AGGRESSIVE BEHAVIOR OF TWO ACACIA ANT SPECIES IN RESPONSE TO SIMULATED CATTLE BROWSING

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Abstract: Near Palo Verde National Park, Costa Rica, *Acacia collinsii* trees occur in pastures where they are browsed by cattle. We focused on two ant species, *Pseudomyrmex spinicola* and *P. flavicornis,* which occur on *A. collinsii*. Protection of their host trees should influence the population dynamics of these obligate mutualists. We tested the null hypothesis that both *Pseudomyrmex* species would defend the tree equally by reacting similarly to simulated cattle browsing. Both ant species responded with similar aggression. The number of attacking *P. flavicornis* increased significantly during the course of morning experiment.

Key Words: Acacia collinsii, *defense, mutualism,* Pseudomyrmex flavicornis, Pseudomyrmex spinicola

INTRODUCTION

Acacia collinsii participates in a mutualism with several ant species in which the tree provides shelter and resources for the ant colony in exchange for protection from herbivory. Our study site, a pasture southeast of the field station in Palo Verde National Park in Costa Rica is dominated by *A. collinsii*, which are heavily browsed by cattle. Two common ants occupying *A. collinsii* are *Pseudomyrmex spinicola* and *Pseudomyrmex flavicornis*. As obligate mutualists, their population dynamics should be influenced by differences in their defense of their host. We compared the defense behavior of the two ant species in response to simulated cattle browsing. We tested the hypothesis that the two *Pseudomyrmex* species would defend the tree equally and therefore react similarly to simulated cattle browsing.

METHODS

We used a matched-pair design to compare the response of *P. flavicornis* and *P. spinicola* to cattle browsing. We chose ten *A. collinsii* trees occupied by *P. flavicornis* and paired each with a nearby *A. collinsii* occupied by *P. spinicola.* Pairs were chosen based on proximity (within 10 m), height (within 1 m), number of branches, and foliar condition (by visual assessment). We did this to control for potential differences in ant aggression due to these variables. Trees in very poor foliar condition were not used.

On 10 January 2005 we gathered data at a pasture 6 km SE of the Palo Verde research station, beginning at ca. 0930. We spent ca. 10 minutes at each tree pair and finished at ca. 1130. We observed that temperature increased during this time, while cloud cover decreased.

We mimicked cattle browsing on

each tree and recorded the ants' response. Cows browse by wrapping their tongues around foliage, closing their mouths over the leaf, and pulling (Lyons 2000). To simulate the inside of a cow's mouth we used a leather glove, conditioned with human saliva upon arrival at each tree. We browsed the leaves that appeared most healthy, just as a cow might. Our simulated cow browsed each tree for three minutes, pulling off a leaf every fifteen seconds. At every one-minute interval during browsing we counted the number of ants stinging the cow (the sleeve of the person removing leaves), and the number of ants on the cow that were not stinging. We also recorded the number of ants removed from our simulated cow during each one minute interval. (To protect the researcher, ants were removed when they reached the shoulder.)

Using JMP 5.0.1, we compared mean number of attacking ants and total number of ants between ant species, using a paired t-test. We also evaluated time trends in the number of attacking ants for both species.

RESULTS

We found no significant difference between the number of attacking *P. flavicornis* and *P. spinicola* after 1, 2, or 3 minutes of simulated herbivory (Table 1). We also found no significant difference between the total numbers of *P. flavicornis* and *P. spinicola* on the simulated cow after 1, 2, or 3 minutes (Table 1). Our results were not affected by the inclusion or exclusion of removed ants in our data. We conclude that *P. spinicola* and *P. flavicornis* have similar aggressive responses to cattle browsing.

