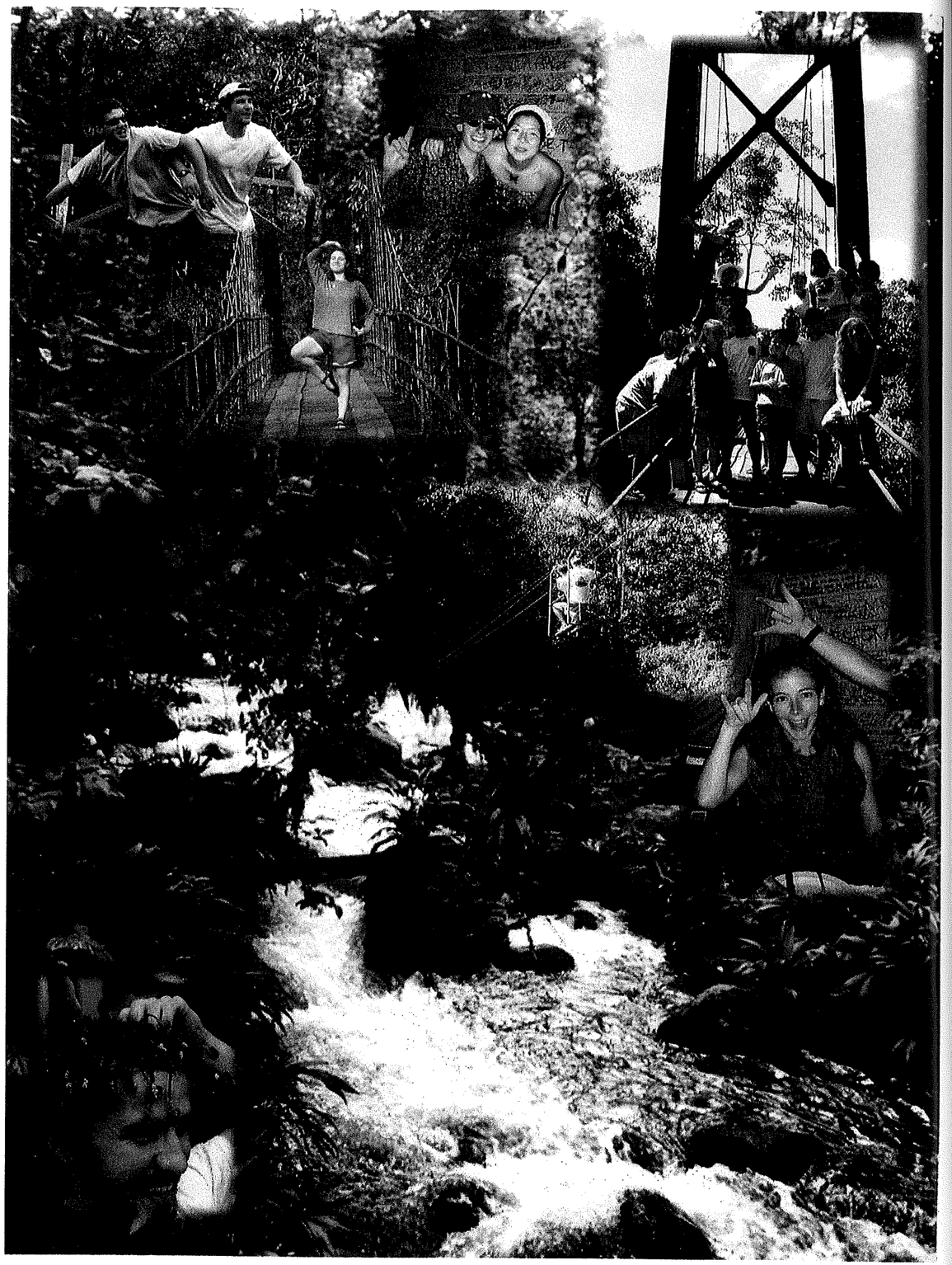

Effects of light environment and intruder type on the aggressive responses of *Pseudomyrmex spinicola* on *Acacia collinsii*

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Abstract: We examined the responses of *Pseudomyrmex spinicola* colonies to simulation of plant and insect herbivore intrusion on *Acacia collinsii* trees in light and shade environments. We predicted that ant response to plant intruders would be stronger in sunny environments, and response to insect intruders would be stronger in shade. We found no significant difference in relative local ant abundance between light or intruder type (introduced plant or insect). Ants discovered the mobile insect invaders more frequently than the stationary plant invaders. The intensity of intrusion may be important in determining the strength of ant reaction to an intrusion.

Key Words: ant-acacia

Introduction

The mutualistic relationship between *Pseudomyrmex spinicola* ants and the *Acacia collinsii* tree is well documented. In exchange for nectar, protein, and shelter in hollow thorns, the ants defend their host tree against potential herbivores and competing plants (Janzen 1983).

