DENSITY DEPENDENCE OF HERBIVORY ON *RUELLIA INUNDATA* AT SMALL SPATIAL SCALES

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Abstract: We investigated density-dependence of herbivory on *Ruellia inundata* in Palo Verde National Park in Costa Rica. We hypothesized that the proportion of leaves with herbivore damage would be positively related to stem density / m^2. However, our results suggest no relationship between stem density and herbivore damage at the 1 m^2 scale, or leaf density and herbivore damage at the stem scale.

Key Words: Ruellia inundata*, density dependence, herbivory, scale*

INTRODUCTION

Ruellia inundata is a common, multi-stemmed herbaceous perennial occurring in patches of varying density (# stems / m^2) in Palo Verde National Park, Costa Rica. Patches with higher stem densities provide more concentrated food resources for herbivores. Therefore, herbivores may forage longer or in higher numbers in high density patches, causing more leaf damage. Thus, we predicted that herbivore damage would increase with stem density at the 1 m^2 scale. We also predicted that herbivore damage to leaves would increase with the density of leaves per stem.

METHODS

On 9 January 2006, on the former airstrip in front of the OTS station in Palo Verde National Park, Costa Rica, we haphazardly selected 1 m^2 plots (n = 32) of *R. inundata* and counted the number of green stems in each plot as a measure of stem density. We haphazardly sampled 5 stems in each plot, recording the total number of leaves on each stem, and herbivore damage. We calculated herbivore damage as the proportion of leaves on the plant missing partial leaf area. We analyzed the relationship of herbivore damage (proportion of leaves damaged) to stem density at the 1 m^2 scale, and also at the leaves/stem scale, using linear regression analysis in JMP 5.0.1.

RESULTS

R. inundata stem density ranged from 5 to 173 stems / 1 m^2. Stems sampled within each plot contained between 4 and 58 leaves/stem. Herbivore damage was not significantly related to stem density at the scale of 1 m^2 ($r^2 = 0.05$, df = 1, 158, P = 0.20; Fig. 1). Although we found a significant positive relationship between the number of leaves damaged and leaves/stem (df = 1, 154, $P < 0.001$), the proportion of leaves damaged did not change significantly with increasing leaves/stem ($r^2 = 0.01$, df = 1, 153, P = 0.18; Fig. 2).

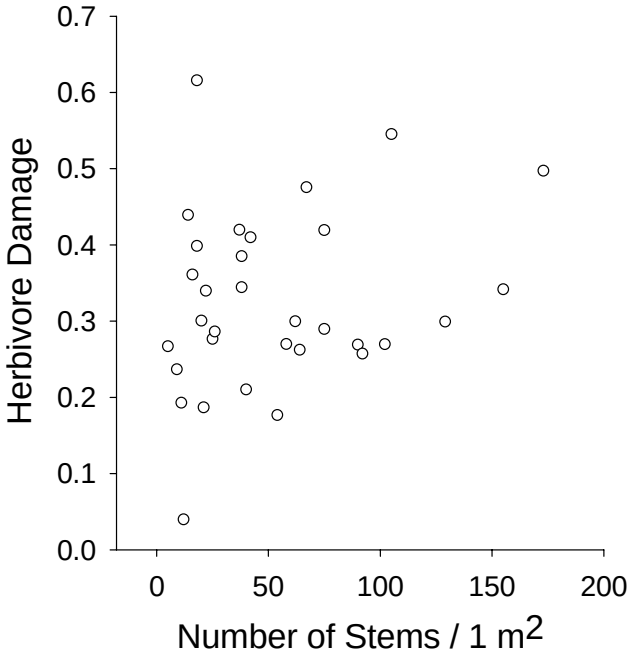

Figure 1. The relationship between the number of stems and herbivore damage in 1 m^2 plots of *Ruellia inundata* in Palo Verde National Park, Costa Rica (r^2=0.05, df=1, 158, P=0.20). Herbivore damage was defined as the proportion of leaves in the plot missing partial leaf area.

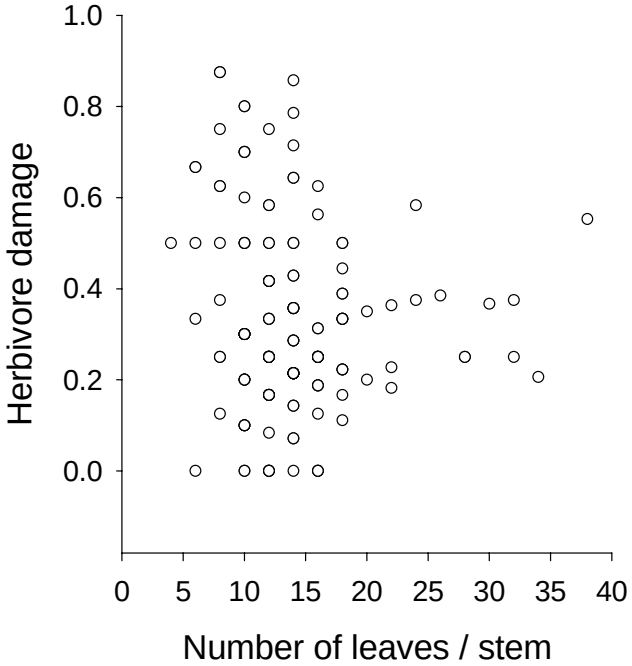

Figure 2. The relationship between the number of leaves and herbivore damage, per stem, in 1 m^2 plots of *Ruellia inundata* in Palo Verde National Park, Costa Rica (r^2 = 0.01, df = 1, 153, P = 0.18). Herbivore damage is defined as the proportion of leaves per stem missing partial leaf area.

DISCUSSION

We found no support for our prediction that herbivore damage would increase with higher stem density at the 1 m^2 scale, or with the number of leaves per stem. The effect host plant density has on intensity of herbivore damage should depend on the scale at which herbivores make foraging decisions. Grasshoppers, which were present in the study plots, are potential *R. inundata* herbivores capable of making foraging decisions across areas larger than 1 m^2. They are also generalist herbivores, and if they do not preferentially feed on *R. inundata*, they may not respond to the density of this species.