



DominANT Invasive Species Disrupt Food Webs



Annie McElvenny, Andrew Godard, Meredith McSwain, Dr. Carmen Blubaugh

College of Agriculture, Forestry, and Life Sciences, Clemson University

Abstract

Fire ants are invading the Southeastern US and dominating food webs. They are capable of altering many species interactions at multiple trophic levels due to their omnivorous and aggressive feeding behavior. We used a seed-based food web to evaluate potential antagonistic interactions between the fire ants and native community of seed feeders (insects and small mammals) and then determined their impact on pigweed seed removal across a variety of habitats. We measured ant activity, other invertebrate granivore activity, seed removal, and vegetative refuge. Ant activity and seed removal increased in plots with higher amounts of refuge. Unexpectedly, the activity of the rest of seed-feeding invertebrate community was reduced in weedier plots. We saw indirect evidence of antagonistic interactions between fire ants and other invertebrate granivores and also between small mammals and other invertebrate granivores, both mediated by the refuge. Overall, we found that refuge is the strongest predictor of top-down suppression, despite the complexity of the interactions between the other groups of seed-feeders.

Methods

- We manipulated the availability of refuge with three treatments (5 replicates x 3 treatments = 15 total plots)
- To determine **refuge** availability, we estimated percent coverage within 0.25 m² quadrats



Weedy

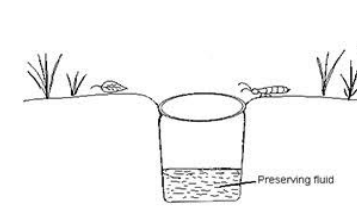


Rye



Tilled

- To determine **invertebrate activity**, pitfall traps were placed below ground level in each plot.



- Seed removal** was calculated by placing two seed trays with 100 redroot pigweed seeds in each plot, one caged and one uncaged.

