on each foreign body. However, the ants acted markedly different with respect to these two foreign objects, responding aggressively toward the control and feeding on the artificial food source. It is possible that the presence of a nutritional reward on the foreign body will initiate a shift in ant behavior from aggression to feeding.

Key Words: acacia-ant, ant-acacia, foreign food source

INTRODUCTION

A mutualistic association between ant colonies and the acacia tree, *Acacia collinsii*, is found in the Pacific coastal lowlands of Costa Rica. *A. collinsii* provides the ants with a habitat and food. The acacias provide protein sources and nectaries as an energy source. *Pseudomyrmex nigrocincta*, one of the ant species that inhabits ant-acacias, protects the host acacia from herbivory and kills competitive vegetation that touches the tree or grows around the base of the tree (Janzen 1983).

To test this aggressive defense response, we presented *P. nigrocincta* colonies on five ant-acacias with a foreign body containing an alternate food source. We questioned whether the ants would compromise their standard aggressive behavior and forego a defensive attack to exploit a windfall food source. We predicted that when confronted with a foreign body that offers a food reward, the ants will accept the food source and exhibit feeding behavior rather than aggression.

METHODS

Our experiments were performed on five acacia trees inhabited by *P. nigrocincta*. These five trees were of similar foliage content in addition to having observable ant activity.

Cylindrical foam plugs (2 cm X 1 cm) were soaked with sugar water. The controls contained no sugar solution. A small incision was made in the sponge and glue was applied so that the sponge could be straddled securely over the branch.

Both the sugared sponges and the control sponges were placed at the same time on paired branches on the same tree at approximately the same distance from the main stem. The branches were of similar length, diameter, and height from the ground.

We defined ant activity level as the number of times the ants crossed a pre-determined point on the branch. This point was approximately 3 cm from the sponge, toward the center of the tree. Crosses from each direction were counted, including multiple crosses by any one ant. Observations on activity level started 2 min. before introduction of the sponges in order to gauge normal activity levels, and continued 7 min. after sponge introduction. The total time spent on the sponges was also recorded during the 7 min. period by recording the times at which ants moved on and off the sponge and summing those times.

During subsequent observations we recorded the total number of ants on each sponge and categorized incidences of feeding or aggressive behavior. We defined feeding as one, all, or any combination of the following: low leg movement, lack of intense mandibular action, a straight gaster, and generally low activity levels. We defined aggressive behavior as: pulling action; separation of fibers of the sponge; curling and thrusting of the gaster at the sponge; and/or a quicker, more constant activity level. Feeding and aggressive behavior were considered mutually exclusive.

RESULTS

ants approaching the sugared and non sugared sponges (paired t-test, df=5, P = 0.91). Also, there was no significant difference between "ant time" spent upon the sugared and non sugared sponges (paired t-test, df=4, P= 0.84).

Due to time constraints we made post-trial observations of only two of the five trees treated. We observed significantly more feeding behavior upon the sugared sponge, and was exclusively aggressive behavior directed towards the non-sugared sponge (Table 1). These differences in ant behavioral response to sugared vs. non sugared sponges were significantly different (G test, G=13.917, df=17, P=0.0002).

Opportunistic observations during the trial revealed that in addition to those feeding directly on the sugared sponges, there were a total of 45 ants feeding upon sugar solution spilled upon the branches in the vicinity of the foreign bodies.

Table 1: Post-trial observations of the total number of ants exhibiting either feeding or aggressive behavior on the sugared and non-sugared sponges. Data from both trees are combined.

Behavior	sugar	non-sugar
feeding	10	0
aggressive	2	10

Discussion

Ants clearly fed on the sugar treatment and exhibited aggressive behavior towards the foreign object with no sugar treatment. These observations support our hypothesis that ant aggressive behavior will change to feeding behavior when confronted with a foreign body that also supplies food. In spite of these qualitative differences in ant behavior between the sugar and non sugar treatments, the activity level of the ants and the time ants spent on the foreign bodies did not differ between the two treatments. This is probably because the initial disturbance of placing the objects may have been interpreted by the ants as identical, and thus they recruited equally in the two treatments. The similar time ants spent on the two foreign bodies may be explained by noting that this estimate only measured time on the foreign body, not ant behavior on the foreign body. In fact, as stated earlier, ant behavior differed greatly on the two treated sponges. The observation that ants fed on spilled sugar water near the foreign body also lends support to the hypothesis that ants will exploit a food source, even when associated with a foreign body.

The accepted theory of acacia ant behavioral patterns is that the ants will attack any object disturbing the host tree. (Janzen 1983) The observed behavioral shift from aggression to feeding contradicts this notion, suggesting that the ants' number of aggressive responses to a disturbance is not absolute. Our results therefore indicate that ant behavior is not rigid in the defense of the host acacia tree. Evolutionarily, this behavioral plasticity would have allowed the ants to feed not only on the tree nectaries, but additional food sources. It may be that the lack of absolute aggression by the ants allows, for example, for the presence of Streak-backed Oriole (*Icterus pustulatus*) and Rufous-naped Wren (*Campylorhyncus rufinucha*) nests in the host acacia tree. The means by which these birds avoid eliciting aggressive defense from the ants, however, remains unknown (Hang et al., 1997).

In interpreting the results, it is important to note that one of the tested non-sugar branches may have been effectively larger and thus contained more ants than the comparative sugared branch. In this case, the branch with the non-sugar sponge was in contact with a nearby branch, increasing the effective size of the branch and possibly confounding the data. If this non-sugar branch was larger and contained more ants than the sugared branch to which it was compared, the ant activity levels would be artificially higher on the non-sugar branch.

In the future, it would be useful to examine ant behavior during the experiments. We observed that initial ant behavior on the sugar-containing sponge was aggressive but seemed to shift to feeding over time, suggesting a temporal shift in behavior. This may be important in understanding ant responses because it could demonstrate a shift in ant behavior due to a disturbance which offers the ants a nutritional benefit.

Literature Cited

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