

# Does Productivity Matter? An Investigation of Habitat Use by Insect and Small Mammal Herbivores in a Grassland System

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**Abstract.** Although some ecological theory predicts that herbivore density should increase with plant quality or biomass, few studies have directly measured the response of grassland herbivores to changes in plant production. In this study, we experimentally manipulated plant biomass by fertilizer addition and measured density and diversity of small mammals and insects (primarily Rodentia and Orthoptera). A total of 245 small mammals representing 9 species were captured during the study but three species (*Peromyscus leucopus*, *Peromyscus maniculatus*, and *Sigmodon hispidus*) comprised 82% of all captures. In general, the density of the rodent community was higher in fertilized than in unfertilized plots. Additionally, we detected an effect of increased plant biomass on total rodent mass. The body mass of *S. hispidus* was higher in the fertilized than in unfertilized plots but no effect was observed for the *P. leucopus*. For insect herbivores, grasshopper biomass as well as density was higher in fertilized than unfertilized plots. Because fertilization had weak effects on plant biomass, mammal and grasshopper populations may be more sensitive to changes in plant quality than quantity.

## 1. Introduction

Insect and mammal herbivores may have important effects on plant biomass and diversity, but it is unclear how the density and diversity of these herbivores may vary with plant production. In grasslands, herbivores may prefer high production because of increased biomass or nutrient content in plant tissues. However, increased plant production can reduce plant diversity, which may reduce the diversity of food resources available to herbivores. In addition, predation risk may also change with plant production. For example, increased production may decrease predation by avian predators. Due to lack of experimental evidence available, I conducted a field experiment testing whether herbivore biomass and density varied with manipulated soil fertility (increased plant production).

## 2. Experiment, Results, Discussion, and Significance

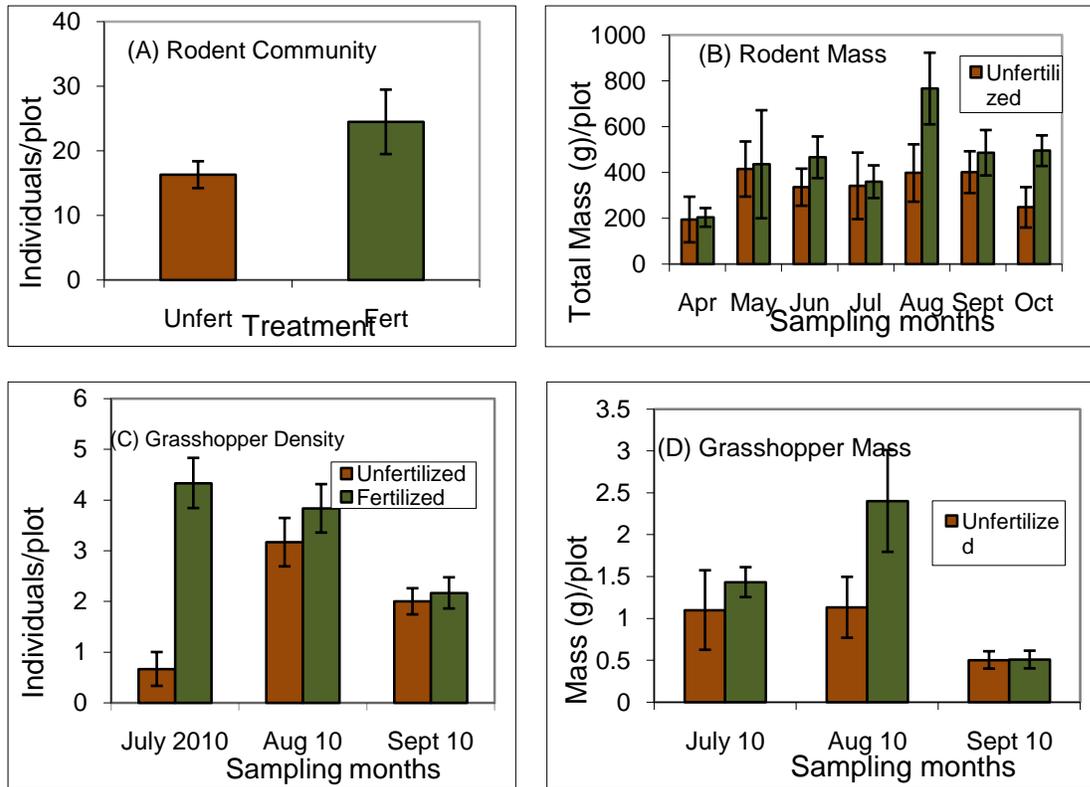
The experiment included sampling plant biomass, small mammals and insect populations in plots (30 x 30 m) with or without fertilizer addition. We established six pairs of plots which were assigned to either fertilized or unfertilized treatments. Urea-based nitrogen fertilizer was applied in late spring from 2005-8 and a slow release 20-10-3 NPK (Professional turf fertilizer, Howard Johnson's Enterprises, Milwaukee Wisconsin) thereafter both at a target rate of 12 g m<sup>-2</sup> yr<sup>-1</sup>.