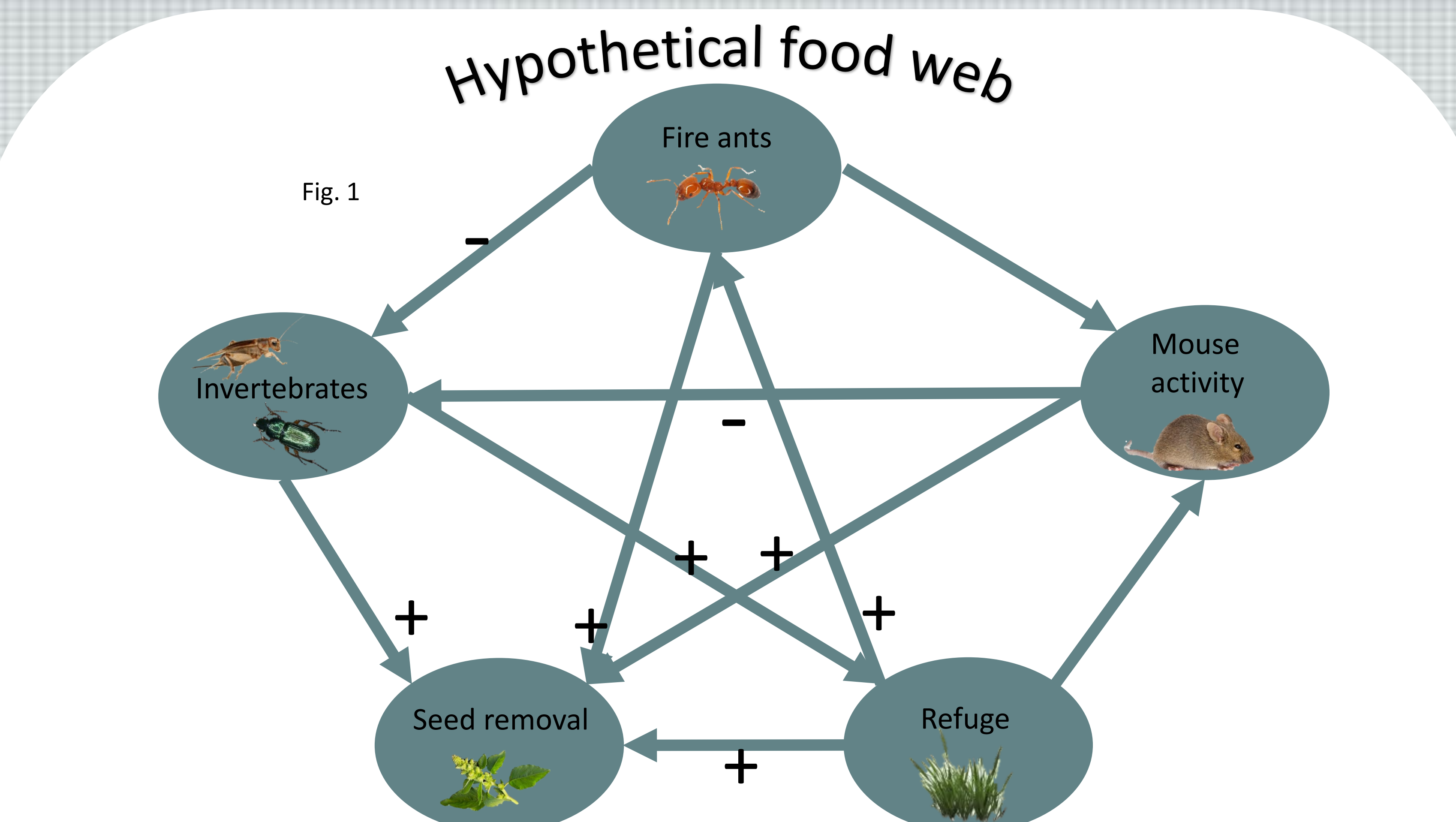


Uncaged seed tray



Caged seed tray

- Fire ant activity** was determined by placing tubes with one centimeter of hotdog into each plot for two hours.



Results

As percent vegetative cover increases, seed consumption and fire ants increase, while invertebrate granivores decrease

