A FAILED MUTUALISM BETWEEN *ACACIA CORNIGERA* AND ITS RESIDENT ANTS

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Abstract: The ant-acacia mutualism at Palo Verde National Park has been well studied for *Acacia collinsii*, but not *A. cornigera*. We examined the relationship between *A. cornigera* and its associated ants and found it was not consistent with well-documented ant-acacia mutualisms. The plants appeared healthy and provided abundant resources to ants (Beltian bodies, nectaries and thorns). However, the ants did not fully use these resources, and only 8% of the ant colonies on *A. cornigera* responded aggressively to prolonged disturbance. *P. flavicornis*, the only ant-acacia mutualist we found on *A. cornigera*, was far less aggressive than on nearby *A. collinsii*. Thus, the mutualism between these species appears to be dysfunctional, at least at our study site.

Key Words: Acacia cornigera, Acacia collinsii, *mutualism*, P. flavicornis, *defense*

INTRODUCTION

The ant-acacia mutualism at Palo Verde National Park has been well studied for *Acacia collinsii*, but not *A. cornigera*. Both species provide resident ant colonies with hollow thorns to inhabit, carbohydrates in the form of nectaries, and protein and lipids in the form of Beltian bodies. In return for these investments, mutualistic ant species provide aggressive defense against natural enemies (Janzen 1983).

Aggressive defense of *A. collinsii* by *P. spinicola* and *P. flavicornis* has been recorded repeatedly and consistently in the literature (e.g. Janzen 1983, annual reports in Dartmouth Studies in Tropical Ecology). Janzen (1983) suggests that the ant mutualisms with *A. cornigera* and *A. collinsii* are similar. We decided to test this assertion. We censused a local *A. cornigera* population and investigated the presumed mutualistic relationship with its resident ant colonies.

METHODS

During the late morning 8 January 2006, we censused a spatially well-defined population of *A. cornigera* in the open, cattle-grazed area between the marsh edge and the fence, in front of the OTS field station at Palo Verde. We measured the height of each tree and recorded the density of Beltian bodies on a 0-3 scale. A value of 3 signified higher than typical density (based on general observations of *A. collinsii* at Palo Verde), 2 represented a more typical density, 1 was less than typical, and 0 signified absence. We recorded the presence of holes in the thorns, indicating whether a tree had been colonized.

We classified visible ant density and activity on the same 0-3 scale. We then simulated vertebrate herbivory by manually removing leaves and stems, and noted the change in activity of the ant colony, which we again ranked on a 0-3 scale (0 represented no change in activity, 3 a dramatic increase). Aggression was ordered on a scale of 0-3 based on the ants'

propensity to sting when disturbed: 3 represented an immediate sting or bite, 2 an intermediate response (bites and/or stings), 1 required extreme provocation (prolonged simulated browsing) before a sting or bite, and 0 represented no bite or sting. We collected a sample morphotype of each resident ant colony and identified the morphotype to species.

RESULTS

Over a three-hour period we sampled 43 *A. cornigera* trees. Most trees (n=35) hosted only one species, but more than one ant species was found on 2 trees. Only 7.7% of the 39 ant colonies present showed any aggressive response. Among the 12 *P. flavicornis* colonies (each of which had sole occupancy of a tree), only 25% showed an aggressive response (i.e. aggressiveness of 1, 2 or 3 on our scale). In the Dartmouth long term ant-acacia study at Palo Verde, *P. spinicola* is common on *A. collinsii*, yet we found no *P. spinicola* in our study area (Table 1).An informal survey of ant species on *A. collinsii* within 50 m of the study site revealed the presence of several aggressive *P. spinicola* colonies. We found a higher frequency of *P. nigropilosa* (an ant-acacia parasite) than has been found in past studies (Table 1). Further, 18.6% of previously colonized *A. cornigera* had been abandoned. Yet, these abandoned *A. cornigera* appeared to be healthy, based on abundant nectaries and Beltian bodies, green, shiny foliage and large thorns, compared to the normal appearance of *A. collinsii* at Palo Verde.

DISCUSSION

Four observations indicate a failure of the mutualism between *A. cornigera* and its resident ants: (1) low aggression in the usually aggressive *P. flavicornis*, (2) a high frequency of non-aggressive and parasitic *P. nigropilosa* and the absence of *P. spinicola* (Table 1), (3) a high frequency of abandoned *A. cornigera* trees, and (4) a high density of Beltian bodies on *A. cornigera* at the study site. It is clear that the ants were not providing defense for the tree even though the tree was providing resources for the ants. Despite the lack of defense, the trees appeared in good health.

The presence of nearby *A. collinsii* trees indicates that a comparative study of

TABLE 1. Comparison among three sites at Palo Verde of ant species occupying acacia trees. Marsh edge (*Acacia cornigera*) was a cattle-grazed site with no canopy. Study A (*A. collinsii*) was a grazed site with no canopy, 4 km from our site. Study B (*A. collinsii*) was an ungrazed site with a canopy, 0.2 km away from our site. Percentage values represent percent of trees colonized by each species.

	A. cornigera (Marsh edge)	*A. collinsii* (Study A**)	*A. collinsii* (Study B**)
Total no. of *Acacia*	43	63	74
P. flavicornis	27.9%	12.7%	0.0%
P. nigropilosa	39.5%*	1.6%	5.4%
P. spinicola	0.0%	15.9%	55.4%
Crematogaster	4.7%*	55.6%	5.4%
Other spp.	18.6%	9.5%	21.6%
No ants present	14.0%	4.8%	18.9%

*In both instances of *Crematogaster* species, *P. nigropilosa* was also found on the plant

**Study A and Study B data are from a Dartmouth College long- term acacia-ant study (C. Layne, pers. comm.)

the two acacia species in the area is possible. Thus, it would be possible to investigate experimentally whether ant mutualists preferentially colonize *A. collinsii* rather than *A. cornigera.* In the meantime, the puzzle remains: why has the mutualism failed in this study area?

LITERATURE CITED

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