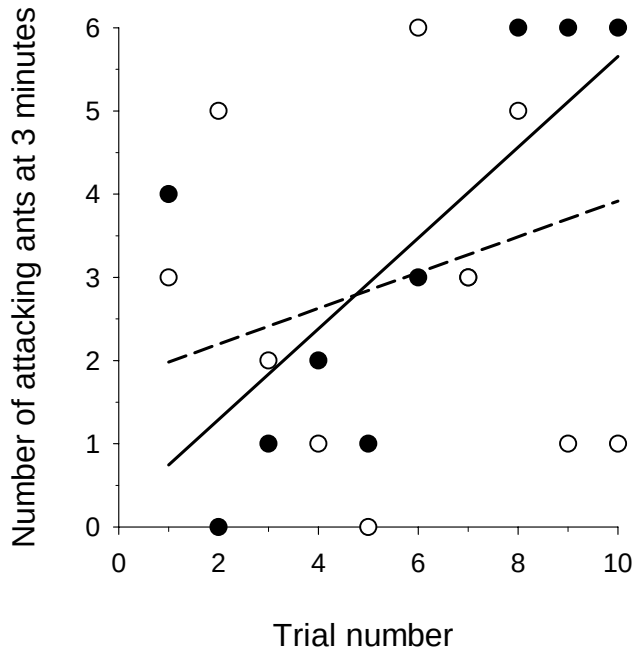

Figure 1. Number of attacking *P. flavicornis* [black dot, solid line] and *P. spinicola* [open dot, dashed line] after 3 minutes of simulated cattle herbivory as a function of trial number. Trial number corresponds to time of day, (between 0930 and 1130). The number of attacking *P. flavicornis* increased with time ($r^2 = 0.54$, df = 8, $P < 0.02$). *P. spinicola* response did not change over time ($r^2 = 0.029$, df = 8, $P < 0.64$). Trends were similar after 1 and 2 minutes.

We noticed an increase in temperature over our sampling period. Trials were consecutive, so we used trial number to represent time. The number of attacking *P. spinicola* showed no significant trend with time. In contrast, the number of attacking *P. flavicornis* increased over the course of the morning (Fig. 1).

DISCUSSION

The similar number of attacks by *P. flavicornis* and *P. spinicola* in response to cattle browsing suggests that exposure to

cattle browsing should not favor either ant species in their population dynamics in pasture habitats. However, it is possible that *P. flavicornis* trees could be better defended. Cattle browsing peaks in the early to mid-morning, and again in the early afternoon (Lyons 2000). If *P. flavicornis* continue to increase in aggression throughout the afternoon and cattle tend to browse when *P. flavicornis* aggression is relatively high, *P. flavicornis* would provide more effective defense than *P. spinicola* over the course of the day. If so, this may offset the better defense by *P. spinicola* against arthropod intruders and competing vegetation (Cook 1993, Janzen 1984).

To elucidate mechanisms that may influence population trends of *P. flavicornis* and *P. spinicola* in pasture habitats in Guanacaste, we suggest two priorities for future research. First, trends in *P. flavicornis* and *P. spinicola* defense over a 24h cycle could be investigated more thoroughly. Second, the species could be compared in their abilities to colonize young *A. collinsii* hosts. Finally, because several other obligate and facultative ant mutualists occur on *A. collinsii* in pastures, research on defense and colonization could be usefully extended to this wider suite of ant species.

LITERATURE CITED

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Table 1. Comparison of the responses of *P. flavicornis* and *P. spinicola* to simulated cattle herbivory.

	Minute	Difference between mean number of ants (*P. flavicornis- P. spinicola*)	Paired t-test results
Attacking ants	1	-0.4	t = 0.37, df = 9, P = 0.72
	2	0.8	t = -0.94, df = 9, P = 0.37
	3	0.5	t = -0.51, df = 9, P = 0.62
Total ants	1	-1.1	t = 0.66, df = 9, P = 0.53
	2	-0.3	t = 0.21, df = 9, P = 0.84
	3	-1.1	t = 0.66, df = 9, P = 0.52
Total ants + removed ants	1	-1.1	t = 0.66, df = 9, P = 0.53
	2	-0.2	t = 0.13, df = 9, P = 0.90
	3	-1.2	t = 0.63, df = 9, P = 0.54