Discussion

Our results refute the hypothesis that more aggressive *P. spinicola* dominate in shady habitats because tree health is better in shady habitats. Instead, we found that open site trees seemed healthier than shady site trees. Unfortunately, we found no trees inhabited by *P. spinicola* in either transect and therefore, could not directly correlate tree health and ant species distribution.

Ruben and Hourdequin (1996) suggested that acacias do better in disturbed pasture than in wide open sites. Because our open site was actually a somewhat shaded pasture, we may not have sampled the acacias in the poorest health. Less competitive black ants may only be found in these acacias. Future studies could test whether acacia tree health is greatest in pastures, intermediate in shady areas, and poorest in wide open areas. The broader question that remains is whether tree health determines ant colonization preferences or whether distribution of ant species determines tree health.

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ABUNDANCE OF PSEUDOMYRMEX FLAVICORNIS AND P. SPINICOLA ON ACACIA COLLINSII IN SUN AND SHADE HABITATS

James W. Hourdequin, Christie D. R. Jackson, Sarah E. Kopplin, Gregory M. Lief, and Matthew K. Little

Abstract. We examined *Pseudomyrmex flavicornis* and *P. spinicola* in *Acacia collinsii* stands to test how species distribution and abundance were affected by habitat differences. In both habitats, *P. flavicornis* occupied about 5 % of the trees, and *P. spinicola* occupied about 95% of the trees. Tree vigor, as measured by leaf appearance, was greater in sunny habitats than in shady habitats, and *P. spinicola* abundance within trees was greater in vigorous trees. Thus, sunnier habitats support healthier trees and strengthen the ant-acacia mutualism, which presumably further increases *A. collinsii* health.

Key Words: Ant-acacia, mutualism, specialist, generalist

Introduction

Acacia collinsii shares a mutualistic relationship with several species of acacia ants. Two of the most common ants, *Pseudomyrmex spinicola* and *P. flavicornis* are found on acacia trees throughout Palo Verde National Park, Costa Rica. We examined the distribution and abundance patterns of P. spinicola and *P. flavicornis* on *A. collinsii* in different light environments.

Janzen (1983) suggested that P. flavicornis is a habitat specialist that occurs primarily in sunny environments, while P. spinicola is a habitat generalist distributed across both sunny and shady habitats. We tested these observations and hypothesized that light conditions, through effects on host tree health, influence within tree ant abundance.

Methods

We examined *A. collinsii* trees within two sunny transects measuring 5 by 50 m, two shady transects measuring 10 by 50 m, and one intermediate coverage transect measuring 10 by 50 m. Shady and intermediate transects were larger because they had lower *A. collinsii* densities. All locations were adjacent to the main road 0.5-1.5 km east of the Organization for Tropical Studies Estacion Biologica. For each A. collinsii over 1 m tall within the transect we: (1) recorded ant species present; (2) classified ant abundance as absent, low, or high; (3) classified A. collinsii health as poor, medium, or good (based on leaf appearance); and (4) classified canopy cover as sunny (0-50% cover) or shady (51-100% cover). This study was conducted on 7 January 1996, at Palo Verde National Wildlife Park, Costa Rica.

Results

The proportion of trees occupied by *P. flavicornis* was similar between the two habitats, as was the proportion of trees occupied by *P. spinicola* (Table 1; $X^2 = 0.34$, df = 2,P > 0.50). Trees in the sun hosted large within-tree ant populations no more frequently than trees in the shade. 67 of 115 trees in the sun (64%) hosted large ant populations compared to 60 of 126 in the shade ($X^2 = 3.00$, df = 2, P > 0.10). However, within-tree ant populations were high more frequently on trees with high vigor (41 of 46 = 89%) than on trees with medium vigor (71 0f 114 = 62%) or low vigor (15 of 81 =18%; $X^2 = 78.50$, df = 4, P < 0.001), and high vigo trees were more frequent in the sun (34 of 115 = 30%than inthe shade (12 of 126 = 10%; $X^2 = 16.11$, df = 2, P < .001; Table 2).

Table 1: Percentage of *P. flavicornis* and *P. spinicola* inhabiting *A. collinsii* in sunny and shady habitats.

	# of Trees	% with *P. flavicornis*	% with *P. spinicola*
Sun	106	4.7	95.3
Shade	136	6.6	93.4

Table 1: Cross-classification of *Acacia collinsii* trees by habitat, tree vigor, and ant abundance within trees

		Ant Abundance			
	Tree Vigor	None	Low	High	Sum
Sun	Low	15	12	9	36
	Medium	1	18	26	45
	High	0	2	32	34
	Sum	16	32	67	115
Shade	Low	18	21	6	45
	Medium	1	23	45	69
	High	0	3	9	12
	Sum	19	47	60	126

DISCUSSION

Our data did not support the generalization that *P. flavicornis* occupies a greater proportion of trees in sunny habitats than trees in shady habitats. However, we found a total of only 14 acacias occupied by *P. flavicornis* and the test was not very robust. In contrast, *P. spinicola* occupied a similar majority of trees in both habitats, supporting Janzen's (1983) description of *P. spinicola* as a habitat generalist.

Trees with high vigor frequently hosted large ant populations, perhaps because they were more frequently in sunny habitats. Healthy trees may put more energy into nectar production and the creation of habitat for colonizing ants. As the ant population grows in response to these factors, the host tree's health is further improved through better defense from herbivory and understory competition.

Future studies could identify the relative importance of the different mechanisms by which ants improve tree health, whether through defense against herbivores or through clearing of competing herbaceous vegetation. These factors may have implications for acacia regeneration across habitats in which herbivory and understory competition exert different levels of influence on seedling establishment.

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