Broad patterns in the distribution of herbivory are elusive due to the importance of local scale variation and differences between specialist and generalist herbivores

Tara Massad[1], André Rangel Nascimento[2], Diego Campos[3], Wilmer Simbaña[4], Humberto Garcia Lopez[4], Lidia Sulca Garro[5], Cintia Lepesqueur[6], Lora Richards[4], Matt Forister[7], John Stireman[8], Eric Tepe[9], Kathryn Uckele[4], Laura Braga[10], Thomas Walla[11], Angela Smilanich[12], Ari Grele[4], and Lee Dyer[12]

[1]Gorongosa National Park
[2]Universidade Estadual de Campinas
[3]Universidad Nacional de Colombia
[4]University of Nevada Reno
[5]Universidad Nacional Mayor de San Marcos
[6]Universidade de Brasilia Departmento de Zoologia
[7]University of Nevada
[8]Wright State University
[9]University of Cincinnati
[10]Universidade Federal de Ouro Preto
[11]Colorado Mesa University
[12]University of Nevada, Reno

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Abstract

Insect herbivory is a critical top-down force structuring plant communities, and quantifying the factors that mediate damage caused by herbivores is fundamental to understanding biodiversity. As herbivory is the result of numerous ecological and evolutionary processes, including complex population dynamics and the evolution of plant defense, it has been difficult to predict variation in herbivory across meaningful spatial scales. In the present work, we characterized patterns of herbivory on plants in a speciose and abundant tropical understory genus (Piper) across forests spanning 44° of latitude in the Neotropics. We modeled the effects of geography, climate, resource availability, species richness and top-down pressure from parasitoids on the mean, dispersion, and skew of generalist and specialist herbivory. By examining these multiple moments of the distribution of herbivory, we were able to determine factors that increase biologically meaningful herbivory at the upper ends of its distribution. The strongest pattern that emerged at a large spatial scale was a roughly two-fold increase in herbivory in humid relative to seasonal forests. Site level variables such as latitude, seasonality and maximum Piper richness explained variation in herbivory at the local scale (plot level) better for communities of Piper congeners than for a single species. Predictors that varied between local communities, such as resource availability and diversity, best explained the distribution of herbivory within sites, dampening any broad patterns across latitude and climate and demonstrating why generalizations about gradients in herbivory have been elusive. The estimated population means, skew, and dispersion of herbivory respond differently to abiotic and biotic factors, demonstrating the need for careful studies to explore the distributions of herbivory and their effects on forest diversity.

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