Herbivory at the edge of *Acacia collinsii* clearings

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Abstract. We measured levels of herbivore damage for a species of grass on the edge, and 3 m outside the edge, of the clearings made by *Pseudomyrmex spinicola* ants under 20 *Acacia collinsii* trees. Grass on the edge had greater levels of herbivore damage than did grass 3 m outside. Herbivore damage increased with acacia clearing radius but we found no such relationship for the vegetation 3 m outside. We found no difference in herbivore abundance between clearing edge and 3 m outside.

Keywords: herbivore damage, Pseudomyrmex spinicola

INTRODUCTION

In Palo Verde National Park, *Acacia collinsii* (Fabaceae) is an important early successional tree species. It is a well-documented obligate mutualist with the acacia ant, *Pseudomyrmex spinicola* (Formicidae). The ants often clear all vegetation from an area around the tree, freeing the acacia from all competition except shading by tall trees.

We hypothesized that herbivore damage would differ between the edge of clearings and areas 3 m outside of them. Herbivore damage at the edge could be lower if patrolling *P. spinicola* adversely affect herbivores. However, herbivore damage at the edge could be greater if there are higher herbivore densities there than 3 m outside; insect herbivores landing in the basal clearing may tend to move to the edge microhabitat in search of food and/or in response to ant attacks.

METHODS

Data were collected from 20 *A. collinsii* trees at a site 500 m east of the Palo Verde Research Station on 14-15 January, 1999. All were occupied by *P. spinicola* colonies, which we assumed were responsible for the cleared areas surrounding their stems. We measured the size of each clearing as the distance from the stem to the closest edge.

We measured herbivory on a single species of grass (Poaceae) which was abundant at the site. We randomly selected 10 grass ramets at each clearing, 5 in edge habitat paired with 5 in "exterior" habitats (defined as > 3 m from any acacia clearing). Herbivore damage (foliage loss) was estimated as percent leaf loss for the 4 youngest leaves on a ramet. We then calculated the mean percent foliage loss on edge and exterior plants for each clearing.

We used these data to calculate the ratio of edge foliage loss to exterior foliage loss for each clearing. We then estimated herbivore densities for the 3 clearings with the highest and lowest ratios. At these 6 clearings, we sampled insects with a sweep net (10 sweeps per sample), and measured the biomass of grass within a 30 x 30 cm quadrat from randomly selected areas (3 edge and 3 exterior samples for both insects and grass biomass per clearing). We defined herbivore density as the number of insect herbivores per unit grass biomass.

RESULTS

We found a significantly higher percentage of herbivore damage on grass leaves at the edge of clearings than 3 m from the edge (Fig. 1; paired-t=4.87, df=19, P<0.01).

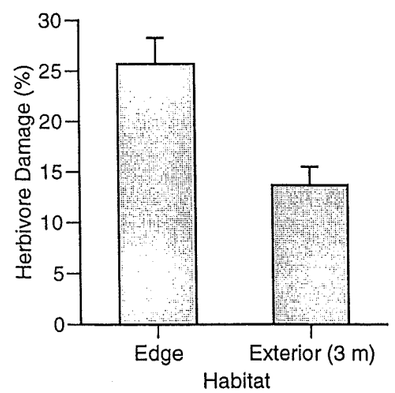

Fig. 1. Herbivore damage (Mean ± 1 SE) on a grass species at the edge of, and 3 m away from, *A. collinsii* clearings at Palo Verde National Park, Costa Rica.

Herbivore damage at the edge increased with clearing size (Fig. 2A; r^2=0.39, df=19, P<0.01). In contrast, herbivore damage beyond the edge was unrelated to clearing size (Fig. 2B; r^2=0.11, df=19, P=0.16). Grass biomass per unit area did not differ between the edge and exterior (Wilcoxon signed-rank test, U=4.50, df,=5, P=0.44). Similarly, the number of herbivorous insects per unit biomass did not differ between edge and exterior (Fig. 3; paired-t=-1.27, df=5, P=0.87).

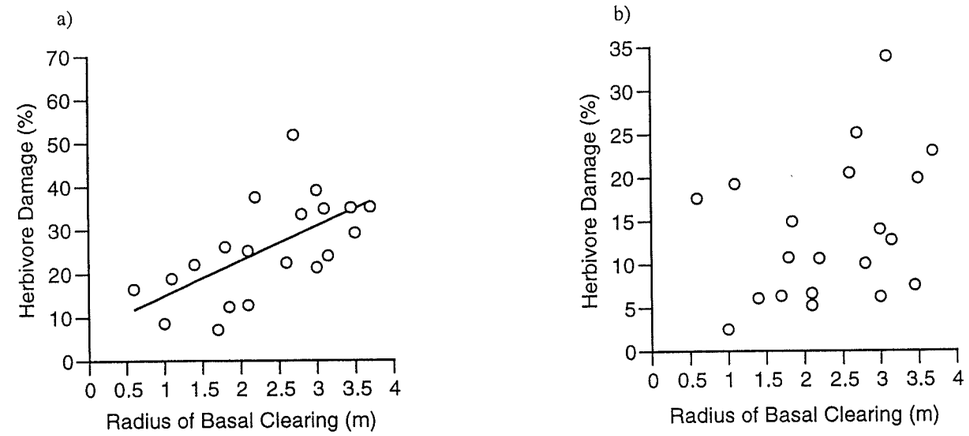

Figure 2. Relation between herbivore damage on a grass species and radius of basal clearing around *A. collinsii* at Palo Verde National Park, Costa Rica. a. Edge of clearing. b. 3 m outside edge.

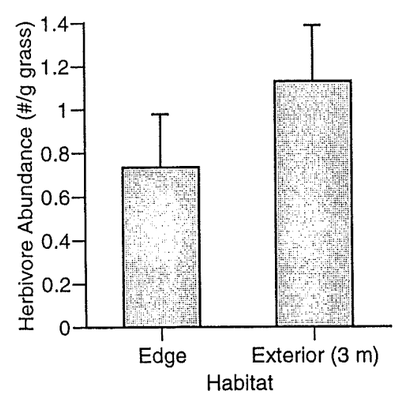

Fig. 3. Abundance of herbivorous insects (Mean ± 1SE) for sweep net samples at the edge of, and 3 m away from, *A. collinsii* clearings at Palo Verde National Park, Costa Rica.

DISCUSSION

Although we found strong evidence for higher herbivore damage along clearing edges, we found no evidence of higher herbivore densities there. However, other untested mechanisms could account for the observed difference. Grass at edges may experience less competition, leading to enhanced growth and possibly greater palatability. Additionally, it is plausible that the ants are causing the difference, either directly by removing foliage, or indirectly by damaging plants and making them more susceptible to herbivore damage. However, we found no acacia ants within our insect samples.

We cannot confidently reject the herbivore density hypothesis for the disparity in herbivory between edge and exterior grasses. Our insect survey had a small sample size, and herbivore density may vary both daily and seasonally. Furthermore, the positive relationship between herbivore damage and clearing size are consistent with the idea that herbivorous insects become concentrated along the edges of acacia clearings. In larger clearings, more insects are likely to arrive, then move from the bare substrate to the edges, thus generating higher densities at the edges for large clearings. These insects may move to the edge in search of food and/or to escape patrolling ants.