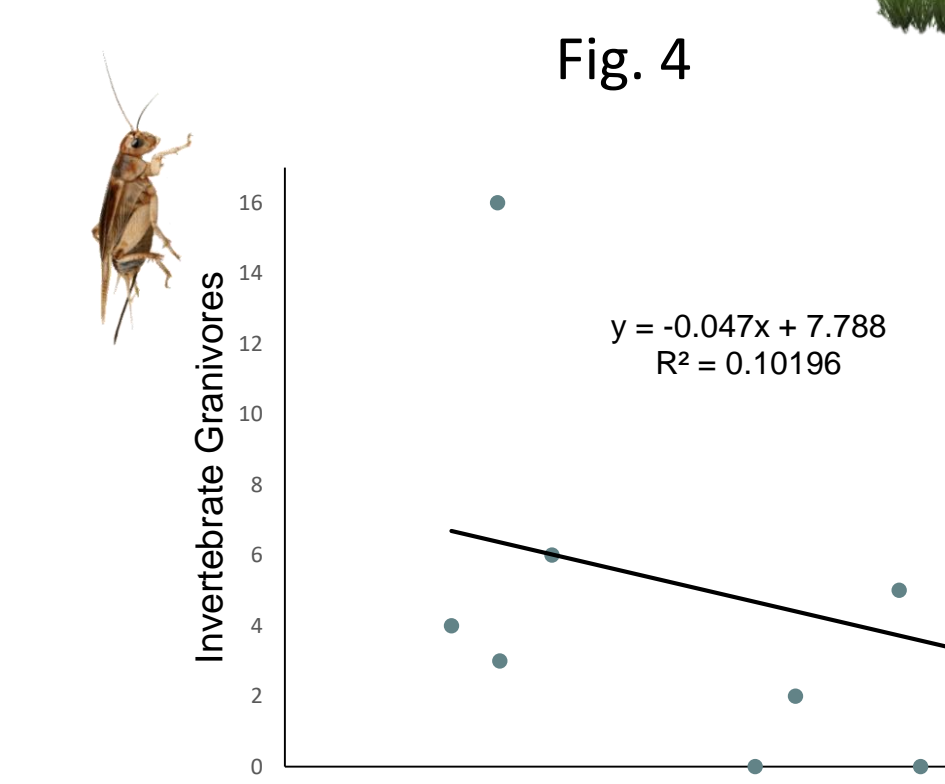
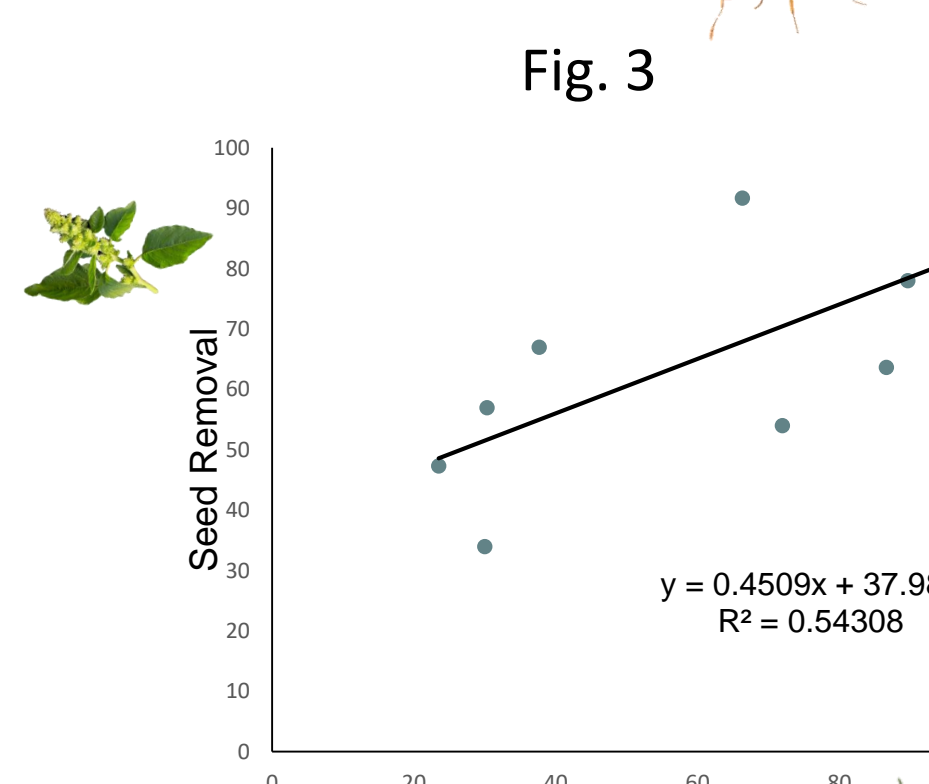
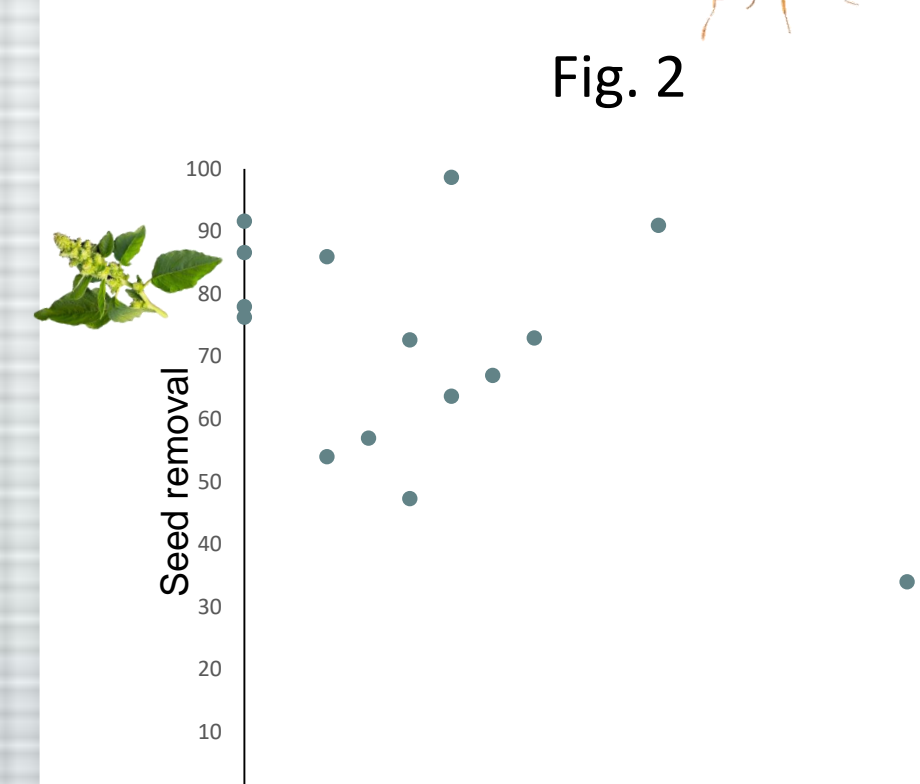
