Hide-and-seek among wolf spiders and grasshoppers: applying "ecology of fear" to invertebrates

Jesús E. Gómez[1], **Angela Nardoni Laws**[2], and **Anthony Joern**[2]

[1]Department of Biology, University of Puerto Rico, Humacao Campus

[2]Division of Biology, Kansas State University,

Project Overview

Introduction. The ecology of fear describes the importance of nonlethal interactions between predators and their prey. The theory predicts that predator presence alone can affect behavior, such as feeding by prey individuals. However, this theory has only been applied to mammalian species. We tested predictions from the ecology of fear applied to interactions between invertebrate species – grasshoppers (Acrididae) and wolf spiders (Lycosidae), common predators of grasshoppers. Our study had three goals: to determine (1) variability in grasshopper and spider densities among watersheds with different management regimes; (2) if spider presence alters the spatial distribution of grasshoppers within sites; and, (3) whether spider presence can affect grasshopper herbivory.

Methods. Spider abundance was determined using pitfall traps at nine sites at the Konza Prairie Biological Station in northeastern Kansas Flint Hills tallgrass prairie. Pitfalls were arranged in a 15m x 15m grid and monitored daily for ten to fifteen days. The body sizes of captured spiders were measured (mm) and all spider were identified to family, genus or species level. Grasshopper density was determined with ring count transects. Vegetation biomass was determined by destructively sampling five 0.2 m^2 plots at each site to measure plant biomass.

Results. Both spider and grasshopper densities varied significantly among sites (spider density varied from 0.02-0.15 individuals/ m^2 and grasshoppers varied from 4.15 -10.85 individuals/ m^2). We did not observe relationship between vegetation biomass and spider (p=0.99) or grasshopper density (p = 0.97). A significant negative relationship between grasshopper and spider densities among sites (p<0.036) was seen. Results suggest that biotic interactions between grasshoppers and spiders may be important to influencing grasshopper population dynamics. Grasshopper feeding was measured by setting up bioassays at three of the nine plots based on spider density. We observed that grasshopper herbivory decreased with spider density among plots. Within plots, the spatial distribution of feeding by grasshoppers was also influenced by spider density. Results are consistent with predictions based on the ecology of fear.

Results

Wolf spider (*Lycosidae*) of Konza

Genus	Species
Hogna	aspera?
Schizocosa	mccooki?
	retrosa
Rabidosa	rabida?

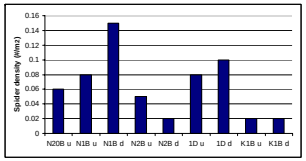


Figure 1. Left: spider density; right: grassghopper density in sites at Konza Prairie Biological Sation, Kansas.

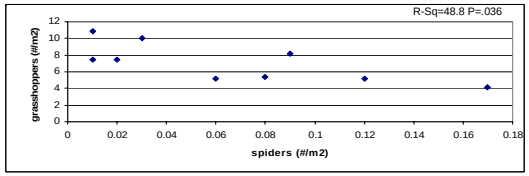


Figure 2. Negative relationship between spider and grasshopper densities at Konza.

Spiders may have a strong influence on grasshoppers density on a site scale.

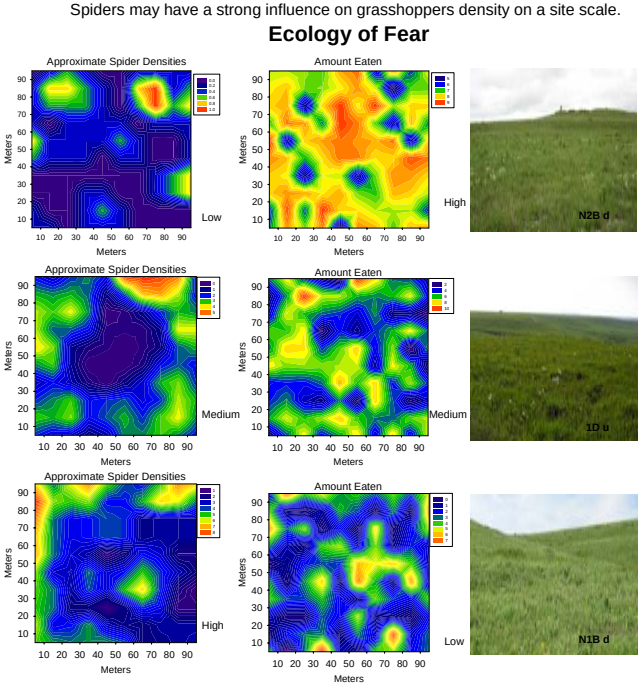
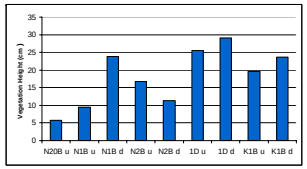


Figure 3. From left to right Approximate spider density (within the study plot –based on daily capture data-), in the center is the Amount of vegetation eaten by grasshopper in a determinate period of time and at the right is the picture of the study area. On the left and center column warm colors means areas of high density of organisms or activity.



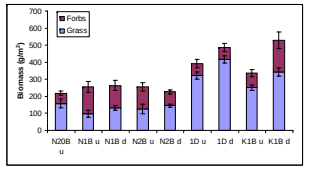


Figure 4. Left: Mean vegetation height; right: Mean Biomass composition at the sites at Konza Prairie.

Vegetation height or biomass may did not obviously influence grasshopper or spider densities on a site scale.

Conclusions

Patterns of Feeding

In general, more is eaten when spider densities are low, within or among plots.

Spatial distributions of feeding by grasshoppers were influenced by local patterns of spider density.

Overall Conclusions

No relationship between vegetation biomass (habitat structure) and spider or grasshopper density was detected.

The negative relationship between grasshopper and spider density suggests that biotic interactions are important.

The spatial distribution of feeding by grasshoppers within the plot was consistent with predictions of the ecology of fear.

Acknowledgments

Gregory Zolnerowich, Jennifer L. Apple, Sheena Parsons, Jayne Jonas, Jennifer Hill, Ellen Welti, Gail Wilson & Brett Sandercock

NSF LTER KONZA PRAIRIE BIOLOGICAL STATION