The effects of cattle grazing on arthropod communities

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Abstract: Concern for biodiversity has created controversy over land use policy in Palo Verde National Park, Costa Rica. Cattle grazing is currently permitted in the marsh and adjacent forest in Palo Verde during the dry season. We compared arthropod diversity and abundance between areas open and closed to grazing by sweep netting plots randomly located in each area. Mean values of Shannon-Weiner indices and evenness were not significantly different between grazed and ungrazed. However, the composition of arthropod communities was significantly different between grazed and ungrazed plots. This suggests that alteration of plant communities by cattle alters arthropod communities.

Key Words: arthropod diversity, cattle, grazing

Introduction

Concern for biodiversity has created controversy over land use policy in Palo Verde National Park, Costa Rica. Cattle raising in the Guancaste region has shaped modern cultural values and drastically altered biological environments. It has transformed most lowland deciduous forests into pasturelands, while maintaining wetlands vital to bird diversity. Cattle grazing was eliminated from the park in 1981, but reintroduced in 1986 during the dry season.

Cattle grazing has the potential to alter the vegetative composition of an area (Mahar et al 2000, Abram et al. 1994). In general, cattle grazing opens up the understory. Though this effect is patchy, microhabitat available to vegetation-dwelling arthropods is significantly altered. Our goal was to assess one aspect of ecological differences between areas open and closed to grazing, by measuring arthropod diversity and abundance in each.

Methods

We selected an area of tropical dry secondary forest in which areas open and closed to grazing were separated by a barbed-wire fence. The site was approximately 0.5 km E of the Palo Verde Biological Research Station in Costa Rica. Thirteen sites along the fence were randomly selected for analysis. Each site had two plots on opposite sides of the fence. Distance of each plot from the fence was equal within sites and selected from a random number table, with a range of 10 - 30 m. Arthropods were collected with a sweep net (ten sweeps per plot) and recorded by arthropod order, morphotype, and abundance.

Results

We collected 306 arthropods of 104 morphotypes. We calculated Shannon-Weiner diversity and evenness indices for each plot; mean values were not significantly different between grazed and ungrazed plots (Table 1). However, the distribution of individuals within the 7 most abundant orders was significantly different between grazed and ungrazed plots ($\chi^2 = 19.43$, df = 7, 298, P = 0.007, Fig. 1). Five orders, containing a total of 10 individuals, were not included in this analysis. We also noted overlap and unique morphotypes for each side (Fig. 2).

Table 1. Shannon-Weiner Index of diversity and evenness of arthropods calculated for areas open and closed to grazing.

Side	Shannon-Weiner Index (H)	Evenness (J)
Closed to Grazing	3.50	0.839
Open to Grazing	3.59	0.863

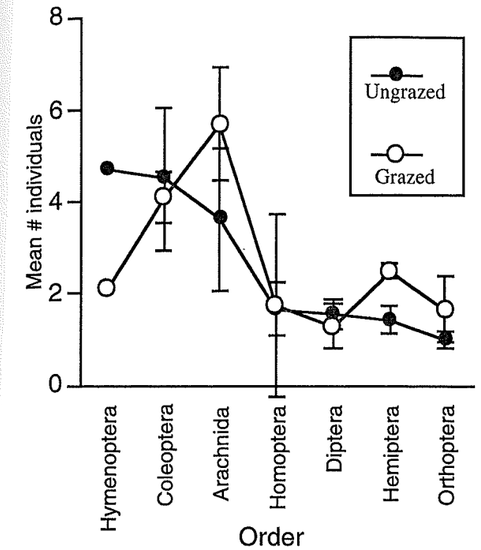

Fig. 1. Mean abundance of individuals found in each order per plot on each side.

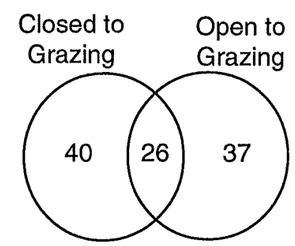

Fig. 2. Venn diagram of insect morphotype diversity in studied areas. Data represent the number of morphotypes found only in non-grazed areas, number of morphotypes found in both areas, and number of morphotypes found only in grazed areas.

Discussion

The tropics are believed to harbor at least 50% of the world's plant and animal species (Vandermeer and Perfecto 1995). The arthropod diversity found in our small sample echoes this statement. Approximately 1 of every 3 arthropods collected in this study was a new morphotype. Our assessment of arthropod communities revealed high diversity. The Shannon-Weiner index showed both grazed and ungrazed areas to be equally diverse and the evenness index suggests that no one morphotype was dominant in either area studied. The obvious diversity in our relatively small sample suggests that both grazed and ungrazed areas are viable habitats for diverse arthropod communities.

However, the Venn diagram of morphotype overlap between areas and the Chi-square analysis of the number of individuals per order in each area both suggest that grazed and ungrazed areas support different arthropod communities. The communities may be responding to microhabitat differences. If different arthropod species respond to or depend on different microhabitats, we would expect arthropod communities to change with microhabitat variation. Our observations suggest that the understory of the non-grazed plots tended to be denser than the understory of grazed plots. Cattle grazing has been shown to alter the vegetative composition of an area (Mahar et al. 2000) and thus potentially associated microhabitats. Therefore, cattle grazing may have an indirect effect on arthropod communities.

Literature Cited

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