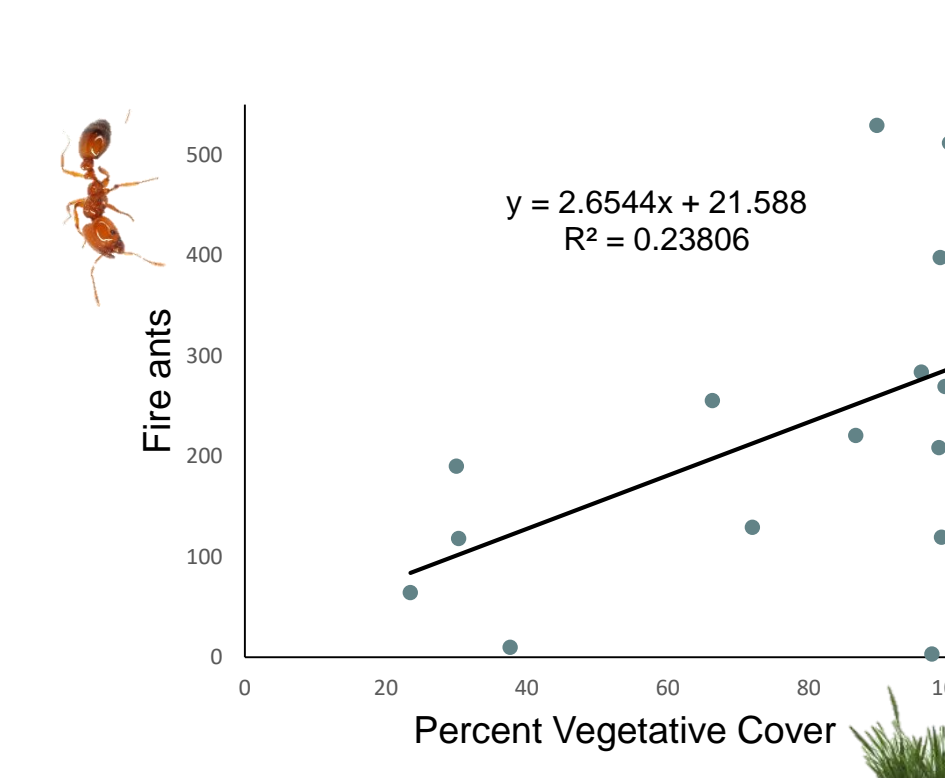
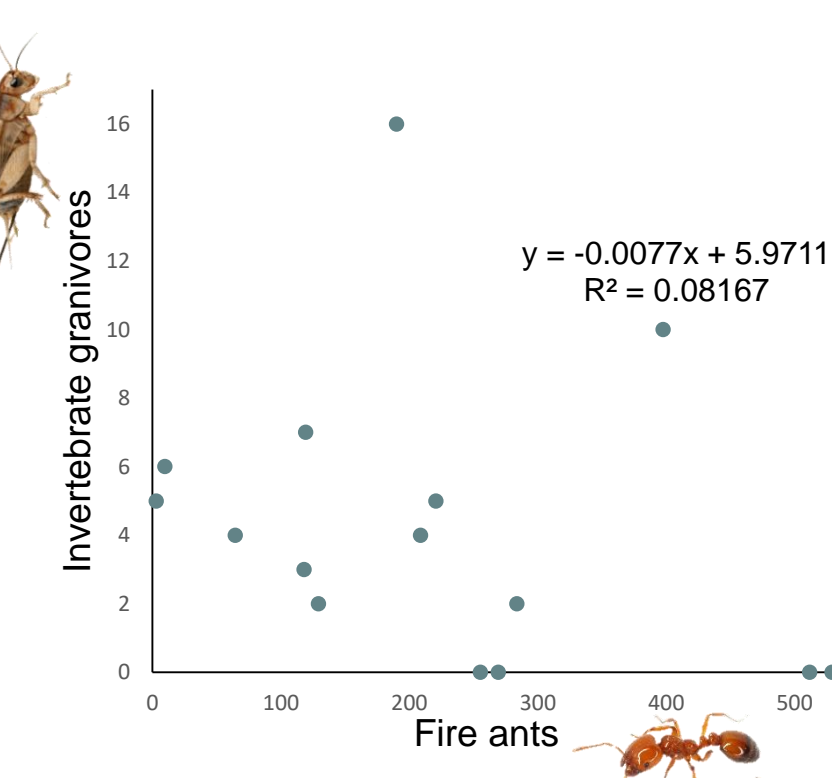