We hypothesized that ant response to plant and animal intruders would be differentially affected by light environment. In sunny areas under relatively open canopy, the threat of vegetation growing on the forest floor may be greater than in shaded areas, so we predicted that ants would respond more strongly to plant intruders in sunny than shaded areas. Conversely, in shaded areas, other plants may be less likely to grow under acacia trees, but the greater structural complexity under neighboring trees may harbor more insect herbivores; we predicted that ant response to an insect herbivore would be greater in shaded areas than sunny.

Methods

We compared *P. spinicola* response to simulated vine and herbivore intrusion on *A. collinsii* trees in light and shade environments along the Sendero La Venada trail, through secondary growth forest approximately 0.5 km east of the OTS Biological Station in Palo Verde National Park, Costa Rica on the morning of January 8, 2001. We selected 11 *A. collinsii* trees 2-3 m tall and inhabited by *P. spinicola* colonies. Six trees were classified as inhabiting sunny environments and five as shade. A locally abundant vine was harvested and cut into 50 cm lengths, and hemipteran larvae (*Pyrrhocoridae*) were collected, to serve as intruders. On each tree, we selected two observation branches of similar length at eye level. Prior to introducing the invaders we counted the number of *P. spinicola* individuals on each branch to establish a baseline level of local ant density. We then simultaneously placed a looped length of vine on one branch and a hemipteran larva on the other. To determine whether intrusion elicited ant response, we then counted the number of ants present on each branch at 1-minute intervals for three minutes.

Pseudomyrmex spinicola local abundance for the three minute period after intrusion was standardized by subtracting the baseline abundance from the abundance at each minute interval, and then averaging the results (mean change in ant abundance). These data were analyzed using a two-way ANOVA comparing local ant density in re-

sponse to intruder type and light environment. The number of trials in which at least one ant discovered (made physical contact with) the intruder was compared between insect and vine treatments using a Chi-square analysis.

Results

Relative ant abundance was unrelated to light (2-way ANOVA, F = 0.28, df = 1, P = 0.6), intruder treatments (F = 0.42, df = 1, P = 0.5), or the interaction of these treatments (F = 0.088, df = 1, P = 0.7696, Fig. 1).

Discovery probability was significantly affected by intruder identity ($\chi^2 = 7.719$, df = 1, P = 0.006); the insect invader was discovered in 10 out of the 11 replicates, while the plant invader was discovered in only 4 replicates. We also observed that the insect dropped from the branch immediately after the first or second encounter with an ant.

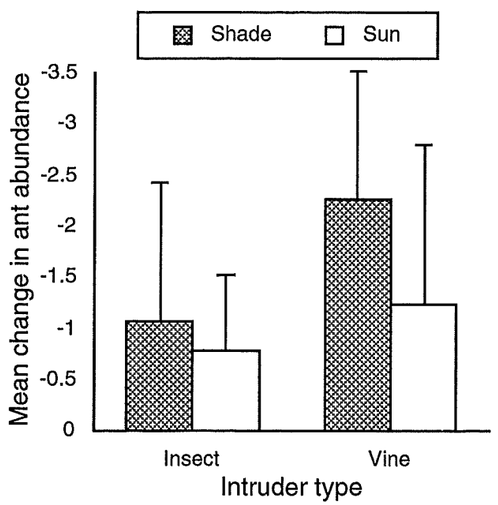

Fig. 1. Mean change in *P. spinicola* abundance (± 1 SE) on experimental branches of *Acacia collinsii* at Palo Verde National Park, Costa Rica, by intruder type and light environment (n = 6 for sun treatment, n = 5 for shade treatment). Mean change in ant abundance was calculated by subtracting the number of ants counted on the branch at each of three one-minute intervals following the introduction of the intruder from the pre-introduction counts of ants, and then averaging those differences.

Discussion

Macintosh et al (2000) showed that manipulations apparently designed to mimic herbivory by large vertebrates, such as cutting leaves and tapping branches, had a significant effect on ant activity. Small herbivores, such as insects, or plant intruders, such as vines, do not appear to elicit such a response when placed carefully on the branch. The insect intruders in this experiment were often knocked off the branches by only one or two ants, suggesting that more ants were not needed to defend the tree, and that the degree of ant response is proportional to the intensity of intrusion (Dums et al 1997). *Pseudomyrmex spinicola* response does not seem to be affected by light environment. Perhaps it is more advantageous for the ants to respond to the degree of threat an invasion poses rather than altering responses to herbivores or plants according to light environment. The greater number of discoveries of the insect invader may be explained by the mobility of the insect intruder, which increases its probability of being encountered.

In addition to testing the hypothesis that intensity of disturbance is the determining factor in *P. spinicola* response, further work might focus on quantifying the difference between "sun" and "shade" environments, and more accurately mimicking events of insect herbivory and vine encroachment.

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