

Fig. 3. Relationship between the relative condition of *A. collinsii* and tree shape, as quantified by basal area to height ratio. See Fig. 1 for calculation of tree condition index.

variation in tree condition.

Data did not show that Beltian bodies or cleared area beneath the tree were associated with tree condition. Beltian bodies are produced by trees and may be consumed by *Pseudomyrmex* at the rate of production, resulting in little to no standing abundance. Our data on cleared area was limited to a small subset of our sample, and the criteria for what

constitutes "cleared" must be better defined for future study. Fig. 2 suggests that stem volume may be a more important factor in determining cleared area than tree condition. Further research should apply the index to a broader scope of *A. collinsii* performance attributes, such as *Pseudomyrmex* population size.

We found a significant correlation between tree condition and tree shape, or allometry (Fig. 3). Trees with a greater height to basal area ratio tended to be in better condition, though we cannot infer the causal mechanisms involved. Numerous factors affect tree shape and resource allocation, such as resource availability, habitat structure, and herbivory. The relative contribution of each factor is not well understood. Although the adjusted r^2 value from Fig. 3 is low (0.07), tree morphology is such a fundamental attribute that any factor contributing significantly to it is worthy of note.

Though we had mixed success in the application of this index, the fundamental physiological assumption and the observed significant allometric relationship suggest that the index may be a convenient and powerful tool.

EFFECTS OF LIGHT AND TREE SIZE ON THE SPECIES IDENTITY OF MUTUALIST ANTS ON *ACACIA COLLINSII*

Palo Verde

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Abstract: The ant *Pseudomyrmex spinicola* is a more common mutualist with the tree *Acacia collinsii* than is *P. flavicornis* in the dry forest of Palo Verde National Park. We hypothesized that *P. flavicornis* specializes on young, high light patches of *A. collinsii* and would be associated with early successional areas of the forest. However, there was no difference in the light environments of *P. spinicola* and *P. flavicornis* ant trees, and *P. flavicornis*-inhabited trees were taller than trees with *P. spinicola*.

Key Words: acacia-ant mutualism, *Pseudomyrmex*, spatial distribution

INTRODUCTION

Pseudomyrmex spinicola, the black ant, and *P. flavicornis*, the red ant, are alternative mutualists of the tree *Acacia collinsii*. The red ant species is more aggressive than the black ant species in defending its host tree from herbivores (Balsler 1992, Janzen 1983). Additionally, the red ant species inhabits trees both in the sun and the shade while black ant species is most common on acacias in the sun (Janzen 1983). We hypothesized that the red ant species colonizes young, unoccupied *A. collinsii* trees in gaps and on forest edges. Thus, we predicted that the black ant species would be found on smaller trees and in higher light than the red ant species.

METHODS

Relatively few *A. collinsii* individuals host *P. flavicornis*; most support colonies of *P. spinicola*. We first located 24 trees hosting the black ants in a haphazard search though a grazed area of secondary tropical dry forest within 2 km northeast of the OTS Field Station at Palo Verde National Park, Costa Rica, on January 8, 2001. We designated each of these trees as the focal tree for sampling of neighboring trees, and refer to the focals as B1 trees. For each replicate focal (B1) we located and measured the distance (BB) to its nearest acacia neighbor hosting black ants,

(B2), and the distance (BR) to its nearest neighbor hosting red ants (R1, Fig. 1). We also determined the distance (RR) from R1 to its nearest neighbor also hosting red ants (R2, Fig. 1). We measured the heights of B1 and R1 with a tape measure for small trees and a clinometer and triangulation for trees over 2 m tall. Light intensity was averaged from four measurements around the bases of B1 and R1 using an electric meter connected to a photovoltaic cell (units in μA). Light and height data were log transformed for normality. Light and height data for focal trees were used in the logistic model:

neighbor = light + height + height*light
to test for an effect of these variables on community composition.

RESULTS

There was a strong trend that mean BB (518.0 cm; SE = 164.0) was greater than the mean RR (117.2 cm; SE = 34.05; paired- t = 2.05, df = 23, P = 0.052). The mean height of B1 was significantly greater than the height of R1 (paired- t = 2.48, df = 23, P = 0.021). The mean light intensity at the base of B1 (5.20 μA ; SE = 1.20) and that of R1 (6.55 μA ; SE = 1.43) were not significantly different (paired- t = -0.556, df = 23, P = 0.58). The ranges in light intensities were also similar, from 1.0 μA to 31.4 μA for B1, and from 1.0 μA to 28.8 μA for R1. The

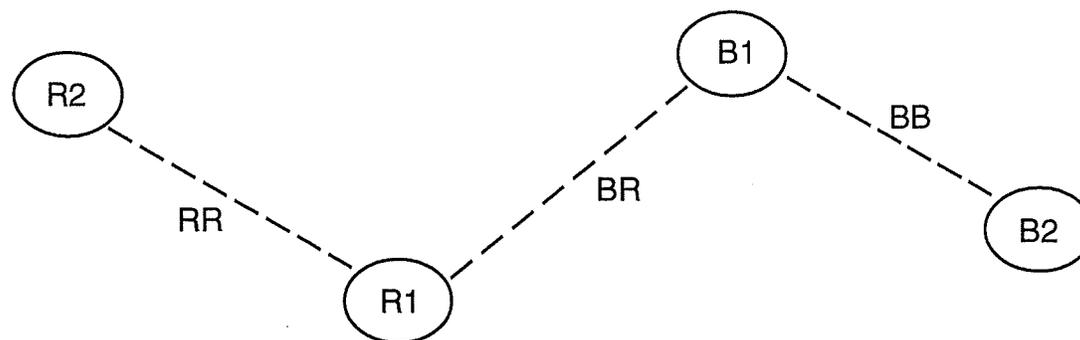


Fig. 1. Configuration of sample trees in relation to each replicate "focal" tree with a *P. flavicornis* colony. BB represents the distance between the focal tree and nearest *P. flavicornis* tree. BR represents the distance between the focal tree and nearest *P. spinicola* tree. RR represents the nearest neighbor distance between two *P. spinicola* trees.

ant species found on the focal's nearest neighbor is associated with a significant interaction of height and light of the focal tree (logistic regression, whole-model $P < 0.001$, effects test: height $P = 0.047$, light $P = 0.049$).

DISCUSSION

As expected from the higher density of *P. spinicola* colonies, the distance between neighboring red ant trees was less than that for *P. flavicornis* trees. However, we found no evidence that the black ant is an early successional species. Black ants and red ants occupy the same range of light environments. Furthermore, the trees that we initially located as focal trees with black ant colonies were taller than the nearest neighboring *A. collinsii* hosting red ant colonies. These trends were the reverse of our predictions. However, it is possible that the height comparison was biased, as we may have found tall trees more easily than short ones in our initial search for black ant colonies.

We cannot explain the mechanisms underlying the significant interaction between focal tree, height, and light environment in our logistic model predicting nearest neighbor species. This may be an interesting pattern to investigate in future studies.

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