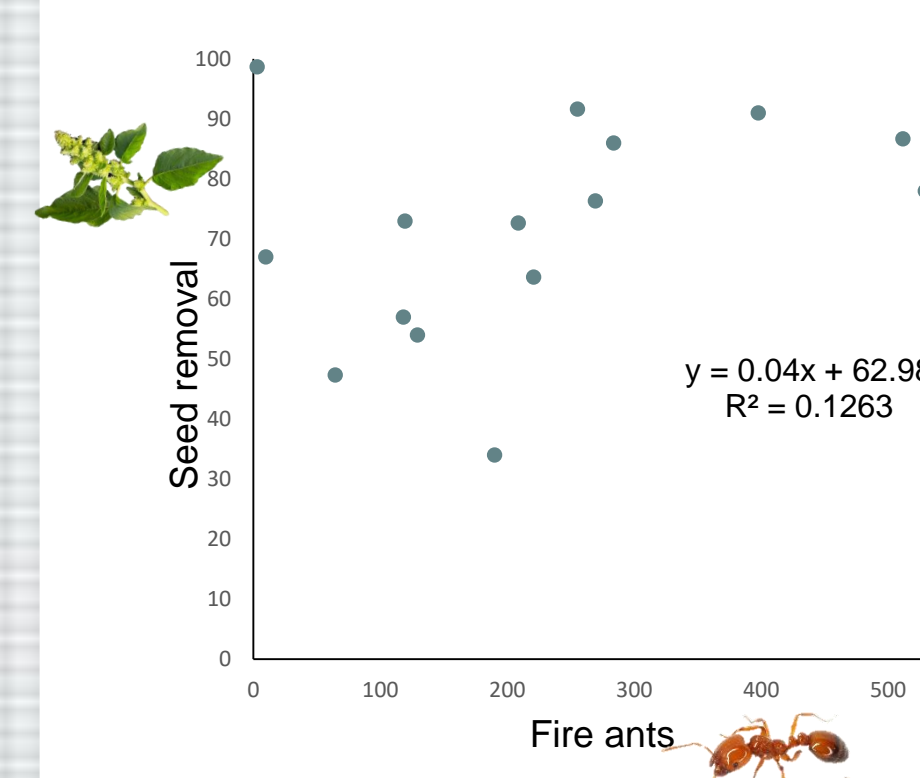
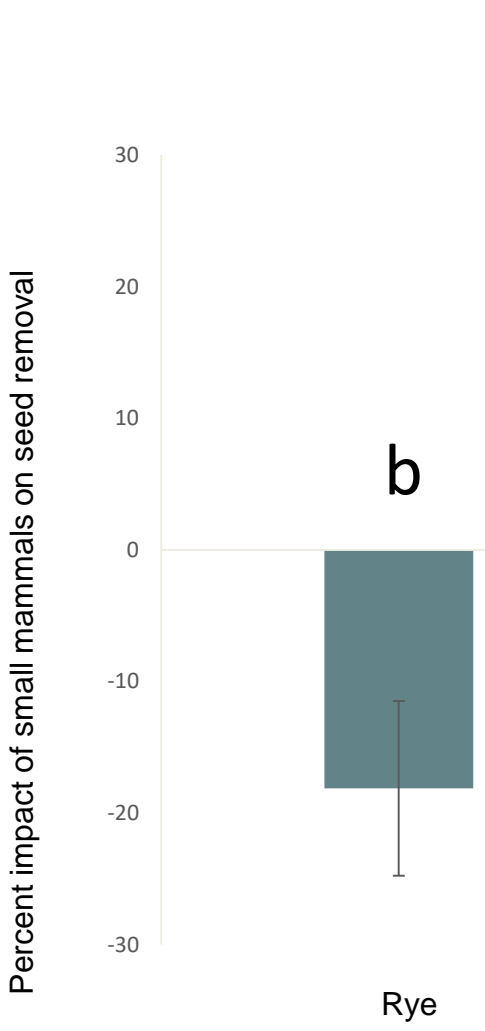
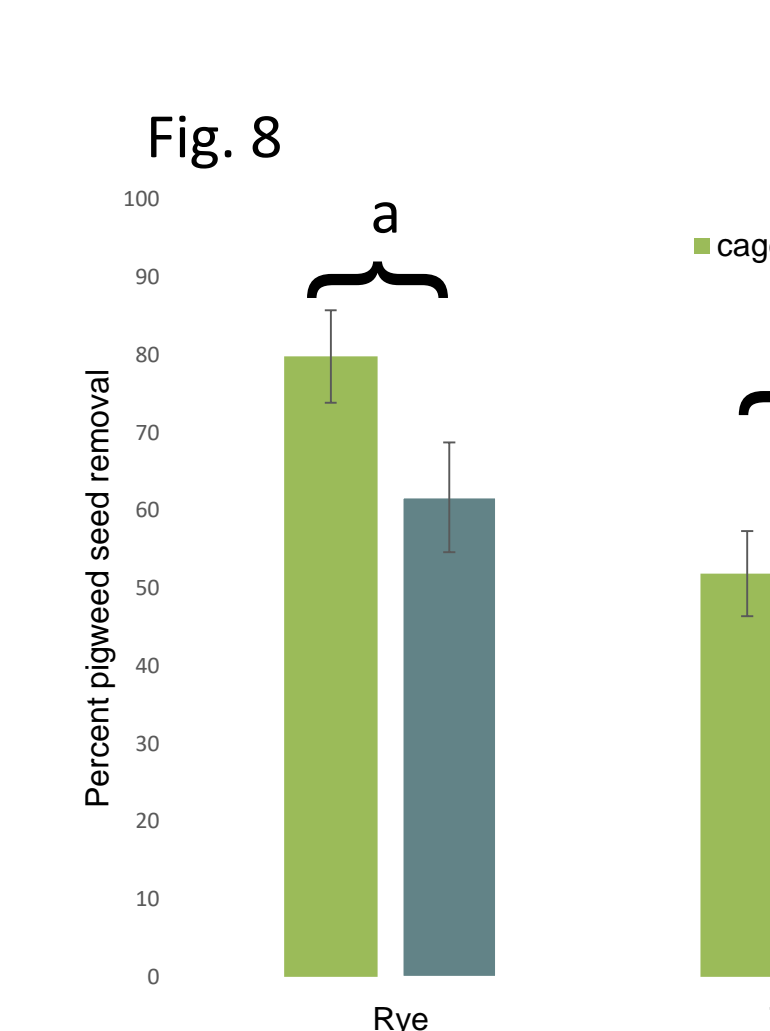