### Small Mammal Sampling

Monthly trapping was used to quantify the population densities of small mammals. Four Sherman live traps (762 x 889 x 305 mm) and two pitfall traps (plastic buckets of 60-L volume, 402 mm diameter at the top, 332 mm diameter at the bottom, and 540 mm depth) were placed in each plot. Trapping was conducted every 4-6 weeks from November 2009 until October 2010. During each sample period, traps were set and checked on 3 consecutive mornings (within 3-4 hours of dawn or dusk) and the 2 intervening afternoons (Brady and Slade, 2001). All individuals were marked with a numbered ear tag (Monel #1, National Band and Tag Co., Newport, Kentucky) and were released at the location of capture immediately following data collection. At each capture, identification number, location, species type and weight was noted. Between trapping sessions, traps were decontaminated with a bleach solution (Yunger and Randa, 1999).

### Insect Sampling

Insects were sampled within each experimental plots using sweep netting and D-vac along three transects per plot.



The density of the rodent community was found to be marginally higher in the fertilized rather than unfertilized plots, indicating that the mammals used the fertilized more than the unfertilized plots ( $t = 2.31$ ;  $P = 0.06$ ; Fig. A). Also, when mass of small mammals was combined, there was a significant interaction between fertilization and time ( $F_{6, 60} = 2.63$ ;  $P = 0.03$ ; Fig. B). For insect herbivores, grasshopper density was higher in fertilized plots ( $F_{1, 5} = 12.31$ ;  $P = 0.01$ ; Fig. C) but only in July ( $F_{2, 18} = 7.18$ ;  $P = 0.005$ ). Additionally, the total grasshopper mass was higher in fertilized plots ( $F_{1, 5} = 8.41$ ;  $P = 0.03$ ; Fig. D) but only in August ( $F_{2, 20} = 3.24$ ;  $P = 0.06$ ).

### 3. Conclusions

This study showed that manipulation of soil fertility may play an important role in the choice of habitats by herbivores, which may impact the entire food chain. Because fertilization had weak effects on plant biomass with only 24% increase in plant biomass achieved in fertilized plots, mammal and grasshopper populations may be more sensitive to changes in plant quality than quantity.

### 4. Acknowledgements

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### References

- [1] M.J. Brady and N.A. Slade, Diversity of a Grassland Rodent Community at Varying Temporal Scales: The Role of Ecologically Dominant Species. *J. Mammal.* Vol. 82, 4, 974-983, 2001.
- [2] J.A. Yunker and L.A. Randa, Trap Decontamination Using Hypochlorite: Effects on Trappability of Small Mammals, *J. Mammal.* Vol. 80, 4, 1336-1340, 1999.