Fig. 5

Fig. 6

Fig. 7



Seed removal was highest in weedy plots, while small mammals decreased seed consumption in the rye plots

Discussion

- The increased presence of fire ants (Fig. 2, $p = 0.99241$) and other invertebrate granivores had no effect on seed removal (Fig. 5, $p = 0.31365$)
- There are no positive links between seed removal and ants or other invertebrate granivores. Because of their omnivorous behavior, we can not directly correlate their feeding to a single food source (seeds). (Symondson et al. 2001)
- However, as percent vegetative cover increased, the number of fire ants increased (Fig. 3, $p = 0.065$) and the number of seeds removed increased (Fig. 6, $p = 0.03901$).
- Refuge was the strongest predictor of seed consumption. Vegetation provides refuge and preferable climate for granivores (Blubaugh et al. 2016).
- Although, as vegetative cover increased, the number of non-ant invertebrate granivores marginally decreased (Fig. 7, $p = 0.06679$). This was unexpected because granivores are typically associated with vegetative cover. This might have occurred because the non-ant granivores were avoiding the fire ants in the vegetation.
- It can be concluded that vegetative cover has the strong impact on seed consumption, fire ants, and granivores. The positive correlation between refuge, and fire ants and seed removal is consistent with what we expected, but fire ants disrupted other trophic interactions.
- Small mammals may have also disrupted seed consumption of the invertebrates. The effects of our small mammal enclosure was mediated by habitat. Mice had a negative effect on seed consumption in only the rye plots (Fig. 8, Significant cage x cover interaction; $F_{2,24} = 5.837$, $p = 0.0086$).
- Small mammals prefer thatch environments and eat insects, which might explain why there was a strong negative impact of small mammal consumption in rye plots.
- Fire ants dominate the food web and strongly affect the behavior of the species surrounding them
- Despite the various other antagonistic interactions happening, refuge still leads to increased seed destruction

References

- Blubaugh, C. K., Hagler, J. R., Machtley, S. A., & Kaplan, I. (2016). Cover crops increase foraging activity of omnivorous predators in seed patches and facilitate weed biological control. *Agriculture, Ecosystems & Environment*, 231, 264-270. doi:10.1016/j.agee.2016.06.045
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Acknowledgments

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